Global Veterinaria 14 (1): 23-33, 2015
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2015.14.01.91188

A Study on Feed Stuffs Role in Enhancing the Productivity of Milch Animals in Pakistan- Existing Scenario and Future Prospect

Muhammad Aamir Iqbal, Asif Iqbal, Nadeem Akbar, Haroon Zaman Khan and Rana Nadeem Abbas

Department of Agronomy, Faculty of Agriculture,
University of Agriculture Faisalabad-38040, Pakistan

Abstract: Agriculture sector serves as the backbone of Pakistan's economy by contributing 21.4% to national GDP. The share of livestock sector in agricultural GDP is more than 11%. Pakistan is blessed with 39.7 million heads of cattle and 34.6 million buffalos. The gross milk production in Pakistan is around 51 million tons which is not sufficient enough to meet the needs of over 182 million masses. The productivity of milch animals in Pakistan is much low as compared to their known high potential. Under nourishment is one of the key factors behind poor performance of milch animals. Roughages and concentrate constitute the feed resources but dairy animals are deficient by 29 and 33% in total digestible nutrients (TDN) and crude protein (CP) respectively. There is a dire need to initiate a breeding program to produce quality seed of forage crops and an extension program should be launched to make farmers aware of latest production technology of forage crops. Forage trees such as moringa must be incorporated into the forage supply chain. Rangelands are needed to be protected from overuse and a governing body needs to be constituted to manage the rangelands on scientific basis to enhance the milk production by improving the productivity of milch animals.

Key words: Dry roughages · Feed resources · Forages and fodders · Moringa · Rangelands

INTRODUCTION

Livestock are the natural factories to convert roughage like grasses and shrubs into quality food products such as milk and meat for human beings. It is a well-known and an established nutritional fact that animal proteins are superior to vegetable proteins as far as the supply of essential amino acids is concerned [1]. Milk, meat, wool, hair, bones, fat, blood, hides and skins are some of livestock products but milk and meat are taken as major livestock products. For a large population of rural household in rain-fed agricultural production system in Pakistan, livestock provide security against crops failure. For the poor masses in the villages, livestock especially the milch animals have taken the form of social security because of their potential to be cashed at the time of need. Livestock are also used in sports and entertainment and also considered as a symbol of prestige in certain areas of Pakistan. Pakistan is 3rd largest milk producing country in the world [2]. Milk is produced by buffalo, cattle, sheep, goat and camel but cattle and buffalo are considered as major dairy animals. These dairy animals are also used as draught and beef animals. When a dairy animal has spent her productive life and becomes uneconomical for milk production then she is used as a beef animal. Male calves of dairy animals and dairy bulls when no further required for breeding purposes are also utilized for beef purposes. Pakistan is endowed with 39.7 million heads of cattle, 34.6 million buffalo, 21.9 million sheep and 66.6 million goats with total milk and meat production of 51 and 3.5 million tons respectively. Buffalos found in Pakistan make up 47% of Pakistan's major dairy animal's population and provide more than about 61% of the total milk produced in the country [3]. Buffalo breeds found in Pakistan are Nili Ravi, Kundi and Aza Kheli. Nili Ravi is considered to be the best buffalo breed in the world and is known as Black Gold of Pakistan. Cattle constitute about 53% of the national livestock population in Pakistan and contribute almost 35% to the total milk production in country. The cattle breeds found in the country are Sahiwal, Cholistani,

Corresponding Author: Muhammad Aamir Iqbal, Department of Agronomy, Faculty of Agriculture, University of Agriculture Faisalabad-38040, Pakistan.

Red Sindhi, Achai, Bhagnari, Dajal, Dhanni, Gibrali, Kankraj, Lohani, Rojhan and Thari. Out of these, Sahiwal, Cholistani and Red Sindhi are main dairy breeds and well known internationally due to their distinct characteristics [4, 5]. Goat is considered as poor man's cow. Some rural and urban people keep goats and sheep and use their milk for domestic consumption. The same is true about certain nomads who raise camels and use their milk to meet family needs. Some camel-men when in peri-urban situation, sell milk in urban areas. Certain breeds of camels in Pakistan have the potential to be called as dairy animals, but being slow breeders they remained ignored since long. More than 96% of the milk produced in Pakistan comes from cattle and buffalo. The rest of it is collectively produced by sheep, goat and camel which, most of the time, is not sold as such, rather mixed with buffalo and cow milk. It has been revealed that animals in Pakistan are getting 29% and 56.5% less nutrients regarding their required TDN and DP, respectively. It is reported that livestock are getting 39.41 and 56.66% less in their TDN and DCP (digestible crude protein) requirements, respectively [6]. Akram [7] reported that livestock in Pakistan are 25 and 40% deficient in required amount of TDN and DCP, respectively. Hanjra *et al* . [8] and Heydari *et al* . [9] estimated that approximately 63.2 million tons of TDN and 5.53 million tons of DCP are required. Only then a dairy animal can maintain its best production potential. Sarwar *et al* . [10, 11] reported that 10.92 and 90.36 MT of CP and TDN respectively are required for livestock annually in Pakistan. However, respective availability of these nutrients is only 6.7 and 69.00 MT, which indicates a deficiency of 4.22 and 21.36 MT of CP and TDN, respectively, per year. The matter of fact is that animals are getting only their maintenance requirements. It is because of this reason that animals are not achieving and exploiting their best production.

This study provides a comprehensive review of animal feed resources of Pakistan, existing scenario of different feedstuffs and future prospect regarding feed resources in order to increase the productivity of milch animals in terms of milk production.

Livestock Population and Milk Production Trends: The number of large ruminants (cattle and buffalo) as well as small ruminants (sheep and goat) population in Pakistan has increased over the time. In 2013-2014, the cattle, buffalo, sheep and goat population was 39.7, 36.4, 29.1 and 66.6 million respectively in Pakistan (Fig. 1) with gross milk production of 51 million tons (Fig. 2) [3]. Buffalo share in gross milk production was greater than

Fig. 1: Livestock population (million) in Pakistan.

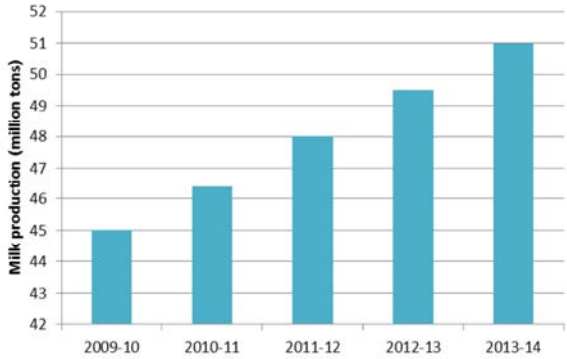

Fig. 2: Gross milk production (million tons) in Pakistan.

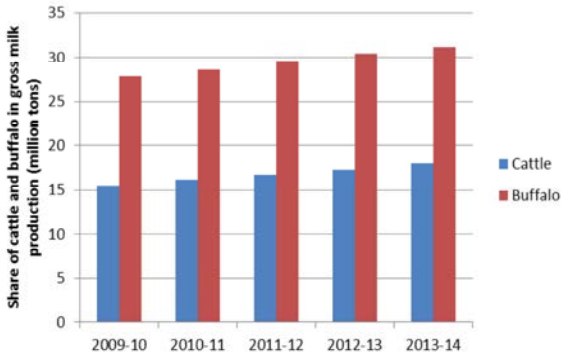

Fig. 3: Share of cattle and buffalo in gross milk production in Pakistan.

cattle (Fig. 3) despite the fact that cattle population is more than buffalo population which shows that buffalo productivity is more than cattle.

Production Systems: Till late eighties, more than 60% of buffaloes and some cows were maintained under the system of rural subsistence production system. In this system on an average there were 3 to 4 dairy animals with one or two adult females. Almost 50 to 60% of the feed requirements of these animals were fulfilled from grazing along with wheat straw and some green forages. ¼th of

milk produced was sold out and the remaining was utilized for domestic use. With passage of time, this system was changed into rural market-oriented small holder production system. Under this system, on an average there were 5 to 7 animals per herd. Feed requirement of lactating animals was fulfilled from forages along with wheat straw and seed cake to some extent. More than 70% of milk produced was sold either directly or through middlemen. This system was practiced by those smallholders who have access to nearby livestock markets. In 1980s, dairy sector in Pakistan moved towards commercial side and development of rural commercial dairy farms started. A typical rural dairy farm running on commercial basis consisted of about 30 animals of which 70% were females, including some cows. Approximately 40% of these adult females were giving milk during most of the year. Forage crops provided 50% and straws about 35% of the feed requirements and concentrates made the rest of it. More than 90% of the milk produced at the farm was sold. With growing demand for milk in urban areas rural commercial dairy farming has now moved toward peri-urban areas. In peri-urban areas, there are large and small dairy herds consisting of 20-50 animals with nearly 90% of adult females in production [9]. Male calves are disposed of within first two weeks of birth. These animals are fed chopped green forages and wheat straw and concentrate mixture with target to sell almost total milk produced. Due to enhanced rate of urbanization over the last 2 to 3 decades, large peri-urban commercial dairy farming is going towards urban commercial farming. Targets of these farms are to get the maximum milk production with economical and quality feeding and good management. Animals on these farms are fed good quality green forage or silage along with concentrate mixture. Dairy animals maintained at these farms are considered elite animals; hence their yields per lactation are considerably higher than those of animals maintained under other production systems [8, 9, 11]. Milk produced on these farms is either sold out in processed/fresh form through outlets or departmental stores or supplied to dairy companies. During last ten years major changes has been occurred in dairy sector of Pakistan and due to these change this sector is on the way to become an industry. A large number of modern dairy farms have been established in different areas. Most of these dairy farms have exotic animals and number of these animals is in hundreds and even in thousands. Such farms have adopted most modern management and feeding practices and well trained man power. Milk produced on these farms is either sold out in processed or fresh form [12-20].

Feed Requirements of Dairy Animals: The first and foremost requirement of dairy animals is water which is considered to be the cheapest nutrient. Animal get water from three sources including free water intake, water contained in feed and water produced by body's metabolism. Dry matter intake is quantity of dry matter which is consumed by an animal over a period for 24 hours. Average size cattle's dry matter intake is 2.5 - 3% of its body weight. Animals need energy which is provided by different feed stuffs. The capacity to do work is called energy. It is the basic requirement of animals and essential to maintain normal body functions. Carbohydrates, fats and protein are the main sources of energy. Mostly the energy is supplied to the dairy cattle in the form of carbohydrates because these are the most economical source of energy. Protein is also a good source of energy but it is usually 5 to 10 times higher in price as compared to carbohydrates and therefore it is less used as an energy source. Fat is also a very good source of energy and supply 2.25 times more energy as compared to carbohydrates and protein [21]. Crude fiber is also an essential quality parameter of feed stuffs. Crude fiber, acid detergent fiber and neutral detergent fiber are the most common measures of fiber used for routine feed analysis, but none of these fractions are chemically uniform [22]. Neutral detergent fiber measures most of the structural components in plant cells like cellulose, hemicellulose and lignin. Acid detergent fiber does not include hemicellulose and crude fiber does not quantitatively recover hemicellulose and lignin. The fineness at which forages are chopped during harvesting can alter the effectiveness of fiber for maintaining chewing activity. crops to make hey or silage should be chopped at a minimum of 3/8 inch theoretical length of cut (TLC) to provide 15 to 20% (weight basis) of the particles greater than two inches long. Chopping at 1/4 inch TLC provides only about 10% of the forage particles greater than two inches long. Protein is required in animal rations to provide the supply of amino acids which are needed for tissue repair and synthesis, hormone synthesis, milk synthesis and many other physiological functions [23]. Protein requirements are expressed as crude protein (CP), either in amounts or as a percentage of the dietary dry matter. Crude protein is determined by multiplying the nitrogen content in a feed by the factor.25 (feed protein averages 16 percent nitrogen) [24]. Feedstuffs that contain nitrogen in a form other than proteins or peptides are called non-protein nitrogen (NPN) sources. Urea and ammonium slats are examples of NPN sources. They have crude protein value, but they do not supply any amino

Table 1: Quality parameters of different green and dry roughages [30].

Name of Roughage	DM (%)	CP (%)	EE (%)	CF (%)	Ash (%)	NFE (%)
Green Roughages						
Maize	23.7	9.8	1.8	27.1	9.8	51.6
Sorghum	33.4	6.8	1.5	31.8	6.8	53.1
Millet	25.0	4.4	1.5	32.6	11.5	50.1
Barley	19.8	13.3	3.6	21.9	13.5	47.7
Berseem (1st cut)	15.2	18.9	1.8	15.8	14.7	42.3
Berseem (2nd cut)	13.2	19.1	2.2	17.9	15.6	45.2
Berseem (3rd cut)	15.5	19.6	1.9	20.8	15.2	42.5
Berseem (4th cut)	18.4	15.3	1.5	26.8	15.7	40.7
Berseem (5th cut)	19.3	15.2	1.8	26.7	15.5	40.8
Berseem (6th cut)	20.0	15.4	2.2	28.4	15.2	38.8
Oat	17.2	13.5	2.9	23.0	13.3	47.3
Lucerne	18.2	22.5	1.7	24.0	12.4	39.4
Sugarcane	27.2	6.2	2.7	31.2	7.5	52.4
Guar	21.7	19.2	1.3	14.0	12.8	52.7
Bajra-Napier grass	23.7	15.3	2.2	28.3	15.2	39.0
Hybrid Napier grass	28.8	16.3	1.2	26.1	13.9	42.5
Range grass	35.7	5.1	3.0	36.7	8.1	47.1
Moth	24.5	1 1	1.5	31.3	12.6	43.6
Mung	23.1	14.5	1.1	32.2	10.8	41.4
Dry Roughages						
Wheat straw	90.5	3.0	0.1	41.8	10.9	44.2
Rice straw	90.5	4.1	0.2	31.9	15.4	48.4
Maize stovers	95.2	5.5	0.4	38.0	10.0	46.1
Sorghum stovers	94.5	3.5	0.9	40.5	7.5	47.6
Range grass hay	91.1	3.1	1.5	40.6	6.8	48.0
Mung straw	95.5	8.4	2.3	37.8	14.9	36.6
Chickpea straw	95.2	5.5	0.6	44.2	10.3	39.4
Sugarcane straw	92.3	2.1	0.9	47.8	3.6	45.6

DM=Dry matter CP= Crude protein EE= Ether extract CF= Crude fiber
NFE= Nitrogen free extract

acids directly [25]. Minerals and vitamins are also essential dietary constituents and required in relatively small quantities.

Feed Resources: There are two types of feed resources namely conventional and non-conventional feed resources. Conventional feed resources refer to those which are traditionally used for animal feeding. In Pakistan conventional feed resources include roughages and concentrates. Roughages are further classified as green roughages and dry roughages. Roughages are plant materials in a fresh, dried or ensiled state which are bulky and fibrous in nature and normally contain higher percentage of crude fiber (18%) and low percentage of total digestible nutrients (less than 60%) [26]. Fodders, forages, range grasses, sugar cane tops and tree leaves are the examples of green roughages. Green roughages are high in moisture content, easily digestible and are commonly used for the feeding of dairy animals. Dry roughages include hays, straws, stovers and hulls. Hay is prepared by drying the fodder and then preserving it so it is the air dried forage. In Pakistan farmers mostly prepare hay from lucern, sorghum, millet, oats and grasses. Hay is used during the scarcity period of forages. When the grain portions of the crops are removed, remaining dried plant material are straws and stovers. They consist mostly of stems and leaves. These may also be termed as crop residues. These are low in protein, high in fiber, less digestible, low in minerals and cannot be consumed in large quantities by the animals. Therefore they are classified as poor quality or low quality roughages. The commonly available straws and stovers in different areas of Pakistan are wheat straw, rice straw, barley straw, chickpea straw, moth and moung straw, soybean straw, maize stovers and sorghum stovers [27]. Hulls are the outer hard coverings of grains which are obtained as by-product during seed processing. Cotton seed hulls are commonly used for livestock feeding in some parts of country. Seeds broken during processing are mixed with the hulls to increase their nutritive value. Rice hulls are also abundantly available but they are of extremely poor quality [28, 29]. Among green roughages, lucern forage contains the highest crude protein and is followed by guar, while among dry roughages leguminous crops have a higher crude protein contents as compared to cereals dry roughages (Table 1).

Table 2: Quality parameters of different concentrates [22].

Name of Concentrate	DM (%)	CP (%)	EE (%)	CF (%)	Ash (%)	NFE (%)
Mustard seed cake	91.7	32.4	9.6	19.8	12.0	26.2
Cottonseed cake	91.9	23.4	8.8	27.4	6.8	33.6
Maize oilcake	94.6	16.5	12.1	9.3	1.6	60.5
Wheat bran	89.7	14.5	3.5	8.8	4.1	68.7
Rice bran	89.7	8.2	7.7	13.0	17.2	53.9
Wheat bread	89.7	14.9	3.5	8.8	4.1	68.7
Maize gluten feed	87.9	12.5	10.6	12.7	1.0	63.2
Maize gluten meal 30%	90.9	26.2	1.8	8.7	6.7	56.6
Maize gluten feed 60%	91.5	54.7	3.4	2.6	1.5	37.8
Cottonseed meal	92.2	36.7	8.7	15.4	7.2	32.0
Guar meal	93.2	44.3	5.7	12.2	1.5	36.3
Soybean meal	91.8	48.4	2.8	7.2	8.5	33.1
Sunflower meal	91.1	35.5	1.1	19.1	8.6	35.5
Rapeseed meal	96.7	35.7	8.6	12.4	7.5	35.8
Fish meal	90.7	56.3	8.7	0.9	19.9	14.2
Blood meal	92.1	54.5	1.5	0.9	15.8	27.3

DM=Dry matter CP= Crude protein EE= Ether extract CF= Crude fiber
NFE= Nitrogen free extract

Concentrates are the substances which are high in energy and protein while low in fiber and are highly digestible. Being the expensive part of feed these are used mostly in small quantities as energy supplement. Concentrates are classified as energy rich concentrates and protein rich concentrates [30]. Protein rich concentrates are further differentiated on the basis of their origin as plant origin and animal origin concentrates. Cereal grains (wheat, maize, barley, oats, sorghum, rice etc.), wheat bran, rice polishing, molasses and sugar beet pulp are categorized as energy rich concentrates. Although cereal grains are mainly used as human food and not included in the feed of dairy animals but their by-products like rice polishing, maize bran and wheat bran are commonly used as animal feed. Molasses are the by-product of sugar industry. It is a thick viscous material which is high insoluble carbohydrates and contains some minerals. Although molass is a cheap and energy rich feed but is still not commonly used by local farmers. Molasses can be included in the diet by mixing it with other concentrates, spraying it on dry roughages, providing it as a free lick or as solidified molasses urea block. The palatability and consumption of poor quality roughages are increased by the use of molasses [31]. Fats and oils contain energy about 2.25 times as much as carbohydrates or proteins [32]. Due to their high cost, fats and oils are not routinely used for livestock feeding. Protein rich concentrates are derived from plants and animals. Protein concentrates of plant origin are mostly by products of the oil extraction industry. Oilcakes are produced when oil from seed is extracted mechanically while oil meals are the byproducts of the solvent extraction process. Compared to oil meals oilcakes are low in protein and high in residual fat [33]. They generally include the fibrous part of seeds. Among the available oilcakes, cotton seed cake and maize oilcake have high protein value for ruminants as compared to mustard seed cake which is highly degradable [34]. Generally all animal origin proteins like blood meal, fish meal, bone meal, meat meal and feather meal are less degradable in the rumen and therefore are good sources of protein for ruminants. The nutritive value of different concentrates is given Table 2 which shows that maize gluten and blood meal are the richest source of crude protein, while cotton seed cake contains the highest crude fiber. It is worth mentioning that concentrates of animal origin contain much more crude protein in comparison with concentrates of plant origin but these do not constitute the major proportion of animal feed and greater chunk is provided by concentrates of plant origin, because of availability in greater quantities and at comparatively cheaper price.

It was reported by nutritionists that only 3.5 to 4 kg of balanced mixture of concentrates may support 10 liters of milk production [3]. Normally in dairy animals this mixture is fed at rate of ½ of the milk yield (one kg of concentrate mixture for every two liters of milk). Balanced concentrate mixture feeding is essential for dairy animals because a single concentrate like maize, barley or oat and oilseed cake alone cannot meet the requirements properly, so different mixtures containing concentrates of plant origin in greater quantities and concentrates of animal origin in comparatively smaller quantities can give nutritious feed and will also reduce the price. If a single concentrate, such as maize, sorghum, or barley is considered for feeding of

Table 3: Different ingredients and their ratio in wanda.

Ingredients	Ratio (%)
Sunflower cake	10-13
Cotton seed Cake	20-25
Rape seed cake	10-13
Peanut cake	20-25
Cotton seed meal	15-20
Soybean meal	10-15
Rapeseed meal	15-20
Rice polishing	18-20
Wheat bran	23-25
Wheat grains	15-20
Maize grains	40-50
Maize gluten 20%	20-30
Maize gluten 30%	20-25
Maize gluten 60%	5-10
Molasses	10-15
Urea	1-2
Oil	2-3
Common salt	1-2
Mineral mixture	2

Existing Scenario:

400 kg lactating buffalo yielding 10 liters milk, about 7 kg grain will be needed to be provided to meet the protein requirement [35]. Inferior quality hay or straw roughage is not only costly but also harmful. Similarly when high protein oilcake like groundnut and till cakes is used as single concentrate, the excess of protein is wasted and the ratio between protein and carbohydrate is also disturbed which affects milk production. The major ingredients of wanda prepared and provided to dairy farmers in Pakistan by different livestock feed manufacturing companies include cotton seed cake, maize gluten, rice and peanut bran along with energy rich concentrates like wheat grain, wheat straw and rice polishing left overs as shown in Table 3. But matter of concern is that there is no government regulation and checks on price and quality of wanda that infest the local markets and their high cost make their use limited to dairy farmers only. Local farmers with 2-3 livestock heads do not give much attention to provision of different concentrates to their livestock and depend on grazing along bank canals and limited supply of forages and ultimately result in limited productivity of milch animals.

The livestock population in Pakistan is supported by feed resources derived mainly from crops residues, fodders, forages, rangelands and from agro-industrial by-products. It is estimated that existing feed resources are deficient by 29 and 33% in total digestible nutrients (TDN) and crude protein (CP) respectively [36]. The feed supply balance for the livestock feed pool is estimated to be deficient by 21 % of total dry matter (DM), by 29 % of energy and by 33 % of crude protein requirements [37]. In resource management, rangelands have a vital contribution. Rangelands are 63% of the total area of Pakistan. Rangelands are important nutrient reservoir and prevalent at mountain beds. It is estimated that ranges have 38% contribution in feed resources for livestock in Pakistan which is second major contribution after fodder-crop residues, which has 51% contribution [30]. The most economical way to consume rangeland vegetation is grazing but no attention is focused on maintenance of these ranges and drip irrigation and water sprinkling in deserted areas. It is a need of time to conserve these ranges by different strategies, like, artificial reseeding, introduction of competitive and ecological friendly exotic species, water conservation procedures and extension services regarding rangeland conservation and by proper research work. This can provide quality biomass in large quantity from these ranges or waste lands. One of the major causes of the low productivity of our animals is the poor grazing condition of these rangelands. Now, they are deficient in nutrients and overgrazed; deforestation and uprooting of the range vegetation is occurring rapidly. Rangelands are undergoing deterioration but yet no proper strategies have been made to maintain and improve their productivity. For improvement of rangelands, limited research is conducted traditionally. This condition is worse in Baluchistan province and there is no research facility on conservation of ranges in the province. Rangelands come under forestry department and there is no coordination between the livestock and dairy development department and forestry department to improve the condition of ranges. If some policies are constituted by both of these departments for the rangelands improvement, then problems of livestock issues can be addressed. Forages are considered to be the most palatable animal feed resource. There are two types of forages depending upon the amount of protein present. These include leguminous forages and non-leguminous forages. Leguminous forages are higher in protein content because they have the ability to utilize the environmental nitrogen with the help of nitrogen fixing bacteria present in their roots. On the other hand non-leguminous forages have no such ability so they are low in proteincontent. Important legume forages are barseem, lucern, shaftal, soybean, cluster bean and cowpea. Non-leguminous forages include many cereal forages such as maize, sorghum, millet and oats. On the basis of growing season green forages in Pakistan are classified as spring forages and autumn forages. Autumn forages are grown in November and December and include barseem, oats,

Table 4: Nutrient supply from different sources [30]

Source	Share %
Forages and Crop residues	51
Rangelands	38
Post-harvest grazing	3
Cereal by-products	6
Oil cakes	2

Future Prospects:

barley, mustard/rape seed, lucern etc. Spring forages are grown in May-June and include sorghum, millet, mott grass, sadabhar, guar, jantar, sugar beet tops. Forages and crop residues provide about 51% of total required nutrients in Pakistan and second biggest source of nutrients is pastures (Table 4) [38]. The present forage supply is 1/3 less than the actual needs and the area under forage crops is decreasing at the rate 2% per decade and that too without any significant corresponding increase in per hectare yield [10, 39]. The present day aim of the animal scientists and researchers should be to enhance the productivity of livestock rather than increasing the total number of animals. The contribution of livestock (which largely depend on natural grazing lands) to the economy is substantial. Keeping in view the livestock numbers and their requirements, range productivity is very poor. It indicates the importance of the livestock industry, which ultimately depends on rangelands as its base. The present feed resources hardly meet the maintenance requirements. According to some estimates, livestock are getting only 75% of the required amount of digestible energy and 40 % of the digestible crude protein [40, 30]. The productivity of livestock in Pakistan, despite their known high genetic potential, is low. This may be attributed to many reasons, of which mal-nutrition is probably the most important. Green forages are not available in sufficient quantities especially in extreme hot months (June-July) and during cold season (December-January) and most of the animals are underfed. Straws of the cereals and other by-products are commonly used to overcome feed shortages, but these do not meet the actual feed requirements of the animals. The treatment of straws and stovers is also not very common. The concentrates are expensive and cattle feed manufacturing has not taken place to meet these requirements [41, 42].

Under prevailing scenario and problems like growing pressure of the human population, decreasing area under fodder crops, shortage of irrigation water, less and erratic rainfalls, barren rangelands, low priorities to forage production and preservation, no significant change is envisaged in the years to come regarding sufficient feedstuffs availability [43, 44, 45]. It seems that the shortage of feeds and forages will be a great challenge to the future livestock industry. But there is a dire need to ensure efficient utilization of available feed resources and will have to make untiring efforts to increase the quantity as well as quality of feedstuffs in order to ensure milk and meet provision on continuous and sustainable basis. There is a need to increase production of forages on sustainable basis to increase milk and meat production. Continuous research has been carried out on intercropping of cereal forages with legumes such as cowpea, cluster bean, soybean etc. to increase yield on per hectare basis and to provide mix forage of comparatively higher quality, however there is dire need to place these research activities on higher place in the list of priorities. There is a need to initiate a breeding program to produce quality seed of forage crops having higher yield potential as well as quality particularly protein content. A wide and comprehensive extension program should be initiated to make the farmers aware of latest production technology as farmers in Pakistan continue to remain stick to traditional agronomic practices and provincial agricultural departments should take initiative in this regard. Forestry agencies in many regions of the world tend to evict pastoralists when planting exotic trees on large swaths of grazing land. Tension between foresters and pastoralists is further increased because the former favors fast growing, drought resistant species over fodder trees, which are preferred by the pastoralists. Joint Forest Management as well as other management approaches has promoted alternative fores management ideas to solve conflicts between foresters and pastoralists [46, 47]. One approach consisted of including local communities in the management process of forests and anticipating the needs of these communities when selecting species to be planted. Trees and browse species have been used as livestock fodder for centuries. For example, poplar and willow, Acacia albida, Prosopis and Gleditsia are being used as fodder trees in New Zealand, Africa and South Africa, respectively. These have been used for multiple purposes such as food, shelter, wood, non-wood-based products, oil, biodiesel, or medicines. However, it is very difficult to g*et al* l these benefits just from one plant or system [48, 49, 50]. Plant scientists are focusing their work on tree species that can provide good-quality fodder especially in dry periods when no other forages are available. Tree species like Leucaena leucocephala, Ziziphus jujuba, Morus alba, Terminalia arjuna [51, 52] and *Moringa oleifera* are being widely studied nowadays. *M. oleifera* is a remarkable species with its high nutritional value and good biomass

production, which can be used as a nutritional supplement. Moringa cultivation practices and its utilization as livestock fodder and in fish diet has been established [53, 54, 55, 56], who have shown that this species has potential as livestock fodder. *Moringa oleifera* has been a focus of scientists for its quality to be utilized as livestock fodder. Less importance has been given to other species belonging to the family Moringaceae [57-61]. A few researchers have evaluated the potential of *Moringa stenopetala* as livestock fodder. It is reported that *M. stenopetala* leaves have high CP contents (9% of DM), 280 mg kg^{-1} of vitamin C and 160 mg kg^{-1} of â-carotene contents with iron and calcium contents of 30.8 and 7928 mg kg^{-1}, respectively [62-67]. Government should take initiative to prevent the over use of grazing lands in Pakistan and should form a governing body to manage the rangelands on scientific basis to ensure white revolution in the country. Dairy farmers should be made aware of milch animals feed requirements and their management on scientific basis. Thus an integrated approach regarding feed resources can ensure sustainable production of milk for teeming millions in times to come.

CONCLUSION

Nutrition plays a vital role in the productivity and performance of livestock and particularly milch animals which suffer a serious setback in terms of milk production where the currently feed resources are quite insufficient to meet its nutrition requirement. There is a dire need to initiate a breeding program to produce forage seed with more yield potential and high in quality parameters. A comprehensive extension program should also be initiated to make the farmers aware of latest production technology of forages. Rangelands should be scientifically managed to prevent them from continuous overuse. Forage trees like moringa tree must be integrated into the forage supply chain to ensure milk production on sustainable basis for skyrocketing population.

REFERENCES

1. Afzal, M. and A.N. Naqvi, 2004. Livestock Resources of Pakistan: Present Status and Future Trends. Quart. Sci. Vis., 9(1-2): 15-27.
2. Hasnain, H.U. and R.H. Usmani, 2006. Livestock of Pakistan. Livestock Foundation, Islamabad, Pakistan.
3. Economic Survey of Pakistan, 2013. Govt. of Pakistan, Ministry of Food, Agri. and livestock Div. Economic Wing, Islamabad.
4. Bilal, M.Q., M. Suleman and A. Raziq, 2006. Buffalo: Black Gold of Pakistan, Livestock Research for Rural Developmen. pp: 66-79.
5. Dahlin, A., 1998. Genetic studies on Sahiwal cattle in Pakistan. Doctoral thesis, Swedish univ. of agric. Sci. Uppsala, Sweden.
6. Khan, B.B., M.A. Sial and A.H. Gilani, 1988. Livestock feed resources and requirement scenario of Pakistan. Dairy production potential and challenges. Proc. Natl. Faisalabad, Pakistan.
7. Akram, M., 1990. Pakistan, Animal Feed Resources in Asia and Pacific. Asian Productivity Organization, Tokyo, Japan.
8. Hanjra, S.H., J.B. David and M.J. Akhtar, 1995. Fodder production. FAO. Small dairy holder dairy development in Punjab, Pakistan.
9. Heydari, G., A.T. Yansari and H. Zali, 2006. Inspection on three plant spices as an animal forage source in Mazandran wetland. Pak. J. Nutr., 5(4): 382-386.
10. Sarwar, M. and Zia-ul-Hassan, 2001. Nutrient Metabolism in Ruminants. University Press, Univ. Agric. Faisalabad, Pakistan.
11. Sarwar, M., M.A. Khan and Z. Iqbal, 2002. Feed resources for livestock in Pakistan. Int. J. Agric. Biol., 1: 186-192.
12. Farooq, M.K. and A. Qudoos, 1999. Constraints in the Adoption of Modern Livestock Practices. Pak. Vet. J., 19(1): 53-55.
13. Habib. G., A. Hameed and M. Akmal, 2007. Current Feeding Management of Peri-Urban Dairy Buffaloes and Scope for Improvement. Pak. Vet. J., 27(1): 35-41.
14. Hasnain, H., 1983. Feed-the key to more food in Pakistan. Proc. FAO PARC Workshop on Least Cost Formulation, Islamabad.
15. Idrees, M., Z. Mahmood, D. Hussain, M. Shafi and U. Sidique, 2007. General problems regarding extension services with livestock and dairy farmers of Peshawar district, Pakistan. Sarhad J. Agric., 23(2): 123-127.
16. Iqbal, M. and M. Ahmad, 2002. An assessment of livestock production potential in Pakistan: Implications for livestock sector policy. The Pak. Dev. Rev., 38(4): 615-628.
17. Jalil, H., H.U. Rehman, M.H. Sial and S.S. Hussain, 2009. Analysis of milk production system in peri-urban areas of Lahore (Pakistan): A case study. Pak. Eco. Soc. Rev., 47(2): 229-242.
18. Moaeen-ud Din, M. and M.E. Babar, 2006. Livestock Farming in peri-urban areas of Faisalabad. Livestock research for rural Development. pp: 33-47.

19. Qamar, M.K., 2004. Demand for services planning by villagers. A case study from Pakistan. Annual meeting of Neuchatel Initiative Group, Aarhus, Denmark.
20. Raziq, A., M. Younas and Z. Rehman, 2010. Prospects of livestock production in Balochistan. Pak. Vet. J., 30(3): 181-186.
21. Mlay, S., P.P. Appolinaria, P.E. Chikula, J.S. Balthazary, H. Torben, R.W. Martin and M. Jørgen, 2006. Feed value of selected tropical grasses, legumes and concentrates. Veterinarski Arhiv., 76(1): 53-63.
22. Van Soest, P.J., J.B. Roberston and B.A Lewis,1991. Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science, 74: 3583-3597. 23. Habib, G. M.M. Siddiqui and S.M. Suhail. 2003. Livestock management, feeding and health in Khyber Pakhtunkhwa, Pakistan. FAO Rep. Faculty of Anim. Husb. & Vet. Sci. Agric. Univ. Peshawar, Pakistan.24. Bilal, M.Q. and M.S. Sajid. 2005. Meeting milk demand (The only way is to modernize dairy farming). The Nation: P-26.
23. Bilal, M.Q., M.S. Sajid and M.U. Iqbal, 2005. Debate whether oxytocin is dangerous for dairy animals and human health. The Nation October 16: 26.
24. Burki, A.A., M. Khan and F. Bari, 2005. The state of Pakistan's dairy: An Assessment, CMER Working Paper, 05-34, LUMS, Lahore.
25. Farooq, M.K. and A. Qudoos. 1999. Constraints in the Adoption of Modern Livestock Practices. Pakistan Vet. J., 19(1): 53-55.
26. Ullah, E., 1998. The study of small holders milk production in the central punjab and strategies for an effective development approach. M.Sc. Theses, Dept. of Livestock Management, Univ. of Agric. Faisalabad, Pakistan.
27. Khan, M.J., A. Abbas, M. Naeem, M.M. Ayaz and S. Akhter, 2013. Current issues and future prospects of dairy sector in Pakistan. Sci. Tech. Dev., 32(2): 126-139.
28. Ibrahim, M.N.M., 1983. Physical, chemical, physico-chemical and biological treatments of crop residues. In: Pearce, G.R. (ed.), The Utilization of Fibrous Agricultural Residues. Research for Development Seminar Three, 19-23 May 1981, Australian Development Assistance Bureau (ADAB), Los Baños, The Philippines and Australian Government Publishing Service, Canberra, pp: 53-68.
29. Ibrahim, M.N.M., 1987. Rice bran as a supplement for straw-based rations. In: Dixon, R.M. (ed.), Ruminant Feeding Systems Utilizing Agricultural Residues. Proceedings of the Sixth Annual Workshop of the AAFARR Network, 1-3 April 1986, University of The Philippines at Los Baños and International Development Program of Australian Universities and Colleges (IDP), Canberra, pp: 139-146.
30. Younas, M. and M. Yaqoob, 2005. Feed resources of livestock in the Punjab, Pakistan. Livestock Res. Rural Dev., 17(2): 63-71.
31. Ibrahim, M.N.M., 1994. Livestock development programmes and their impact on small-scale dairy farming in Sri Lanka. In: Zemmelink, G. Leegwater, P.H. Ibrahim, M.N.M. and van Bruchem, J. (eds), Constraints and Opportunities for Increasing the Productivity of Cattle in Small-scale Crop/Livestock Systems. Proceedings of an International Mid-term Workshop, 14-19 November 1994, pp: 146-152.
32. Ibrahim, M.N.M. and J.B. Schiere, (eds) 1986. Rice Straw and Related Feeds in Ruminant Rations. Proceedings of an International Workshop, 24-28 March 1986, Kandy, Sri Lanka. Straw Utilization Project, Agricultural University, Wageningen, The Netherlands.
33. Khanum, S.A., T. Yaqoob, S. Sadaf, M. Hussain, M.A. Jabbar, H.N. Hussain, R. Kausar and S. Rehman, 2007. Nutritional evaluation of various feedstuffs for livestock production using in vitro gas method. Pak. Vet. J., 27(3): 129-133.
34. Anjum, M.S., K. Lodi, A.A. Raza, F. Walters and S. Krause, 1989. Pakistan's dairy industry: issues and policy alternatives. The economic analysis network project/USAID/394-0491-C-00-5035 Islamabad, Pakistan.
35. Aziz, H.S. and B.C. SIivia. 2008. Dairy Industry In Pakistan. Scientific Papers Management, Economic Engineering in Agriculture and Rural Development. 8(1).
36. Habib, G., A. Hameed and M. Akmal, 2007. Current Feeding Management of Peri-Urban Dairy Buffaloes and Scope for Improvement. Pakistan Vet. J., 27(1): 35-41.
37. Hasnain, H.U. and R.H. Usmani, 2006. Livestock of Pakistan. Livestock Foundation, Islamabad, Pakistan.
38. Iqbal, Z., M.S. Sajid, R.Z. Abbas and Z.U.D. Sindhu, 2011. Determination of condensed tannin contents from different plants of kherimurat rangeland (Attock, Pakistan). J. Agric. Soc. Sci., 7: 114-116.

39. Nouman, W., S.M.A. Basra, M.T. Siddiqui, A. Yasmeen4, T. Gull and M.A.C. Alcayde, 2014. Potential of *Moringa oleifera* L. as livestock fodder crop: a review. Turk. J. Agric. For., 38: 1-14.
40. Jayasuriya, M.C.N., 2000. Principles of ration formulation for ruminants. Proceedings of the final review and planning meeting of an IAEA Technical Cooperation Regional AFRA. Cairo, Egypt.
41. Krishnamurthy, U., H. Soller, H. Steingass and K.H. Menke, 1995. Energy and protein evaluation of tropical feed stuffs for whole tract and ruminal digestion by chemical analysis and rumen inoculum studies in vitro. Anim. Feed Sci. Technol., 52: 177-188.
42. Sergio, L.G. and N. Filho, 2005. The effects of increasing levels of roughage on coefficients of nutrient digestibility in the collared peccary (Tayassu tajacu). Anim. Feed Sci. Technol., 120: 151-157.
43. Ishaque, S.M., 1993. Sheep management systems. In: Mackintosh, J.B. (Ed.) Sheep production in Pakistan. Pakistan Agricultural Research Council, Islamabad, Pakistan.
44. Shah, S.K., 1991. Buffaloes of Pakistan. Pakistan Agricultural Research Council, Islamabad, Pakistan.
45. Corleto, A., E. Cazzato and V. Laudadio, 1992. Quantitative and qualitative evaluation of tree and-shrubby pasture species in Southern Italy. Forage Shrubs Breeding and Methodology Meeting, Palermo.
46. Malede, B. and T. Adugna, 2014. Livestock feed resources assessment, constraints and improvement strategies in Ethiopia. Middle-East J. Sci. Res., 21(4): 616-622.
47. Birhan, M., 2013. Livestock Resource Potential and Constraints in Somali Regional State, Ethiopia. Global Veterinaria, 10(4): 432-438.
48. Amir, P., A.S. Akhtar and M.D. Dawson, (eds) 1987. Livestock in Pakistan Farming Systems Research. Proceedings of a Workshop, 8-15 April 1987, Agricultural Research Council, Islamabad, Pakistan.
49. Garcia, O., K. Mahmood and T. Hemme, 2003. A Review of Milk Production in Pakistan with Particular Emphasis on Small-scale Producers. PPLPI Working Paper No. 3. Rome: Food and Agriculture Organization of the United Nations.
50. Usmani, R.H. and S.K. Shah, 1986. Establishment of Nucleus Jersey Herd for the Improvement of Non-Descript Cattle of Barani Areas in Pakistan. Islamabad: Pakistan Agricultural Research Council.
51. Ahmad, N., R. Yasmeen, A. Rehman, M. Saleem, A. Rehman and H. Ullah, 2012. Effect of Grewia Opposite of Olia leaves and conventional oil cakes as feed supplement on cell wall intake, digestibility and nitrogen retention in sheep. Sarhad J. Agric., 28(1): 69-74.
52. Shah, A., A. Saboor and S. Ahmad, 2009. An estimation of cost of milk production in Pakistan: A microeconomic approach. Sarhad J. Agric., 25(1): 141-147.
53. Abdulkarim, S.M., K. Long, O.M. Lai, S.K.S. Muhammad and H.M. Ghazali, 2005. Some physico-chemical properties of *Moringa oleifera* seed oil extracted using solvent and aqueous enzymatic methods. Food Chem., 93: 253-263.
54. Afuang, W., P. Siddhuraju and K. Becker, 2003. Comparative nutritional evaluation of raw, methanol extracted residues and methanol extracts of Moringa (*Moringa oleifera* Lam) leaves on growth performance and feed utilization in Nile tilapia (*Oreochromis niloticus* L.). Aqu. Res., 34: 1147-1159.
55. Iqbal, M.A., A. Iqbal, N. Akbar, R.N. Abbas, H.Z. Khan and Q. Maqsood, 2014. Response of canola to foliar application of moringa (*Moringa olifera* L.) and brassica (Brassica napus L.) water extracts. Int. J. Agric. Crop Sci., 7(14): 1431-1433.
56. Aregheore, E.M., 2002. Intake and digestibility of *Moringa oleifera* and batiki grass mixtures by growing goats. Small Rumin. Res., 46: 23-28.
57. Yasmeen, A., S.M.A. Basra, A. Rashid and A. Wahid, 2011. Performance of late-sown wheat in response to foliar application of moringa oleifera L. leaf extract. Chilean J. Agric. Res., 72(1): 92-97.
58. Price, M.L., 1985. The Moringa Tree. ECHO, 17391 Durrance Rd. North Ft. Myers FL 33917, USA.
59. Fuglie, L.J., 2000. ECHOs Technical Note. biomassa. @ibw. com.in.
60. Foidle, N., H.P.S. Makkar, G. Francis and K. Becker, 2001. The potential of moringa olifera for agricultural and industrial uses. In a miracle tree: the multipurpose attributes of moringa CTA publications, Wageningen, The Netherlands. pp: 285.
61. Phiri, C., 2010. Influence of Moringa oleifera leaf extracts on germination and early seedling development of major cereals. Agric. Biol. J. N. Ameri., 1(5): 774-777.
62. Phiri, C. and D.N. Mbewe, 2010. Influence of Moringa oleifera Leaf Extracts on Germination and Seedling Survival of Three Common Legumes. Int. J. Agric. Biol., 12(2): 315-317.

63. Makkar, H.P.S. and K. Becker, 1996. Nutritional value and antinutritional components of whole and ethanol extracted Moringa oliefera leaves. Anim. Feed Sci. Tech., 63: 211-228.
64. Anjorin, T.S., P. Ikokoh and S. Okolo, 2010. Mineral composition of Moringa oleifera leaves, pods and seeds from two regions in Abuja, Nigeria. J. Agric. Biol., 12(3): 431-434.
65. Iqbal, M.A., 2014. Improving the growth and yield of canola (*Brassica napus* L.) with seed treatment and foliar sprays of brassica (*Brassica naups* L.) and moringa (*Moringa olifera* L.) leaf extracts. American-Eurasian J. Agric. Environ. Sci., 14(10): 1067-1073.
66. Iqbal, M.A., 2014. Role of Moringa, Brassica and Sorghum Water Extracts in Increasing Crops Growth and Yield: A Review. American-Eurasian J. Agric. Environ. Sci., 14(11): 1150-1158.
67. Iqbal, M.A., 2014. Managing sunflower (*Helianthus annuus* L.) nutrition with foliar application of moringa (*Moringa oleifera* Lam.) leaf extract. American-Eurasian J. Agric. Environ. Sci., 14(12): 1339-1345.