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What is Holding Back Milk Production Potential in Pakistan?

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ABSTRACT

Pakistan produced 55 million tonnes of buffalo and cow milk during 2019-20. The estimated potential production is much higher—at the research station level, the estimated potential is 82 million tonnes, while the maximum breed potential is 110 million tonnes. Several factors, including; low return for dairy farmers, credit constraints, the low genetic potential of milking animals, the absence of a formal milk marketing system, lack of healthcare for milking animals, insufficient/ improper feeding, and lack of research, constrains opportunities in the dairy sector.

I. INTRODUCTION

Pakistan is a leading milk-producing country; its milk production system is dominated by smallholders (Tahir, et al. 2019; Khan, et al. 2013). However, the milk production in Pakistan is not enough for the demand of a fast-growing population. Only in Karachi, the daily shortage has been reported at four million liters. The demand for milk is projected to grow by at least 5.0 percent annually in the coming years (Arijo, 2018). To cover the present and future demand-supply gap, we would require an increase in milk production at 3.5 percent per annum, greater than the population growth of 2.1 percent (Milk Cluster Report, 2020). Given the growing population and income levels, the demand and supply gap is likely to jump further in the future.

The dairy sector of Pakistan has a vast potential to augment milk production to meet future demand. Considering the importance of this sector, the Government of Pakistan developed the first-ever livestock policy in 2007 to attract investment from stakeholders in farming, procurement, and processing of dairy and dairy products. However, the main stakeholders, small dairy farmers, are still facing constraints, including limited opportunities to access consumers or the industry directly. They have little control over the price of milk owing to their small-sized enterprises. Overall, the dairy sector is confronted with a plethora of impediments impinging milk production potential in Pakistan.

This paper suggests measures aimed at achieving dairy sector development, with an overall objective of finding out the foremost reason behind the factors holding back the milk production potential in Pakistan. Four specific objectives of the study are: (1) to review the state of the milk economy in Pakistan; (2) to estimate the milk production potential; (3) to explore the constraints in achieving milking potential; and (4) to set the goals for harnessing the milk potential.

The rest of the study is organized as follows. Section II examines relevant literature. Section III is devoted to an overview of the milk economy of Pakistan. Section IV presents methodology and data sources. Section V is about the estimation of milk production potential; Section VI uncovers the factors holding back the full potential of milk production, while Section VII deals with harnessing the milk production potential in Pakistan.

II. LITERATURE REVIEW

About 150 million family units are engaged in milk production around the globe. The world's milk production was 852 million tonnes in 2019. The contribution of cow and buffalo milk was 81 percent and 15 percent, respectively, while the combined share of goat, sheep, and camel milk contributed just 4 percent. In the developing world, milk is mostly produced by small dairy farmers to fulfill their basic needs. Most milk production is spread out in South Asia, while the main driver of its growth has been the developing world since the 70s (FAO). India is the largest milk producer, producing 186

million tonnes, while Pakistan ranks the 3rd largest milk producer, producing 57 million tonnes. The share of both countries was 28 percent in the world's milk production in 2019.

World milk production is likely to grow at 1.6 percent per annum till 2029 to reach 997 million tonnes. India, the USA, and Pakistan would be producing 255, 107, and 64 million tonnes respectively. It is expected that India and Pakistan will contribute more than 30 percent to world milk production [FAO, (2020)]. Livestock is not only the backbone of the agriculture sector but is also a major source of income for landless rural households and small farmers. It has an important role in the development of the rural economy, and its importance may well be recognized from the fact that 35-40 percent of the income of the 8 million rural families is associated with livestock [Economic Survey of Pakistan (2019-20)]—primarily milk supports their livelihoods. Moreover, its gross product value is Rs. 236 billion which is 54.4 percent of the total gross value of livestock and poultry products of Rs. 434 billion [MNFS&R, (2017-18)]. Keeping in view the importance of the milk economy, the government has identified five major milk clusters at the country level [Milk Cluster Report, (2020)]. While milk production, the number of dairy cows, dairy farms, and dairy consumption have decreased in developed countries, milk and dairy products have increased in developing countries (Knips,2005). Milk production per animal is much higher in the developed countries. For example, Garcia et al. (2003) show that one milking animal in developed countries produced milk equivalent to three to seven milking animals in Pakistan. As noted earlier, the current milk production in Pakistan is not enough to meet the growing domestic demand. It should increase at the rate of 3 percent annually to cope with the growth of milk consumption and the population of Pakistan [Economic Survey of Pakistan, (2008-09)].

The farm gate fresh milk price in leading milk-producing countries, including India, is 40-100 percent higher than the price in Pakistan. The foremost issue limiting milk production in Pakistan is the low milk yield of milking animals (Shahid et al., 2012). The low milk production potential of animals is usually due to a lack of breed improvement strategies, non-availability of sufficient healthy feed, and traditional dairy farming techniques in Pakistan. Milk production is also adversely affected due to seasonal changes. Typically, it declines by around 55 percent in May-June, while the demand in this period increases by around 60 percent relative to December (winter season). The patchy shelf life of milk in summer further aggravates the problem. The scarcity thus generated in the summer season causes an increase in milk price (PDDC, 2006). The snags confronting milk production potential in Pakistan are described in the literature, but the knowledge gap exists in understanding the actual reasons. The reasons holding back the milk production potential in Pakistan have been discussed later on in this study. Moreover, the potential of milking has been estimated separately for buffaloes and cows.

III. MILK ECONOMY OF PAKISTAN

This section presents a brief discussion on the milk economy of Pakistan by focusing on the key relevant issues such as milk production, livestock population, milking animals and their yield, milk marketing, processing, pricing and import, and export. This discussion would help in understanding the dynamics of Pakistan's milk economy.

III.1. Milk Production

In 2018-19 the livestock sector accounted for around 61 percent of agriculture value-added and 12 percent of GDP, which is greater than the contribution of crops to the GDP. The share of the livestock sector grew at a rate of 4 percent, contributing 3.1 percent to total exports in 2018-19 (Pakistan, 2018-19). Milk is the single largest commodity in the livestock sector.

Table 1

Milk Production in Pakistan (Million Tonnes)

Year	Buffalo Milk	Cow Milk	Goat Milk	Sheep Milk	Camel Milk	Total Milk Production
1961	4	1.7	0.09	0.02		6
1971	5	2.1	0.19	0.02		8
1981	7	2.2	0.44	0.04		9
1991	11	3.7	0.53	0.04		15
2010	22	12.4	0.74	0.04		35
2019	34	21	0.94	0.04	0.91 ¹	57

Source: FAO Country STAT, ¹Camel Milk Data: Economic Survey of Pakistan (2019-20).

Table 1 shows the milk production for 1961–2019 for six selected years, 1961, 1971, 1991, 2010, and 2019. The total annual milk production jumped from only 6 million tonnes in 1961 to 57 million tonnes in 2019. It remained low until 1991 at 15 million tonnes. The production increased three and half times between 1991 and 2019. Milk production has increased by nine times with an average growth rate of more than 3 percent during the last six decades. Buffaloes and cows always remained the major drivers in milk production. The share of buffalo milk always remained higher than cow milk, while the share of goat, camel, and sheep milk together is considerably lesser than the share of buffalo and cow milk (Table 1).

Lohano and Soomro (2006) forecasted that milk production would see an annual increase of 4.2 percent for the next decade in Pakistan. However, the milk demand was likely to escalate by 15 percent, much higher than the 3 to 4 percent annual increase in production. The excess demand for milk in 2015 was around 3.6 billion liters (Jano, 2011). Table 1 shows the milk produced by buffaloes, cows, and goats. The share of buffaloes milk in the total annual milk production is around 60 percent, while more than one-third of the milk of the total milk production is owed to cows. To sum up, milk production has considerably increased during the last six decades, but the increase in supply remained much lower than the increase in demand.

III.2. Livestock Population

Livestock plays a crucial role in increasing milk production. Out of the households that own livestock, around 84 percent possess a herd size of 1-4 animals (cow and buffalo), while 14 percent have ten animals. (Pakistan, 2009). In 1961, the total number of livestock (buffaloes, cows, sheep, goats, and camels) was 41 million (Table 2). By 2019-20 it had jumped to 201 million. The number of livestock has increased five times with an average growth rate of 3 percent, and animal composition has also changed during the last six decades (Table 2).

Table 2

Livestock Population (1961-2019-20)

Livestock	1961 (Million)	2020 (Million)
Cattle	14	50
Buffalo	7	41
Goat	9	78
Sheep	10	31
Camel	0.6	1.1
Total	41	201

Source: FAO Country STAT, Economic survey of Pakistan (2019-20).

The total number of livestock increased by five times while the number of cattle and buffaloes increased around four times and six times respectively during the last six decades. The number of goats, sheep, and camels increased by 9, 3, and 2 times respectively during the same period.

III.3. Milking Animals and Milk Yield

Milking animals, as well as milk yield play an important role in enhancing milk production. During 1961–2019, the milking buffaloes increased from 2.6 million to 14.9 million, and milk yield increased from 1.6 tonnes to 2.3 tonnes. During the same period, milk production increased from 4 million tonnes to 34 million tonnes. The number of milking cows increased from 1.9 million to 14.1 million, and their milk yield increased from 0.9 tonnes to 1.5 tonnes. The cow milk production increased from 1.7 a million tonnes to 21 million tonnes in Pakistan during 1961–2019 (Table 3).

Table 3

Number of Milking Animals, Milk Yield (1961–2019)

Years	Milking Buffaloes	Buffalo Milk Yield	Buffalo Milk Production	Milking Cows	Cow Milk Yield	Cow Milk Production
	(Millions)	(Tonnes)	(Million Tonnes)	(Millions)	(Tonnes)	(Million Tonnes)
1961	2.6	1.6	4	1.9	0.9	1.7
2018	14.5	1.9	28	13.6	1.2	16.3
2019	14.9	2.2977	34	14.1	1.4606	21

Source: Calculations based on FAO Country STAT.

It is also observed that milking buffaloes' population and their milk yield increased six times and 1.4 times respectively while milking cows' population and their milk yield increased seven times and 1.6 times, respectively. Table 3 also shows that the milking cows' population and their milk yield growth was slightly higher than milking buffaloes' population and yield growth during 1961–2019. In short, milk production is dominated by milking animals, not their milk yield.

III.4. Milk Composition

The composition of milk coming from different sources in 2019 is given in Table 4.

Table 4

Change in Milk Composition (1961-2019)

Years	Buffalo Milk (%)	Cow Milk (%)	Goat, Sheep and Camel Milk (%)
1961	70	28	1
2019	60	37	3

Source: Calculations based on FAO Country STAT.

Table 4 also shows that the share of buffalo milk decreased by 10 percent while the share of cow milk increased by 9 percent in total milk production during the last six decades. But the combined share of goat, sheep, and camel milk starting from a very low base of just 1.0 percent tripled during the same period. The buffalo milk still has a dominant share in total milk production though the share of cow milk is rapidly rising in total milk production.

III.5. Milk Marketing, Processing, Pricing, and Import, Export

Most dairy farmers live in disorganized and scattered rural areas with a small number of milking animals. Small dairy farmers have never benefited from the real fruit of credit due to rather higher interest rates, lengthy and complex procedures. About 80 percent of milk is produced by the small dairy farmers in rural areas, 15 percent in peri-urban, and 5 percent in the urban areas of Pakistan (Sharif et al., 2003). Milk is the most essential daily consumable item, and more or less every household spends more than 26 percent of its budget on milk and milking products (Farooq, 2016). About 97 percent of milk is marketed through middlemen in loose form, and the rest of 3-5 percent is processed (UHT), while 15 to 20 percent of the total milk production is wasted during transportation due to the absence of a formal milk marketing system (Zia, 2006). The processed buffalo ghee production was 120 thousand tonnes in 1961 and reached 730 thousand tonnes, while skimmed cow milk production was 9 thousand tonnes in 2003, which increased to 69.8 thousand tonnes in 2014 (Table 5).

Table 5

Livestock Processed Items (1961–2014)

Year	Buffalo Ghee (000) Tonnes	Skimmed Cow Milk (000)Tonnes
1961	120	0
2003	530	9.0
2004	560	9.9
2005	580	21.2
2014	730	69.8

Source: FAO Country Stat.

It is important to note that producer milk prices increased at a decreasing rate compared to consumer milk prices during that period. Currently, the average producer milk price is Rs. 50-60 per kg in rural and urban areas depending upon the quality of milk, while middlemen sell it at double the price of Rs.100-120, and UHT milk is sold at

three times the price of Rs.140-150 per liter to the end consumer. Unfortunately, the milk price that small dairy farmers charge in Pakistan is 35 percent less than the world milk price (Sattar, 2020).

Pakistan is the major milk-producing country but also imports dairy products to meet its domestic demand. Pakistan imported around 86 thousand tonnes of milk products in 2019, 86 percent of this comprised skimmed dried milk, and 11 percent was whole dried milk. Details on the monetary value of imports are given in Table 6.

Table 6

Import and Export of Dairy Products (1961-2018)

Years	Quantity Imported (Tonnes)	Value (US\$ Million)	Quantity Exported (Tonnes)	Value (US\$ Million)
1961	5216	2	0	0
2013	25054	77	45558	74
2015	51577	186	31399	46
2017	50116	138	25183	35
2018	48798	132	26309	27
2019	86498	140	18484	14

Source: FAO Country STAT.

The country exported slightly over 18 thousand tonnes of milk products in 2019. The bulk of the exports comprised cow milk (95 percent) and skimmed dry milk (5 percent). Table 6 shows that dairy imports are increasing while dairy exports are on the decline in Pakistan.

The major exporters of dairy products produce all the dairy items from cow milk. But Pakistan has a unique opportunity in producing dairy products from buffalo as well as cow milk. Most of the world is unfamiliar with buffalo milk and its dairy products. Pakistan can benefit from it by producing dairy items from buffalo milk for its domestic needs, while cow milk and its dairy products can be exported to the highest milk deficit countries like China, Russia, and Indonesia at a cheaper price than the rest of the world. Khan (2021) states that Pakistan has the potential to earn US\$30 billion by exporting dairy products if impediments impinging the dairy sector are resolved. Therefore, Pakistan should focus on the production of cow milk, processing, and its dairy products like casein, cheese, butter, skimmed milk powder (SMP), whole milk powder (WMP), and whey powder (WP). In this way, Pakistan can increase its dairy export as well as save its foreign exchange of Rs. 20 billion per year by reducing its dairy imports (Sattar, 2020).

IV. METHODOLOGY AND DATA SOURCES

We have estimated the milk production potential. The data on milk productivity-related variables for different major local cattle and buffalo breeds are usually not available. However, Bhutto et al. (1993) had estimated milk production potential at three levels [Actual national production, production at research station (under better conditions), and maximum breed potential for different local cattle and buffalo breeds of the country. These estimates are usually recognized as the national averages of milk

production. These averages and breed potentials are attainable at the research stations as well as at progressive livestock farms.¹ The data developed by Bhutto et al. (1993) on national milk production averages and production potential of local breeds of buffalo and cows are given in Table 8.² Iqbal and Ahmad (1999) have also estimated the potential of milk production in Pakistan using the data developed by Bhutto et al. (1993). Their estimates suggest the country's milk production of buffaloes and cows at 23 million tonnes, production at research stations at 33 million tonnes, and the maximum breed potential as 44 million tonnes. They conclude that milk production potential can be increased by 50 to 100 percent by managing milking animals' genetic potential. They have estimated the aggregate (buffalo and cow) milk production potential. This study estimates disaggregate as well as aggregate milk production and potential of buffaloes and cows.

V. ESTIMATION OF MILK PRODUCTION POTENTIAL

It is a widespread belief that the milk production potential of milking animals is underutilized, and per animal, milk productivity is lower than its genetic potential in Pakistan. Milk production is attributed to milking animal's population and not yield. Bhutto et al. (1993) estimated the national average milk production and potential of different breeds of buffaloes and cows (liters per lactation) at the research station level and the breed's maximum potential level. Bhutto et al.'s estimates are presented in Table 7.

Table 7

National Averages of Milk Production at Farmers' Level and Production Potentials of Different Breeds (Litres per Lactation)

Breeds	National Average Production	Research Station Potential	Breed Maximum Potential
Nili-Ravi	2300	3150	5000
Kundi	2000	3000	3500
Other	1769	2500	3000
Sahiwal	2200	3600	6500
Red Sindhi	1800	2700	4000
Thari	1200	1800	2160
Bhagnari	800	1160	1392
Rojhan	900	1305	1566
Dhani	800	1160	1392
Kankraj	1200	1740	2088
Lohani	700	1015	1218
Cross Bred	2600	3600	4320
Others*	700	1015	1218

Source: Bhutto, et al. (1993).

¹The research station is a place where different breeds of high milking yield animals are kept to monitor their milk productivity.

²The data on milk yield of elite local cattle and buffalo breeds are maintained by the progressive dairy farmers as well as the Livestock Production Research Institute,.

Using Bhutto, et al. estimates (Table 8), the milk production and potential of buffalo and cow is estimated at disaggregated and aggregated levels in the following manner.

A closer analysis of the Bhutto et al. informs that output at Research Stations is 1.5 times the national average, and the maximum breed potential is two times the national average (see Table 8-A). Using these factors (Research Station potential: 1.5 times the national average and maximum breed potential: 2 times the national average). We compute the potential at the level of Research Station and the maximum breed potential separately for Buffaloes and Cows, using the actual current national production (2019-20) as the base figures. The estimates are presented in Table 7a.

Table 7a
National Averages of Milk Production at Farmers' Level and Production Potentials of Different Breeds (Tonnes per Lactation)

	National Average	Research Station Potential	Breed Maximum Potential
Buffalo Breeds			
Nili-Ravi	2.30	3.15	5.00
Kundi	2.00	3.00	3.50
Others	1.77	2.50	3.00
Σ	6	9	12
	<i>6/6=1</i>	<i>9/6=1.5</i>	<i>12/6=2</i>
Buff. Milk Production (2019-20)			
<i>(34 Million Tonnes)</i>	<i>34*1=34</i>	<i>34*1.5=51</i>	<i>34*2=68</i>
Cow Breeds			
Bhagnari	0.80	1.16	1.39
Rojhan	0.90	1.31	1.57
Dhani	0.80	1.16	1.39
Kankraj	1.20	1.74	2.09
Lohani	0.70	1.02	1.22
Cross Bred	2.60	3.60	4.32
Others	0.70	1.02	1.22
Σ	13	19	26
	<i>13/13=1</i>	<i>19/13=1.5</i>	<i>26/13=2</i>
Cow Milk Production (2019-20)			
<i>(21 Million Tonnes)</i>	<i>21*1=21</i>	<i>21*1.5=31</i>	<i>21*2=42</i>

Source: Calculations converted from litres into tonnes and based on Bhutto, et al. (1993) data.

The disaggregated data for buffalo and cow milk potential are given in Table 7b.

Table 7b

<i>Average Milk Production and Milk Production Potential (Million Tonnes)</i>			
Milking	National	Research	Maximum
Animals	Average	Station	Breed
	Production	Potential	Potential
Disaggregated Level			
Buffalo	34	51	68
Cow	21	31	42
Aggregated Level			
(Buffalo & Cow)	55	82	110

Source: Calculations converted from liters into tonnes based on Bhutto et al.'s (1993) data.

It is evident from Table 8b that the production of cow milk and its potential are higher than the actual production and potential of buffalo milk.

VI. REASONS FOR HOLDING BACK MILK PRODUCTION POTENTIAL

Based on the situation analysis and an estimate of the potential of milk production undertaken in the preceding sections, it appears that milk production in Pakistan has enormous potential to increase. Still, certain factors are holding back milk production. Factors holding back the production of milk to reach its potential are discussed below.

VI.1. Lack of Awareness in Small Dairy Farmers

About 66 percent of population dwellings in rural areas are dependent on agriculture and livestock. It is a major source of revenue for them to fulfill their basic needs. Around 84 percent of small dairy farmers with small size herds are living in rural areas of Pakistan. Burki and Khan (2019) state that about 2.5 million dairy farms with a herd size of 10 or more have the potential of adopting modern dairy apparatus. But most of the small dairy farmers are; illiterate, rigid, living from hand to mouth, and are reluctant to adopt the contemporary dairy practices due to lack of awareness.

VI.2. Little Rewards for Small Dairy Farmers

There is a substantial difference between what the producer receives and what the consumer of milk pays - a sizable margin goes to the middlemen. Thus milk producers are not enjoying the real fruit of the difference in production and end-consumer prices. Most of the small dairy farmers are leaving this sector. Malik (2006) finds that small dairy farmers in Pakistan are earning 35 percent lesser as compared to the world milk price. They argue that the farm gate prices of milk at U\$13/100 kg in Pakistan is the lowest among the major milk producers of the world. Burki and Khan (2019) explain that buffalo only, dairy farms are dwindling while mix (buffaloes and cows) and cow only dairy farms are on the rise because the dairy farms housing buffalos only are registering losses. This is due to the increasing cost of feed and fodder and the static farm gate price of milk.

VI.3. Lack of Access to Credit

Credit availability also plays a critical role in boosting the dairy farming business. Abedullah et al. (2009) state that credit provision to the dairy farmers flourished the livestock sector, resulting in its expansion at more than double the rate. It also amplified family monthly income from livestock by 181 percent. Though the government's credit policy has always been favorable to the agricultural sector, however, more than 70 percent of disbursement is allocated to the crop sector while only 15 percent of the credit for agriculture goes to the livestock sector [State Bank of Pakistan, (2008)].

The government had been promoting the dairy sector by providing credit to dairy farmers in the early 70s. As a result, bank credit to the dairy sector increased significantly over time. In 1979-80, the total bank credit to the dairy sector was Rs. 6.9 million provided together by the Zarai Taraqati Bank Limited (ZTBL) and commercial banks. It is worth noting that the ZTBL remained a major financier till 2004-05 but more recently commercial banks are taking the lead. In 2005-06, commercial banks provided Rs. 4 billion to nonfarm activities. The different credit institutions disbursed Rs. 250 billion to livestock/dairy and the meat industry in 2020-21. But the small dairy farmers never managed to reap the real fruit of credit provision due to high mark-up, lengthy, and complex credit mechanisms. Big and influential dairy farmers have always enjoyed the credit facility. The lack of credit availability and the mismanagement of credit for the landless and small dairy farmers is a major hurdle in the development of the dairy sector in Pakistan.

VI.4. Low Genetic Potential of Milking Animals

The leading milk-producing countries have a lesser population of high genetic potential milking animals, but their yield is much greater. It is important to note that one milking animal of the developed country produces more milk than eight milking animals of Pakistan. According to Ali (2006), one of the prime hurdles in increasing milk productivity is the low genetic potential of Pakistan's local breed of animals. The genetic advancements in cross-breeding cattle with high-yielding exotic breeds provide the tremendous long-term potential of increasing milk yields by three to four times at the farm level. The practice has been adopted in many developing countries, and doing so will be fruitful for Pakistan as well (Burki and Khan, 2019). However, milk production in Pakistan has been increasing only due to the increase in the number of milking animals and not the yield!

VI.5. Insufficient Livestock Feed

Fodder is an essential source of energy for animals as it helps in increasing milk production. The overall performance of fodder area, fodder production, and fodder yield per hectare is hovering around less than 3 million hectares, 60 million tonnes, and 24 tonnes, respectively. The fodder; area and production, was 2.06 million hectares and 46 million tonnes respectively in 2017-18. During this period, the fodder yield per hectares was 22 tonnes. The decrease in fodder production from 58 million tonnes in 1999-2000 to 50 million tonnes in 2018-19 is alarming (Agricultural Statics of Pakistan, various issues). This level of fodder production does not even fulfill the feed requirement of even half of the livestock population. The fodder deficit varies between 15-30 percent (PARC). About 65 percent of small dairy farmers have no land, and 20 percent have land less than 12 acres,

while only 15 percent have land of more than 12 acres for fodder cultivation. India is producing 186 million tonnes of milk with green fodder of 462 million tonnes in 2019, having an 8.4 million-hectare fodder area which is 5 percent of the total cultivated area of India. Iqbal (1994) explains that the total available feed resources for livestock have been estimated at 52 million tonnes while the actual need for feed had been estimated at 66 million tonnes. Iqbal and Ahmad (2005) show that Pakistan has a 30 percent deficit in feed resources to fulfill the dietary needs of existing animal stock.

VI.6. Poor Livestock Health

The livestock population was about 201 million in 2019-20. The main drivers of milk production are buffaloes and cows, which have always remained at risk due to fatal diseases. Dirty water, improper and insufficient feed, and extreme weather are the major sources of diseases and infections in livestock. Particularly foot and mouth diseases are common in cows and buffaloes. The diseases not only harm animal health but also affect the milk yield of the small dairy farmer. The Livestock Department oversees animal treatment in Pakistan. There are 6,706 facilities to treat these diseases, including veterinary hospitals, veterinary dispensaries, and veterinary centers in the public sector which are managing 201 million animals and that also provide vaccination against major infectious diseases (Afzal, 2009). Iqbal (1994) states that not more than 10 percent of the country's animal stock is vaccinated against infectious and fatal diseases. The budgetary allocations to the livestock sector never exceed 0.5 percent of total development spending, which is not even enough for purchasing the medicines required to treat various diseases afflicting livestock (Afzal, 2009). The result of meager government spending on animal healthcare means insufficient government veterinary centers, scarcity of veterinary doctors, and the shortage of life-saving medicines for animals. Unfortunately, this gap is filled by quacks, expired medicines, and traditional treatment methods. The small dairy farmers have to forcefully adopt such risky practices and incur significant costs to treat the animals.

VI.7. Absence of Formal Milk Marketing System

As mentioned earlier, about 97 percent of milk is marketed in loose form, and 3-4 percent is processed (UHT), while 15 to 20 percent of the total milk production is wasted in some areas of Pakistan. The milk supply is marketed through the traditional and complex informal system in which the milkmen (i.e., middlemen) enjoy the real fruit of small dairy farmers' precious products. The producers are forced to sell milk to milkmen at low prices due to poor marketing. Iqbal and Ahmad (1994) conclude that the present system of marketing milk has not succeeded in fiddling with seasonal vacillations in the supply-demand of milk. This is due to the insufficient infrastructure in the rural areas of Pakistan.

VI.8. Low Priority for Research and Development

Research and development (R&D) is the backbone of a country. The major milk-producing countries like the USA, New Zealand, etc., are leading in the dairy world only due to dairy research and development. They are using modern technologies in the dairy sector. Mostly it is observed that R&D is carried out by the private sector in these countries.

India is spending a considerable amount to transform the whole dairy sector with the latest modern technology. Ratna and Sharma (2017) used time-series data (1993-94-2010-11) about India (Himachal Pradesh). They stated that one percent increment in the number of cross-bred cows and artificial insemination would increase the total milk production by 0.64 and 0.90 percent, respectively, while overall economic surplus from milk production was estimated to be Rs 222.04 with a benefit cost ratio of 1.41 and a 62 percent internal rate of return.

Unfortunately, the opportunities for the latest research and development i.e., livestock research labs locally produced high milking yield animals through genetic technology, latest vaccines, and new varieties of animal feed and healthcare of animals, are in a dismal state. The small dairy farmers are not fully aware of the latest dairy research and dairy equipment. Also, they are unfamiliar with modern dairy techniques, which can increase animal productivity and save time, money, and labor. The dairy sector lacks the basic R & D environment, and it is not clear who will lead in this regard?

Due to a lack of research and development opportunities, the dairy sector has also suffered and remains traditional. Without it, the snags like fodder shortage, chronic animal disease, low milk yield, lack of formal milk marketing system, lesser return, and non-availability of financial support to small dairy farmers, etc. cannot be addressed

VII. HARNESSING THE MILK PRODUCTION POTENTIAL

Keeping in view the importance of the dairy sector, it should be separated from agriculture, and a separate budget should be allocated to the dairy sector in which a significant chunk should be allocated to dairy research and development. In the past, milk yield augmentation had been practiced through artificial insemination, which had a very diminutive impact on milk production. Milk yield can be raised only through genetic advancement and cross-breeding of cattle with high-yielding exotic breeds. It would endow with increasing milk yield by three to four times. Government should formulate an appropriate producer milk pricing policy to stop the exploitation of milk producers. The small dairy farmers living in rural areas should be financially supported in the short and long term with interest-free loans. This should be done through banking and non-banking channels for purchasing high milking yield animals, fodder production, and animal treatment. The credit policy needs to be formulated in such a way that soft-term loans reach small farmers. This will positively impact milk production in Pakistan.

Moreover, insurance companies should launch insurance programs for valuable milking animals through insurance policies. The small dairy farmers should focus not only on the sale of milk rather they should focus on value-added items like desi ghee, yogurt, butter, khoya, and cheese. The farmers should start switching to cow milk rather than focusing only on producing buffalo milk as raising buffaloes is more expensive than raising cows due to higher prices of feed and fodder. They should also focus on the production of green fodder because it is economical relative to other feeds. The private sector should establish more milk collection centers and cold chains in rural areas. The sector can provide high-yield milking animals in reasonable installments to the small dairy farmers. The milk processing companies should also focus on dairy items from cows like casein, butter, cheese, skimmed milk powder (SMP), whole milk powder (WMP), and whey Powder (WP).

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