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RESEARCH ARTICLE

Assessment of Livestock Production Resources and Challenges Faced By Farmers in Nineveh Plains

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ABSTRACT

This study investigated the production and challenges of broiler chickens, backyard chickens, sheep, and cow farming in the Nineveh Plains. The data were collected from 27 villages in Al-Hamdaniya, Bashiqa, and Telkaif. A total of 325 farmers were directly interviewed. A comprehensive questionnaire was designed to collect specific information. For broiler production, more than 50% of farmers used the old version of housing systems. The results showed that 41, 33, and 52% of interviewed farmers received poor-quality chicks in Al-Hamdaniya, Bashiqa, and Telkaif, respectively. More than 50% of interviewed farmers reported high production costs due to poor feed quality, medicines, and vaccines and high feed cost. Also, the lack of governmental services and laboratories and the spread of diseases increased the mortality rates, negatively affecting production costs. For the local breeds production, the mortality varied between 15-31% and hen day from 17-33% among studied districts. The data revealed a lack of governmental or private services in most villages. More than 59% of farmers reported decreased sheep and cow numbers for sheep and cow production compared to the previous year. The reason for decreased large animals, as reported by above 55% of farmers, was feed price. the utilization rates of antibiotics were 98.4%, 77.3%, and 90.3% in Al-Hamdaniya, Bashiqa, and Telkaif, respectively. On the other hand, the antibiotic utilization rates in cows were 97.1%, 90.9%, and 66.7% in Al-Hamdaniya, Bashiqa, and Telkaif, respectively. The percentages of farmers who did not use AI for sheep and cows in Al-Hamdaniya, Bashiqa, and Telkaif were 96.8%, 77.3%, and 80.6%, 55.9%, 68.2%, and 66.7%, respectively. This study contributed to a better understanding of farmers' risks and the factors influencing their practices and decision-making in livestock farming.

INTRODUCTION

The Nineveh Plain is known as the "breadbasket" of Iraq because of its fertile land and agricultural importance. It has historically been a productive agricultural region, contributing significantly to food production in Iraq. The fertile land of the Nineveh Plains and its favorable climate make it a suitable area for various forms of animal production. The agricultural potential of the region extends to livestock farming,

including broiler farms, backyard chickens, sheep, and cattle (Ur, 2005). The fertile soil of the Nineveh Plains provides a reasonable basis for growing animal feed crops, which is essential for livestock sustainability. The climate of the region is suitable for sustaining livestock production. The presence of moderate temperatures and sufficient water resources facilitates the breeding of animals. The historical emphasis on agriculture in the Nineveh Plain implies a foundation of agricultural knowledge that can also be extended to animal husbandry. Livestock has potential economic prospects for local communities to enhance their livelihoods and the region's economy. In 2014, the Nineveh Plains was taken over by the Islamic State in Iraq and Syria (ISIS). The group targeted various commercial and government buildings, schools, and other institutions and displaced people (Kruczek, 2021). The ongoing conflict in the region has caused significant damage to livestock production and agricultural infrastructure (Calicioglu et al., 2019).

After the battle, there were concerted efforts to restore and renew agricultural infrastructure in the region, especially in animal husbandry. This includes livestock, sheep, backyard chickens, and commercial poultry production. The recovery and reconstruction process in post-conflict contexts is complex and demanding (Lioutas and Charatsari, 2021). The method includes various aspects, such as rebuilding physical infrastructure, facilitating the return of displaced populations, restoring agricultural techniques, providing expertise and technical resources, and addressing the consequences. The recovery process can be time-consuming and requires cooperation between local governments, international agencies, NGOs, and the local population. Despite the difficulties it faces, reviving agricultural endeavors in the Nineveh Plains is critical not only for the region's economic development but also for the well-being of its population in general and their ability to recover from adversity. Gaining a comprehensive understanding of the difficulties and possible solutions to livestock production resources in the Nineveh Plains has excellent potential to improve local populations' well-being significantly. This study aims to assess livestock production resources and constraints facing farmers in the Nineveh Plains.

This research was conducted to address the following research objectives:

1- Establish a comprehensive baseline of the status of animal production, including farming of cattle, sheep, backyard chickens, and commercial poultry production,
2- Evaluate the perspectives, current circumstances, goals, and challenges of animal farmers, and
3- Determine farmers' potential solutions for animal production resources in the Nineveh Plains.

MATERIAL AND METHODS

Study site

This study was conducted in Al-Hamdaniya, Bashiqa, and Telkaif districts in the Nineveh Plains, northern Iraq. The Nineveh Plains region is located east and northeast of Mosul, one of the most important cities in Iraq. The coordinates for Al-Hamdaniya are 36° 16' 15.35" N latitude and 43° 22' 39.29" E longitude. Bashiqa's coordinates are 36.45046° N latitude, 43.34977° E longitude, and Telkaif's coordinates are 36.5922° N latitude, 43.0621° E longitude.

Data collection

Data were gathered from July 2022 to July 2023 through direct interviews conducted by the in-country researchers with farmers in selected villages, employing a questionnaire as the primary data collection method. The prepared questionnaire covered local breeds, commercial broiler production, sheep and cow production, and veterinary services. A total of 27 villages from three districts (Al-Hamdaniya, Bashiqa, and Telkaif) were selected randomly. Nine villages were chosen from each district Table 1. The villages in these districts were randomly distributed to guarantee that the study's findings accurately represented the overall livestock production in the Nineveh Plains. Each district's sample size (N) was subject to variation due to considerations such as security, geography, and time limitations. The district sample sizes were 148

for Al-Hamdaniya, 90 for Bashiqa, and 87 for Telkaif. The researchers sought to collect extensive data on the farmers' methodologies, difficulties, and viewpoints about livestock production and administration in the Nineveh Plains region.

Table 1: The selected villages from each

Al-Hamadaniya District	Telkaif District	Bashiqa District
Kremlis	Khatara	Baybokht
Kabarli	Doghata	Fadhliya
Wardak	Tlesqoof	Bahzane
Shanaf	Baqofa	Bashiqa
Telaban	Shrikhan	Teskhrab
Palawat	Gubba	Barema
Qarqasha	Sharafiya	Al Sumaqiya
Kharabsultan	Batnaya	Darawesh
Qaryatagh	Srichka	Telyara

Statistical analysis

The data were submitted to SPSS (SPSS, 2019) for analysis. The chi-square test for non-parametric data and ANOVA (Analysis of Variance) for parametric data were used, in addition to the frequencies and Pie/Histogram/Curves. The village district was the main fixed factor affecting the characteristics studied. The characteristics were separated using the Duncan multiple range Test (Duncan, 2955).

RESULTS

Commercial broiler production

Table 2 presents the Chi-square test for the characteristics of broiler chickens researched in the three districts studied. Relative data on the current practices of farmers in Nineveh Plains regarding broiler house usage show that most of the farmers (66.67% in Al-Hamdaniya, 53.33% in Bashiqa and 65.22% in Telkaif) used traditional house design. This study showed that 41, 33, and 52% of the farms had poor-quality chicks in Al-Hamdaniya, Bashiqa, and Telkaif, respectively. Farmers in Al Hamdaniya 54%, Bashiqa 66.67, and Telkaif 47.83 % said the commercial feed quality was good. The majority of farmers surveyed in this study reported that imported frozen chickens significantly influenced the local market prices. The 100% of farmers in Al-Hamdaniya, 100% in Bashiqa, and 95.65% in Telkaif acknowledged this impact.

Poultry feed and health considerations

Broiler chick characteristics

High feed prices, medicines, vaccines, mortality rates, and production costs had a negative impact on broiler production in the Nineveh Plains. The data showed that 100% of Hamdaniya farmers, 100% of Bashiqa farmers, and 95.65% of Telkaif farmers suffered from high feed prices. The results of this study revealed that the farmers in Nineveh Plains suffered from the high prices of medication and vaccination (50% in Alhamdaniya, 60% in Bashiqa, and 47.83 % in Telkaif) and mortalities (83.3% in Alhamdaniya, 80 % in Bashiqa and 69.53 % in Telkaif). Interviewed farmers in Al Hamdaniya (100%), Bashiqa (100%) and Telkaif (86.96) reported diseases spreads. More than 53% of farmers reported high cost of production and mortality rates. For the medication and vaccination prices, 50, 60 and 47 % of farmers in Al Hamdaniya, Bashiqa, and Telkaif, respectively stated high price of medication and vaccination prices.

Table 2: Comparisons of broiler chicken characteristics among Al-Hamdaniya, Bashiqa, and Telkaif districts

	District no (%)			
	Al-Hamdaniya n= 24	Bashiqa n=15	Telkaif n=23	P-value
Type of house Tunnel Traditional	 8 (33.33) 16 (66.67)	 7 (46.67) 8 (53.33)	 8 (34.78) 15 (65.22)	0.675
Quality of chicks Bad Good	 10 (41.67) 14 (58.33)	 5 (33.33) 10 (66.67)	 12 (52.17) 11 (47.83)	0.505
Quality of feeds Bad Good	 11 (45.83) 13 (54.17)	 5 (33.33) 10 (66.67)	 12 (52.17) 11 (47.83)	0.520
Quality of medicine Bad Good	 12 (50.00) 12 (50.00)	 9 (60.00) 6 (40.00)	 14 (60.87) 9 (39.13)	0717
Government services Yes No	 2 (8.33) 22 (91.67)	 0 (0.00) 15 (100)	 5 (21.74) 18 (78.26)	0.001
Disease spread. No Yes	 0 (0.00) 24 (100)	 0 (0.00) 15 (100)	 3 (13.04) 20 (86.96)	0.25
Lack of laboratory services No Yes	 0 (00.00) 24(100)	 0 (00.00) 15 (100)	 (00. 00) 23 (100)	0.269
Effect of imported frozen chicken on market price. No Yes	 0 (0.00) 24 (100)	 0 (0.00) 15 (100.00)	 1 (4.35) 22 (95.65)	0.644
High feed prices No Yes	 0 (0.00) 24 (100)	 0 (0.00) 15 (100)	 1 (4.35) 22 (95.65)	0.880
Cost of production Medium Average High	 8 (33.33) 2 (8.33) 14 (58.33)	 6 (40.00) 1 (6.67) 8 (53.33)	 9 (39.13) 0 (0.00) 14 (60.87)	0.274
Mortality Medium Low High	 4 (16.67) 0 (0.00) 20 (83.33)	 3 (20.00) 0 (0.00) 12 (80.00)	 5 (21.74) 2 (8.70) 16 (69.56)	0.631
Medication & vaccination price Medium Low High	 12 (50.00) 0 (0.00) 12 (50.00)	 5 (33.33) 1 (6.67) 9 (60.00)	 12 (52.17) 0 (0.00) 11 (47.83)	0.381
A chi-squared test was performed for statistical analyses. The green numbers show significant differences.				

Local poultry breed production

The egg production and mortality percentages for the local breeds in the respective districts were as follows: Al-Hamdaniya: Egg production (hen day) 32.46, Mortality percentage 15, Bashiqa: Egg production

(hen day) 26.87, Mortality percentage 30.94 and Telkaif: Egg production (hen day) 33, Mortality percentage 21.94 Figure1. Table 3 compares local poultry breed health care among the three studied districts. It could be observed that most characteristics differ among districts insignificantly ($p>0.05$). the data showed more than 81% of farmers in studied districts used antibiotics for their local poultry breeds, and antibiotics were used to treat infection. A high percentage of farmers stated no laying and health problems. Lak of private laboratory services was noted among interviewed farmers in Al-Hamdaniya (81.5%), Bashiqa (74.2%), and Telkaif (67.6%).

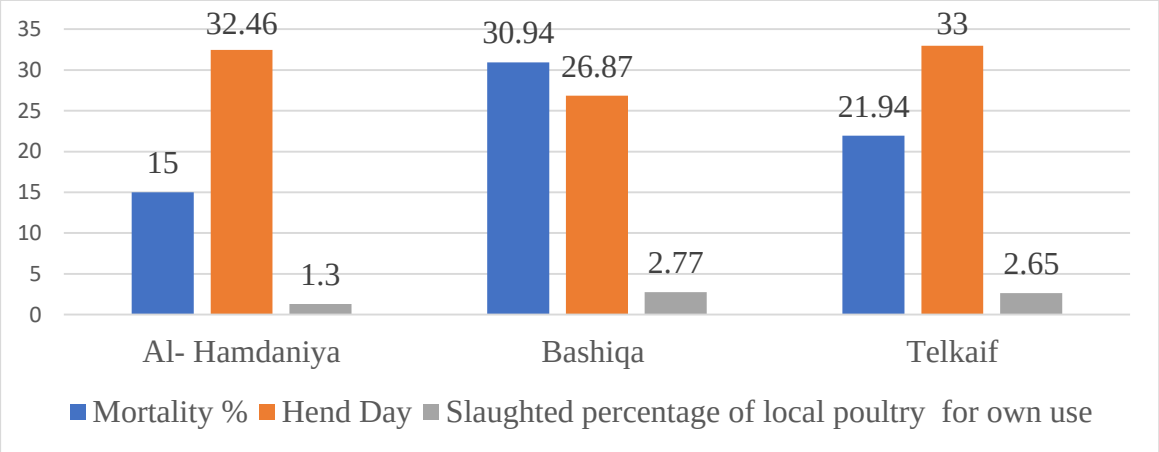

Figure 1: Some quantitative characteristics of local breeds

Table 3: Comparisons of local poultry breeds among Al-Hamdaniya, Bashiqa, and Telkaif districts.

	District no (%)			
	Al-Hamdaniya N=27	Bashiqa N=31	Telkaif N=24	P value
Antibiotics use No Yes	 5 (18.5) 22 (81.5)	 5 (16.1) 26 (83.9)	 5 (14.7) 29 (85.3)	0.763
Purpose of antibiotics Infection Prevention	 25 (92.6) 2 (7.4)	 25 (80.6) 6 (19.4)	 29 (85.3) 5 (14.7)	0.425
Flock health status Not healthy Healthy	 3 (11.1) 24 (88.9)	 9 (29) 22 (71)	 11 (32.4) 23 (67.6)	0.134
Laying problem No Yes	 23 (85.2) 4 (14.8)	 20 (64.5) 11 (35.5)	 25 (73.5) 9 (26.5)	0.202
Vaccination No Yes	 2 (7.4) 25 (92.6)	 5 (16.1) 26 (83.9)	 15 (44.1) 19 (55.9)	0.002
Private veterinary service No Yes	 22 (81.5) 5 (18.5)	 23 (74.2) 8 (25.8)	 23 (67.6) 11 (32.4)	<0.0001
A chi-squared test was performed for statistical analyses.				

Sheep and cattle production

Tables 4 and 5 present the characteristics of sheep and cattle in the studied districts. This study shed light on the most coon lactation periods, weaning practices, milk usage, feeding preferences, and the

impact of feed costs on sheep and cattle farming in the Al-Hamdaniya, Bahiqa, and Telkaif districts. Most of the sheep and cows were in the lactation period during the study period. Farmers allowed lambs to suckle from ewes for 2-3 months in sheep and 4 months in cows, which is the weaning period. After weaning, a significant portion of the farmers used the milk produced by their sheep (81% in Al-Hamdaniya, 77.3% in Bahiqa, and 87.1% in Telkaif) and Cows (75.5% in Al-Hamdaniya, 90.9% in Bahiqa, and 77.8 % in Telkaif) for selling as raw milk. Among the farmers surveyed, 77.3% relied on concentrated feed in Al-Hamdaniya, 41.3% of farmers depended on concentrated feed in Bashiqa, while in Telkaif, the lower percentage (29%) relied on it for their sheep nutrition. However, the feeding practices of cows' data showed that 82.4% in Al-Hamdaniya, 54.5% in Bashiqa, and 77.8% in Telkaif farmers used combined feeding practices (concentrated feed and grazing).

The study also revealed a decrease in sheep and cattle compared to the previous year. The results indicate that many farmers in the Al Hamdaniya, Bashiqa, and Telkaif districts reported fewer sheep and cows. In Al-Hamdaniya, 69.8% of farmers reported fewer sheep, and 67.6% of farmers reported a decreased number of cattle. In Bashiqa, 59.1% of farmers reported fewer sheep and cattle. In Telkaif, 61.3% of farmers reported fewer sheep, and 88.9% of farmers reported fewer cattle

Table 4: Comparisons of sheep characteristics among Al-Hamdaniya, Bashiqa, and Telkaif districts

District no (%)				
Sheep Characteristics	Al-Hamdaniya N=63	Bashiqa N=22	Telkaif N=31	P value
Milk uses Own Selling	 12 (19) 51 (81)	 5 (22.7) 17 (77.3)	 4 (12.9) 27 (87.1)	0.631
Feeding practices Combined Concentrated	 37 (58.7) 26 (41.3)	 5 (22.7) 17 (77.3)	 22 (71) 9 (29)	0.002
Number of sheep compared to the previous year. Decreased Increased	 44 (69.8) 19 (30.2)	 13 (59.1) 9 (40.974)	 19 (61.3) 12 (38.7)	0.557
A chi-squared test was performed for statistical analyses.				

Table 5: Comparisons of Cattle characteristics among Al-Hamdaniya, Bashiqa, and Telkaif districts

District no (%)				
Cow characteristics	Al-Hamdaniya N=34	Bashiqa N=22	Telkaif N=9	P -value
Milk uses Own Selling	 8 (23.5) 26 (75.5)	 2 (9.1) 20 (90.9)	 2 (22.2) 7 (77.8)	0.378
Feeding practices Combined (concentrate and grazing) Concentrated	 28(82.4) 6 (17.5)	 12 (54.5) 10 (45.5)	 6 (77.8) 3 (22.2)	0.235
Cattle No. compared to last year Decreased Increased	 23 (67.6) 11 (32.4)	 13 (59.1) 9 (40.9)	 8 (88.9) 1 (11.1)	0.009
Reasons for decrease in cattle No. Feed price	 31 (91.2)	 14 (63.6)	 5 (55.6)	0.015

Other reasons	3 (8.8)	8 (36.4)	4 (44.4)	
A chi-squared test was performed for statistical analyses.				

Veterinary services

Tables 6 and 7 present veterinary services data for sheep and cattle in selected districts. The results show that 100% of the farmers in the area chosen relied on private veterinary services, and all farmers in selected districts reported no governmental veterinary services. The data showed widespread antibiotic administration among the farmers in the studied districts. For sheep, the utilization rates of antibiotics were 98.4%, 77.3%, and 90.3% in Al-Hamdaniya, Bashiqa, and Telkaif, respectively. On the other hand, the antibiotic utilization rates in cows were 97.1%, 90.9%, and 66.7% in Al-Hamdaniya, Bashiqa, and Telkaif, respectively. All farmers used vaccinations for their sheep and cattle for disease prevention. More than 63% of farmers interviewed reported relying on veterinarians for their sheep and cows' vaccinations. Artificial insemination (AI) in sheep and cows significantly affected reproductive practices and overall livestock production in selected districts. The percentages of farmers who did not use AI for sheep and cows in Al Hamdaniya, Bashiqa, and Telkaif were 96.8%, 77.3%, and 80.6%, 55.9%, 68.2%, and 66.7%, respectively.

Table 6: Veterinary services among Al-Hamdaniya, Bashiqa, and Telkaif districts for sheep

	District no (%)			
Veterinary services	Al-Hamdaniya N=63	Bashiqa N=22	Telkaif N=31	P-value
Veterinary service Private	63 (100)	22 (100)	31 (100)	NA
Antibiotics holding No Yes	1 (1.6) 52 (98.4)	5 (22.7) 17 (77.3)	3 (9.7) 28 (90.3)	0.006
Types of vaccines Farmer Veterinarian	0 (0.00) 63 (100)	6 (27.3) 16 (72.7)	0 (0.00) 31 (100)	<0.001
Governmental service No Yes	63 (100) 0 (00)	22 (100) 0 (0.00)	31 (100) 0 (0.00)	0.111
Do you use Artificial insemination? No Yes	61 (96.8) 2 (3.2)	17 (77.3) 5 (22.7)	25 (80.6) 6 (19.4)	0.003
A chi-squared test was performed for statistical analyses.				

Table 7: Veterinary service among Al-Hamdaniya, Bashiqa, and Telkaif districts for cattle

District no (%)				
Veterinary service	Al-Hamdaniya N=34	Bashiqa N=22	Telkaif N=9	P-value
Veterinary service Private	34 (100)	22 (100)	9 (100)	NA
Antibiotics holding No Yes	1 (2.9) 33 (97.1)	2 (9.1) 20 (90.9)	3 (33.3) 6 (66.7)	0.020
Types of vaccines Farmer	0 (0.00)	5 (22.7)	3 (30.77)	0.005

Veterinarian	34 (100)	17 (77.3)	6 (69.23)	
Storage of drugs/vaccines Fridge Room	 19 (55.9) 15 (44.1)	 7 (31.8) 15 (68.2)	 5 (55.6) 4 (44.4)	0.186
Governmental service No Yes	 33 (97.1) 1 (2.9)	 22 (100) 0 (0.00)	 9 (100) 0 (0)	0.629
Do you use Artificial insemination? No Yes	 19 (55.9) 15 (44.1)	 15 (68.2) 7 (31.8)	 6 (66.7) 3 (33.3)	0.113
A chi-squared test was performed for statistical analyses.				

DISCUSSION

Commercial broiler production

Poultry housing and management had fundamental effects on production. Broiler chicken facilities designed for breeding chickens for meat production and using traditional versions of homes can have implications for the efficiency and well-being of birds (Lay et al., 2011). Modern broiler chicken houses often include ventilation, heating, cooling, and maintenance developments. Other techniques to provide a more controlled environment for optimal chicken growth and health. Based on this study, the results showed high percentages of farmers suffered from poor quality broiler chickens. Agricultural extension services, government support, and collaboration with agricultural organizations are required (Khanal et al., 2022). For the latest and most accurate information on the situation in the Nineveh Plains or any other area, it is recommended to consult recent reports, studies, or local agricultural organizations with up-to-date data on the challenges faced by farmers and ongoing initiatives to improve the quality of chicks and feed. Farmers in the selected area reported no governmental services or laboratory services. The absence of such services can impair the spread of diseases and hinder poultry industry development (M'Sadeq, 2019). However, it is common for some regions, especially developing areas, to face challenges in providing adequate governmental and laboratory services for the agricultural sector, including commercial poultry production. The lack of such services can lead to difficulty controlling disease outbreaks and implementing effective disease prevention programs (Hafez and Attia, 2020). This may lead to economic losses and impacts on food security. To address these difficulties, local and national authorities and international organizations must provide help, training, and resources to enhance the current state of affairs. This could include initiatives to strengthen veterinary services and disease surveillance and reporting systems and invest in laboratory infrastructure to diagnose and identify diseases quickly (Vudriko et al., 2021). It is necessary to consult newer and local sources for the most accurate and up-to-date information on the current state of government and laboratory services in the Nineveh Plains.

The results revealed the impact of opened borders and imported frozen chickens on market prices. Various elements influence the effect of imported frozen chicken on the domestic market. Imported frozen chicken can be manufactured in countries with low production costs, enabling them to be sold at a reduced price compared to locally produced broiler chickens (Mahama et al., 2013). This leads to price competitiveness within the local market (Hafez and Attia, 2020). Also, consumers may prefer imported frozen chicken due to their perception of higher quality, brand familiarity, or other influencing factors, notwithstanding the advantages of locally raised broiler chickens. The market can be significantly impacted by the size of imported frozen chicken (Alsoufi, 2021). The presence of imported frozen chickens could produce heightened competition for local broiler farmers. Certain regional producers encountered difficulties in competing with reduced pricing, which might have an

impact on their financial viability and long-term viability. This can lead to decreased investment in the local poultry industry, impacting employment and the broader economy. To minimize the adverse effects of imported frozen chickens on the domestic market, the government could adopt trade restrictions such as tariffs or quotas to safeguard local producers. Furthermore, endorsing and advertising domestically raised broilers through marketing initiatives emphasizing their freshness, traceability, and the advantages of supporting the local economy might enhance customer inclination towards domestic goods. The influence of imported frozen chickens on the local market in Iraq will be determined by additional factors, including the extent of imports, consumer patterns, and the ability of local producers to adapt to market changes. It is essential for policymakers and stakeholders to thoroughly examine these aspects to formulate efficient measures to bolster the local poultry business. To tackle these difficulties, it is imperative for local and national authorities, as well as foreign organizations, to assume crucial responsibility in helping, educating, and making necessary provisions to enhance the current state of affairs.

High feed prices, medicines, vaccines, mortality rates, and production costs negatively impacted broiler production in the Nineveh Plains. In poultry production, feed is 60-70 % of the total cost of production. Reduced feed costs can significantly affect the cost of raising broiler chickens (Karaman et al., 2023). High prices of medications and vaccines increase production costs and impact the overall health and welfare of the birds. High mortality rates were a concerning issue for broiler farmers, as they not only affect the number of birds available for sale but also indicate potential health and management challenges within the production system. Mortality can result from various factors, including disease outbreaks, inadequate nutrition, poor housing conditions, and lack of proper management practices (M'Sadeq et al., 2015). High mortality rates negatively affect the overall efficiency of production. The combination of these challenges Nineveh Plains farmers face remains competitive, especially with cheaper imported frozen chicken alternatives. To address these challenges, governmental financial assistance to local farmers can compensate for the high feed costs, medications, and vaccines. Implementing biosecurity procedures can help reduce mortality rates and costly medications. Investing in research and providing training to farmers on best practices, efficient feed utilization, and disease prevention can enhance productivity and reduce costs. Addressing these challenges requires a comprehensive approach involving collaboration between the government, industry stakeholders, and agricultural experts to support sustainable and competitive broiler production in the region.

Local poultry breed production

Small-scale local poultry breeders support village livelihoods and rural communities in many ways. For many rural families, raising local poultry breeds could be a significant source of income. Selling eggs, meat, or live birds can provide a steady income stream, especially in areas with limited alternative job opportunities. Poultry raising can create employment opportunities for local villagers, women, and youth. Several factors contribute to low egg production and high mortality in local poultry breeds in rural areas. These factors included lack of clean water, poor nutrition, limited veterinary services, inadequate housing conditions, and lack of information (Wong et al., 2017; do Amaral, 2004; Enahoro et al., 2021; Usman and Diarra, 2008 and Tadesse, 2012). This study showed they were generally healthy, with fewer disease infections and no laying problems. Farmers were using vaccinations and medication based on veterinarian advice. However, a lack of private veterinary services was noted in most of the villages, negatively affecting farmers in the Nineveh Plains' rural areas. The absence of a private veterinarian has several negative implications, for instance, delayed diagnosis and treatment, limited preventive care, lack of expertise, reduced productivity, and lack of guidance (Galière et al., 2019).

Sheep and cow production

Selling dairy products in rural communities is important for their daily income. Farmers in Nineveh plains started selling raw milk. Selling raw milk can be a crucial economic activity for rural communities in regions like the Nineveh Plains. Raw milk is a valuable agricultural commodity providing local farmers with income and livelihood opportunities (McDermott et al., 2010). The prolonged absence of rainfall in Nineveh Plains significantly impacted the availability of natural forage and grazing resources for the farmer's sheep and cattle (Tahir and Harun, 2022). In such a scenario, relying on concentrated feed becomes a practical solution to ensure that the sheep and cattle receive the necessary nutrients to maintain their health and productivity. Lack of rainfall can lead to dry and barren pastures, making it difficult for sheep and cattle to find adequate food. Concentrated feed, specifically formulated to provide essential nutrients, can help fill this nutrition gap when natural grazing options are limited or nonexistent (Brown, 2018). However, relying on concentrated feed due to the prolonged drought can increase the cost of production. Purchasing and transporting concentrated feed can be expensive, and keeping the sheep adequately nourished becomes a necessary expense (McDowell, 1996). This cost factor and other potential challenges, like increased feed prices due to supply shortages caused by drought conditions, can place a significant economic burden on the farmer.

These findings suggested a common trend across the three regions where a significant majority of farmers had experienced a reduction in the number of both sheep and cattle. This could indicate several factors affecting livestock production, including high feed cost, medication, vaccination, overall production costs, and selling some livestock to cover the other expenses. The combination of high feed, medication, vaccination, and overall production expenses likely created a significant financial burden for the farmer (Adeyemo et al., 2022). As a result, the farmers strategically decided to sell some of their sheep or calves to generate funds. These funds were likely intended to cover the costs of feed, medication, and veterinary services for the remaining animals. It allows them to allocate resources where they are most needed and to make the best use of available funds.

Sheep and cow's veterinary services

Farmers in these regions had limited access to professional veterinary treatment from government agencies. Private veterinary services became the primary source veterinary service for livestock owners. Private veterinary services might charge fees for their knowledge and treatments, which could increase production costs (Nigussie et al., 2017). Specialized private veterinarian services may focus on specific aspects, limiting the alternatives available to farmers for managing particular health conditions (Arvidsson et al., 2022). The data showed widespread antibiotic administration among the farmers in the studied districts. Antibiotics could be used for clinical or subclinical bacterial infection treatment. However, overuse or improper use of antibiotics might lead to antibiotic resistance and potential health risks for animals, humans, and the environment (M'Sadeq et al., 2015). All farmers used vaccinations for their sheep and cattle for disease prevention. Relaying farmers to private veterinarians might create an environment where veterinarians could prioritize profit over the welfare and appropriate treatment of the animals (England, 2019). Education of farmers about the relevant information on vaccines and antibiotics used for their animals is required. Having this information might allow farmers to advocate for the health and well-being of their animals and make better decisions regarding veterinary care.

Artificial insemination (AI) in sheep and cows significantly affected reproductive practices and livestock production in selected districts. Due to a lack of information about AI, lack of quality semen, or religious practices, a higher percentage of farmers do not use Al. The AI implementation with high-quality semen could lead to several positive outcomes for sheep and cattle farming (Dalton et al., 2021). Educating farmers and providing them with the necessary training about the advantages and implementation of AI is crucial to increased utilization of AI technology.

CONCLUSION

It can be concluded from the results of this study that farmers in Nineveh Plains faced several challenges in livestock production. The main challenges faced by commercial poultry producers in selected areas were high mortality rates, fluctuating market prices for broiler chickens, and high feed and medication costs. The lack of a laboratory and the high risks of disease outbreaks negatively affected commercial meat chicken producers in the studied districts. Imported frozen chicken and opened borders were the main challenges for meat chicken producers. The quality of available medication and vaccines seems to be a concern. Sub-par quality of management can lead to ineffective disease control and lower flock health.

Production of large animals, sheep, and cows in the Nineveh Plains faced various challenges. These challenges included the feeding cost, which directly impacted farm profitability. The lack of governmental veterinary and laboratory services weakened livestock disease control, prevention, and health management. Furthermore, the sector grappled with the absence of accessible, dependable, and high-quality medicine and vaccines, constituting a substantial obstacle to maintaining the health of livestock populations. Insufficient housing facilities and overall management practices contributed to various animal health issues. All the challenges mentioned forced farmers to sell portions of their livestock to offset expenses. The underutilization of AI techniques affects farmers' ability to maximize livestock productivity and genetic enhancements.

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