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Review

Dairy Industry in Pakistan: A Scenario

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ABSTRACT

Milk and its products provide nearly one third of world's intake of animal protein (FAO, 1998). Milk and milk products represent 27% of total household expenditures on food items in Pakistan. Per capita availability of milk in Pakistan is 82.4 kg per annum. About 80 thousand tons of dry milk, worth rupees 1213.5 million, was imported to Pakistan during 1999-2000 to meet local demands of milk. Small herd, poor genetic potential of animals for milk, low quality feeds, high risks of epidemics, improper marketing channels, lack of technical man power for dairy industry, high environmental stress, reproductive failure and high udder abnormalities, lack of commercial rations, orthodox management practices and poor extension services are the major constraints of dairy sector in Pakistan. The buffalo is the main dairy animal in Pakistan that accounts for roughly 75% of all milk produced in the country. The milk production in excess during winter and less during summer months causes many problems in its marketing. Pacca dodhis (milk suppliers) supply their milk to collection center or milk shops, usually after decreaming. Peri urban milk producers usually sell their product directly to consumers, milk shops and to larger establishments through contracts. If the pacca dodhis sell their milk to decreamer or hire his services, the milk is separated into cream and skim milk. The skim milk is mixed with other whole milk and sold to urban milk shops. The producer appears not to receive a premium for summer milk or for milk with higher milk fat content except for that paid by the milk collection centers that are operated by processors. The milk products and byproducts produced in the country are pasteurized milk, ultra high temperature (UHT) milk, powder milk, cream, butter, ghee, yogurt and cheese. The price of UHT milk is nearly double the price of raw milk. Dairy animals with high genetic potential for milk production always remain the corner stone of dairy production strategy. The genetic potential for milk production in indigenous cattle and buffalo could be improved by selective breeding. Legume and grass fodder combination could improve the feeding status of livestock. Better feeding of livestock could be achieved if vertical expansion of livestock production is followed. Ensiling and hay making systems should be devised and extended to the farmers according to local livestock production system. Coordination of research and extension activities is needed for the progress of dairy sector. The rural small holders should be trained in the skills of efficient dairy production. There is no price motivation for the milk producers so most of the milk is produced on subsistence basis rather than commercial basis. Education of farmers regarding, mastitis, vaccination, metabolic, nutritional and reproductive problems is required to avoid monetary losses in dairy sector.

Key Words: Dairy; Buffalo; Cow; Milk; Feeding

INTRODUCTION

Agriculture sector with its integral component of livestock (animal agriculture) is regarded as most vital part of the national economy since the emergence of Pakistan. Agriculture not only contributed importantly to the national GDP of Pakistan during last five decades but also the provision of employment and food to rapidly growing nation remains important obligations of this sector. In the changing scenario of economy of Pakistan and other developing nations, agriculture is still the largest sector. In Pakistan, agriculture contributes slightly above 25% to GDP, employs around 44% of work force, is the main source of foreign exchange earnings and provides linkages through which it can stimulate growth in other sectors (Economic Survey of Pakistan, 1999-2000).

Livestock is the most important sub sector of agriculture in Pakistan that accounts for nearly 37% of agriculture value added and about 9% of the GDP. The net foreign exchange earnings were about 35 billion rupees in 1999-2000, which was about 9% of the overall export earnings of the country (Economic Survey of Pakistan, 1999-2000). Livestock sector has its due importance in Pakistan due to the fact that 30-35 million rural population is engaged in livestock keeping (Economic Survey, 1999-2000).

Milk plays a tremendous role in building a healthy society and can be used as vehicle for rural development, employment and slowing down the migration of the rural population. Pakistan stands 7th position among the top ten world's milk producing countries. Milk and milk products provide nearly one third of world's intake of animal protein (FAO, 1998). This is not true for Pakistan where milk provides more than half of the 17.4 g of animal protein available for each person daily and so traditional diets assign a balancing role to milk (Anonymous, 1996). However, per capita availability of milk is far less than the recommended levels (0.5 liter per person per day) of World

Health Organization. About 80 thousand tones of dry milk was imported in Pakistan during the last year to meet local demands of milk (Agriculture Statistics, 1999-2000). The total milk yield in Pakistan is 26.4 million tones and entire dairy processing industry was using only about 15% of it (Hemani & Khan, 1997). The importance of milk as a cash crop is always neglected in the past. While comparing the value of milk with other cash crops, it was mentioned that milk had a value about 60% higher as compared to both wheat and cotton together.

The land of Pakistan is benefited with both irrigated plains through mighty Indus river with its tributaries and desert areas like Cholistan and Tharparker. Pakistan is expended from costal range areas in the south to the alpine pastures in the north and has variability in topography, rainfall, humidity, temperature, plant and animal species, social and cultural heritage. So dairy development is not only needed to meet the growing demands of animal protein but for socioeconomic reasons as dairy animals provide regular cash income, economic utilization of family labor, create social security and supply growing markets.

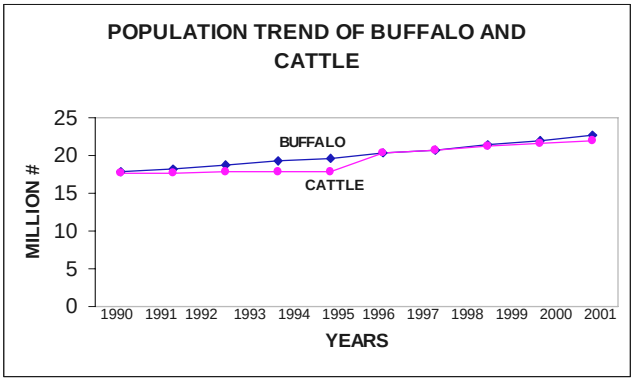
Milk production is an extremely labor intensive occupation, however, in many countries of the world including Pakistan, it is the most productive way of converting crop residues and agro industrial wastes into valuable food. But due to biological and technical constrains like shortage of feed, high mortality rate, poor genetic potential etc; socio economic constraints like high input cost, scarcity of sources, inadequate marketing systems, commercial feed industry and policy constraints render this sector undeveloped and truly in a miserable condition. The main objective of this article is to review the potentials, problems and solutions pertaining to dairying in Pakistan.

Main features of dairy sector in Pakistan. Dairy industry in Pakistan has similar characteristics, like other developing Asian nations, which include small herd, poor genetic potential of animals for milk, low quality feeds, high risks of epidemics, improper marketing channels, lack of technical man power for dairy industry, high environmental stresses, reproductive failure and high udder abnormalities, orthodox management practices, poor extension services and lack of commercial rations. Despite of all above problems, dairy animals, mainly buffalo and cattle are producing 26.4 million tones of milk in Pakistan (Agriculture Statistics, I999-2000). Per capita availability of milk in Pakistan is 82.4 kg annually. This quantity of milk provides more than half of the 17.4 g of animal protein available for each Pakistani daily. But Pakistan still has to import dry milk and other milk products e.g. butter, cheese, yogurt, cream, whey etc. every year to fulfill the ever increasing demands for milk and milk products. During year 1999-2000 Pakistan expended about 1213.5 million rupees of valuable foreign exchange to import the milk and milk products (Agricultural Statistics, 1999-2000). The increasing demands for dairy products are attributed to high population growth rate and rapid urbanization.

Population of buffalo and cattle. Pakistan owns about 23.3 million heads of buffalo (Agriculture Statistics 1999-2000). The buffalo population increased about 14.7% during the last 6 years from 1996 to 2001 in Pakistan. Population trends indicate that their number is likely to further increase in future (Khan, 1998) Punjab, Sindh, NWFP and Balochistan provinces contribute 64, 28, 7 and 1%, respectively, to the total buffalo population of the country (Livestock Censes, 1996). These figures indicate that most of the buffaloes are present in irrigated areas and along riversides of the country. About 60% of the total buffalo stock is, female buffalo stock, of above three years of age. It is estimated that about 8.7 million heads of buffalo are in milk, remaining either in dry stage or not yet calved. About 0.42 million buffalo bulls are available either for breeding or for work purposes.

According to Economic Survey (1999-2000) of Pakistan about 22.4 million heads of cattle are available in the country. Data about cattle population in Pakistan from 1996 to 2001 indicated about 9.36% increase cattle population as shown in Fig. 1.

Fig. 1. Population trend of buffalo and cattle from 1990 to 2001



It was estimated that around 10.4 and 4.1 million heads of mature cows and bulls are present in Pakistan. However, cattle population data from 1986-1996 suggest a negative growth for bull population. This may be supported by the fact of increased mechanization in agriculture sector or it may be due to the preference for artificial insemination in cattle by the farmers. However, second factor seemed to be ineffective because data in 1996 livestock censes indicated a positive growth trend for cattle breeding bulls and negative for cattle bulls engaged in work.

Dairy breeds and breeding. Worldly two well-known breeds of buffalo (Nili Ravi & Kundi) are major contributors to buffalo stock in the country. Buffaloes are the main dairy animals in Pakistan (Khan, 1998). According to Livestock Censes (1996) about 33 and 20.8% of the total buffalo population belongs to Nili Ravi and Kundi breeds, respectively. Other buffaloes belong to either their crosses or some other breeds of the region. Khan (1998) reported

that milk yield in Nili Ravi buffaloes ranged from 1835 to 2543 kg per lactation. Ahmad (1999) reported that production recording on civil and military dairy farms in an organized manner was undertaken in 1920. Under field condition, the first milk recording was undertaken in 1979. Progeny testing of buffalo bull was started in 1980. In 1996, Pakistan government approved a technical document entitled "production of breeding bulls in Pakistan for implementation. The production of breeding sires is a multiple step process that requires simultaneous action on production recording and identification of "Elite cows", identification of male bull calves and their raising up to performance testing, raising of donor bulls at semen production units, artificial insemination and progeny testing of donor bulls. As follow up, various actions were initiated during 1996-1999 for implementation of the above steps. In spite of prolonged efforts, the proposed and planned actions have failed to achieve required objectives. Khan (1998) reported that breeding values for milk yield averaged 9.3 and 32.2 kg in Nili Ravi buffaloes and bulls, respectively. Variation in the breeding values of tested bulls was lower than expected. He reported that genetic trend in buffaloes was negative but sire used in the recent years was better than those in the past. The negative trend in the buffalo population merely depicts lack of effectiveness of the selection procedures employed in the past. Selection based on the physical condition of the bull, or the type in general, and dam's performance failed to bring any genetic improvement in the past. He stated that policy of choosing on the basis of genetic worth is likely to be a step in right direction. However extensive studies are required in refining the procedures of data collection and evaluation. He suggested that with millions of small buffalo farmers, sustainable development of buffalo requires national and international programs.

Payne and Wilson (1999) described that Sahiwal, Red Sindhi and Tharparker (a dual purpose cattle) breeds of cattle are important cattle milch breeds of Pakistan. Sahiwal is a large, heavily built, long deep rather flashy animal. The coat color varies, but reddish dun is common. Red Sindhi is medium to small animal having round droopy quarters. Coat color is usually red to dun yellow. The origin herd is found at Malir in Sindh province. They survive under subtropical and semi arid environment. It is considered one of the best breeds of subtropics. It has been exported all over the tropical world and is used for upgrading indigenous cattle, especially for milk. Tharparker (white Sindhi) breed is present in Thar Desert in south west of Sindh province. This is an arid area where rainfall averages 200 mm per annum and during drought years cattle have had to be removed to surrounding areas where they have crossbred with Kankrej and Red Sindhi. They are strongly built, medium size animals with comparatively short, straight limbs and good feet. The coat color is white to gray with gray strip along top line. This is one of the best dual purpose, milk and work, breeds found in Indian subcontinent.

It has been documented that age of first calving in Sahiwal and Red Sindhi varies between 30 and 43 months. Milk production in Sahiwal ranges from 1200 to 3100 liters with maximum record of 5500 liters in a lactation (Nagarcenkar, 1983). Length of lactation in Sahiwal and Red Sindhi varies between 270 and 490 days (Pyne & Hodges, 1997).

Sahiwal is one of the most productive tropical dairy breeds. In Jamaica, they have been crossed with jersey to provide the foundation stock for the milch breed known as Jamaica Hope. In Australia, the Sahiwal has been used in the development of two new dairy breeds, the Australian Milking Zebu and Australian Friesian Sahiwal. In both Australia and New Zealand a new export trade has been developed that of crossbred (Sahiwal x European milking breeds) dairy heifers to Southeast Asia (Nagarcenkar, 1983). Payne and Wilson (1999) reported that unless crossbred animals were managed in closely controlled environment, it is very doubtful whether crossbred dairy cattle should be used under tropical conditions.

Ahmad (1990) reported that crossbreeding of local cattle with Bos taurs was started in 1900 on military dairy farms and by 1937 sufficient information and data had emerged and published. He further reported that for a long time after independence, the introduction of cross breeding in the country remained controversial. However, it has been well documented that indigenous cattle have been adapted to the local conditions through natural selection over generations. In view of the impressive results obtained from selection in many temperate dairy breeds, there should be considerable scope for improving indigenous cattle. The variability, in terms of the coefficient of variation is generally higher in Zebu than in temperate cattle so there is possible scope of improving milk production in Sahiwal and Red Sindhi cattle through application of modern animal selection techniques.

In modern dairy cattle breeding programs in temperate countries, 60-70% of genetic progress was derived from the selection of bulls on the basis of progeny testing. Dahlin (1998) reported that genetic trend in Sahiwal cattle for all traits were closed to zero over the period studied, but substantial deterioration in the performance caused by environmental factors was observed. It was concluded that selection against milk production and poor reproduction in cows was desirable, but feeding and body condition call for greater attention if reproductive performance is to be improved. He reported that alternative selection strategies showed that the expected annual genetic gain by selection for 305-day milk production might be in the range of 0.7 to 1.1% of the mean. The number of pure Sahiwal breeding and crossbred cows was ranging from 9000 to 10500 and 100,000, respectively in Pakistan (Pyne & Hodges, 1997). Although the Sahiwal is the premier dairy breed among the zebus, the pure bred population has been decreasing. By virtue of its unique characteristics the Sahiwal represents a genetic resource, which is of the utmost importance. Dahlin

(1998) suggested that in the long run it was likely that best course of action to maintain and to conserve the breed, was to keep it commercially viable. He reported that a much quicker improvement, measured in kg per animal, could be achieved with Sahiwal. By using better methods for genetic evaluation and modern reproductive techniques, genetic gain can be increased considerably.

Feeds and feeding. Feeding and nutrition have repeatedly been highlighted as the major constraint in animal production (ILRI, 1995) and also sub regionally in South East Asia (Devendra *et al*., 1997) and South Asia (Devendra *et al*., 2000). The significance of improved nutrition in dairy production is therefore a major consideration. The report of working group on milk (1999) indicated that the feed/fodder deficit was variously estimated at 15-30% of the total animal requirement in terms of total digestible nutrient. However, the shortage will be probably larger in terms of digestible protein and energy. Sarwar *et al*. (2001) explained that in Pakistan dairy animals are raised under 3 different managerial feeding circumstances.

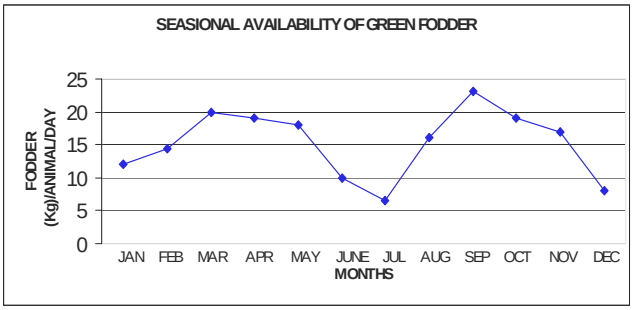
- In irrigated rural areas (Punjab & Sindh provinces) in the form of small herds where buffaloes and cattle mainly rely on crop residues and fodder crops.
- Under peri urban environment where dairy animals are maintained on fodder crops, agro industrial wastes and concentrates (oil cakes).
- Large herds of cattle are raised under range and barani conditions where they are kept on naturally grown grasses, shrubs and tree leaves.

The major constraint in the development of dairy sector in Pakistan is poor availability of nutrients in quality and quantity for dairy animals. In Pakistan nutritional requirements of dairy animals mainly met through fodder crops, shrubs, grasses and agro industrial wastes. It has been reported that livestock are getting 51, 38, 3, 6 and 2% of their required nutrients from green fodder/ crop residues, grazing/vacant lands, post harvest grazing, cereal by products and oilcakes/meals, respectively (Hanjra *et al*., 1995). In advance countries where dairy animals are fed liberal grains forage still contribute about 75% of the nutrients but when grains are not available like in Pakistan, 95% nutrients are obtained through forages (Bula *et al*., 1977).

It was reported by the working group on milk (1999) that the shortage of feed and fodder in the country affected the production potential of dairy animals. The situation is further aggravated by the continuous increase in the number of dairy animals. Fodder yields have not significantly increased and low productivity per acre has further worsened its availability.

It has been reported that Livestock are getting only 75% of the required amount of total digestible nutrient (TDN) and there is also shortage of digestible crude protein (CP) up to 60% (Akram, 1990). Improvement in quantity and quality of feeds could bring improvement of livestock production up to 50% from exiting genetic pool of animals (Hasnain, 1983). The nutrient reservoir like rangelands are subjected to deterioration and still no proper attempt has been made to sustain and improve their productivity. Livestock farmers hesitate to use agro-industrial byproducts or non-conventional feed resources to improve livestock feeding because they are unaware of the usefulness of such materials and so strictly adhered to their traditional feeding patterns. Area under fodder production is decreasing @ of 2% after each decade (Gill, 1998). According to Fig. 2, June-July and October-November are fodder scarcity periods in our region.

Fig. 2. Seasonal availability of fodder in Pakistan



Livestock policies in Pakistan are supportive to the horizontal expansion of livestock rather than vertical expansion of the sector, which cause further problems. Currently, 121.1 million heads of animals require about 10.92 and 90.36 million tones of CP and TDN, respectively, annually in Pakistan. However, the respective availability of these nutrients is only 6.7 and 69.00 million tones, which indicate a deficiency of 38.10 and 24.02% of CP and TDN, respectively, per year (Sarwar *et al*., 2001). Thus the existing available feed resources can only fulfill the maintenance requirements of animals. There is an immediate need to explore the available feed resources and to suggest remedies to minimize the gap between nutrients availability and nutrients requirements of animals (Sarwar *et al*., 2001).

The gap between requirement and availability of nutrients could be minimized through proper fodder research and extension policies in terms of better quality seed, seed rate, improved agronomic practices and improved inputs (fertilizers, water, pesticides). Rangelands are 60% of the total area of Pakistan and proper range management and improvement policies like artificial reseeding, introduction of exotic species, water conservation methods and community organization could bring improvement in the supply of quality biomass in sufficient quantity. Urea and poultry litter as a source of NPN could help a lot to minimize the gap between protein availability and protein requirements of ruminants if proper coupling of nutrients at feed, digestive and cellular level is achieved. Agro industrial byproducts and non-conventional feed resources could be used for feeding of livestock if farmers are trained to do so. Situation may be further improved if year round fodder

system and fodder conservation techniques are introduced in livestock feeding systems. Establishment of cattle feed industry is required to provide dairy mixes to the farmers at cheaper rates.

Usage of treated straws. Methods to improve the quality of straws have not gained popularity among the animal owners because the scientists contributed so little to increasing animal outputs in developing countries. There seems to be a number of reasons but among the strongest influences have been 1) the lack of opportunity for farmers to communicate their priorities for animal improvement to scientists and have the appropriate research undertaken, 2) the preoccupation of scientists with accurately describing the nutritional constraints under controlled conditions rather than to work on problems of farmers as they pertain to the field conditions, 3) the largely unrecognized or ignored differences in nutrient requirements of livestock in the tropics as compared with temperate countries, 4) an inability of many scientists to translate their research results into appropriate developments and apply them to farming systems, 5) logistic problems in taking the technology to the massive number of farmers in the developing countries who in general own only 1-5 animals, 6) gender considerations - often information is not given to the real managers of livestock on a farm, 7) an unwillingness of farmers, who are risk averse to take up new technologies unless the rewards are large and/or immediate and 8) lack of market access, often aide programs push technology on to farmers rather than pull them into a production area by creation of markets.

There appears to be an increasing ground swell for change and acceptance of innovation by farmers in many developing countries who are presently experiencing a substantial increase in demand for animal products, particularly in Asia, as the population expands and standard of living improves. The increase in demand for animal products is likely to be much higher than for plants in the less-well developed countries over the next 20-50 years (i.e. 3.6% as compared with 2.4% per annum for crops) There are other influences which have seen a change in attitude, particularly the need to consider environmental pollution in development projects and in particular the value of curbing greenhouse gas emissions into the atmosphere from agriculture.

Animal health. The importance of maintaining animal's health does not need to be expressed. This is the basic requirement, but despite the widespread veterinary hospitals and dispensaries, the prophylactic measures are not reaching down to farmers. Regular vaccinations program against foot and mouth disease, which affects the production severely and not only seasonally but has a lasting effect, and the prevailing bacterial/viral diseases, which cause mortality, should be effectively launched. In addition, heavy worm burden and arthropod borne diseases inflict high production losses in dairy animals. Among helminthes, *Fasciola hepatica* invades dairy population, and nematodes cause severe parasitic gastro-enteritis leading to low production. The parasitic problems further multiply due to poor management and unawareness of the farmers about the common control measures.

Dairy production system. Dairy production in Pakistan competes with crop farming and under traditional agriculture farming; preference always goes to crop production because of high grain demand for human population. Existing livestock production systems in Asia have been well documented by various investigators such as that by Devendra *et al*. (1997). Pakistan has similar dairy production systems like other developing nations in the region with little difference. Under Pakistani conditions dairy animals are kept under different production set ups including 1) grazing systems, 2) mixed farming system and 3) peri-urban dairy colonies (Devendra *et al*., 1997; Devendra, 2001). Now this third category of dairy production is becoming important to supply fresh milk for urban population.

Grazing system. This system is especially important for small ruminant (goat and sheep) and to lesser extent to the dairy animals (buffalo) in Pakistan. In this system, animals depend on grazing in open grasslands or lands not suitable for cropping. Pakistan has 63% of its area as rangelands that supports most of the cattle population in Balochistan, sindh and to lesser extent in Punjab province. Alpine pastures of northern high lands are vital for yak, which is the only milk source in northern areas. However buffaloes in Punjab and sindh provinces may use the natural vegetation around canal riverbanks, along roadsides and in wastelands. According to livestock censes (1996) only 8.69% of cattle and 6.28% of buffaloes in Pakistan totally reside on grazing and about 40.8% of grazing cattle and 49.3% of grazing buffaloes are kept in less than 10 animals/herd. Now it is being realized that grazing systems for animal production will become likely to deteriorate in future due to rising demands for food by high population growth rate in Pakistan.

Mixed farming system. The ownership of 2-15 animals, in which milk production is major component of farm income, is the main characteristic of this system. This system is prevalent in Pakistan in which fodders, crop residues, agro industrial by products and weeds in cropland after harvest are used as animal feed. The much advance farm of mixed system is smallholder dairying, which with additional input like mixed concentrate feeding and slightly better managemental practices are going to make its place in Pakistan. Devendra (2001) reported that among the avenues of food production of animal origin, smallholder dairy production systems are potentially important. They are characterized by their rapid expansion, strong market orientation in rural areas and the many opportunities for increasing the current level of production. Some of the milk produced is used for home consumption, but most of it is sold directly by the farmer or to middleman. It is evident from the figures in livestock censes (1996) that this system is most important contributor to total milk production in Pakistan. According to livestock censes (1996) about 59.3%

of total cattle and 45.5% of the total buffalo population is dependent on both stall feeding and grazing that is the main characteristic feature of mixed farming system. About 57.4% of buffalo and cattle population that is raised under this system is kept in small herds below 10 animals. This system is of a subsistence nature and resource-poor situation has not enabled intensification and specialization, mainly because of access to services and resources.

Peri urban dairy colonies. The government of Pakistan had launched a campaign to depopulate the livestock from metropolitan cities to avoid pollution problems. As a result of this campaign, a large number of buffaloes and cattle colonies have erupted in the periphery areas of big cities like Lahore, Karachi and Faisalabad to meet the urban demand for fresh milk. The aim of confining milk production to rural areas is to reduce pollution and traffic load, mass migration to urban areas, to curtail genetic degradation of dairy stock and provision of employment opportunities in the rural areas. This system is more advanced and mature when compared to other systems. It is formed from a natural aggregation and concentration of small dairy holder units.

The peri urban dairy colonies enable the farmer to improve their competitive edge in open market economies. Devendra (2001) reported that Landhi cattle colony in Karachi had about 220,000 animals in a 5 km radius. Pregnant animals are purchased from rural areas, and they are completely stall-fed on cereal straws, green fodders and concentrates. After calving, female calves are sold except for a small number, which are kept as replacements for breeding while male calves are fattened for four months and slaughtered. At the end of lactation, dry animals are also sold out which are consequently slaughtered. Indiscriminate growth of these colonies in the absence of any regulatory and policy interventions has given birth to a serious situation, which is further complicated by poor hygiene, health hazards such as contaminated ground water, ever increasing unused manure. All this has adverse impact on the environment. Under this system of dairying stall feeding is preferably practiced, fodder crops, agro industrial wastes and concentrate dairy mix are importantly contribute to the daily nutrient requirements of dairy animals. According to livestock censes (1996) about 31.99 and 48.71% of total cattle and buffalo population, respectively, is being wholly dependent on stall-feeding.

In peri urban dairy colonies dairy animals (mainly buffalo) are kept under better feeding, managemental conditions and a good veterinary cover is now being advocated. However, number of problems likes fodder availability, milk collection and transportation facilities, proper manure disposal and availability of artificial insemination facilities are needed to be solved (personnel communication). As peri urban dairy colonies have large number of animals in specific areas so it is viable and feasible to develop these setups in to a modern dairy enterprise with relatively more ease.

Milk production patterns. The dairy buffalo is the major contributor to the milk production by accounting for roughly 75% of all milk produced in Pakistan. Cattle account for the remaining production with small share coming from goat, camel and sheep. The Nili Ravi is most popular breed of buffalo and is liked due to its high productivity standards in terms of high fat %age and milk production. Dairy cattle farms are less popular in Pakistan due to consumers demand for buffalo milk and preference of buffalo by farmers because of its abilities to effectively utilize poor quality fibrous feeds and withstands high environmental temperature. However, Sahiwal, red Sindhi, Cholistani and Tharparker breeds of cattle are considered worthy for milk production in areas of Punjab and Sindh province as previously mentioned.

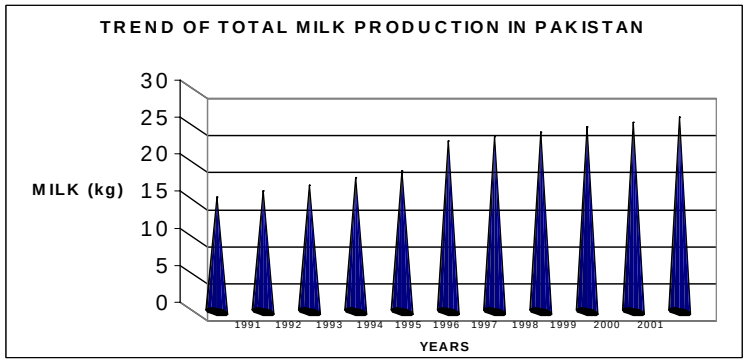
Crossbred cattle (*Bos taurs* and *Bos indicus* crosses) are also becoming considerable contributor to total milk production in the country. However, unplanned crossbreeding practices in combination with poor feeding and managemental conditions rendered the crossbred cattle as poor performer in Pakistan.

Pakistan economic analysis network project (1989) reported that a cow annually produced 2530, 1840, 860 and 450 kg under progressive dairy farming, peri urban, irrigated and arid (barani) dairy production systems, respectively. However, in contrast to this it was estimated that under commercial, peri urban, rural market oriented and rural subsistence setups buffalo annually produced 2510, 2460, 2060, and 1200 kg milk, respectively. It was also established that commercial and peri urban dairying could only able to market their product (milk).

The calving season of buffaloes is concentrated during the autumn and start of winter months so they reach their peak milk production after two months from November to February. The abundant legume fodder available at that time resulted in high milk production. But during summer season milk production of buffaloes drops rapidly due to low feed availability, high environmental temperature and late lactation. This is not true for dairy cows, which are more productive during summer, however, as noted earlier, most milk produced in Pakistan is from dairy buffalos. During the summer when demand for milk is high and supply is low, adding water and ice to fresh milk fills the gap. This excessive milk production during winter and less milk production during summer month causes many problems in milk marketing. Currently 26.6 million tones of milk are being produced in the country. Milk production trend is given in Fig. 3.

Milk consumption patterns. Milk and its products are important food items in diets, representing 27% of total household expenditures on food items (Economic Survey, 1999-2000). As food group milk and its products are second only to cereals in terms of per capita consumption and by weight milk makes up about one third of the food consumed by each Pakistani. About 55% of the total milk produced in the country is consumed as fresh and remaining is used in the form of processed milk, as yogurt, lassi (butter milk),

Fig. 3. Milk production trend in Pakistan

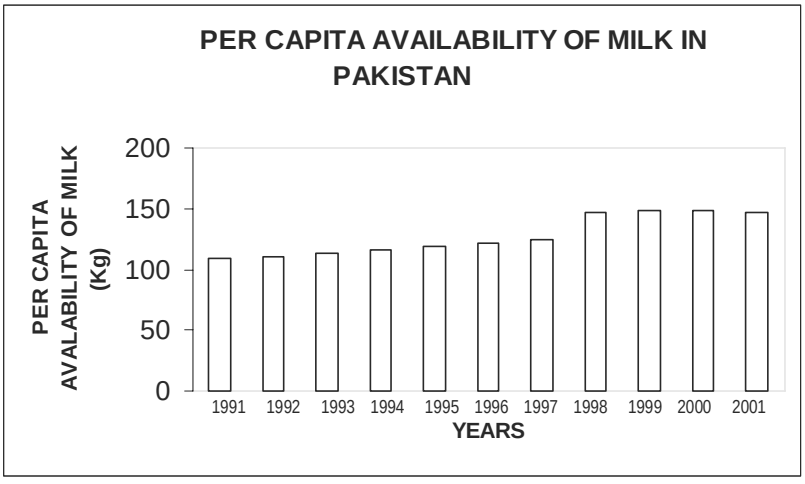


butter, cheese, ice cream, sweat meals and other confectioneries (Agricultural Statistics, 1999). Out of the total milk produced in the country about 25% is consumed in urban areas and about 70% in rural areas (Hemani & Khan, 1997).

An about 80 thousand tone of dry milk was imported in Pakistan during last year to meet local demand of milk. According to Agricultural Statistics (1999-2000) per capita availability of milk is 82.4 kg /annum which is increasing at the rate of 2.44% annual (Fig. 4).

Milk marketing. Milk is a highly perishable commodity so prompt collection from producer and its quick transportation to consumer is prerequisites to market it properly without any change. The prerequisite of successful production of high quality dairy products is that the raw milk must be of good quality. Efficient cleaning of equipment dealing with milk handling is of paramount importance. All possible efforts must be made to preserve its quality during storage and transportation. The basic method to preserve a high milk quality is cooling or activation of naturally occurring Lactoperoxidase system in milk. In Pakistan, the landless dairy owners in remote areas either use milk for their own consumption or sell out surplus milk, as a supplementary income source to meet their daily monetary needs.

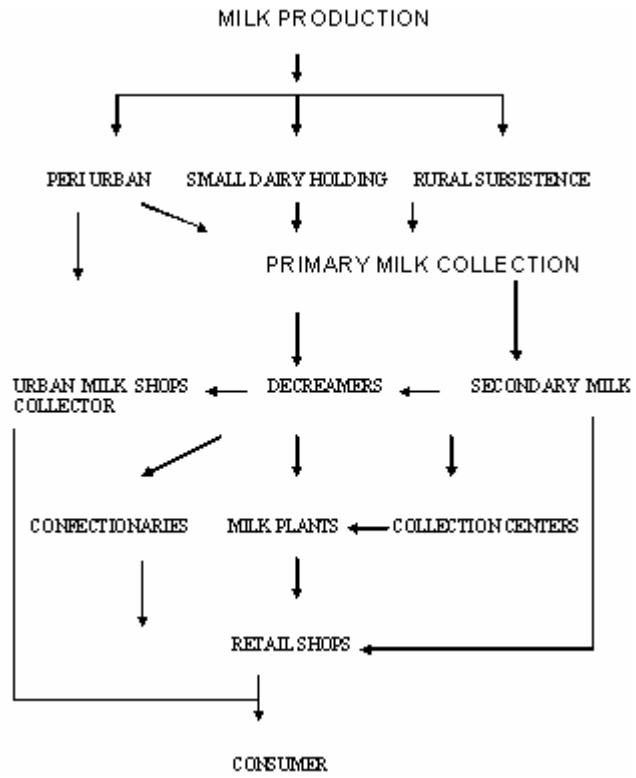
Fig. 4. Per capita availability of milk in Pakistan



The general backwardness of dairy production and marketing can be judged from the fact that although the value of milk produced (26.2 million tones) is second only to wheat crop, the commercial herds comprise only 0.5% while 54.4% comprise rural subsistence herds with out any proper market out let with only 33.5% as having rural market orientations and 11.5% as peri urban herds that provide milk to urban areas (Anjum *et al*., 1989). At present condition is almost similar with smaller increase in peri urban milk production and marketing system. This indicates that more than half of the milk produced in rural areas has no access to market. This resulted in an annual import of an about 1.4 million tones of dry milk and milk products that costs about rupees 1213 million of valuable foreign exchange (Agricultural Statistics, 1999-2000). In terms of volume, it is estimated that out of the total production of 26.2 million tone milk about 50% (13.1 million tones) only is marketed; 35% is used by the producer themselves either at home or converted to ghee or other milk products and 15 % is used for calf feeding or wasted.

Marketing channels for milk are largely determined by the location and nature of the producer. The farmers usually sell their milk to first stage collector 'katcha dodhis' who are the backbone of our present day milk collection system. Katcha dodhis collect the small marketable surpluses of fluid milk from several small producers and transport it either direct to consumers or to milk shops or to the milk collection centers. The transportation facilities used in this system are poor and Katcha Dodhis usually own a bicycle to transport milk. They usually carry about 100 liters of milk in each trip. To ensure the milk supply around the year they advance some money to the producer. Pacca dodhi (second stage milk collector) have better transportation facilities so they are able to collect the milk from more remote areas and in large quantities. Pacca dodhis usually own a horse driven cart or van and usually carry about 1000 liters daily in two trips. Pacca dodhis supply their milk to collection center or milk shops, usually after decreaming. Peri urban milk producers usually sell their product directly to consumers, milk shops and to larger establishments through contracts. The adulteration and decreaming of milk are common practices of all milk collectors. The milk marketing channels are given in Fig. 5. If the pacca dodhis sell milk to decreamer or hire his services, the milk is separated into cream and skim milk. The skim milk is mixed with other whole milk and sold to urban milk shops. Anjum *et al*. (1989) reported that this multi layer marketing system appears to buffer the producer from the price and purchase signals given by the

Fig 5. Milk marketing channels



consumer. The producer appears not to receive a premium for summer milk or for milk with higher milk fat content except for that paid by the milk collection centers that are operated by processors. Also the producer is not known to receive a premium or penalty for solids not fat. However, the apparatus and procedures used by the collection centers are not reliable to estimate milk fat% accurately. It is suggested that digital fat measuring instruments should be used on milk collection centers.

The investment of public and private sector in dairy industry is scarce. The financial institutions do not have a pleasant experience with the milk processing industry. During 70's and 80's huge loans were sanctioned by banks (particularly Agriculture Development Bank) and about 23 milk processing plants for pasteurizing and sterilizing were imported in the country to establish milk processing industry on modern lines. The milk products and byproducts produced in the country are pasteurized milk, UHT milk, milk powder, cream, butter, ghee, yogurt and cheese. However, no consolidated information is available to assess the production of above cited products. Report of working group on milk in Punjab (1999) showed that a large number of milk plants are not in operation. The possible reasons of failure of these milk plants may be unskilled and inexperienced management, high level capitalization due to kick backs at the time of setting up, resulting in misuse of funds, conventional purchasing system, high price of processed milk, low demand of processed milk, high production cost and the over build UHT milk processing capacity to suit the needs of consumers. Anjum *et al*. (1989) reported that after all experimentations a new set up of Milk Pack Ltd., Pakistan, could only able to sell its UHT treated milk in the country. At present Choudry Dairy Pvt. Ltd. is also making a great contribution in production and sale of UHT milk.

However, at present Tetra Pack Pakistan Ltd. is the only domestic plant producing aseptic packaging material for UHT milk. This monopoly position and its implications for cost and quality of material are of major concern to the present day and future UHT milk manufacturing industry in the country. Anjum, *et al*. (1989) further reported that on an over all bases, UHT is an inherently expensive process. If all the various taxes and regulations were removed then it would still remain as a relatively high priced product beyond the purchasing capacity of most consumers. Under 1987 market conditions, UHT milk was nearly 40% higher priced than raw milk (Anjum *et al*., 1989) where as at present it almost costs double than the price of raw milk. To promote the consumption of hygienic milk among a large segment of population, Pakistan will have to look towards alternative technologies, particularly pasteurization as previously reported by Anjum *et al*. (1989) and in report of working group on milk in Punjab (1999). As reported previously that the experience with pasteurization plants in 1970s was not successful, a large part of the failure was probably due to the public sector orientation with emphasis on recombined milk, poor management and inadequate marketing. Conditions for marketing of pasteurizing milk are now favorable because the marketing infrastructure has improved. Pasteurized milk, because of its low processing and packaging costs, could compete more affectively with unprocessed milk and the future development of the dairy industry may lie in this direction.

RECOMMENDATIONS

Dairy animals with high genetic potential for milk production always remain the corner stone of dairy production strategy in any country of the world. Pakistan owns a quite a number of breeds having the characteristics of high milk production and are well adapted to the local environmental conditions. The genetic potential for milk production in indigenous cattle and buffalo could be improved by selective breeding.

Feeding management . Superior fodders germplasm should be identified and propagated in the field. Hybrid seeds either imported or endogenously produced should be distributed among the farmers. With the seed provision a complete package of agronomic practices should be transferred to the farmer. Year round fodder production systems should be devised. Legume, non-legume crop combination could improve the feeding status of livestock. Farmer training is required so that they can use cheaper feed resources (non-conventional feed resources) for feeding of animals. Better

feeding of livestock could be achieved if vertical expansion of livestock production is followed. Ensiling and hay making systems should be devised and extended to the farmers according to local livestock production system. Different rations should be formulated to achieve synchrony of nutrient utilization in animals. Feeding should be aimed keeping in view the physiological stage of the animals rather than feeding animals haphazardly.

Coordinating research and extension activities. There should be close collaboration amongst different institutions (universities, livestock research stations and research institutions) so that they can benefit from each other's results and also avoid any duplication of work. The rural small holders should be trained in the skills of efficient dairy production. Specially designed literature and audio visual aids be used for this purpose. The small holders (maintaining about 80% of total dairy animals) must get due attention of policy makers for support and necessary assistance in running their day-to-day activities. There is no price motivation for the milk producers. Most of the milk is produced on subsistence basis rather than commercial basis. It needs to be organized on a commercial basis.

Disease control. Proper vaccination against different diseased to maximum dairy stock should be carried out. Manufacturing of different vaccines in quantities to meet demand of livestock population is essential. All viral vaccines being prepared by conventional methods should be shifted to tissue culture technology. Control of internal and external parasites through efficient and adequate drenching and dipping operations especially in crossbred is needed to avoid morbidity and mortality. Expansion and modernization of diagnostic facilities at least at district level can be helpful. Education of farmers regarding, mastitis, vaccination, and metabolic nutritional and reproductive problems is required to avoid monetary losses in dairy sector.

Public sector participation. Short-term interest free loans to help small farmers may be extended so that they could able to use optimum level of farm inputs. To attract, motivate and encourage private sector to invest in the livestock sector, facilities like tax holidays/ rebates and duty free import of necessary machinery pertaining to dairy should be provided.

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