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Goat Farming and Breeding in Jordan

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Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/intechopen.69015>

Abstract

Goats are multifunctional species and play an important role in the livelihoods and food security of farmers particularly in rural areas. Goats are well-adapted animals to the various ecological zones in the tropics and dry zones of developing countries such as Jordan. In the country, goat farming is a major component of the agricultural system. This chapter provides an overview of the present status and prospects of Jordan's goat production sector, changes in goat populations, and includes an evaluation of constraints and their impacts on goat production in the region. It discusses the general trends occurring in goat raising, diversity, and characterization of the prevailing production systems. The chapter also focuses on the major breeds of goats and the differences and unique characteristics of each goat breed. Additionally, this chapter covers a considerable contribution of goats in terms of meat, milk, and culture to the socioeconomics of householders and its role in poverty and hunger alleviation in Jordan. Moreover, this chapter also discusses basic goats' productive and reproductive performance. Management calendar for goat production in Jordan is reviewed. Finally, the chapter covers goat health, diseases, and approaches or management practices for prevention and control of goat diseases.

Keywords: goat production systems, goat production constraints, goat breeds, goat health, economic performance, reproductive performance

1. Introduction

In tropical and subtropical regions of the world, goats are kept over other livestock because of their adaptive capacity, tolerance, performance, and importance to the livelihoods of the farmers.

In Jordan, goat farming is a major part of agricultural systems as goats play a significant role in the economy, food security, and livelihoods of farmers in rural areas. Locally, goats are the second most abundant ruminant livestock species after sheep, with a total number of goats to be around 857,728 heads in the country in 2014 [1]. The goat breeds in Jordan include Shami (Damascus goat), Mountain Black goat, Dhawiwi (Bedouin goat), and Desert goat in addition to crossbred goats. Goat breeds are distributed across different regions. Therefore, goats are raised in different production systems that are classified into sedentary (semi intensive), transhumant (semi-extensive), and nomadic (extensive) systems. Mountain Black goat is the main goat breed with the largest population. The proportional contribution of goats to households varies from breed to breed and system to system. Jordan is an Arab kingdom in Middle East region (**Figure 1**) with a total area of approximately 89,342 km² (land 88,802 km², water 540 km²) and has a population estimated at 9.5 million people. The proportion of rural and urban population is around 16.3% and 83.7%, respectively [2]. The climate in Jordan is characterized by long, dry, hot summer and short, wet, cold winter seasons. Yearly temperature ranges from about maximum 26°C to minimum 13°C in winter to more than 32°C in summer; the temperature increases between 3 and 7°C toward the south, with the exception of some southern highlands. Rainfall varies considerably with location, mainly due to the national topographic profile. Between 1985 and 2014, the average annual rainfall in whole country was about 226 mm, with the lowest amount in the eastern and southern desert and the highest amount in the northern highlands [3]. Jordan’s climate is, therefore, classified as semiarid with approximately 7% of arable land. Jordan is susceptible to climate change impact. Increasing temperatures, coupled with changing precipitation patterns, are expected to decrease water availability.

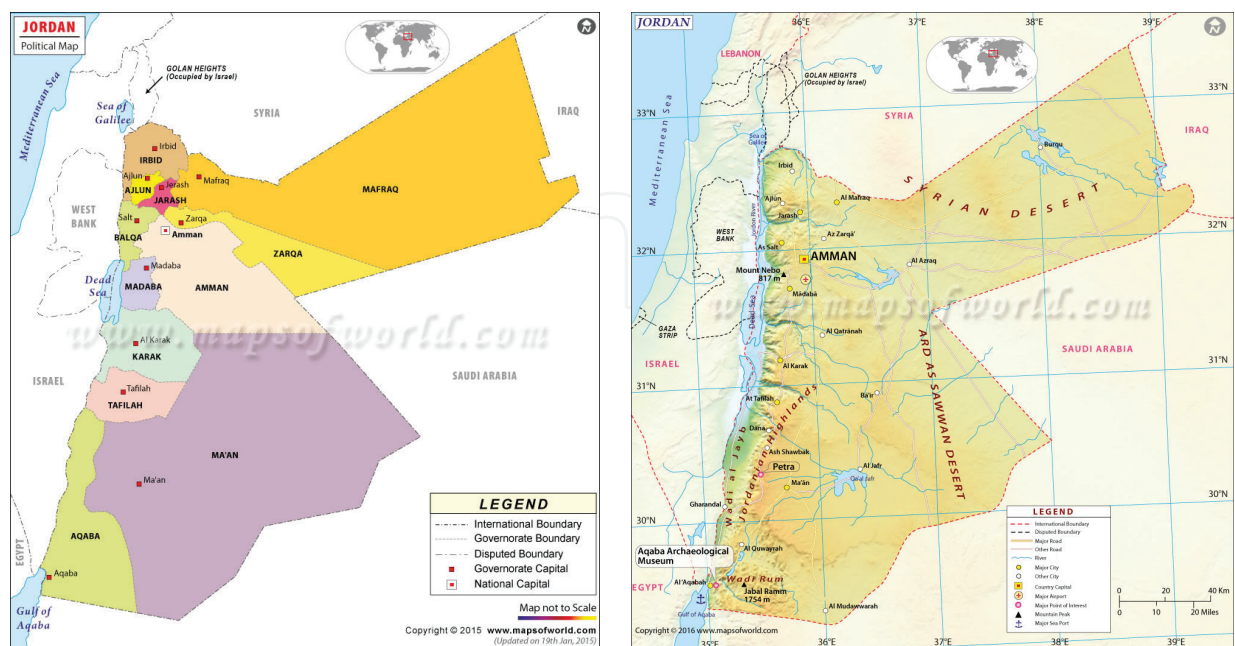


Figure1. Map of Jordan and where Jordan is located in the world. Source: <http://www.worldatlas.com/webimage/countrys/asia/jordan/jomaps.html>.

2. Research methodology

The research methodology of chapter consists of a comprehensive, up-to-date compilation of available information on goat farming in Jordan. The methodological approach of the chapter involves the use of different elements, including (1) reviewing many articles and resource books in the field of goat science and searching the current topics in the literature related to goats in Jordan and (2) the experience of the author and consultation of other professors at different institutions in the region regarding goat production in Jordan.

3. An overview of the present goat farming status

Goats play an important role in the economy of the country. Goat farming in Jordan is the most important among all livestock activities in regions such as mostly desert plateau in east, highland area in west, and the Great Rift Valley separating the eastern region. Jordanian goat breeds are used to produce meat, milk, and milk products. Market demand for these different products varies. Goats contributed about 24.8 and 9.6% of red meat and milk yield of the total local production, respectively [4].

In fact, goat products are the basis of the livelihoods of farmers in some regions, particularly, in remote areas that have no other source of income. Goats are the only source of cash income, food, and savings for those households. Therefore, the maintenance of a viable goats sector is crucial to Jordan's economy. **Table 1** shows the estimated production value and quantity for goats in 2015. The goat meat production (newborn goats) in the country reached 610,243 head. The sheep and goat milk production (including dairy products) were 98,781 and 2496 (M.T), respectively.

The breeding organizations that should control the genetic improvement and management of the various breeds are still lacking. The current condition of the goat sector needs to be assessed and appropriate measures need to be implemented to ensure that it is developed sustainably. Goat meat production should be improved to meet the increasing demand for goat meat by human population.

3.1. Changes in the population of goats throughout the country

During the time period from 2000 to 2015, the goat population increased, reaching up to 860,220 animals in 2015. Most of these goats are owned by individual household. **Table 2** provides data

Type	Unit	Number or quantity	Value in JD
New born goats	Head	610,243	85,801,215
Sheep and goats milk	M.T	98,781	74,652,046
Dairy product	M.T	2496	17,576,606

Source: JD = Jordanian Dinar (1 JD \approx 1.4 USD in 2015) [5].

Table 1. Livestock production value and quantity for goat holdings in 2015.

Govern.	Year			
	2000	2005	2010	2015
Amman	88,310	74,650	103,600	119,120
Balqa	35,150	54,350	82,310	91,220
Zarqa	46,260	43,830	41,790	50,720
Madaba	42,150	29,730	53,440	75,030
Irbid	29,180	47,190	48,940	75,280
Mafarq	40,710	69,560	80,240	97,000
Jarash	53,940	23,940	20,650	43,710
Ajloun	10,180	13,100	49,820	50,700
Karak	34,850	85,290	116,840	101,990
Tafilah	5590	18,560	36,210	30,450
Ma'an	30,380	28,800	77,550	87,140
Aqaba	55,760	27,140	40,340	37,850
Total	472,460	516,130	751,730	860,220

Source: [6].

Table 2. Number of goats by governorates during the period of time from 2000 to 2015.

on the changes that have occurred in Jordan’s goat populations throughout the country from 2000 to 2015.

4. Goat breed characterization, regional distribution, and production system of goat breeds

Due to their behavioral, morphological, and physiological adaptations, indigenous goats are able to thrive under extreme temperatures and shortage of water [7]. Little information is available on the Jordanian goat breeds. Therefore, goat breeds have not been characterized well, and most of the information that is available has usually been gathered by the few researchers. Most of Jordan’s native goat breeds are owned by farming households. They vary in morphological characteristics (**Figure 2**), production systems, regions, agro-ecological zones, household types, and herd size [8–10].

4.1. Black Bedouin goats

They are also known as Bedouin, Dihawi, Dwarf, and Hejaz Goat. They originate in Arabian Peninsula. Black Bedouin goats are small and have the lightest body weight. This breed of goat is known as “Dwarf breed” long time ago. The ears of Bedouin goats are medium in size and spotted white, most animals are black; however, brown individuals

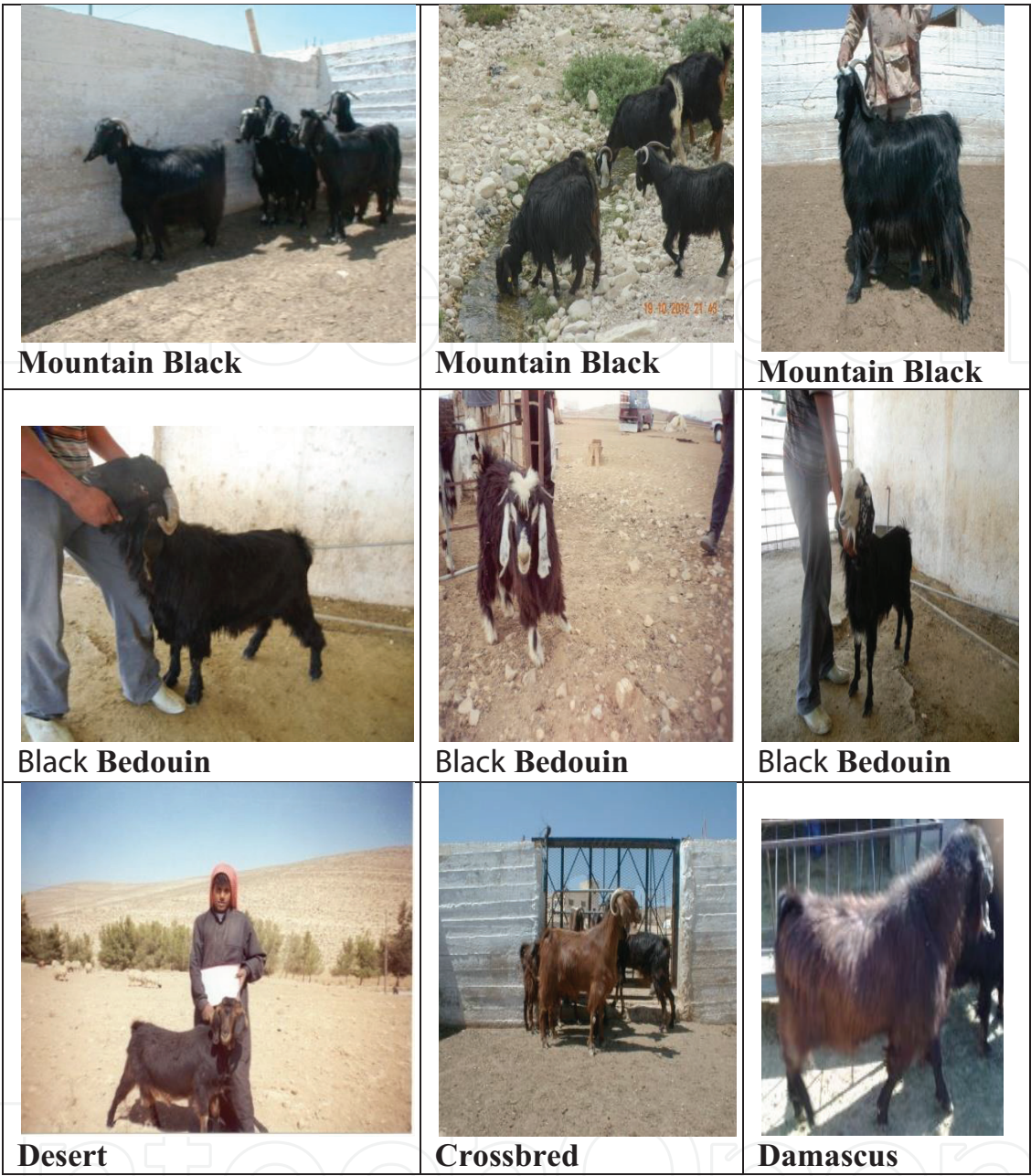


Figure 2. Morphology of Jordanian goat breeds. Source: Author and Dr. Tabbaa M. (2011, permission was obtained).

also occur. Black Bedouin goats are mainly kept in the southern part of the country (Petra and Wadi Rum). The Black Bedouin goats are adaptive and raised under nomadic (extensive) production systems under harsh environmental conditions of deserts. These breeds are mainly exploited for their meat.

4.2. Damascus goats

They are known by other names such as Damanscence or Shami Goat. They originated in adjacent Syria and are imported to Jordan because of their high productivity of milk and

twins [11]. They are used as dual purpose breeds for milk and meat. Damascus goat has a large body size. It has a Roman-shaped nose and is the most discriminating variable among different goat breeds of Jordan. Their ear type is pendent and has a high leg. They are reared around towns and countrysides of the northern part of Jordan and are kept under sedentary production system [10].

4.3. Mountain goats

They are also called by other names, namely Mountain Black goat or Balady (local). They are indigenous to Jordan and nearby countries. They are large dual-purpose breed and play an important role in meat and milk production in Jordan. They are distributed throughout all regions of the Jordan especially in the country’s mountainous areas. They are kept mainly in semiextensive and sedentary systems. Because of their ability to survive and reproduce under the prevailing arid and harsh environmental conditions, this breed was used to develop highly productive crossbreeds especially with Damascus breed in Jordan.

4.4. Desert goats

They are indigenous to Syrian Badia desert. It is also known in Jordan as northern desert goat. They are light in size and mainly kept in northern-eastern Badia of Jordan and reared under extensive production system.

Figure 3 shows the relationship between goats breeds based on morphological-structural variables (nose shape, ear shape, presence or absence of horns and wattles, color, body

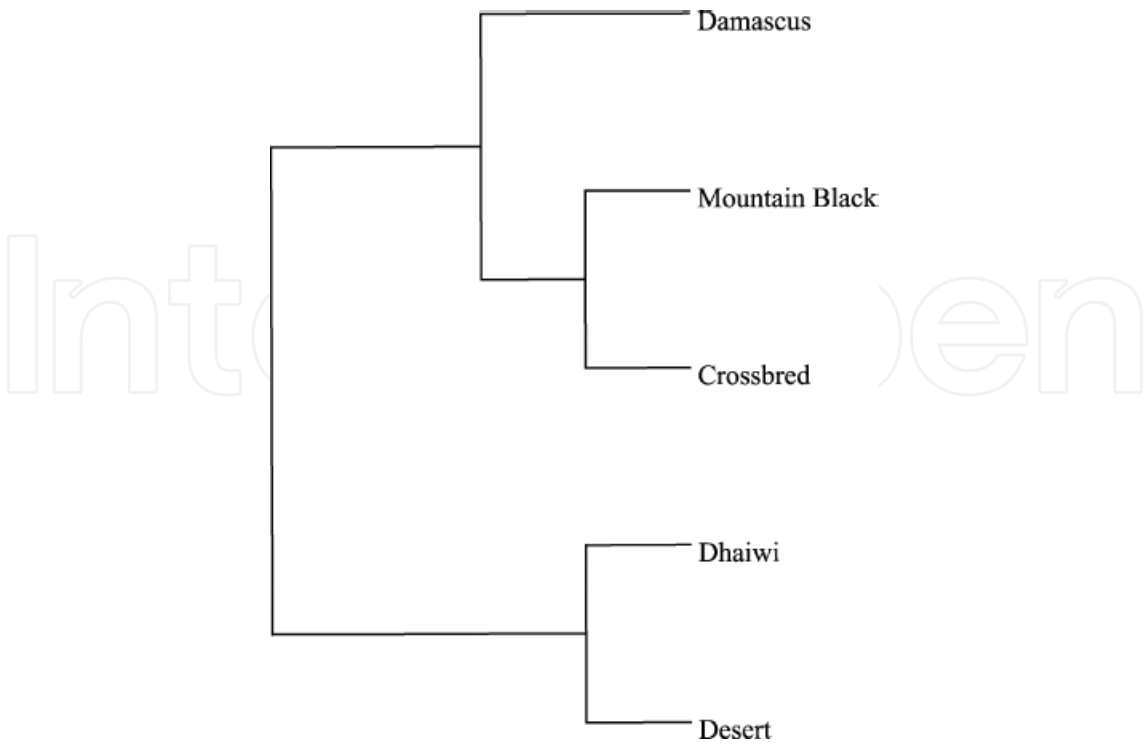


Figure 3. Relationship between goat breeds based on morphostructural variables [8].

weight, head length, and width, etc.). **Figure 3** shows two large clusters, first cluster includes Damascus breed as a large group and two subclusters of Mountain breed and crossbred goats, whereas the second cluster includes the Desert and Dhawi breeds.

Table 3 accounts for the distribution of goat breeds in the country. No information is available on the estimated population of Bedouin and Desert goat breeds of Jordan. However, Mountain Black and crosses accounted for the largest proportion of the current goat population.

Govern.	Breed	
	Mountain Black	Crossbreed
Amman	119,119	0
Balqa	91,223	0
Zarqa	50,718	0
Madaba	75,034	0
Irbid	75,139	139
Mafarq	96,997	0
Jarash	43,678	29
Ajloun	50,145	559
Karak	101,992	0
Tafilah	30,452	0
Ma'an	87,140	0
Aqaba	37,853	0
Total	859,490	727

Source: [12].

Table 3. Number of goats in the kingdom by governorates of different breed in 2015.

5. Goat performance

At birth, female kid's average weight is similar to male kid's average weight but male kids show higher weight gains during the suckling period. The body weight of males was significantly higher than those of females due to sexual dimorphism. The weight of adult goats has also been recorded by Al-Khaza'leh et al. [13] who reported that the mean body weight of adult does was about 45 kg with little variation ('5.4). The author also reported that the mean body weights of growing kids (of 1–11 months age) was 24.4 ' 5.7 ranging from 7.3 to 41.1 kg. Zaitoun et al. [14] reported a significant difference in mean body weight among the goat breeds, with the Damascus does being the heaviest, crossbred does having intermediate

weights and Mountain Black does having lowest weights. The differences in body weight of goat breeds were also recorded due to a region and production system effects.

Abu-Zanat et al. [9] reported that the lactation period usually lasts for 120 days from April to September with an average milk yield of about 40 and 67 kg per doe post suckling period for nomadic and transhumant systems, respectively, compared to about 81 kg per lactating female in the sedentary system. In the middle and northern Badia region of Jordan that is characterized by low and erratic annual rainfall, goats are mostly important for milk during the dry season [15, 9]. In general, goats have a lactation period of 300 days and produce about 100 kg of milk under extensive conditions [16, 17].

Damascus goats exhibit a high level of prolificacy [18]. In Jordan, the average prolificacy rate of goats is slightly more than 1 kid/doe bred per breeding season [19]. The information on the reproductive performance of goat breeds under transhumant and sedentary systems is displayed in **Table 4** [20].

Production system							
Transhumant (n = 76)				Sedentary (n = 38)			
Variables	<i>n</i>	LSM	SE	<i>n</i>	LSM	SE	<i>p</i> -Value
Number of goats	76	91.7 ^a	9.0	38	60.3 ^b	12.8	0.047
Number of goats by breed							
Mountain Black	75	52.1 ^a	5.3	34	32.1 ^b	7.9	0.037
Dhaiwi	22	4.7	0.6	7	3.3	1.0	0.230
Crossbred	71	41.6	5.3	35	33.6	7.5	0.384
Goat flock performance*							
Fertility rate (%)	76	88.4	1.6	38	86.7	2.2	0.531
Flock mortality (%)	76	17.2	1.6	38	20.1	2.2	0.284
Productivity rate	76	1.03	0.03	38	1.00	0.1	0.588

Source: [20].
LSM: least squares mean; SE: standard error of the mean.
LSMs in the same row with different superscript letters differ significantly at $p < 0.05$.
*Fertility rate: number of does kidding at least once divided by the number of does in the flock during the year; productivity rate: number of kids born alive divided by the does kidding during the year; mortality rate: total deaths of goats in a 12-month period divided by the total number of goats in the flock at the beginning of the year.

Table 4. Performance traits of goat breeds by production system in Jordan.

As indicated in **Table 4**, the fertility and productivity rate per flock were similar between production systems. The barren rate was (12%) which is higher than that (6.6%) reported in the same study area by Aldomy et al. [21]. The proportion of barren does increases with age, regardless of the breed. **Table 5** shows the overall data on the fertility of Damascus does using different type of reproduction hormones [22].

Variables	Treatment			
	CON (n = 8)	S (n = 15)	GP (n = 15)	GSP (n = 15)
Kidding (rate %)	6 ^b (75%)	15 ^a (100%)	15 ^a (100%)	14 ^a (93%)
Kids/doe kidding (mean ' SEM)	1.5 ^b ' 2	1.5 ^b ' 0.2	2.1 ^a ' 0.2	2.0 ^a ' 0.2
Kids/exposed doe (mean ' SEM)	1.1 ' 0.3	1.5 ^b ' 0.2	2.1 ^a ' 0.2	1.9 ^{ab} ' 0.2
Litter birth weight (mean ' SEM)	7.0 ^{ab} ' 0.7	5.9 ^b ' 0.4	7.5 ^a ' 0.4	7.6 ^a ' 0.4
Lambing date (mean ' SEM)	147 ' 3.6	152 ' 2.3	153 ' 2.3	149 ' 2.4
Multiple births (no.)	4/6 ^{ab} (67%)	6/15 ^b (40%)	13/15 ^a (87%)	14/14 ^a (100%)

Treatment: No treatment (CON), progestagen sponges and equine chorionic gonadotropin (S), gonadotropin releasing hormone plus prostaglandin F2a (GP) or gonadotropin releasing hormone, and progestagen sponges and prostaglandin F2a (GSP).

^{a,b}Values within the same row with different superscripts differ ($p < 0.05$).

Table 5. Overall kidding data from mating during the induced and spontaneous cycles in Damascus does.

6. Goat flock management, husbandry, and constraints

Table 6 shows the details of the events and dates for goat production in Jordan.

Feed shortage, diseases, water shortage, high feed prices, rangeland shortage, poor veterinary service, poor breeding, and poor marketing are among the major constraints and challenges limiting goat production in Jordan. A study by Al-Khaza'leh et al. [23] showed that the most important problems confronting goat productivity in mountain zone of southern Jordan were feed shortage followed by disease, drinking water shortage and high feed prices while in the semidesert zone the top ranked constraint was high feed price followed by feed shortage, rangeland shortage, and water shortage. Al-Assaf [24] reported that inadequate feed and water supply, poor veterinarian services and weak management practices are the main challenges for goats in Jordan. Under the arid climatic conditions such as Jordan, it is obvious that the aforementioned constraints namely shortage of water, feed, and occurrence of diseases can adversely affect the performance of animals.

Events and Husbandry	Months											
	D	J	F	M	A	M	J	J	A	S	O	N
Flush feeding												
Mating												
Kidding												
Lactation/Suckling												
Weaning												
Lactation/ Commercial milk												
Hair cut												
Concentrate feeding												
Grazing on rangeland												
Grazing on stubbles												
Dipping												
Dry seasons												
Wet seasons												

Source: compiled by author

Table 6. Management and husbandry calendar of goats in Jordan.

7. Current and prospects for goat breeding in Jordan

The breeding program for goats in Jordan has not been set up, yet considering breeding objectives, selection criteria, genetic parameter evaluation, etc. Many goat breeds are kept by goat owners throughout the country and few of them use progestagen sponges for estrus synchronization and artificial insemination is no longer undertaken at the farm level. A high proportion of farmers owned crossbred goats as a result of either indiscriminate uncontrolled breeding or controlled upgrading of their does with Damascus bucks. At farm level, goat farmers mainly used subjective more than objective selection criteria to attain their breeding objectives. Farmers' decisions on selection criteria for replacement does of each breed are shown in **Table 7** [10].

In Jordan, goat breeding efforts initiated through the governmental organizations (Ministry of Agriculture, National Center for Agricultural Research and Extension). There are two stations that breed major goat breeds; one located in northern part of Jordan (Al-Kanasry) and the major goat breed raising is Mountain Black breed. The other station located in west-south of Jordan (Al-Waleh) and the major goat breed keeping is Damascus goat. The non-governmental organizations are also involved in goat breeding. For instance, few faculties of agriculture conducting researches on goat breeding aim to increase performance of goats by keeping different goat breeds mainly Bedouin, crossbred, and Damascus.

In Jordan, a national breeding program should be set up aiming to improve the performance, the genetic resources, and productivity of the country's goat population. To achieve this, scientists at research organizations and centers should involve farmers in breeding program and use modern methods that can be used to improve the breeds. Therefore, determining the capacity of certain indigenous goat breeds to cope with climatic change impact may prove a

comparative advantage compared to non-adapted breeds and eventually sustain goat production and conservation of indigenous genotypes.

Selection criterion	Overall
Does source	77
Last season productivity	59
Longevity	52
Disease resistance	49
Overall merit	41
Twinning ability	19
Fertility	13

Source: [10].

Table 7. Overall proportion of goat farmers of different breeds considering doe selection criteria.

8. Goat diseases and health management

Diseases of goats in Jordan are mainly caused by bacteria, viruses, and parasites. As previously mentioned, diseases were the major constraints affecting goat production. Consequently, economic losses are resulted due to decreased production, reproductive inefficiency, and death of animals. In Jordan, there are many infectious, noninfectious diseases and disorders for goat that mainly include subcutaneous and skin diseases, mastitis, emaciation, digestive disorders, reproductive diseases, and respiratory diseases. The last three diseases cause the major problems and economic losses among goat in Jordan.

The major symptom associated with digestive disease is diarrhea. Diarrhea in neonates is most commonly caused by specific bacteria called *E. coli* that secrete an enterotoxin. A previous study by [20] reported that the perinatal and postnatal mortality (abortion, neonatal) accounted for 98.9% of the total losses of goats in the southern Jordan (**Table 4**). Other study by [24] showed that the top ranked diseases affecting small ruminants in the northern area of Jordan were diarrhea, enterotoxaemia, and pneumonia. The high mortalities in young animals can severely affect the farmers' economic returns. Goats also get sick due to diseases of the respiratory system; pneumonia is the common disease in goats.

To protect the goat herd from disease, the health program (e.g., treatment, vaccination, and dipping) should be interconnected with other activities on the farm such as feeding, milking, and breeding programs. Moreover, the surrounding environmental conditions are important considerations in assuring that health program will be effective for flock. Furthermore, there is a need for good veterinarian services to reduce economic losses. And most of all, the prevention is the useful tool for health management.

9. Conclusion

In Jordan, goat production is an integral part of farming systems and plays a significant role for the food security, socioeconomic, and cultural needs of rural households. In the country, goats are valued mainly for meat, and less for milk, skins, and hair. Favoring goat keeping in these regions is attributed to the ease of rearing and efficiency of low-quality roughage utilization. Due to their unique biological and physiological abilities, they can be raised successfully in zones with poor grass vegetation.

Different Jordanian goat breeds have been identified and characterized under different production systems. Damascus (Shami), Mountain Black, Dhawi (Bedouin goat), and Desert goats are the main Jordanian goat breeds.

Goat production systems in Jordan changed gradually and shifted from extensive production to systems that involve cropping of arable land. There are several constraints limiting goat production in Jordan. Feed, disease, and drinking water shortages are some of them.

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