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Review Article
Status of Buffalo Production in Bangladesh Compared to SAARC Countries

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Abstract

The present study attempts to examine the scenario of buffalo production in SAARC countries. The buffalo plays a very important role in the SAARC countries which constitutes 73.77% of world buffalo population. The SAARC region has a great biodiversity of buffalo germplasm, including the world famous buffaloes Murrah and Nili-Ravi-renowned for high milk production potential. The SAARC countries share 93.19% of world buffalo milk production where India and Pakistan contributes 67.99 and 23.96%, respectively. About 71.4% of world buffalo meat is produced in South Asian countries. Although, buffalo is an essential part of livestock in SAARC countries, it has never been addressed in Bangladesh and always neglected despite their important role in the national economy. In Bangladesh, the total buffalo population are 1.457 million heads that are managed in household subsistance farming and extensive bathan farming in saline coastal region that are used as a draught animal and partially for milk and meat production. This study has tried to unreath the present scenario of buffalo production in SAARC countries and find out the constraints of buffalo production and recommendations of buffalo development in Bangladesh. This study has also explored the further development of buffalo in SAARC countries as well as in Bangladesh.

Key words: Buffalo, SAARC countries, milk, meat, buffalo breeds, production and reproduction performances, growth

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INTRODUCTION

SAARC, the South Asian Association of Regional Cooperation was established on December 8, 1985 by the 7 member states of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka for the economic and political cooperation in this region. Afghanistan joined as the 8th member at the 14th Summit in New Delhi, India in 2007. The present populations of all the member states combined together with around 1.61 billion[1]. Buffaloes are economically and culturally important livestock species especially in developing countries[2]. It plays a significant role through contributions in social and cultural aspects[3]. They possess the highest potential for production with a promising gene pool, which is still not fully used. It is also source of meat and milk. Buffalo milk can be converted into many kinds of cheese, primarily mozzarella[4]. Furthermore, buffaloes are valuable work animals by Perera[5], commonly used as draught animals in crop fields. Due to these reasons, water buffalo is often called the living tractor of the East since it is relied upon for draught and transportation in many parts of Asia[6]. Leather is another major contribution of buffalo in the world market[7]. Dung is used as organic fertilizer. Buffalo racing and plowing contests and fighting are among traditional festivities after rice harvest in Thailand[6]. The water buffalo is the second most important species in the world in terms of milk production, after dairy cows[8] and good source of milk and meat in SAARC region. Comparing to cow, buffalo milk is higher in protein, fat, lactose and energy. The population of global buffalo is 194.29 million; Asian buffalo dominate the world population, representing 92.52% (179.75 million) of the total buffalo population[9,10]. Within the Asian region, about 74.80% of buffaloes in the South Asia, 12.80% in East Asia and only 8.40% found in South-East Asia.

Buffaloes are members of bovine animals classified into two main species[6]. These are African wild buffaloes (*Syncerus*) and Asian buffaloes (*Bubalus bubalis*), which is the most domesticated[11]. Asian buffaloes are further classified in to river and swamp buffalo sub species[5]. River buffaloes are often called water buffaloes and have high lactation yields than swamp buffaloes. Presently, there are 72 buffalo breeds in the world, where as 57 are in Asia. In India, there are 20 buffalo breeds, most popular of which are the Murrah and Nili-Ravi, noted for their high milk yield performance[12]. India is the highest buffalo populated country in the world comprising 112.91 million buffalo (58.11% of the world). India is the world's topmost milk producing country in the world where buffalo forms the backbone of India's dairy industry which share 67.99% of world's buffalo milk production[10]. It is the largest exporter of dairy and dairy products globally. Pakistan is the second most buffalo populated country in the world, contributes 16.83% of world buffalo population[9]. The famous Pakistani breeds are Nili, Ravi, Nili-Ravi, Kundi etc.[13]. Pakistan is the 2nd largest buffalo milk producing country in the world, contributes 23.96% of total buffalo milk production. The Asian countries represent 91.89% of world's buffalo meat and with volume of 3.08 Mt in 2008 FAO[14]. About 78.5% of Asian buffalo meat was produced in South and South West Asia with the greater bulk contributed by India and followed by Pakistan[14]. India is the world's 4th meat producing country and largest buffalo meat exporting country globally.

Bangladesh is a South Asian country where the economy is based primarily on agriculture and livestock is an essential component of the rural economy. The buffalo is an important part of livestock in Bangladesh. The total buffalo population of the country is 1.457 million[15] of which coastal regions posses[16] about 40%. Most of the populations are reverine type with the exception of some swamp type found in Bangladesh. In Bangladesh, buffalo used primarily for draught purpose or dairy and meat production is a secondary option. There is no recognized breed of water buffaloes in Bangladesh and are mainly indigenous non descriptive types. Though total milk production of Bangladesh is about 6.09 Mt in 2014 out of which about 3-4% is produced by the buffalo in spite of the number buffalo growth rate are increasing during last 10 years[15]. The consumption of milk and meat was increased by at 4.0 and 12.7% during 2005-2010. At the same time, rice consumption was decreased by 5.0%. Presently, it is increasing the number of consumer of buffalo milk because of its white color, high fat content and flavor. As a result there is a high demand for buffalo milk in the country but milk yield per dairy buffalo is very low which is 600-1000/L 250-270 days lactation period[17]. This indicates that Bangladesh have great opportunity to produce buffalo milk because of its high consumer preference and demand. However, the sector is not poetically utilized yet due to many constraints. In Bangladesh, buffalo has never been addressed and always neglected species despite their important role in the national economy[17].

According to the national health strategy an adult people need 250 mL milk and 120 g of meat every day. However, presently the availability is only 43.44 and 67.17%, respectively[15]. Under these circumstances, to meet up the deficiency of milk and meat, the government and private organizations should put efforts together to enhance the present milk and meat production status. Recently, the demand for animal derived products such as milk, meat, butter, cheese, ice-cream, baby foods, locally made sweets are increasing which are heavily dependent on milk plus sugar.

Though the buffalo is an important part of livestock in Bangladesh as well as in SAARC countries, there is no documented research studies so far that investigated the scenario of buffalo production in SAARC countries. It is emerging for Bangladesh and other South Asian countries to develop buffalo breed, their production and reproduction performances through various scientific programs. In order to develop buffalo production in Bangladesh as well as in SAARC countries, it would be worthy to know details about the scenario of buffalo production, such as buffalo breeds, their population, their inheritance characteristics, production and reproduction performances, contribution of buffalo to milk and meat production, contribution of buffalo to national economy etc. Therefore, we did this study to solve the problems related to buffalo development in South Asian countries.

The purpose of the present studies was to examine the scenario of buffalo production in SAARC countries, to determine the scopes and opportunities of buffalo production in South Asian countries and to find out the constraints of buffalo production in Bangladesh and to provide their recommendations.

A brief profile of SAARC countries: A brief demographic and socio-economic profile of the SAARC countries is presented in Table 1. The SAARC countries vary a great deal in terms of geographical area, total population, density of population and literacy rate. They are, however, comparable in terms of per capita Gross Domestic Product (GDP). Moreover, culturally and historically they share many common features and could be considered as comprising the Indian subcontinent.

Livestock population scenarios in SAARC countries: The livestock populations of SAARC countries are presented in Table 2. It is evident that India is the largest livestock populated country in SAARC region as well as in the world. India is also the highest buffalo populated country in the world. Pakistan is the 2nd largest livestock populated country in SAARC region. It is also the 2nd largest buffalo populated country in the world.

Buffalo distribution in the world, in Asia and in SAARC countries: Buffalo distributions in major buffalo producing countries of world are presented in Fig. 1 and 2. Presently, there are 72 buffalo breeds in the world, whereas 57 are in Asia and 20 are in India[12]. In Europe and countries of the near East, buffaloes are all of the river type, with similar phenotype but variable size, ranging between a minimum of 280 and 300 kg live weight for the adult female and male respectively in Egypt to a maximum of 900 and 1000 kg in Iraq, the most frequent size being 600 and 800 kg. European buffaloes are all considered to be of the same breed, named the Mediterranean: in Italy the Mediterranean type was particularly selected and it is called Mediterranean Italian breed, in Turkey there is the Anatolian, in Egypt it is called the Egyptian, in Iraq there is the Khuzestani or Iraqi breed, in Azerbaijan it is called the Azeri or Caucasian and in Iran there are Azeri and Khuzestani breeds. In Bulgaria, cross breeding with the Murrah breed was undertaken, by importing in 1962

Table 1: Salient demographic and socio-economic features of SAARC countries

Features	Afganistan	Bangladesh	Bhutan	India	Maldivs	Nepal	Pakistan	Sri Lanka
Total area ('000' km^2)	652.86	147.57	38.39	3287.26	300.00	147.18	796.10	62.71
Total population (million)	25.99	149.77	0.72	1210.19	0.32	26.62	177.10	20.33
Population growth rate (%)	2.03	1.10	1.70	1.60	1.69	1.40	2.05	0.90
No. of density of population (km^{-2})	37.50	1033.00	18.80	382.00	27.70	181.00	222.00	324.00
Rural population (%)	12.60	76.57	69.10	68.84	34.68	82.93	67.50	81.70
Urban population (%)	2.00	23.43	30.90	31.16	65.32	17.07	32.50	18.30
Adult literacy rate (15 years and over) (%)	N/A	55.90	52.80	66.00	95.80	60.00	55.00	90.70
Per capita GDP (US $)	1352.00	1677.00	5167.00	1499.00	9332.00	1255.00	1275.00	2923.00
Growth rate of real GDP (%)	17.30	5.8	11.77	9.60	5.5	4.60	3.00	6.40

Source: SAARC[1] statistical year book

Table 2: Livestock population in SAARC countries (million)

Species/countries	Afghanistan	Bangladesh	India	Pakistan	Nepal	Sri Lanka	Bhutan	Maldivs
Cattle	5.244	23.488	199.075	36.908	7.226	1.350	0.366	NA
Buffaloes	-	1.457	106.000	33.700	5.000	0.475	0.001	NA
Sheep	13.820	3.206	71.558	28.410	0.807	0.392	0.010	NA
Goat	7.311	25.439	140.537	63.146	9.513	-	0.039	NA
Other livestock	1.799	-	13.184	6.288	1.108	2.219	0.116	NA
Total livestock	28.174	53.590	530.354	168.452	23.654	4.436	0.532	NA

Sources: India DAHDF[32], Bangladesh DLS[15], FAO[9], NA: Data not available

Fig. 1: Buffalo distributions in the world

Fig. 2: Recognized buffalo breeds of the world

a considerable number of animals from India and the Bulgarian-Murrah breed was created, that was spread out in many countries in the world, particularly in South America. In Asia, there are many recognized distinct breeds/strains of both riverine and swamp buffaloes; some are more common while many are less known and are destined to get lost in the future in the absence of organized and deliberate efforts to save these breeds. India has about 22 breeds of the riverine-type[18], most popular of which are the Murrah and Nili-Ravi, noted for their high milk yield performance. Zaffarabadi is popular in many countries for cross breeding due to its inherent big size, harnessing its meat-producing potentials as well. In Pakistan, 34% of the buffalo population is Nili Ravi, 21% Kundi and the rest are nondescript[13]. In Nepal, there are three indigenous buffalo breeds named Gaddi, Parkote and Lime which contribute 70-76% of total population. There are some exotic

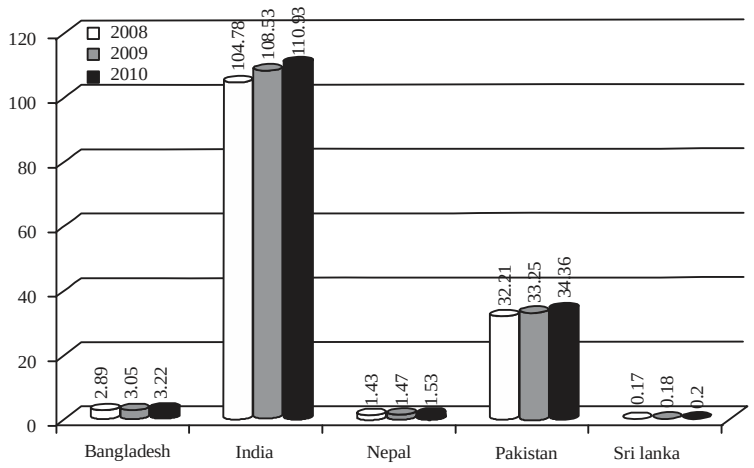

Fig. 3: Total milk production scenarios in SAARC countries (Mt), source: Siddiky[41]

buffaloes are non-descript indigenous which contributes 55% of total population. There is no recognized breed of water buffaloes in Bangladesh and are mainly indigenous non descriptive types. Swamp buffaloes are distinctly of Chinese origin and has 18 known breeds/strains in China[19] while Indonesia has identified seven breeds/strains[20]. Among the breeds of Indonesia, the spotted swamp buffalo is more unique and is largely raised for socio-religious purposes. The swamp buffalo found in the Philippines are believed to have originated from China, although some deliberate efforts were made to import Chinese Shanghai buffaloes in the early part of the century. Thai swamp buffalo are found mostly in the Northeast of Thailand and have received special program of selection and improvement for growth and size.

Contribution of SAARC countries in the world buffalo population: Asian buffaloes dominate the world population, representing 92.52% of the worldwide population of 194.29 million[9]. Within the Asian region, about 79.74% of buffaloes are in SAARC countries and the rest 20.26% in other countries[10]. The buffalo populations in the world, in Asia and in SAARC countries are presented in Table 3. During the last 10 years, world buffalo population has increased by 20.0 million head and 89.41% of that increases occurred in Asia, infact, that population growth has been largely contributed by India and Pakistan[9].

Milk production potentiality of buffalo in different countries: The production potentiality of buffaloes in different countries is presented in Table 4. According to production potentiality, it is observed that Pakistan and India has the highest milk producing buffaloes than others. Pakistani buffalo Nili-Ravi is the best performing buffalo in the world for milk

Table 3: Total buffalo population in the world and in SAARC countries

Region/country	Total population (million)	Share in world population (%)
World	194.29	100.00
Asia	179.75	92.52
Rest of world	14.54	7.48
India	112.91	58.11
Pakistan	32.70	16.83
Nepal	4.99	2.57
Bangladesh	1.394	0.717
Sri Lanka	0.405	0.208
Bhutan	0.000851	-

Sources: FAO[9] and Chakravarty[10]

production (2500 L/305 days lactation). Average milk production of Pakistani buffaloes is 5-7 L day^{-1}. India is home to great biodiversity of buffalo germplasm, including the world famous Murrah buffaloes-renowned for high milk production potential. The average milk production of Indian buffaloes is 8-10 L day^{-1}.

Milk and meat production and consumption scenarios in SAARC countries: India is the world's top most milk producing country in the world where buffalo forms the backbone of India's dairy industry which share 67.99% of world's buffalo milk production[10]. It is the largest exporter of dairy and dairy products globally. Pakistan is the 2nd largest milk producing country in SAARC region. The total milk production scenarios in SAARC Counties are presented in Fig. 3.

The buffalo milk production in SAARC countries represents 96.05% Asian and 93.19% of world's total buffalo milk production[10]. India and Pakistan contributed a hefty 67.99 and 23.96% of total buffalo milk production in the world. The buffalo milk production in the world, in Asia and in SAARC countries are presented in Table 5.

The Asian countries represent 91.89% of world's buffalo meat and with volume of 3.08 Mt in 2008 FAO[14]. About 78.5%

Table 4: Average buffalo milk production in different countries

Country	Average milk yield (kg animal^{-1})
Pakistan	1909
India	1407
Vietnam	1000
Turkey	969
Nepal	842
Sri Lanka	648
China	505
Bangladesh	407
Asia	1389

Source: Kareemulla and Meena[33]

Table 5: Buffalo milk production (Mt) in the world and in SAARC countries

Region/country	Total production (Mt)	Share in world production (%)
World	95.815	100.000
Asia	92.962	97.020
Rest of world	6.525	2.980
SAARC countries	89.290	93.190
India	65.140	67.990
Pakistan	22.955	23.960
Nepal	1.109	1.157
Bangladesh	0.037	0.039
Sri Lanka	0.046	0.048
Bhutan	0.000084	-

Source: Chakravarty[10]

Table 6: Buffalo meat production (Mt) in the World and in South Asia during 1998-2008

Years	World	South Asia	Share in world population (%)
1998	2,881,073	1,959,142	68.0
2004	3,112,609	2,169,537	69.7
2005	3,171,721	2,202,409	69.4
2006	3,249,474	2,333,324	71.8
2007	3,327,645	2,357,359	70.8
2008	3,358,946	2,398,922	71.4

Source: Wanapat and Chanthakhoun[14]

Table 7: Comparative milk and meat consumption rate in SAARC countries

Countries	Milk consumption (mL h^{-1} day^{-1})	Meat consumption (g h^{-1} day^{-1})
Bangladesh	109	20.0
India	290	25.0
Nepal	155	38.0
Pakistan	525	45.0
Sri Lanka	160	27.0
Maldives	200	31.5

Sources: Khan[34] and other sources

of Asian buffalo meat was produced in South and South West Asia with the greater bulk contributed by India and followed by Pakistan (Table 6). India is the world's 4th meat producing country and largest buffalo meat exporting country globally. This is easily explained by the fact that these two countries have 75% of the buffalo population in the region. Improvement in buffalo meat yield is contributed by the increasing usage of male calves which were not fully utilized. In the past in the greater part of India, farmers were not paying enough attention to rescue the young animals from high mortality before reaching 6 months of age. In recent years, however, the rising export of Indian buffalo meat have given enough incentives for small herd farmers to rear these animals and put additional weight prior to slaughter, thereby sustaining the growth in the meat harvest from the Indian buffalo sector. On the average, however, the extraction rate registered among Asian countries is highest in Pakistan, Nepal and China[14]. The comparative milk and meat consumption rate in SAARC Counties are presented in Table 7.

STATUS OF BUFFALO PRODUCTION IN INDIA

The Republic of India is a country that occupies a greater part of the Indian subcontinent and is the second most populated country in the world. India is home to great biodiversity of buffalo germplasm, including the world famous Murrah buffaloes, renowned for high milk production potential. The country is host to both river and swamp types of Asian buffaloes, apart from the wild Asian buffaloes. India is the highest buffalo populated country in the world comprising 112.91 million buffalo (58.11% of the world). The increase of buffalo population trend in India is presented in Fig. 4. India is also the largest livestock populated country in the world which is shown in Table 2. India is the world's top most milk producing country where buffalo forms the backbone of India's dairy industry. It is the largest exporter of dairy and dairy products globally. India is the world's 4th meat producing country and largest buffalo meat exporting country globally.

Major buffalo breeds in india: Buffaloes in India are spread over almost all parts of the country with varying density of population in different states and union territories. It possesses the best milch breeds of the world namely Murrah, Nili Ravi, Surti and Jaffrabadi, which had their origin in North Western states of India and have high potential for milk and fat production besides being used for work and surplus stock used for meat production. There are also other breeds in India which have regional importance and add to economic value of the farming community, e.g., Bhadawari, Nagpuri, Pandharpuri, Manda, Toda, Mehsana, Tarai etc. Mehsana breed has been developed from grading up of Surti buffaloes with Murrah in Mehsana district of Gujrat. Similarly, continued grading up of local non-descript buffaloes with Murrah breed in Krishna and Godawari districts of Andhra Pradesh has resulted into a strain popularly known as Godawari 1 and 2. The major buffalo breeds of India and their breeding tract is presented in Table 8.

Table 8: Major buffalo breeds in India

Breed	State	Breeding tract
Murrah	Haryana, UP and Punjab	Hisar, Jind, Rohtak, Bhiwani, Delhi, Western UP, (AP, MS)
Nili-Ravi	Punjab	Ferozepur, Amritsar
Bhadawari	UP and MP	Bah Tehsil-Agra, Adjoining Gwalior
Surti	Gujarat	Kheda, Vadodara
Jaffarabadi	Gujarat	Kathiawar and Honreli
Mehsana	Gujarat	Mehsana, Banaskantha
Nagpuri	Maharashtra and Andhra	Wardha, Nagpur, Adilabad
Pandharpuri	Maharashtra	Solapur, Kolhapur, Sangli
Toda	TamilNadu	Ooty, Coimbatore

Source: Singh[12]

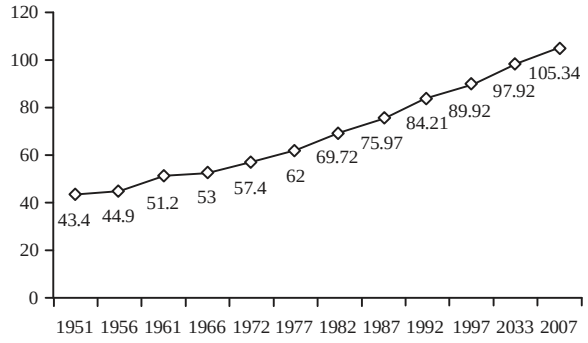

Fig. 4: Buffalo population trend in India, source: Siddiky[41]

Production performances of Indian Murrah buffaloes: The Murrah buffalo is good milk producer, not only in India but also probably in the world. The bulls of this breed are extensively used to upgrade the non-descript buffalo stock all over the world. In India, the production of Murrah had been recorded 14-15 L, sometimes upto 31.5 L. The elite Murrah buffalo produces above 18 L milk day^{-1}. A peak milk yield of 31.5 kg in a day has been recorded from a champion Murrah buffalo in the all India milk yield competition conducted by the Government of India. The production performances of Murrah buffaloes in India are presented in Table 9.

Trends of animal food production in India: The animal food production in India is shown in Table 10. India is the world's top most milk producing country. The per capita availability of milk in India is 268 g day^{-1} and increasing rate at 1.15-5.5% annum^{-1} (2012-13). The milk surplus states in India are Uttar Pradesh, Punjab, Haryana, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. The manufacturing of milk products is concentrated in these milk surplus states. In India, buffalo contributes 48% of total milk production whereas cow and goat contributes 48.7 and 3.3%, respectively[21]. India is the world's 4th meat producing country and largest buffalo meat exporting country globally. The trends of Indian meat production are shown in Table 11.

Table 9: Production performance of Murrah buffaloes at CIRB, Hisar (2012-13)

Traits	No.	Mean±SE
Total lactation milk yield (kg)	110	2478.00±54.36
305 days milk yield (kg)	110	2335.00±45.71
Peak yield (kg)	110	11.23±0.23
Age at first calving (months)	37	44.48±1.42
Service period (days)	72	174.00±8.19
Calving interval (days)	73	481.00±11.87

Source: Singh[12]

Table 10: Animal food products in India

Products	Total production	Position in world
Milk	121.80 MMT	1st
Milk production from buffalo	68.00 MMT (56%)	1st
Meat	9.30 MMT	4th
Egg	52.00 billion	4th
Poultry meat	4.80 MMT	4th

Source: FAO[35]

Table 11: Meat production in India (2010-2011)

Species	Total production (MMT)	Share in total production (%)
Cattle	1.49	16.0
Buffalo	1.58	17.0
Sheep	0.25	3.0
Goat	0.57	6.0
Pigs	0.64	6.4
Poultry	4.80	51.0
Total	9.33	100.0

Source: FAO[9]

Growth rate of buffalo meat production is 4%, where cattle meat is 3.5%. Attendant to the remarkable growth in meat production in India in recent years is the establishment of modern slaughter houses and meat processing facilities that meet international standards, enabling the growth in meat exports.

Exported livestock products in India: India is the largest exporter of milk and milk products in the world. In 2012-13, India exports 87.8000 Mt dairy products and the value is Rs. 1412.1 crore. India export the largest amount of skimmed milk powder which is about 77% of net milk and milk products exported. Major importers of milk and milk products are Bangladesh, China, Hong Kong, Singapore, Thailand, Malaysia,

Table 12: Trends in exports of dairy products by India (million US $)

Country	2003	2004	2005	2006	2007	2008
Bangladesh	4930.54	9257.489	24704.77	10219.57	17309.06	25075.58
Egypt, Arab Republic	56.144	1911.281	9420.70	6503.667	16786.34	11900.87
UAE	1800.451	2319.097	3400.917	3263.51	2921.005	4791.376
Nepal	501.125	1222.172	2741.021	1717.209	1705.38	8939.679
Saudi Arabia	1207.616	3580.07	4497.057	5901.419	8041.849	13645.14

Source: Wanapat and Chanthakhoun[14]

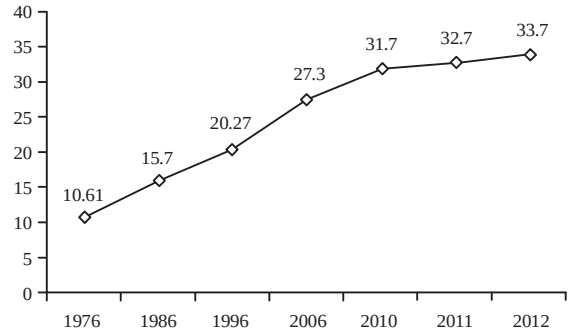

Fig. 5: Buffalo population trend in Pakistan, source: Siddiky[41]

Philippines, Japan, UAE, Oman and other Gulf countries located in close proximity to India. The trends in exports of dairy products for last 5 years by India are shown in Table 12.

Export of buffalo meat from India roses two folds in volume from 234,355 million t in 2001 to 456,907 million t in 2009 and by more than 400% in value from US $243.4 million to US $1.043 billion during the same period. In the year of 2010-11, India exported Rs. 8,000 crore of buffalo meat, in 2011-12 it was Rs. 13,000 crore and in 2012-13 it was Rs. 17,400 crore. The top buffalo meat exporting countries are Vietnam, Malaysia, Egypt, Saudi Arabia, Philippines, Algeria, UAE, Iran, Thailand, Iraq, Kuwait, Syria etc. The live animals and hides and skins exported by India are 7.5 million US $ and 36.3 million US $ (2007), respectively. The total animal products exported Rs. 20,131 crore in 2012-13.

BUFFALO PRODUCTION IN PAKISTAN

Livestock in Pakistan plays a very important role in national economy. It contributes 11.6% in national GDP and 55.1% of the agricultural GDP (2013). Buffalo is an important animal among livestock of Pakistan. There are approximately 32.70 million buffaloes in Pakistan which constitute about 15% of the world buffalo population and 2nd largest buffalo holding country in the world[9] with highest growth rate of 4.8% annum^{-1}. Buffalo contributes around 67% of annual milk production and share 29.78% in world's buffalo milk production. It is the Black Gold of Pakistan.

Table 13: Production and reproduction performances of Pakistani buffaloes

Traits	Value
Age at first calving (months)	36
Age at first service (months)	33
270 days milk yield (kg)	2168-5000
Average carcass weight (kg)	138
Services per conception	1.46
Conception rate peak breeding season (%)	45
Conception rate low breeding season (%)	39

Source: Naqvi and Shami[36]

Table 14: Milk production per lactation of Nili-Ravi buffaloes

Milk yield (L)	Lactation length (days)	No. of observation
2345±858	312	N = 1559
2065±63	284	N = 1300 and 1001
1702±61	279	
2031±19	302	N = 984
1984±773	289	N = 2704
1831±530	273	N = 426

Source: Anwar[37]

Buffalo population trend in Pakistan: The buffalo population over the year in Pakistan is presented in Fig. 5. According to Economic Survey of Pakistan buffalo population in 2012 was 32.70 millions. By this value it showed that the buffalo population was increasing with the passage of time.

Major buffalo breeds and their performances in Pakistan: Pakistani buffaloes are riverine type and mainly belong to five breeds i.e., Nili, Ravi, Nili-Ravi, Kundhi and Azakheli. Nili-Ravi and Kundi are the two main breeds mainly confined to Punjab, Sind and Balochistan. Pakistani buffalo Nili-Ravi is the best performing buffalo in the world for milk production. Body weight of males Nili-Ravi reaches 550-650 kg, while that of the females is 350-450 kg. There are also Murrah, Surti are found in Pakistan. The production and reproduction performances of Pakistani buffaloes are presented in Table 13 and 14.

Contribution of buffalo to milk and meat production in Pakistan: Buffalo plays an important role in milk and meat production system in Pakistan. The buffalo meat production systems in Pakistan are traditional and inefficient. Most of the meat comes from end of the career or emergency slaughter animals. Milk and meat production from different species and their percent share to total production is presented in Table 15.

Table 15: Milk and meat production in Pakistan (2011-2012)

	Milk		Meat	
Species/products	Total production (MMT)	Share in TP (%)	Total production (MMT)	Share in TP (%)
Cattle	17.36	35.08	0.867	26.83
Buffalo	30.45	61.52	0.902	27.91
Sheep	0.025	0.050	0.629	19.46
Goat	0.802	1.62	(Chevon and Mutton)	
Camel	0.856	1.73	-	-
Poultry	-	-	0.834	25.80
Total	49.493	100.00%	3.232 MMT	100.00

Source: Pasha[22]

Table 16: Milk yield from buffaloes in different production systems

Production system	Share No. of animals (%)	Milk yield (L animal^{-1} year^{-1})
Rural market oriented	46.0	3050
Rural subsistence	25.0	1350
Peri-urban	21.0	3450
Commercial buffalo farming	8.0	3450
Total/average	100.0	2825

Source: Pasha[22]

Table 17: Hides from different species in Pakistan

Species	Hides	Total hides (%)
Buffalo	6842000	49.10
Cow	6995000	50.18
Camel	101000	0.72
Total	13938000	100.00

Source: Pasha[22]

In Pakistan, there are several buffalo production systems; including rural subsistence, rural market oriented, peri-urban and commercial. Milk yields of buffaloes in different production systems are presented in Table 16.

Buffalo hides production in Pakistan: Hide is another economic contribution of buffalo in Pakistan. Total world buffalo hide production was estimated 850.16000 t and 818.37 of this quantity came from Asian countries[22]. In this way 96.26% of total buffalo hides were from Asia in which Pakistan is a major share. Hide production from different species and their percent share to total hide production is presented in Table 17.

BUFFALO PRODUCTION IN NEPAL

In Nepal, buffalo is the most important livestock species in terms of LGDP (around 53%). The total buffalo population is around 5 million that contributes about 71% milk and 60% meat of total production. The average milk production of Nepali indigenous buffaloes 2.5-3 L (Gaddi upto 6 L). The buffalo production system is subsistence across the country. There is some free grazing and semi stall feeding with cut and carry mixed with cattle or raised solely. Buffalo production with seasonal migration in the high hills and terai comparatively larger herds. There is small holder dairying in peri urban/urban areas. Semi/commercial buffalo production in major dairy pocket areas is stall-fed.

Buffalo population trend in Nepal: The buffalo population over the year in Nepal is presented in Fig. 6. According to economic survey of Nepal buffalo population in 2011 was 5.0 million. By this value it showed that the buffalo population was increasing with the passage of time.

Buffalo breeds and their performances in Nepal: Buffalo in Nepal all are in riverine types. There are three indigenous buffalo breeds named Gaddi, Parkote and Lime which contribute 70-76% of total population. Gaddi is better producer; milk production varies 300-1800 lactation^{-1}. There are some exotic/crosses/upgraded buffaloes in Nepal contribute 24-30% of total population. These are Murrah, Surti and Jafarabadi which are introduced for upgrading indigenous buffaloes. The production performances of Nepali buffaloes are presented in Table 18. The buffalo milk production trend over the year in Nepal is presented in Fig. 7.

BUFFALO PRODUCTION IN SRI LANKA

Sri Lanka is an island country which boasts a progressive and modern industrial economy and the highest per capita income in South Asia. The Lankan buffaloes are non-descript indigenous and high variation within the population which contributes 55% of total population and present in all over the country except in up country. There are 40% crossbreds (Murrah, Nili Ravi, Surti etc.) and 5% imported buffalo in the country. Lankan buffaloes represent Indian wild buffalo considered as a unique animal. Average milk production of Lankan buffaloes 2 L day^{-1}. The production and reproduction performances of Lankan buffaloes are presented in Table 19. In Sri Lanka, about 87% farmers are crop producers who rear

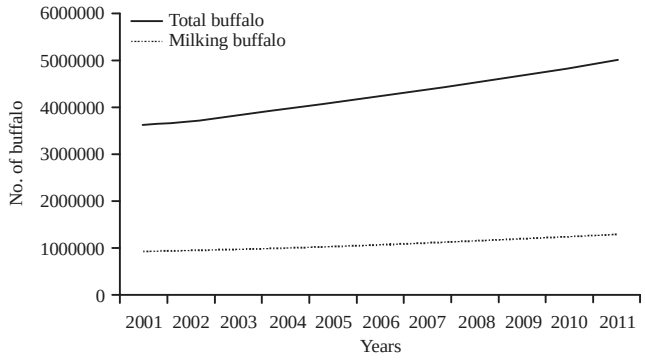

Fig. 6: Buffalo population trend in Nepal, source: Shrestha[21]

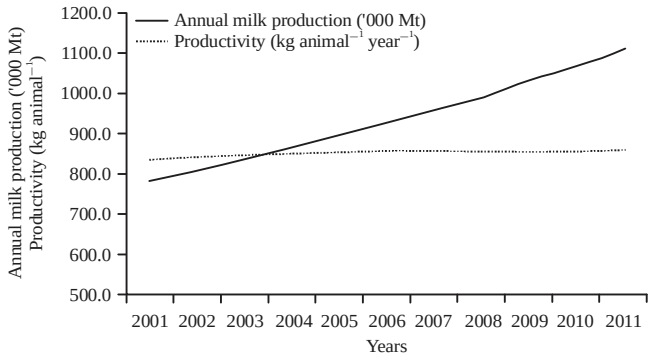

Fig. 7: Buffalo milk production trend in Nepal, source: Shrestha[21]

Table 18: Milk production performances of indigenous buffaloes in Nepal

Breeds	Lactation yield (Mean±SE)	Fat content (%) (Mean±SE)	SNF content (%) (Mean±SE)	Total solid (%) (Mean±SE)
Lime	1418.48±45.56	8.04±0.069	12.39±0.077	20.57±0.083
Parkote	1433.39±45.98	8.17±0.079	12.25±0.082	20.48±0.124
Murrah cross	1726.11±45.89	6.83±0.056	12.31±0.056	19.20±0.099

Source: Shrestha[21]

Table 19: Comparative performances of Lankan buffaloes

Trait	Lankan indigenous	Murrah	Surti	Nili-Ravi	Crosses
Birth weight (kg)	18.1	27.6	27.1	30.1	20.3
Pre pubertal growth rate (g day^{-1})	160	460.0	250.0	465.0	
Mature weight (kg)	300	433.0	405.0		314.0
Age at first calving (month)	45.0	50.9	51.8	52.1	53.9
Calving interval (day)	502	507.0	482.0	491.0	
Milk yield per lactation (L)	353	1300.0	1230.0	1700.0	1000.0

Source: Dematawewa and Ratnayake[38]

buffaloes as an additional source of income. About 64% buffaloes are used for draught purpose, 34% for milk and draught, while only 2% keep buffaloes purely for milk. Buffaloes are spread throughout the country, with high concentrations in certain areas due to particular farming systems and market and socio-cultural reasons. The average herd size is around 22.5 animals. However, this value is heavily dependent on the agro-ecological zone. Larger herds with an average of 40-50 animals are found in rice-growing areas of the dry intermediate zone. Smaller herds with an average of 6-8 animals are found in mid and low zones. The present population is unevenly distributed across the major agro-ecological zones of the island which has an area of 65,000 km^2.

BUFFALO PRODUCTION IN BHUTAN

Bhutan is a small and landlocked country situated between China (Tibet) and India located in the Eastern Himalayas and is mostly mountainous and heavily forested.

Table 20: Population and growth rate of dairy animals in Bangladesh

	Cattle		Buffalo		Goat	
Year	No. (million)	Growth (%)	No. (million)	Growth (%)	No. (million)	Growth (%)
2004-05	22.670	-	1.110	-	19.160	-
2005-06	22.800	0.57	1.160	4.50	19.940	4.07
2006-07	22.870	0.31	1.210	4.31	20.750	4.06
2007-08	22.900	0.13	1.260	4.13	21.560	3.90
2008-09	22.976	0.33	1.304	3.49	22.401	3.90
2009-10	23.051	0.33	1.349	3.45	23.275	3.90
2010-11	23.121	0.30	1.394	3.33	24.149	3.76
2011-12	23.195	0.32	1.443	3.52	25.116	4.00
2012-13	23.341	0.63	1.450	0.49	25.277	0.64
2013-14	23.488	0.63	1.457	0.48	25.439	0.64
Average growth rate (%)		0.39		3.08		3.21

Source: DLS[15]

Dairy animals in Bhutan consist of cattle 87%, yak 12% and buffalo 1%. Buffalo farming is limited to sub-tropical belt; Chukha, Samtse, Sarpang, Sjongkhar, Tsirang and Dagana districts. Buffaloes are used for milk, meat, draught and manure purposes. Buffalo population in Bhutan was 28,000 in 1984 FAO[23]. The trend of buffalo population in Bhutan is declining. Presently, there are 851 heads of buffaloes in Bhutan. Government has also taken initiatives to promote Murrah buffalo and procured some bulls and heifers for breeding purposes[24].

Buffalo breed types and herd sizes in Bhutan: Buffaloes in Bhutan are non-descript riverine type and physically categorized into three types, (i) Kagay is a type with entire black body, (ii) Hyakulae has black body with white or light grey stripes below neck region and (iii) Dobla it is the cross between the local and Surti buffalo. The average herd size of buffalo in Bhutan is around two[24].

STATUS OF BUFFALO PRODUCTION IN BANGLADESH

Bangladesh is one of the largest deltas of the world with a total area of 147,570 km^2. having a population of 155 million as on 2013. Majority of people in the country are Muslim (90%) and remaining inhabitants are mainly Hindus (9%) while Buddhist and Christians constitute around 1%. The country lies in the Southeast part of South Asia between 20°34″and 26°38″ North latitude and 88°01″ and 92°41″ East longitude. The country is bordered by India on three sides West, North and part of East. There is also a small strip of frontier with Myanmar on the Southeastern edge. The country has subtropical climate with average annual rainfall of 2,410 mm. The weather undergoes relatively a small range of temperature variation around the year.

The economy of Bangladesh is based primarily on agriculture and livestock is an essential component of the rural economy. Dairying is one of the major components of animal agriculture and part of mixed farming system in Bangladesh. In Bangladesh, cattle, buffalo and goat are considered as dairy animals. Out of total milk production, about 90% is coming from cattle, 8% from goat and the remaining 2% from buffalo[25].

Buffalo has never been addressed in Bangladesh and it is a neglected species despite their important role in the national economy. Most of the populations are reverine type with the exception of some swamp type found in Bangladesh. Different cross breds population with Murrah, Nili-Ravi, Surti and Jaffrabadi blood lebel are also available in scanty sorrounding Indian border of Bangladesh. The buffaloes are 1.457 million heads and they are managed in household subsistance farming in the villages as a draught animal that can give milk to the family in low quantity, as producing about 800 kg $lactation^{-1}$ and the most part is consumed by calf and a little is sold out. Many buffaloes rear in saline coastal region under extensive farming as bathan farming, they are partially milked and are mostly used for meat production. In Bangladesh, the consumption of milk and meat was increased by at 4.0 and 12.7% during 2005-2010. At the same time, rice consumption was decreased by 5.0%.

Population trend of dairy animals in Bangladesh: In Bangladesh, cattle, buffalo and goat are considered as dairy animals. Out of total milk production, about 90% is coming from cattle, 6-7% from goat and the remaining 3-4% from buffalo[25]. The population of buffalo is presented in Table 20. According to the data of 2013-14 DLS[15] there are about 23.488 million cattle, 1.457 million buffaloes and 25.439 million goats in the country (Table 20). Among the total cattle population, about 85-90% are indigenous and 10-15% are cross bred. Indigenous cattle consisted of (a) Non-descript Deshi, (b) Red Chittagong cattle, (c) Pabna cattle, (d) North Bengal Gray and (e) Munshigonj White cows. On the other

hand, cross bred cattle are the results of crossing between local with different exotic breeds like Holstein, Friesian, Sindhi, Shahiwal, Jersey at different level. Black Bengal, the only dairy goat breed comprises 90% of the total population. Buffalo in Bangladesh is mainly indigenous in origin and most of them are riverine type with exception of some swamp type in Eastern part and have low productivity. There are also some cross breed with Murrah, Nili-Ravi, Surti and Jaffrabadi sorrounding of Indian border[16,17].

Breeds and genetic diversity of Bangladeshi buffalo: Domestic indigenous buffaloes of Bangladesh belong to the *Bubalus bubalis* with most of the population are reverine type with exception of some swamp type found in eastern part of Bangladesh. In Bangladesh, there is no recognized breed of water buffaloes and mostly indigenous in origin which grouped into five types on the basis of their history of domestication, distribution and morphology. These are (i) Native buffaloes in the Eastern part, (ii) Native buffaloes in the western part, (iii) Native buffaloes in the central part, (iv) Native buffaloes in the Southern part and (v) Exotic (Nili-Ravi) and their crosses with indigenous[16]. There are also some crossbred buffaloes (indigenous with Murrah, Nili-Ravi, Surti and Jaffrabadi etc.) are scantly available surrounding Indian border of Bangladesh due to border migration from India[17]. Bangladesh, the former East Pakistan imported a small number of Nili-Ravi from Pakistan during 1960 to supply breeding bulls to the farmers in the coastal area of Southern part for crossbreeding purpose. Department of Livestock Services (DLS) again imported 100 Nili-Ravi pregnant heifer and 1st lactating cows from Pakistan during 1990 that were reared in newly established buffalo farm at Bagherhat district, in South-west part of Bangladesh. But the breed was not maintained properly and mixed up with local buffalo through male distribution program of the DLS. At present, the buffaloes in the farm have mixed up and no record keeping was maintained. Phenotypically Nili-Ravi character is also scantly found in Southern-west part population of buffalo in Bangladesh. Sometimes Murrah was used for upgradation of native stock. Presently, buffalo development project is running since 2010 where cross breeding of indigenous buffalo with Italian Mediterranean semen in limited area using A.I. (39 upazillas of 13 districts). This project also studying genetic characterization of buffaloes, formation of least cost ration based on regionally available feed resources, packages for control of major buffalo diseases etc.

Buffalo genome decoded by Lal Teer Livestock in Bangladesh: Lal Teer Livestock Limited (LTL) and Beijing Genomics Institute (BGI) jointly sequenced buffalo genome under a 3 year project based on Bangladeshi local buffalo stock. It was announced at a press briefing on January 24, 2014 by authorities of Beijing Genomics Institute and Lal Teer Livestock Limited. Hopefully it will increase the country's milk and meat production using the genetic information of local buffalo.

Buffalo production systems in Bangladesh: Buffaloes are raised in Bangladesh throughout the country with some specific distribution of concentration in coastal saline region, plain land, marshy land and hilly area which is fully depends on feed resources availability. On the basis of land areas and type, major buffaloes are raised under three production systems: Household subsistence, semi-intensive and extensive system in coastal saline region which covers about 23.00% of total land areas. The household subsistence farming (HF) buffaloes are reared under stall feeding with 6-7 h grazing in and around backyard or public land with very little feed supply. The average herd size in HF is about 1-3 with highest number 10. The semi-intensive farming (SIF) buffaloes are raised in combination of seasonal based household during rice cultivation and free range system during common land free which is mostly upper part of coastal areas. Seasonal rice cultivation is the main occupation in the areas. The average herd size is 4-15 animals in highest. Buffaloes in the lower part of the coastal area are raised under an extensive farming system (EF) locally called bathan farming. The extensive farming system in bathan coastal region includes offshore islands, mudflats, chars (accreted land) and new accretions. The important occupations include fisheries and salt production and buffalo rearing. Many of the coastal areas have extensive areas of grasslands. These are used as grazing lands for the buffalo. In the coastal area, buffalo are used for milk purpose along with live animal for meat. The herd size is about 51-200 with highest number 600 animals and is reared completely under natural grazing system with almost no extra feed supply. The livestock production systems in Bangladesh are presented in Table 21.

Milk production and value chain development from buffalo in Bangladesh: Buffalo milk production in Bangladesh remained more or less stagnant due to absence

Table 21: Livestock production system in Bangladesh

	Production systems (%)			
Species	Low input	Medium input	High input	Total
Cattle	64.00	24.00	12	100
Buffalo	90.00	10.00	0	100
Goat	73.20	26.80	0	100
Sheep	84.80	15.20	0	100

Source: DLS[39]

of any milk improvement program. According to WHO, per capita requirement of milk per day is 250 mL. By taking this into account the country's requirement of milk is 14.14 Mt. However, Bangladesh produces only 43.07% (6.09 Mt), showing a shortage of 56.93% (8.05 Mt). As the poverty is decreasing and income is increasing, the demand for not only milk but also milk products like butter cheese, ghee, yogurt, ice cream is also increasing. Therefore, it is becoming very important to increase the supply of milk and milk products to meet the increasing demand of milk. Though total milk production of Bangladesh is about 6.09 Mt in 2014 out of which about 3-4% is produced by the buffalo in spite of the number buffalo growth rate are increasing during last 10 years[15]. The average milk yield of water buffalo in Bangladesh is approximately 620-1161 kg in 270-330 days. Faruque *et al.*[16] reported that average lactation yield was 730 kg during 328 days lactation period where fat in milk was found to range 6.80-13.20%. Daily milk yield per buffalo was lower (2.00-3.50 L) than the crossbred cattle (3.50-7.00 L) but it is higher than indigenous cattle. As the buffaloes have high milk production than local cattle in the same climate which shows higher potentiality of buffalo for diminishing gaps of milk production in Bangladesh. The milk value chain development of buffalo milk is required to improve the situation to keep the higher trend of income of the farmers from buffalo milk.

Buffalo meat production in Bangladesh: Buffalo meat is not popular in Bangladesh but its low cholesterol level and higher quality than cattle may attract by the consumers, if quality tender meat is available like cattle. Hasnath[26] reported that the average live weight of buffalo at slaughter age was about 320 kg where the dressing percentage was 44% only. It was reported that the average live weight of adult buffalo[27] was 427 kg. From long passed, all most all buffalo in Bangladesh are slaughtered at older age after completing their whole life in works and animals are usually very emaciated. The meat fiber is very sticky and hard to chewing. However, a big number of buffaloes are slaughtered every day in the city market and it has been sold in disguise of beef with lower price than beef. In general, the quality of meat is one of the main reasons not to well accepted by the consumers. The buffalo meat price is about taka 250 kg^{-1} against cattle meat price taka 285 kg^{-1} which is always lower in between taka 25-35 kg^{-1} (One US $= Taka 81) as tender aged quality buffalo meat is not at all available in common market. These taboos of low quality buffalo meat can be changed by introducing tender aged buffalo meat marketing through buffalo improvement program in the country.

Feeding and health care practices for buffaloes in Bangladesh: The crops residues are mainly constitute the feed materials for the buffalo. Farmers generally follow the traditional feeding practices and are fully dependent on their own farm produces dry roughages rice straw, grazing in common land and some concentrates ingredients like wheat bran, rice bran and pulse bran. Small green grasses are available from rice field, road side grass and char land grazing. Grazing on coastal salt rich herbage in submerged char land areas are also practiced in coastal region. Migratory grazing on river basin areas is practiced. Variation of buffalo feedings are depending on production systems. Only domestic salt are used as mineral supply in upland areas.

Most of the diseases that occur in cattle also inflict harmful effects on the buffaloes. Foot and mouth disease is the most problematic disease in Bangladesh as quality vaccine is not freely available. Diseases such as Haemorrhagic Septicaemia (HS), fasciolosis, ascariosis, anthrax, brucellosis, tuberculosis and black quarter are also important diseases causing more economic losses. Health care practice is not available in most cases of buffaloes as it reared in most remote areas. Now a days very few farmers use hemorrhagic septicemia and anthrax vaccines that are low cost produced in country. Most of the farmers do not use any anthelmintic for deworming in buffalo except a few for only fasciolosis.

Performances of indigenous buffaloes in Bangladesh: In Bangladesh, buffalo used primarily for draught purpose or dairy and meat production is a secondary option. The reproductive performances of indigenous buffaloes is age at puberty 3.5 years, gestation period 300-310 days, inter calving period 15.53-18.2 months and estrous cycle 21 days (17-28 days). The milk production usually 600-1000 L/ 250-270 days lactation period[16].

Contribution of buffalo to milk and meat production in Bangladesh: The contribution of buffalo to milk production in Bangladesh remained more or less stagnant due to absence of any milk improvement program. Milk production from different species and their percent share to total milk production is presented in Table 22. The buffalo meat production systems in Bangladesh are traditional and inefficient. Most of the meat comes from end of the career or emergency slaughter animals. Meat production from different species and their percent share to total meat production is presented in Table 22.

Requirements and availability of milk and meat in Bangladesh: Consumption of milk and milk products in the

Table 22: Milk and meat production in Bangladesh

	Milk		Meat	
Species/products	Total production (MMT)	Share in TP (%)	Total production (MMT)	Share in TP (%)
Cattle	5.786	95.0	1.751	38.74
Buffalo	0.244	4.0	0.043	0.94
Goat	0.061	1.0	0.219	4.85
Sheep	-	-	0.046	1.02
Poultry	-	-	2.461	54.45
Total	6.091	100.0	4.520	100.00

Sources: DLS[15], Gerosa and Shoet[40]

Table 23: Requirement, availability and deficit of meat and milk

Products	Need per capita	Availability per capita	Production per year (Mt)	Demand per year (Mt)	Deficiency
Milk	250 mL h^{-1} day^{-1}	108.66 mL h^{-1} day^{-1} (43.07%)	6.09	14.14	141.34 mL h^{-1} day^{-1} 8.05 (Mt) (56.93%)
Meat	120 g h^{-1} day^{-1}	80.64 g h^{-1} day^{-1} (67.2%)	4.52	6.73	39.36 g h^{-1} day^{-1} 2.21 (Mt) (32.84%)

Source: DLS[15]

country is carried out in different ways: Directly from the producers, from the vendors and from the commercial milk processors and manufacturers. An adult person requires at least 250 mL milk every day but the availability is only about 108.66 mL h^{-1} day^{-1} DLS[15]. This figure indicates that we are in shortage of milk. Total milk production of the country is 6.09 Mt $year^{-1}$ (2013-14) but the requirement is about 14.14 Mt $year^{-1}$. From this value it can be said that the deficiency is about 56.56% (Table 23). If we look forward about the milk consumption pattern of South Asian Association for Regional Cooperation (SAARC) countries (Table 7), then it is easy to understand that our position is at the bottom of all SAARC countries in terms of milk production and consumption.

The huge gap between supply and demand is largely met by import of milk powder and cream from abroad. For this reason the country looses huge amount of foreign currency every year which is about US $ 93.4 million[28].

Constraints of buffalo production in Bangladesh

- Lack of knowledge about the quality of buffalo milk and meat lack of knowledge about feed utilization capacity, adaptability and disease resistance capacity of buffalo
- Lack of public awareness about buffalo husbandry
- Lack of high yielding buffalo breed. The indigenous buffaloes are low producers
- Scarcity of quality feeds, fodder and pasture land
- Lack of technical skills about buffalo production of farm holders
- Lack of long-term breed development policy and research programme
- No or limited facilities to breed improvement technologies
- Lack of breeding infrastructure
- Non-availability of records
- Non-availability of proven bulls
- Lack of coordination within research and government organizations, universities, NGOs and beneficiaries

Recommendations of buffalo development in Bangladesh

- Developing/strengthening the breeding infrastructure in the SAARC countries
- In intensive production system, continuous up gradation of native buffaloes in the plain land with imported semen of Murrah, Nili-Ravi or Mediterranean breed having milk yield production potentiality of 3,000 kg $lactation^{-1}$
- In semi-intensive production system, crossbreeding of native buffaloes with Murrah or Nili Ravi and fixed 50% exotic bloods followed by inter se mating
- In low input production system, crossbreeding of native buffaloes with Murrah or Nili Ravi and fixed 50% exotic bloods followed by inter se mating
- Conservation of the swamp buffaloes of greater Sylhet and Arnee of Chittagong districts through establishment of farms in respective regions
- Breeding, feeding and disease preventive measures should be adjusted accordingly. Reproductive biotechnology should not be ignored
- Public awareness for buffalo production by different media; radio, TV, newspaper etc. should be created
- Quality fodder seed production farms should be established. Increase the land for fodder production should be ensured
- Development of manpower by technical training should be ascertained
- National research and international collaboration should be strengthened

- Buffalo milk and meat market and infrastructure should be developed
- Private investment is to be explored and encouraged to invest in buffalo development infrastructure including marketing of milk and meat products in the country

DISCUSSION

Dairy buffalo production has been a tradition in Asia, especially in south Asia like India, Pakistan; Iraq, Turkey, Afghanistan, Thailand, China, Egypt and some parts of Europe where fresh buffalo milk, cultured sour milk, ghee and yoghurt are popular products. Based on FAOSTAT[29] report, Asia is the continent possessing the largest buffalo population with 119 breeds. Whereas, Africa is the second continent with buffalo population possessing 6 breeds of buffaloes[30]. Majority of the buffalo milk in south Asia is produced by smallholder producers[31]. The major share of buffalo milk in total milk production of India and Pakistan is actually much higher. This is because the best milch breeds of the world namely Murrah, Nili, Ravi, Nili-Ravi are originated in India and Pakistan. They have high potential for milk and fat production besides being used for work and surplus stock used for meat production. Moreover, the society prefers buffalo milk than milk from other livestock species. The production performance of Murrah[12] buffalo above 18 L milk day^{-1}. India is the world's top most milk producing country. The per capita availability of milk in India is 268 g day^{-1} and increasing rate at 1.15-5.5% annum^{-1} (2012-13). In India, buffalo contributes 48% of total milk production whereas cow and goat contributes 48.7 and 3.3%, respectively[21]. India is the world's 4th meat producing country and largest buffalo meat exporting country globally. Growth rate of buffalo meat production is 4%, where cattle meat is 3.5%. In Pakistan, there are approximately 32.70 million buffaloes which constitute about 15% of the world buffalo population and 2nd largest buffalo holding country in the world[9] with highest growth rate of 4.8% annum^{-1}. Buffalo contributes around 67% of annual milk production and share 29.78% in world's buffalo milk production. So, it is called the Black Gold of Pakistan.

The total buffalo population of Bangladesh is 1.457 million[16] of which coastal regions[16] posses about 40%. They are managed in household subsistance farming in the villages. In Bangladesh, buffalo used primarily for draught purpose or dairy and meat production is a secondary option. The average milk yield of water buffalo in Bangladesh is approximately 620-1161 kg in 270-330 days[16]. There is no recognized breed of water buffaloes in Bangladesh and are mainly indigenous non descriptive types. Though total milk production of Bangladesh is about 6.09 Mt in 2014 out of which about 3-4% is produced by the buffalo inspite of the number buffalo growth rate are increasing during last 10 years[15]. The consumption of milk and meat was increased by at 4.0 and 12.7% during 2005-2010.

The productivity and performances of buffalo in India and Pakistan is much more than Bangladesh. The productivity of Bangladeshi buffaloes is much lower with less milk yield, due to the fact that India and Pakistan has established a great deal of effort in recording, selection, breeding and improving feeding strategies. This indicates that Bangladesh did not apply appropriate production strategies to fully utilized and benefited from the available buffalo resources. Huque and Borghese[17] emphasis that lack of effective sustainable breeding programs for local buffalo breeds is the major reason that such breeds are not efficiently utilized. Moreover, nutritional deficiency, infrastructure, diseases and lack of skilled manpower cause inefficient utilization of buffaloes in Bangladesh.

CONCLUSION

Buffaloes are economically and culturally important livestock species especially in developing countries. They possess the highest potential for production with a promising gene pool, which is still not fully used. In SAARC countries, water buffaloes are the most important and popular livestock for milk production. The discussion shows that there is a vast demand for milk and meat and a great employment opportunity in Bangladesh as well as in SAARC countries. Buffalo could be a major source of milk and meat to reduce the milk and meat demand gap in this region. Although the productivity of buffaloes in India and Pakistan is higher than Bangladesh, the country is not obtaining maximum benefit from the sector. Therefore, there is a need to improve the current buffalo production potential through scientific crossbreeding with quality breed, improved management system, providing training, credit and finance, consultancy service, adequate veterinary service, feed conservation, adoption of improved forage and use of agro-industrial by products such as oilseed cakes and infrastructure to increase the production of buffalo in Bangladesh and in SAARC countries. Beside to this, use of milk storage and processing facilities and creating strong market linkage with dairy companies. This study aims to discuss the present situation and future prospects of buffalo production, find out the scopes and opportunities of buffalo production in Bangladesh as well as in SAARC countries.

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