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PRESENT SITUATION AND FUTURE PERSPECTIVE OF BUFFALO PRODUCTION IN ASIA

T. N. Pasha and Z. Hayat*

University of Veterinary and Animal Sciences, Lahore, Pakistan
*University College of Agriculture, University of Sargodha, Sargodha, Pakistan
Corresponding Author e-mail: tnpasha@uvas.edu.pk

ABSTRACT

Buffalo, a triple purpose animal, provides milk, meat and mechanical power to mankind. Due to its highly nutritious milk, leaner meat and best draught power for wet environments buffalo offers immense potential for the improvement of livelihood. It is a versatile animal found across the world from tropical to temperate regions and even at the altitudes of more than 7000 feet. Buffalo can efficiently convert low quality feed stuffs like straws and agro-industrial waste into human food, improve soil structure through bio fertilizer and a financial asset which can be sold when needs arise. Although, buffalo is the flagship of all agricultural revolutions; green, white and red but unfortunately has been neglected in the past. Therefore, aim of this paper is to evaluate present situation and future perspectives of buffalo production in Asia.

Key words: Buffalo, Asia, present situation, future prospective.

HISTORY AND DOMESTICATION OF BUFFALO IN ASIA

The domestic or water buffalo belongs to kingdom Animalia, phylum Chordata, class mammalian, order Artiodactyla and family Bovidae (Wikipedia, 2009). Buffalo was originated from Asian wild buffalo which has been domesticated since pre-historic times in Asia particularly in indo-Pak subcontinent. Riverine buffalo, bubalus bubalus, was domesticated nearly 5000 years ago in Iran, Iraq and indo-Pak subcontinent, whereas domestication of swamp buffalo, bubalus carabensis, took place in China and other part of Southeast Asia after 1000 years (Bruford *et al.* 2003). In this way buffalo is the specie which has been domesticated more recent as compared to *Bos taurus* and *Bos indicus* domesticated 10 000 years ago.

Different Breeds of Buffalo in Asia: According to phenotypes, karyotypes and recent mitochondrial DNA work two subspecies known as the riverine and swamp types has been recognized (Tanaka et al., 1996). These two groups differ in genetic make up as River buffalo has 50 chromosomes of which five pairs are submetacentric, while 20 are acrocentric: the Swamp buffalo has 48 chromosomes, of which 19 pairs are metacentric (Di Berardino and Iannuzzi, 1981).

The riverine buffalo, generally large in size, with curled horns found in the Indian subcontinent, near and middle East, and Eastern Europe. They prefer to enter clear water, and are primarily used for milk production, but are also used for meat production and for draught purposes. The swamp buffalo, found in China and other Southeast Asian countries, are stocky animals with marshy land habitats primarily used for draught power in paddy fields and haulage but are also used for meat and milk production.

The two subspecies are inter-fertile and produce progeny with 49 chromosomes. Male crossbred progeny have sometimes displayed fertility problems while female progeny have manifested longer calving intervals only in the case of further backcross. Each subspecies includes many breeds, most important revierine type are summarized in table 1.

Buffalo Wealth and Growth Rates in the World: According to Food and Agriculture Organization (FAO) statistics global buffalo population in 2007 was 177.25 as compared to 88.32 million heads in 1961 (Table 2). Cattle dominate livestock population of the world consistently since 1971 replacing sheep. Buffalo ranked on 4th position with regard to other livestock species. It contributes almost 5 % in the livestock population excluding poultry (FAO, 2009).

Distribution of world buffalo population 1961-2007 across different continents is presented in table 3. Buffalo population of Oceania (Australia and New Zealand) has been deliberately omitted from the table as it was less than 0.01 million which may be read as zero and confused the reader. It is evident from the data that although buffalo population is concentrated in Asia but it is present in every continent and region of the World varying in ecology, climate, topography as well as socio-economic conditions. This also showed the versatility of buffalo to be raised in all countries of the World irrespective of geography.

Buffalo population of the World increased from 88.32 millions in 1961 to 177.25 in 2007 with an increase

of over 100%. Maximum growth per annum in buffalo production occurred from 1961 to 1971 (2.31 %) which was decreased to 1.43 % during 1971-1981 and eventually registered 1.09 % growth rate in the recent years (2001-2007). Identical trend can be seen in Asia and Africa (Table 4). However, same tendency was not observed in the buffalo production in Americas and Europe. Although, buffalo population of both continents is less than 1% of the world population but dramatic changes in the growth rates of buffalo was observed. Americas after posting positive growth from 1961 till 1991 showed a negative trend during 1991-2001. Opposite is the case with Europe which demonstrated decreasing trend till 2001 but displayed positive growth rate in recent years.

Buffalo Population and Production in Asia: Asian buffalo population in 1961 was 86.02 millions which was raised to 171.86 millions in 2007 (FAO, 2009). Ranking of different species with respect to their population in Asia is somewhat different from the position shown for total livestock population in the World. Goat, sheep and cattle occupied first three ranks (excluding poultry from the list) by interchanging their positions among them during different decades (Table 5). Buffalo remains the 4th major livestock specie from 1961-2007 as the case in the global livestock population. But its contribution to Asian livestock production is more than double (11 %) as compared to 5 % input in the World.

Table 1. Important Riverine Buffalo Breeds in Asia

Name	Distri-bution	Lactation Duration (days)	Milk Production Kg	Milk Fat %
Azeri	Iran, Azerbaijan	200-220	1200-1300	6.6
Azi-Khel	Pakistan	NA	NA	NA
Bangladeshi	Bangladesh	NA	NA	NA
Bhadawari	India	274	780	7.2
Jafarabadi	India	350	1800-2700	8.5
Jerangi	India	NA	NA	NA
Kundi	Pakistan	320	2000	7.0
Lime	Nepal	351	875	7.0
Manda	India	NA	NA	NA
Meshana	India	305	1800-2700	6.6-8.1
Murrah	India	305	1800	7.2
Nagpuri	India	243	825	7.0
Nili Ravi	Pakistan, India	305	2000	6.5
Parkote	Nepal	351	875	7.0
Sambalpuri	India	350	2400	NA
Surti	India	350	2090	6.6-8.1
Tarai	India	250	450	6.6-8.1
Toda	India	200	500	NA

NA = data not available
Compiled from Sethi, (2003); Moioli and Borghese (2005).

Table 2. World Livestock Population 1961-2007 (million heads)

Specie	1961	1971	1981	1991	2001	2007
Cattle	942.18	1096.65	1228.59	1298.86	1317.25	1357.18
Sheep	994.27	1066.50	1112.75	1185.34	1037.97	1086.88
Goats	348.73	381.61	474.20	595.49	754.66	830.39
Buffaloes	88.32	108.71	124.21	150.21	166.36	177.25
Horses	62.16	61.46	59.55	60.66	57.04	58.64
Camels	12.93	16.82	18.41	19.32	22.02	24.25
Mules	10.48	12.46	13.19	14.95	12.95	11.84

Table 3. World Buffalo Distribution 1961-2007 (million heads)

Region	1961	1971	1981	1991	2001	2007
World Total	88.32	108.71	124.21	150.21	166.36	177.25
Asia	86.02	105.86	120.74	145.21	161.47	171.86
Africa	1.50	2.06	2.37	2.99	3.53	3.98
America	0.07	0.14	0.55	1.44	1.12	1.14
Europe	0.73	0.66	0.55	0.57	0.23	0.27

Data on buffalo population (million heads) in different Asian regions, their growth rate (average per annum), regional Asian buffalo contribution to World buffalo population and total Asian population are presented in table 6, 7, 8 and 9 respectively. Southern Asia has maximum (133.38 million) buffalo population among all Asian regions as major countries having buffalo wealth of the World like India and Pakistan are in this region. Eastern Asia is second most populated (22.72 million heads) region of the Asia having China as the main player followed by Eastern Asia which has 15.19 millions buffalos (FAO, 2009).

Table 4. Buffalo Growth Rate in Different Regions of the World (Average per annum)

Region	1961-1971	1971-1981	1981-1991	1991-2001	2001-2007
World Total	2.31	1.43	2.09	1.08	1.09
Asia	2.31	1.41	2.03	1.12	1.07
Africa	3.73	1.50	2.62	1.81	2.12
America	10.00	29.29	16.18	-2.22	0.30
Europe	-0.96	-1.67	0.36	-5.96	2.90

Table 5. Asian Livestock Population 1961-2007 (million heads)

Specie	1961	1971	1981	1991	2001	2007
Goats	198.41	216.15	280.46	354.90	456.48	489.72
Sheep	232.29	268.31	329.37	348.37	408.00	455.74
Cattle	319.01	341.55	352.40	403.67	437.15	428.17
Buffaloes	86.02	105.86	120.74	145.21	161.47	171.86
Horses	15.02	16.86	17.29	16.21	15.99	13.94
Mules	2.14	2.98	4.92	6.19	5.26	4.03
Camels	4.02	4.17	4.17	4.33	3.64	3.75

Table 6. Buffalo Population in Different Asian Regions (million heads)

Region	1961	1971	1981	1991	2001	2007
World Total	88.32	108.71	124.21	150.21	166.36	177.25
Asia Total	86.02	105.86	120.74	145.21	161.47	171.86
Southern Asia	60.22	69.21	83.56	105.10	123.93	133.38
South-Eastern Asia	16.03	18.98	17.39	17.92	14.16	15.19
Eastern Asia	8.37	16.27	18.57	21.71	22.76	22.72
Western Asia	1.39	1.39	1.21	0.48	0.59	0.54

Table 7. Buffalo Growth Rate in Different Asian Regions (Average per annum)

Region	1961-1971	1971-1981	1981-1991	1991-2001	2001-2007
Asia Total	2.31	1.41	2.03	1.12	1.07
Southern Asia	1.49	2.07	2.58	1.79	1.27
South-Eastern Asia	1.84	-0.84	0.30	-2.10	1.21
Eastern Asia	9.44	1.41	1.69	0.48	-0.03
Western Asia	0.00	-1.29	-6.03	2.29	-1.41

Average annual growth rate during 2001-2007 in all Asian counties is 1.07 %. Southern Asia showed consistently positive growth rates throughout the history. Recent growth rate of buffalo production in Southern Asian countries is 1.27 % (2001-2007). South-Eastern Asia recorded positive growth rate of 1.21 % during 2001-2007 after registering a strong declining trend during the preceding decade. This positive growth rate is interesting considering that this region experienced dramatic decline in inventory in the 1990,s due to massive introduction of farm mechanization and intensive irrigation in rice producing areas where the swamp buffalo are utilized primarily as source of draft power as described by Cruz, (2007). Eastern Asian countries showed a negative growth rate in the buffalo production during 2001 to 2007. Slaughtering of buffaloes following feed lot fattening in the Eastern Asian countries like Taiwan may be the reason for this declining trend in buffalo population in the region (Wei and Jea, 2006). Western Asian countries also witnessed of the decreasing tendency in the buffalo wealth due to the phenomenon described above or any other reason.

When we examined contribution of different Asian regions as percentage of the World or percentage of Asia it is clear that Southern Asian region is top of the line (Table 8 and 9). Southern Asian countries contribute 75.25 % and 77.61 % of the total buffalo population of the World and Asia, respectively (FAO, 2009). Role of Eastern Asia is also very important as this region provide home to 12.82 % and 13.22 % buffaloes of World and Asia, respectively. Around 9 % shares goes to South East Asia, whereas the contribution of the Western Asian countries is limited to less than a percent.

Table 8. Buffalo Population in Different Asian Regions (% of World)

Region	1961	1971	1981	1991	2001	2007
World Total	100	100	100	100	100	100
Asia Total	97.39	97.38	97.20	96.67	97.06	96.96
Southern Asia	68.19	63.67	67.27	69.96	74.50	75.25
South-Eastern Asia	18.15	17.46	14.00	11.93	8.51	8.57
Eastern Asia	9.48	14.97	14.95	14.45	13.68	12.82
Western Asia	1.58	1.28	0.97	0.32	0.35	0.31

Table 9. Buffalo Population in Different Asian Regions (% of Asia)

Region	1961	1971	1981	1991	2001	2007
Asia Total	100	100	100	100	100	100
Southern Asia	70.01	65.38	69.21	72.38	76.75	77.61
South-Eastern Asia	18.64	17.93	14.41	12.34	8.77	8.84
Eastern Asia	9.73	15.37	15.38	14.95	14.10	13.22
Western Asia	1.62	1.31	1.00	0.33	0.37	0.32

Table 10 demonstrates buffalo population in different Asian countries from 1961 to 2007. India remained top of the list where buffalo is mainstay of dairy industry. China was ranked 2nd to India from 1961 to 1991. Between 1991 and 2001 Pakistan surpassed China to become the second thickly populated country of the World with respect to buffalo. Nili Ravi and Kundi are finest buffalo breeds of the World present in Pakistan and contribute more than 70 % of total milk production of Pakistan (Khan, 2009).

Thailand had excellent buffalo population and was enjoying number 4th position in Asia before 1991. But during 1991 onward buffalo population decreased with a greater extent. Reasons of this disaster have already been described in the previous paragraphs. However, some increasing trend of buffalo production is seen in Thailand during the recent years.

Nepal, Philippines, Viet Nam, Myanmar and Indonesia are the countries having more than 2 million buffaloes followed by Thailand and Bangladesh completing the list of ten major buffalo producing countries of Asia. Iran, Sri Lanka and Malaysia are the other Asian countries having considerable buffalo population.

Buffalo Products and their Contribution: Buffalo, a triple purpose animal, provides milk, meat and mechanical power to mankind. Among different products obtained from buffalo milk, meat and hides are more important.

Buffalo Milk: Buffalo plays an important role in milk production system in most of Asian countries. Sixty five to seventy percent of total milk is derived from buffaloes in India and Pakistan, top buffalo producing countries of the world. Total buffalo milk production of the World was 86574.5 thousands tons during 2007 of which 97.10 % was from Asian countries (FAO, 2009). In the Asian buffalo milk production more than 96 % contribution is from Southern Asian countries including India, Pakistan and Nepal. Role of buffalo milk in total milk derived from farm animals (all milk) is also of importance which was 34.79 % and 12.75 % of the total World and Asian milk production, respectively during the year 2007.

Buffalo Meat: The 2007 buffalo meat production in Asia represents 91.74 % of the total world buffalo meat (Table 13). Major contribution in the Asian buffalo meat production is from Southern Asian countries accounting for 2357.4 thousand tons. This is because of buffalo population which is mainly concentrated in these countries. Buffalo meat comprise of 2.79 % and 1.23 % of the total meat production of the Asia and world, respectively during the 2007.

Buffalo Hide: Hide is another economic contribution of buffalo to the mankind. Total World buffalo hide production was estimated 850.16 thousands tons and 818.37 of this quantity came from Asian countries. In this way 96.26 % of total buffalo hides were from Asia during 2007.

Constraints to Buffalo Production and Future Outlook: Unfortunately, the production potential of buffalo has not been exploited in the past. Buffalo has some claim to be regarded as the World's most neglected animal but having promising potential and thus may be called as the animal of future (Khan, 2009). Although, Asia has large buffalo population well adapted to the local environment condition and production systems, but productivity per unit of this versatile animals is very low.

Lack of genetic selection programs for the propagation of superior germplasm is the primary factor affecting productivity. Although, progeny testing program of buffalo indeginous buffalo breeds are implemented in many Asian countries. However, consistent and systematic long term programs aimed at improving genetic potential of local buffalo breeds is required.

Feed resources consist of green fodder, crop residues and concentrates. These resources are not enough to meet the requirement of existing livestock in general. Buffalo, being larger in size than cattle, have more nutrient requirements and suffered greatly with the shortage of feed resources. Thus the full genetic potential has not been achieved. Use of improved fodder varieties, utilization of non-conventional feed resources, scientific feeding methods and preservation of fodders may be some of useful strategies to overcome nutrient deficiencies.

Delayed puberty, seasonal breeding, long calving interval, and poor estrus detection hampered the reproductive efficiency in the female buffalo. Artificial insemination (AI) is also limited in buffaloes due to the weakness of oestrus symptoms and variability of oestrus length. Improvement in veterinary services, especially in breed improvement, would defiantly enhance buffalo production considerably.

Table 10. Buffalo Population in Different Asian Countries 1961-2007 (million heads)

Rank	Country	1961	1971	1981	1991	2001	2007
1	India	51.21	56.88	67.50	82.16	95.25	98.70
2	Pakistan	6.70	9.55	11.92	17.82	23.34	28.17
3	China	8.37	16.27	18.57	21.71	22.76	22.72
4	Nepal	0.80	1.13	2.50	3.04	3.62	4.37
5	Philippines	3.45	4.56	2.85	2.65	3.07	3.38
6	Viet Nam	2.25	2.29	2.38	2.86	2.81	3.00
7	Myanmar	1.05	1.60	1.97	2.07	2.50	2.84
8	Indonesia	2.89	2.92	2.49	3.31	2.33	2.09
9	Thailand	4.96	5.57	6.12	4.92	1.52	1.74
10	Bangladesh	0.50	0.70	0.48	0.81	0.92	1.21
11	Iran	0.25	0.23	0.27	0.44	0.51	0.62
12	Sri Lanka	0.77	0.73	0.90	0.83	0.29	0.32
13	Malaysia	0.35	0.30	0.26	0.20	0.14	0.13

Table 11. Buffalo Population and Growth Rate in Different Asian Countries 2001-2007

Country	2001			2007			2001-2007
	Population (millions)	% of World	% of Asia	Population (millions)	% of World	% of Asia	Av. annual growth rate
India	95.25	57.26	58.99	98.70	55.68	57.43	0.60
Pakistan	23.34	14.03	14.45	28.17	15.89	16.39	3.45
China	22.76	13.68	14.10	22.72	12.82	13.22	-0.03
Nepal	3.62	2.18	2.24	4.37	2.47	2.54	3.45
Philippines	3.07	1.85	1.90	3.38	1.91	1.97	1.68
Viet Nam	2.81	1.69	1.74	3.00	1.69	1.75	1.13
Myanmar	2.50	1.50	1.55	2.84	1.60	1.65	2.27
Indonesia	2.33	1.40	1.44	2.09	1.18	1.22	-1.72
Thailand	1.52	0.91	0.94	1.74	0.98	1.01	2.41
Bangladesh	0.92	0.55	0.57	1.21	0.68	0.70	5.25
Iran	0.51	0.31	0.32	0.62	0.35	0.36	3.59
Sri Lanka	0.29	0.17	0.18	0.32	0.18	0.19	1.72
Malaysia	0.14	0.08	0.09	0.13	0.07	0.08	-1.19
Total	159.06	95.61	98.51	169.29	95.51	98.50	1.07

Table 12. Buffalo Milk Production 1961-2007 (thousand tons)

Region	1961	1971	1981	1991	2001	2007
South-Eastern Asia	54.17	68.78	102.37	129.81	150.72	260.00
Western Asia	285.52	305.73	308.31	183.48	155.27	65.68
Eastern Asia	917.00	1035.00	1410.00	1950.00	2680.00	2900.00
Southern Asia	15746.34	18186.30	26046.83	40747.05	63909.30	80841.68
Total Asia Buff Milk	17003.03	19595.81	27867.50	43010.34	66895.28	84067.36
Asia All Milk Prod	42761.45	51685.01	73818.11	111129.9	176415.3	241673.1
Buff Milk/All Milk (Asia, %)	***39.76***	***37.91***	***37.75***	***38.70***	***37.92***	***34.79***
Total World Buff Milk	17858.06	20713.52	29231.75	44400.29	69267.27	86574.53
Buff Milk (Asia/World, %)	***95.21***	***94.60***	***95.33***	***96.87***	***96.58***	***97.10***
World All Milk Prod	344186.9	394868.9	469655.3	533166.3	589762.7	679206.9
Buff Milk/All Milk (World, %)	***5.19***	***5.25***	***6.22***	***8.33***	***11.74***	***12.75***

Table 13. Buffalo Meat Production 1961-2007 (thousand tons)

Region	1961	1971	1981	1991	2001	2007
South-Eastern Asia	248.43	302.68	338.71	355.67	321.19	377.01
Western Asia	18.83	22.98	13.40	12.48	6.35	5.99
Eastern Asia	20.05	47.70	79.25	181.90	378.65	307.56
Southern Asia	691.66	862.71	1121.74	1741.42	2057.35	2357.36
Total Asia Buff Meat	978.97	1236.07	1553.09	2291.47	2763.53	3047.92
Asia All Meat Prod	9050.1	18393.2	29944.2	55099.2	94018.6	109371.7
Buff Meat/All Meat (Asia, %)	***10.82***	***6.72***	***5.19***	***4.16***	***2.94***	***2.79***
Total World Buff Meat	1071.2	1341.0	1680.3	2460.8	2953.3	3322.2
Buff Meat (Asia/World, %)	***91.39***	***92.17***	***92.43***	***93.12***	***93.58***	***91.74***
World All Meat Prod	71361.31	104837.17	139374.7	185425.8	237725.2	269148.5
Buff Meat/All Meat (World, %)	***1.50***	***1.28***	***1.21***	***1.33***	***1.24***	***1.23***

Buffalo Hide Production 1961-2007 (thousand tons)

Region	1961	1971	1981	1991	2001	2007
South-Eastern Asia	37.79	44.81	49.11	53.08	50.38	57.12
Western Asia	3.10	3.66	2.31	1.62	0.72	0.66
Eastern Asia	6.99	16.15	23.67	54.37	113.54	92.19
Southern Asia	257.19	317.20	404.02	528.44	618.22	668.41
Total Asia Buff Hide	305.07	381.82	479.11	637.51	782.86	818.37
Total World Buff Hide	316.94	394.32	494.24	656.89	799.50	850.16
Buff Hide (Asia/World, %)	***96.25***	***96.83***	***96.94***	***97.05***	***97.92***	***96.26***

Lack of access to loans for expansion in the herd is a critical problem for small farmers. Unfortunately, there is little access to formal credit through the cooperatives. Informal credit is available from private traders and agents of private companies, but the interest rate is very high. Government intervention to extend loan facility to small and landless farmers on interest free basis may solve this issue.

Collaborative public-private partnership efforts to conduct applied research for improvement in different aspects of buffalo productivity, consistent Government policies and establishing a permanent vocational and outreach training program for capacity building are some of the key factors which will undoubtedly enhance buffalo production.

REFERENCES

Bruford, M. W., D. G. Bradley and G. Luikart (2003). DNA markers reveal the complexity of livestock domestication. Nature Reviews Genetics, 4(11): 900–909.

Cruz, L. C. (2007). Trends in buffalo production in Asia. Ital. J. Anim. Sci. 6(2): 9-24.

Di Berardino, D. and L. Iannuzzi, (1981). Chromosome banding homologies in Swamp and Murrah buffalo. J. Hered., 72: 183-188.

FAO, (2009). FAOstat (http:// faostat. fao. org/ default. aspx). Food and Agricultural Organization of United Nations.

Khan, M. A., (2009). *Buffalo the animal of future*. Idara Matbuaat-e-Sulemani, Lahore, Pkistan

Moioli, B. and A. Borghese (2008). Buffalo breeds and management systems. In: *Buffalo Production and Research*, FAO report, Antonio Borghese (ed). Food and Agriculture Organization of the United Nations, Rome.

Sethi, R. K. (2003). Buffalo Breeds of India. Proc. of Fourth Asian Buffalo Congress, New Delhi, India, 25 to 28 Feb.

Tanaka, K., C. D. Solis, J. S. Masangkay, K. Maeda, Y. Kawamoto and T. Namikawa (1996). Phylogenetic relation among all living species of the genus *Bubalus* based on DNA sequences of the cytochrome B gene. Biochemical Genetics, 34(11–12): 443–452.

Wei, L.Y. and Y. S. Lea (2006). Conservation of water buffaloes in Taiwan Cryopreservation of spermatozoa. Proc. International Seminar on Reproductive Biotecnologies for Buffaloes, Bogar, Indonesia, pp 108-113.

Wikipedia, (2009). Wikipedia: the free encyclopedia (http://en.wikipedia.org).