

MAPPING THE VALUE CHAIN OF LIVESTOCK PRODUCTS AND BY-PRODUCTS

Muhammad Sleem^{*1}, Akber Jan², Bakht Muhammad³, Rizwan Ullah⁴, Ali Iqbal⁵,
Umer Bin Zarar⁶, Irfan Ullah Khan⁷

^{*1}Institute of Agriculture Extension, Education and Rural Development, University of Agriculture
Faisalabad

²Food Science and Technology, University of Engineering and Technology Lahore

^{3,5}National institute of Food Science and Technology, University of Agriculture Faisalabad

⁶Faculty of Food Science and Nutrition, Bahaudin Zakaria University Multan Pakistan

^{4&7}Balochistan Food Authority

¹saleemshykh@gmail.com; ²akbarbalochfst@gmail.com ³tushnakhan@gmail.com;
⁵aliiqbaliqbal554@gmail.com; ⁶umerzaidi988@gmail.com; ⁷Irfankakar261@gmail.com

Corresponding Authors: *Irfan Ullah Khan* *Irfankakar261@gmail.com

Received: August 15, 2024 **Revised:** September 15, 2024 **Accepted:** September 30, 2024 **Published:** October 09, 2024

ABSTRACT

The livestock sector serves as a significant source of livelihood for millions of people worldwide and plays a crucial role in ensuring food security and economic growth, especially in developing countries. The country is among the leading milk producers in the world, generating over 33 billion liters annually, of which 97% is sold in the informal sector. Moreover, livestock provides approximately 35-40% of rural households' income and accounts for 60.84% of agricultural value added. Keeping in view the importance of the livestock, the present study was designed to know the value addition of livestock in selected study district. For the purpose of collecting data, 101 respondents were consulted those were engaged in the livestock farming. For the purpose of data collection, interview schedule was prepared, after the collection of data, it was analyzed by using Software, Statistical Package for Social Sciences (SPSS). The results depicted that most of the farmers were small farmers in the area, 52.5% of the farmers had a herd size of 5-8 animals in their livestock while whereas only 6.9% of the farmers had more than 13 animals. The second most important attribute was the milk's thickness, which farmers associated with purity. Additionally, 82% of respondents emphasized the importance of smell, while 71% considered sweetness a significant quality factor. The major products was milk, meat, butter and yoghurt. While least consumed products were cheese, Khoya, hides and cream. The major problems being faced by farmers during the products and by products making easily availability of products and by products in the market, time consuming process, lack of technology for processing the products of dairy.

Key Words: Value Chain, Dairy, Products and Byproducts, Problems Faced.

Introduction

Livestock has emerged as a subsistence sector primarily managed by smallholders to meet their daily needs for milk, food, and income. In rural areas, it is regarded as a more reliable source of income for small farmers and landless individuals (Khan et al., 2013). The livestock sector serves as a significant source of livelihood for millions of people worldwide and plays a crucial role in ensuring food security and economic growth,

especially in developing countries. According to the World Bank (2020), over 1.3 billion individuals rely on livestock for their livelihoods. Despite its importance, food insecurity continues to be a major concern, with approximately 820 million people globally, including 13% of the population in developing nations, experiencing malnourishment (FAO, 2018; Mehmood et al., 2022). Livestock contributes significantly to food security by supplying about 34% of dietary protein worldwide (FAO, 2020). However, South Asian countries, including Pakistan, remain

particularly vulnerable to food shortages due to climate change and inadequate technical and economic support for mitigation strategies (Godber & Wall, 2014).

In Pakistan, the livestock sub-sector is essential for the agricultural economy, contributing 55.1% of the total value of the agricultural sector. Livestock products such as milk, hides, and other raw materials are vital for the rural economy and the livelihoods of millions of smallholder farmers (Njage et al., 2018; Weigel & Barlass, 2003). The country is among the leading milk producers in the world, generating over 33 billion liters annually, of which 97% is sold in the informal sector (Kamran & Rizvi, 2013). Moreover, livestock provides approximately 35-40% of rural households' income and accounts for 60.84% of agricultural value added (Govt. of Pakistan, 2024). The sector also presents an opportunity for renewable energy production through biogas, utilizing livestock waste, which can help address Pakistan's energy crisis and contribute to environmental sustainability (Malik & Sukhera, 2012; Akbulut, 2012). Animal draught power and manure enhance the productivity and fertility of land deficient in organic matter, despite methane emissions. Over 10 million draught animals are used in agricultural activities, and significant financial investment is needed to replace them. This substitution would require approximately Rs. 5.12 billion (Raza, 2000).

The most important role of livestock is the production of high-quality animal protein for human consumption through the supply of milk and meat. Milk production is the most efficient process of converting plant material into perfect food. Milk constitutes an integral part of our daily diet necessary for the nourishment and health development of the human being (Vilr and Niaz, 2024). Pakistan is one of the leading producers of milk, ranking as the fourth largest milk producer in the world after India, China, and the USA. with an estimated

production of 52.632 million tons annually. However, the total milk production of the country does not meet domestic human needs (Government of Pakistan, 2009). Although milk production in Pakistan has increased in recent years, this increase is not primarily due to productivity per animal but rather due to an increase in the total number of animals (Saleem et al., 2024).

Although Pakistan is among the largest milk-producing countries in the world, it still imports dry milk and other dairy products (such as butter, cheese, yogurt, cream, whey, etc.) annually to meet the growing demand for milk and its derivatives. Given the significant contribution of the livestock sector, a comprehensive value chain analysis is essential to understand market dynamics, identify key players, and address the challenges that hinder productivity and competitiveness. This study aims to provide insights into the relationships among different stakeholders, highlight the critical gaps, and propose targeted interventions to enhance productivity, efficiency, and sustainability in the livestock value chain. Addressing these issues will help maximize the potential of the livestock sector for economic growth, food security, and socio-economic uplift in rural communities.

Methodology

All farmers residing in the study area constitute the population of the study. For this study, five villages from Tehsil Multan were selected randomly. The list of registered farmers in these villages was obtained from the Livestock and Dairy Development Department, totaling 303 livestock farmers. The sample size was calculated by using the online sample size calculator www.surveysystem.com while keeping a Confidence Level of 95% and a Margin of Error of 8%. The calculated sample size was 101. Furthermore, the number of farmers selected from each village was determined using proportionate sampling.

Villages	No. of Registered Farmers	Sample Farmers
Village -1	81	27
Village- 2	50	17
Village-3	64	21
Village-4	70	23
Village-5	38	13
Total	303	101

For data collection, an interview schedule was prepared, keeping in view the purpose of the study. After preparing the instrument and ensuring its reliability and validity, it was used to collect data through face-to-face interviews. The collected data were then analyzed using the Statistical Package for Social Sciences (SPSS). Different statistics values were computed mean, weighted score and standard deviation.

Results and Discussion

Herd Size

The number of animals owned and reared by farmers, either on the farm or at home, is referred to as the herd size. This includes animals such as cows, goats, sheep, buffaloes, and camels. Farmers were asked about their herd size to assess the number of animals each farmer owns.

4.1 Distribution of the respondent's according to number of livestock herd in the shed

Herd size	Frequency	%
1- 4	22	21.8
5 – 8	53	52.5
9 – 12	19	18.8
13+	7	6.9
Total	101	100.0

The data presented in Table 4.1 shows that more than half (52.5%) of the farmers had a herd size of 5-8 animals in their livestock shed, whereas only 6.9% of the farmers had more than 13 animals. The limited herd size suggests that farmers, especially those with 1-4 animals, lacked resources. During the discussion, it was revealed that these farmers primarily rear animals to meet their household milk

demand. Most farmers with 5-8 animals were selling milk after fulfilling their domestic needs. Farmers with more than eight animals were actively engaged in selling milk, and some were also selling milk by-products, such as butter and desi ghee, as indicated during the conversation with the farmers.

Table 4.2 Distribution of the respondents according to family source of income

Family source of income	Frequency	%
Livestock farming only	17	16.8
Crop farming & livestock farming	67	66.3
Livestock+ business	12	11.9
Livestock+ service	5	5.0
Total	101	100.0

Table 4.2 shows that the majority of farmers (66.3%) were earning and sustaining their livelihood by engaging in agriculture, including crop and livestock farming. About 17% of the respondents were earning their income solely through livestock farming. The third major category was livestock farming combined with

business, in which about 12% of farmers were involved for their livelihood. Only 5% of the farmers were earning their livelihood from livestock farming and providing services. These services were jobs in either the public or private sector.

Table 4.3 Desired attributes of milk

Attributes of milk	Yes		No	
	f	%	f	%
Taste	101	100	0	0
Smell	82	81.2	19	18.8
Sweetness	72	71.3	29	28.7
Thickness	92	91.1	9	8.9

The data shows that farmers categorize good quality milk based on several attributes, with taste being the most recommended. This was highlighted as a crucial quality indicator by all respondents. The second most important attribute was the milk's thickness, which farmers associated with purity. Additionally, 82% of respondents emphasized the importance of smell, while 71% considered sweetness a significant quality factor. Similar findings were reported by Godfrey et al.

(2019) in their study of fresh milk value chains, where 68% of consumers prioritized high-fat content when purchasing milk, whereas only 9% ranked safety and health as their top concern. One consumer interviewed at a retail shop remarked, "There should be cream on top of milk, no matter how many times it is boiled." The preference for high-fat content, particularly in buffalo milk, was a dominant quality attribute across all three chains examined.

Table 4.4 Value Chain Analysis of Livestock Products

Products and by products	Yes		No	
	f	%	f	%
Milk	99	98.0	2	2.0
Meat	90	89.1	11	10.9
Dung	64	63.4	37	36.6
Yoghurt/Lassi	99	98.0	2	2.0
Hides	6	5.9	95	94.1
Cream	21	20.8	80	79.2
Butter	98	97.0	3	3.0
Cheese	9	8.9	92	91.1
Khoya	2	2.0	99	98.0

In the given table, the value chain of dairy products and by-products with which the farmers are dealing is mentioned. According to the data, about 98% of the farmers kept livestock for the purpose of obtaining milk, while a few farmers (2%) were not getting milk from their animals as they had just started dairy farming and their animals were not yet at the milking stage.

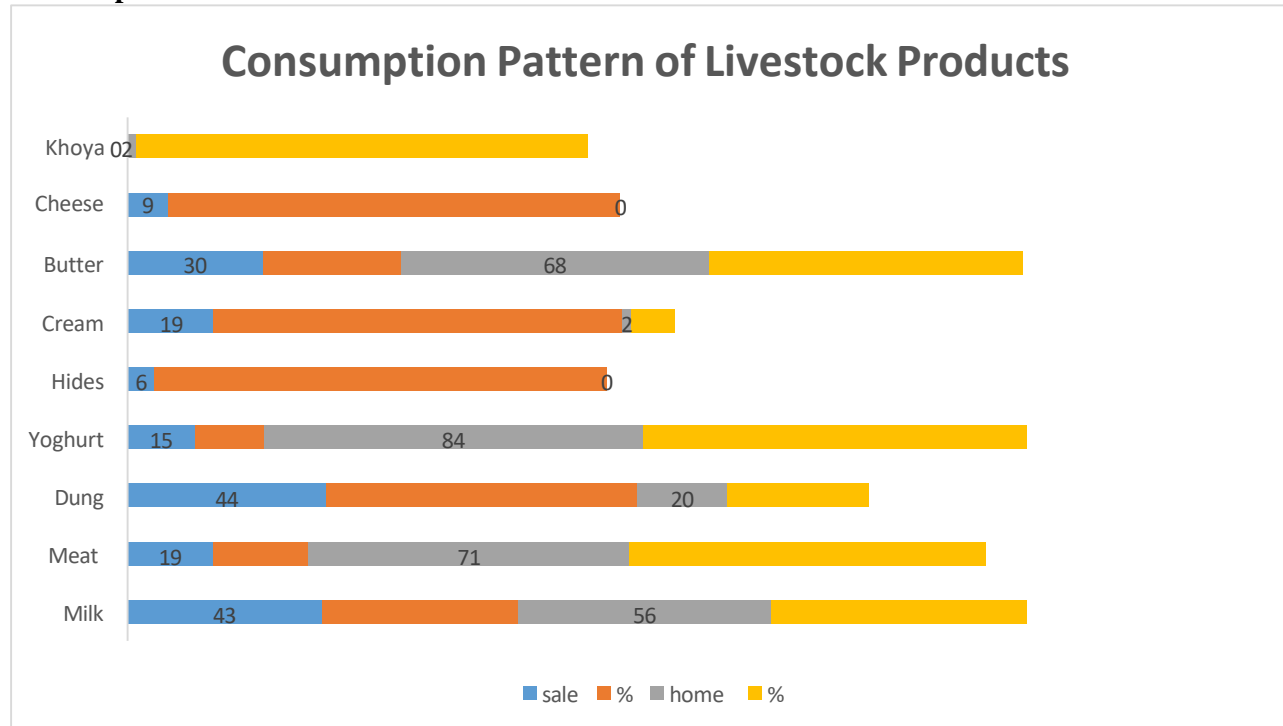
An overwhelming majority (89.1%) of the farmers stated that they reared animals for meat production. They further mentioned that, during Eid-ul-Adha, they mostly either slaughter their animals or sell them to earn a substantial amount of money.

According to another overwhelming majority (98%) of the farmers, they processed the milk to make yoghurt or lassi for domestic use. Farmers also added that it is a common practice among those who own animals to make yoghurt specifically for household consumption. Among these, 97% of the farmers stated that they also obtained butter, which is a by-product of yoghurt or lassi.

A significant majority (63.4%) of the farmers reported that livestock is also a source of dung, which is used as farmyard manure or as an alternative to firewood for cooking purposes. On the other hand, only a few farmers reported

obtaining hides, cream, cheese, and khoya as by-products of dairy production, with percentages of 5.9%, 20.8%, 8.9%, and 2.0%, respectively.

Consumption Pattern of Livestock Products



Graph 1: Consumption Pattern of Livestock Products

In the graph above, the data is divided into two categories based on the consumption of dairy products: one category represents the sale of the product, while the second category represents home consumption. It is clear from the data that the majority (56.6%) of respondents consume the milk at home. About 79 percent of the farmers stated that they raise animals primarily for meat production. Additionally, they mentioned that during Eid-ul-Adha, they do not purchase animals from outside but instead slaughter the ones they have reared. Meanwhile, approximately 21 percent of the farmers sell their animals on occasions such as Eid

and weddings. An overwhelming majority (84.8%) of the 94 farmers engaged in yogurt making were consuming the yogurt at home, while the remaining were also selling it. Similarly, a vast majority (69.4%) of the farmers were consuming butter at home, while the remaining 30% were selling it as well. Additionally, a significant majority (68.4%) of the 64 farmers were selling dung to others and earning income from it. As discussed earlier, only a few farmers were engaged in making hide, cream, cheese, and khoya, with percentages of 5.9%, 20.8%, 8.9%, and 2%, respectively. Most of these farmers were selling these products.

Table 4.5 Descriptive statistics with weighted scores (WS) and ranks

Livestock as a source of livelihood	Mean	SD	WS	Rank
Milk	2.73	0.904	276	1
Yoghurt	2.63	0.703	266	2
Butter	2.58	0.930	261	3
Meat	2.43	1.211	245	4

Dung Cake	1.09	0.991	110	5
Cream	0.44	0.963	44	6
Cheese	0.26	0.956	26	7
Skin and hides	0.06	0.238	6	8
Khoya	0.04	0.280	4	9

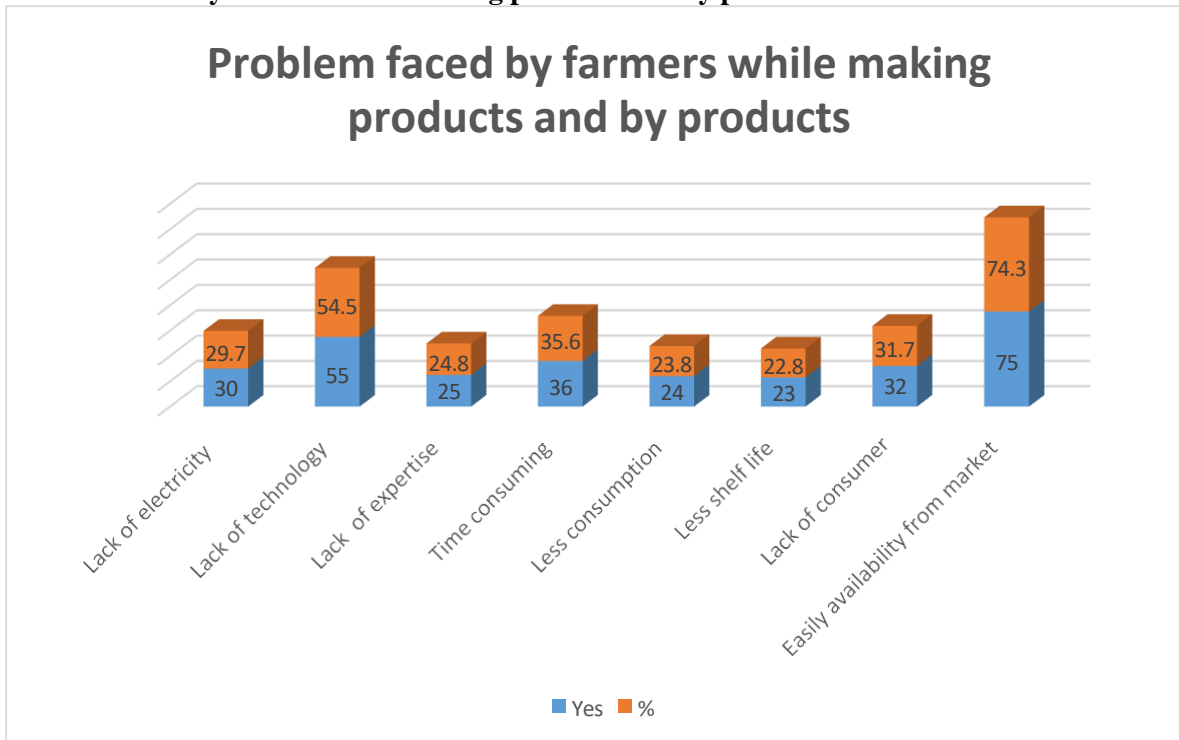
Scale 0= Not preparing, 1=Very Low, 2=Low, 3=Medium, 4=High, 5=Very High

The table shows the ranking of products and by-products used by farmers, based on weighted scores and mean values. The data indicates that milk ranked first, having the highest weighted score and mean value. Farmers commonly make and consume yoghurt and butter, as making Lassi is a widespread practice at the village level. Almost every household prepares Lassi, and both butter and yoghurt are directly linked to its production. As a result, yoghurt and butter ranked second and

third, with mean values of 2.63 and 2.58, and weighted scores of 266 and 261, respectively. Meat ranked fourth, while dung cakes ranked fifth.

According to the table, cream, cheese, skin and hides, and khoya ranked sixth, seventh, eighth, and ninth, respectively. The mean values of these products and by-products were below one, indicating that very few farmers prepared and used them, as represented in Table 4.4.

Problem faced by farmers while making products and by products



Graph 2: Problem faced by farmers while making products and by products

According to the data provided, the major reasons for not processing dairy products and by-products among farmers include various challenges and constraints. A vast majority (74.3%) of farmers reported that these products were easily available in the market, which reduced the need for them to

produce such items. Additionally, a majority (54.5%) mentioned lacking the necessary technology for dealing with the dairy value chain. More than one-third (35.6%) of farmers found dealing with the value chain of dairy to be a time-consuming process, while about one-third (31.7%)

cited the lack of consumer demand for dairy by-products such as cheese and desi ghee, leading them to refrain from producing these items. Furthermore, less than one-third (29.7%) indicated that large-scale production of dairy products and by-products is challenging due to the requirement of electricity, which is often unreliable in rural areas because of power shortages. About one-fourth (24.8%) of farmers pointed out that the lack of expertise in making dairy products and by-products prevents them from engaging in processing activities. Lastly, less than one-fourth (22.8%) reported lacking storage facilities for these products, along with the fact that dairy products have a short shelf life, which discouraged them from processing dairy by-products.

Discussion

Table 1 depicts that in the study area farmers owned the small herd size which depicts the farmers have less resources to sustain the life as reported by Sarwar et al., 2002). Besides earning from the livestock sector to sustain their living farmers were also practicing other profession for earning handsome amount as indicated in table 4.2. Farmers reported during the discussion that dairy sector is not their first preference for earning because of many reasons such as fodder shortage, low price of milk and poor marketing as reported by According to Khan (2010), the main challenges in Pakistan's agricultural marketing system include a lack of awareness about market dynamics, costly transportation, low-quality produce, multiple intermediaries, monopolistic practices by middlemen, insufficient storage facilities, inaccurate weights and measures, poor farm-to-market roads, and inadequate regulation concerning weights, health, and safety standards. Additionally, unauthorized deductions by buyers, a disorganized marketing system, and a shortage of cooperative marketing initiatives pose significant problems for farmers trying to market their agricultural products.

Parahalad (2008) states that farmers receive low prices for their produce because they are unable to delay sales immediately after harvesting due to the lack of storage facilities. Farmers could secure better prices if they were able to store their produce. During agricultural trade, agents often take advantage of farmers' lack of knowledge about market prices, buying at low rates and selling at

higher ones. Farmers need education on the market system to improve their outcomes.

Arrain (2010) notes that Pakistan's livestock marketing system is underdeveloped, with poor information sources, market fluctuations, and the influence of middlemen as major barriers to progress. Farmers lack awareness of how to process, store, and market livestock products, such as properly treating and selling wool, which is often wasted or sold cheaply. The lack of infrastructure in livestock marketing also requires urgent attention to boost the sector's growth.

Khan et al. (2013) highlight several major issues in the livestock industry, including feed scarcity, high mortality rates, degradation of rangelands, a lack of value addition facilities, inadequate marketing systems, poor extension services, and policy constraints. Limited value addition facilities contribute to the underdevelopment of this sector, which needs attention to make dairying a more profitable industry. International markets have an increasing demand for value-added livestock products and by-products, which are sold at premium prices. Considering consumer preferences, adding flavors and colors can improve the appeal of these products. There is significant demand for value-added camel and goat milk internationally, presenting opportunities for increased profitability (Raziq et al., 2010).

Conclusion

The study highlights the various aspects of livestock farming among smallholder farmers, including herd size, sources of family income, desired attributes of milk, value chain analysis of livestock products, and challenges faced in processing dairy products. Most farmers in the study maintained a herd size of 5-8 animals, suggesting that livestock farming is largely small-scale. Farmers with fewer animals were more focused on household milk consumption, while those with larger herds were actively involved in selling milk and milk by-products. Livestock rearing served as a crucial livelihood source for the majority of the respondents, with many combining livestock farming with crop farming or business activities.

Milk was the most valued product, both for household consumption and sale, followed by yoghurt and butter. The desired attributes of good-quality milk included taste, thickness, and

sweetness, reflecting consumer preferences for high-fat content. The value chain analysis showed that while a majority of farmers were involved in milk production, only a small number were processing dairy by-products such as cream, cheese, and khoya. Farmers faced several challenges in processing dairy products and by-products, including the availability of products in the market, lack of necessary technology, time constraints, limited consumer demand, power shortages, lack of expertise, and insufficient storage facilities. These challenges have limited the processing and commercialization of dairy products among smallholder farmers. Addressing these challenges through improved technology, training, and infrastructure could enhance the value addition potential of dairy products, increase farmer income, and boost the local dairy industry.

Recommendations

To enhance the productivity and profitability of livestock farming among smallholder farmers, capacity-building programs should be implemented to train farmers in dairy processing techniques, enabling them to produce value-added by-products such as cheese, khoya, and desi ghee. Facilitating access to appropriate technologies and improving rural infrastructure, particularly through reliable energy sources like solar power, will further support these efforts. Establishing community-based storage facilities and developing market linkages can help farmers overcome challenges related to the short shelf life of dairy products and improve their income potential. Financial support through microloans or grants will enable farmers to expand their herds and invest in dairy processing equipment, while the formation of cooperatives can allow farmers to pool resources and negotiate better market prices. Additionally, promoting local consumption of dairy by-products and educating farmers on livestock nutrition and feeding strategies will help boost productivity and create a sustainable demand for these products.

References

- Akbulut, A. 2012. Techno-economic analysis of electricity and heat generation from farm-scale biogas plant: Cicekdagi case study. *Energy*. 44: 381-390.
- Arrain, M.A. (2010). Livestock: A Potential Source of Milk, Meat, Forex and Poverty Alleviation in

- Pakistan, *Agro Veterinary News*. 22(09), Dec-2010.
- Asif M., 2009. Sustainable energy options for Pakistan. *Renewable and Sustainable Energy Reviews* 2009;13:903–9, doi:10.1016/j.rser.2008.04.001.
- Aslam, M., Zhiwen, L. I., Naeem, S., & Nasir, S. (2024). Navigating digital frontier: factors influencing supply and demand of fresh milk in Pakistan. *Scientific papers series management, economic engineering in agriculture & rural development*, 24(1).
- FAO (2020). Animal production. Available at:<http://www.fao.org/animal-production/en/>.
- Godber, O.F. and R. Wall (2014). Livestock and food security: vulnerability to population growth and climate change. *Glob Chang Biol*. 20(10): 3092-3102.
- Godfrey, S. S., Ramsay, G. C., Behrendt, K., Wynn, P. C., Nordblom, T. L., & Aslam, N. (2019). Analysis of agribusiness value chains servicing smallholder dairy farming communities in Punjab, Pakistan: three case studies. *International Food and Agribusiness Management Review*, 22(1), 119-136.
- Government of Pakistan (2024). Pakistan Economic Survey of Pakistan. Retrieve at: https://finance.gov.pk/survey_2024.html.
- IFAD (2010). Value chains, linking producers to the markets. *Livestock Thematic Papers Tools for project design*. By Antonio Rota and Silvia Sperandin, <http://www.ifad.org/lrkm/factsheet/valuechains.pdf>.
- Kamran, A., & Rizvi, S. M. A. (2013). Reason and trends for using packaged milk in Pakistan: study of urban Pakistani consumers. In *Proceedings of the Sixth International Conference on Management Science and Engineering Management: Focused on Electrical and Information Technology* (pp. 909-924). Springer London.
- Kennedy S., 2000. Energy use in American agriculture. *Sustainable Energy Term Paper*. Malik, S.N. and O.R. Sukhera. 2012. Management of natural gas resources and search for alternative renewable energy resources: A case study of Pakistan. *Renewable and Sustainable Energy Reviews*. 16: 1282–1290.
- Khan, G. A. 2010 Present and prospective role of electronic media in the dissemination of agricultural technologies among farmers of the Punjab, Pakistan
- Khan, M. J., Abbas, A. S. A. D., Naeem, M. U. H. A. M. M. A. D., Ayaz, M. M., & Akhter, S. (2013). Current issues and future prospects of dairy sector in Pakistan. *Sci. Tech. Dev*, 32(2), 126-139.

- Mehmood, H. Z., Afzal, H., Abbas, A., Hassan, S., & Ali, A. (2022). Forecasts about livestock production in Punjab-Pakistan: implications for food security and climate change. *JAPS: Journal of Animal & Plant Sciences*, 32(5).
- Naqvi, S.R.; Jamshaid, S.; Naqvi, M.R.; Farooq, W.; Niazi, M.B.; Aman, Z.; Zubair, M.; Ali, M.; Shahbaz, M.; Inayat, A.; et al. Potential of biomass for bioenergy in Pakistan based on present case and future perspectives. *Renew. Sustain. Energy Rev.* 2018, 81, 1247–1258.
- Njage, P.M.K., Opiyo, B., Wangoh, J., Wambui, J., 2018, Scale of production and implementation of food safety programs influence the performance of current food safety management systems: Case of dairy processors. *Food Control*, 85: 85-97.
- Parahalad, C. K., 2008. Problems and prospects in agricultural marketing: Issues & Analysis. *The Daily Dawn*. 25th Oct . Online <http://www.Dawn.com>(Website accessed on june, 2011).
- Raza, S.H. 2000. Role of Drought Animals in the Economy of Pakistan. *Drought Animal News*, (32) MAY: 17-18.
- Raziq A, M Younas and Z Rehman. 2010. Prospects of livestock production in Balochistan. *Pak Vet. J.*, 30(3):181-186.
- Saleem,M., Shinwari,A,S., Ali, S., Saghir, A., Bilal, M,Q., Asghar,M., Nawaz. R (2024). Information needs of livestock farm families: a case study of Multan. *International Journal of Contemporary Issues in Social Sciences*, 3(1), 1772–1780.
- Sarwar, M, M.A. Khan and Z. Iqbal. 2002. Feed resources for livestock in Pakistan. *Int. J. Agri. Biol.*, 1:186-192.
- Singh, J.M. 2000. On farm energy use pattern in different cropping systems in Haryana, India. Germany: International Institute of Management, University of Flensburg, Sustainable Energy Systems and Management, Master of Science.
- Vilr, M., & Niaz, S. (2024). Climate-Smart Livestock Breeding: A Study of Holstein-Friesian Cattle in Canada and Pakistan. *International Journal of Agricultural Innovations and Cutting-Edge Research*, 2(1), 34-47.
- Wang, L.; Bandyopadhyay, S.; Cosgrove-Davies, M.; Samad, H. Quantifying Carbon and Distributional Benefits of Solar Home System Programs in Bangladesh; Policy Research Working Paper 5545; The World Bank Environment Department: Washington, DC, USA, 2011.
- Weigel, K., Barlass, K., 2003, Results of a producer survey regarding crossbreeding on US dairy farms. *Journal of dairy science*, 86(12): 4148-4154.
- World Bank (2020). Moving towards sustainability: The Livestock Sector and the World Bank. Washington, DC: World Bank.