

Analysis on trends of geographic and demographic distribution of buffalo population and production in India

Rahul Behl*, R. K. Pundir and P. K. Singh

ICAR-National Bureau of animal Genetic Resources

P.O. Box 129, GT By-Pass Road, Karnal

ABSTRACT

India with 109.85 million buffaloes holds the largest population of buffaloes in the world. Besides, high quality milk with higher protein and fat, buffaloes provide meat, hide, manure and draught power. The present status of buffalo population and production in terms of their geographic and demographic distribution in India was evaluated. It is estimated that population of buffaloes will increase to 126.055 million by 2031. Only four states of India (Uttar Pradesh, Rajasthan, Gujarat and Madhya Pradesh) hold the 61.50 percent of the total buffalo population of the country. The districts of Agra, Bulandshahr, Aligarh, Firozabad, Mathura, Kasganj and Hathras in the *Braj* region of Uttar Pradesh has the highest density of 236.8 buffaloes per km². Banaskantha district in Gujarat has the highest population (1.502 million) of buffaloes followed by Jaipur (1.214 million) and Alwar (1.145 million) in Rajasthan and Budaun (1.107 million) in Uttar Pradesh. In terms population density per km², again Uttar Pradesh has highest density of buffaloes (137.0) followed by Delhi (109.3), Haryana (98.8) and Bihar (82.0). During 2018-19, buffaloes contributed 91.817 and 1.546 million tonnes of milk and meat, respectively. Among the breeds of Indian buffaloes, Murrah has the largest population. Murrah and its grades, in fact, now form 45.81 percent of the total buffalo population of India. Bhadawari and Nili-Ravi now have lesser population than Murrah in their respective native states of Uttar Pradesh and Punjab. In view of deteriorating population of majority of buffalo breeds, it is imperative to formulate suitable programmes of genetic improvement, development and conservation of precious buffalo genetic resources available in India. Genetically improved germplasm of these breeds may also be used in grading up of non-descript buffalo population in their respective breeding tracts.

*Corresponding author: behl1969@rediffmail.com

INTRODUCTION

India with 109.85 million buffaloes holds the largest population of buffaloes in the world (Livestock census 2019). The buffaloes provide high quality milk with higher fat, protein and ash content. They are also an important source of meat, hide, manure and draught power (Banerjee 1998). Although buffalo population in India is only 56.5 percent to that of cattle, they contributed 91.817 million tonnes of the milk compared to 89.833 million contributed by cattle during 2018-19 (BAHS 2019). This paper attempts to describe the present status of buffalo population and production in terms of their geographic and demographic distribution in India

MATERIALS AND METHODS

The data on buffalo population were obtained from Livestock census (Livestock census 1992, 2007, 2012, 2019) and the state and district wise population densities per km² were calculated. The state and district wise census data were grouped for population intervals to obtain the number of states or districts with specified

minimum population. The regression equation for the population trend was developed (Gupta 2011) using census data from 1992 onwards and the population for the years 2023, 2027 and 2031 were estimated by method modified from (Singh *et al.* 1991) as

$$Y' = a + bX'$$

Where, Y' = Estimated population in the year X'

b = Slope in the regression equation Y = a + bX

a = Y, when X = 0

Data for individual breeds was obtained from Breed survey (2013) estimate that is derived by disintegrating the figures of Livestock census (2012). The Andhra Pradesh refer to present day state excluding Telangana and Jammu & Kashmir refer to undivided state including Ladakh until unless specified.

The data on milk and meat production were obtained from BAHS (2019) and percent contribution of the states to the overall buffalo milk and meat production and proportion of the buffalo milk in the total milk of the state were calculated.

RESULTS AND DISCUSSION

Population dynamics of buffaloes in India

Buffalo are reared in almost all parts of our country from temperate to tropical ecology of India characterized by feed and fodder scarcity, marginal land resources and poor economic conditions of the farmers. The buffalo

population in the country has registered a consistent increase from 1992, since when the data was analysed, and shown an increase of 30.46 percent from 1992 (84.206 million) to 2019 (109.852 million). Considering this trend, the population of buffaloes is estimated to increase to 117.830, 121.942 and 126.055 million in the years 2023, 2027 and 2031, respectively (Table 1).

Table 1 Population trend of buffaloes in India

Census-year	Population (in million)	Percent change from previous census
1992	84.206	
1997	89.918	6.78
2003	97.922	8.90
2007	105.343	7.58
2012	108.702	3.19
2019	109.852	1.06
2023 (Estimated)	117.830	-
2027 (Estimated)	121.942	-
2031 (Estimated)	126.055	-

The population of buffaloes is more than 10 million in four states (Uttar Pradesh, Rajasthan, Gujarat and Madhya Pradesh), between 1-10 million in nine states (Bihar, Andhra Pradesh, Maharashtra, Haryana, Telangana, Punjab, Karnataka, Jharkhand and Chhattisgarh) and between 0.1-1 million in nine states (Uttarakhand, Jammu and Kashmir, Himachal Pradesh, West Bengal, Tamil Nadu, Odisha, Assam, Delhi and Kerala). Uttar Pradesh has the largest population (33.017 million) of buffaloes, possessing about 30.06

percent of the total buffaloes of India followed by Rajasthan (13.693 million), Gujarat (10.543 million) and Madhya Pradesh (10.307 million) as per the Livestock census (2019). These four states of Uttar Pradesh, Rajasthan, Gujarat and Madhya Pradesh hold the 61.50 percent of the total buffalo population of the country. These states along with Bihar, Andhra Pradesh, Maharashtra, Haryana, Telangana and Punjab hold the 90.77 percent of the total buffalo population of India (Table 2 and 3).

Table 2: Total population, population density per km² and per 1000 households and percent change during 2007-2012 and 2012-2019 in buffalo population in states of India

State*	Population	Density		Herd size	Percent change	
		Per km ²	Per 1000 overall households		2007-2012	2012-2019
Uttar Pradesh	33016785 ^a	137.0 ^a	987.1b	2.8	28.61	7.81
Rajasthan	13693316 ^b	40.0	1077.3 ^a	2.8	16.99	5.53
Gujarat	10543250 ^c	53.7	860.8 ^d	3.1	18.37	1.52
Madhya Pradesh	10307131 ^d	33.4	682.9	3.9b	-10.31	25.88
Bihar	7719794 ^e	82.0 ^d	408.2	2.2	13.11	2.02
Andhra Pradesh	6219499	38.8	491.1	3.6# ^c	-19.96#	-3.33
Maharashtra	5603692	18.2	229.5	2.6	-7.88	0.17
Haryana	4368023	98.8 ^c	899.2 ^c	2.1	2.22	-28.22
Telangana	4226306	37.7	505.7	\$	\$	0.89
Punjab	4015947	79.7 ^c	728.4 ^c	2.7	1.94	-22.17
Karnataka	2984560	15.6	223.4	2.3	-19.79	-14.00
Jharkhand	1350313	16.9	215.9	3.4 ^c	-21.23	13.86
Chhattisgarh	1174722	8.7	207.9	2.6	-13.33	-15.52
Uttarakhand	866318	16.2	421.2	1.8	-19.00	-12.30
Jammu and Kashmir	690829	3.1	325.9	2.6	-29.64	-6.52

State*	Population	Density		Herd size	Percent change	
		Per km2	Per 1000 overall households		2007-2012	2012-2019
Himachal Pradesh	646565	11.6	435.9	1.9	-5.98	-9.70
West Bengal	630921	7.1	31.0	2.7	-21.79	5.61
Tamil Nadu	518795	4.0	28.0	1.7	-61.15	-33.52
Odisha	458324	2.9	47.6	2.6	-38.95	-36.90
Assam	421715	5.4	65.8	3.5d	-12.93	-3.11
Delhi	162142	109.3b	47.2	4.0a	-41.74	0.00
Kerala	101504	2.6	12.9	1.8	75.89	-0.75
Others*	131227	0.67	32.01	2.4	-6.78	-35.70
India	109851678	33.4	440.4	2.8	3.19	1.06

*States/UTs with total buffalo population of <1 million (see text)

Superscripts ^{a, b, c, d} and ^e indicate rank of the state as first, second, third, fourth and fifth in India in population of buffaloes.

#Undivided Andhra Pradesh, \$ population data not available for Telangana

Table 3 Percent share of the state in total buffalo population of the country and percent share of pure-breds in total buffaloes of the state in states with more than 0.1 million buffaloes

State	Percent share in total buffaloes of India	Percent share of purebreds in total buffaloes of the state*
Uttar Pradesh	30.06	15.77
Rajasthan	12.47	17.70
Gujarat	9.60	40.74b
Madhya Pradesh	9.38	3.44
Bihar	7.03	6.97
Andhra Pradesh	5.66	4.36#
Maharashtra	5.10	20.10
Haryana	3.98	55.97a
Telangana	3.85	-
Punjab	3.66	21.72
Karnataka	2.72	10.87
Jharkhand	1.23	14.95
Chhattisgarh	1.07	3.15
Uttarakhand	0.79	5.37
Jammu and Kashmir	0.63	0.89
Himachal Pradesh	0.59	2.35
West Bengal	0.57	23.18e
Tamil Nadu	0.47	6.89
Odisha	0.42	26.44d
Assam	0.38	0.21
Delhi	0.15	15.81
Kerala	0.09	32.42c
others	0.12	5.58
India	100.0	16.98

Undivided Andhra Pradesh, *Breed survey, 2013, ^aFirst, ^bsecond, ^cthird, ^dfourth and ^efifth highest percent of descript in total buffaloes of the state.

Among the states that has buffalo population of more than 0.1 million, nine states (Uttar Pradesh, Rajasthan, Gujarat, Madhya Pradesh, Bihar, Maharashtra, Telangana, Jharkhand and West Bengal) have shown an

increase in the population of buffaloes during 2012-2019 varying between 0.17 (Maharashtra) and 25.88 (Madhya Pradesh) percent. Buffalo population of Delhi has remained static during the same period. The

maximum decline in buffalo population was observed in the state of Odisha (36.90 %) followed by Tamil Nadu (33.52), Haryana (28.22) and Punjab (22.17) during this period (Table 1). Overall, India has registered only a marginal increase of 1.06 percent in the population of buffaloes during 2012-2019 (Table 2).

In terms of population density per km², again Uttar Pradesh has highest density of buffaloes (137.0) followed by Delhi (109.3), Haryana (98.8) and Bihar (82.0). Among the states that has buffalo population of more than 0.1 million, the density (buffaloes per km²) of buffaloes is more than 100 only in these two states (Uttar Pradesh and Delhi), between 50-100 in four states (Haryana, Bihar, Punjab and Gujarat) and between 10-50 in nine states (Rajasthan, Andhra Pradesh, Telangana, Madhya Pradesh, Maharashtra, Jharkhand, Uttarakhand, Karnataka and Himachal Pradesh). At the national level, India has 33.4 buffaloes per km² (Table 2).

In the states and union territories (UT) that have buffalo population of less than 0.1 million (Manipur, Goa, Meghalaya, Nagaland, Tripura, Arunachal Pradesh, Mizoram, Sikkim and all UTs), Manipur has the largest population (36.2 thousand) of buffaloes, followed by Goa (27.2 thousand), Meghalaya (15.7 thousand) and Nagaland (15.7 thousand). Chandigarh has maximum density of buffaloes per km² of 106.8. Rest of these states and UTs have the buffalo density of less than 10 buffaloes per km².

In terms of density per 1000 overall households, that gives an idea about the density of buffalo population *vis-à-vis* the density of human population, our country has 440.4 buffaloes per 1000 total households. Among the states with buffalo population of more than 0.1 million, Rajasthan (1077.3) has the highest density of buffaloes followed by Uttar Pradesh (987.1), Haryana (899.2) and Gujarat (860.8). The states of Punjab (728.4), Madhya Pradesh (682.9) and Telangana (505.7) also has more than 500 buffaloes per 1000 households. The four states

of Andhra Pradesh, Himachal Pradesh, Uttarakhand and Bihar has the overall buffalo density between 400-500 per 1000 households. To know the average herd size, density of buffaloes per buffalo-rearing household, was also calculated at the state and national level. Overall India has 2.8 buffaloes per buffalo-rearing household. Delhi has the largest overall herd size of 4.0 buffaloes per household followed by Madhya Pradesh (3.9), Andhra Pradesh (3.6) and Assam (3.5) (Table 2).

Some clusters of districts hold large proportion of buffaloes of the respective state or the country with high density. For example, cluster-I in Uttar Pradesh comprising eight districts of Agra, Bulandshahr, Aligarh, Firozabad, Mathura, Kasganj and Hathras in the *Braj* region in the Mid-Western part of the state has 15.6 and 4.7 percent of buffalo population of the state and the country, respectively, with a very high density per km² of 236.8 (Table 4). Similarly, cluster-III, also in Uttar Pradesh, comprising seven districts (Budaun, Sambhal, Bareilly, Shahjahanpur, Amroha, Moradabad and Rampur) in *Rohilkhand* region of the state hold 13.4 and 4.0 percent population of buffaloes of the state and the country, respectively with a density per km² of 200.3. Cluster-I in Gujarat comprising thirteen districts of Banaskantha, Kheda, Katchh, Dohad, Mahesana, Gandhinagar, Anand, Panch-Mahals, Patan, Sabarkantha, Mahisagar, Arvali, Ahmadabad and Vadodara has 68.1 and 6.5 percent buffalo population of the state and the country with a density of 69.4 per km². Likewise, seven North-Western districts (Bijnor, Meerut, Saharanpur, Muzzafarnagar, Bhagpat, Ghaziabad and Hapur) of cluster-VII, again in Uttar Pradesh, hold 8.6 and 2.6 percent population of buffaloes of the state and the country, respectively with a density of 176.3 per km². All the listed clusters of Uttar Pradesh and Cluster-II in Haryana comprising three Southern districts of Faridabad, Palwal and Mewat, has buffalo density of more than 100 buffaloes per km² (Table 4).

Table 4 Clusters of districts holding major proportion of population of buffaloes in the states of India with about 2 million buffaloes

State	Clusters of districts with sizable population of buffaloes
Uttar Pradesh	Cluster I: Agra, Bulandshahr, Aligarh, Firozabad, Mathura, Kasganj, Hathras (5148924a, 236.8b, 15.6c, 4.7d) Cluster II: Kanpur Dehat, Kanpur Nagar, Etah, Mainpuri, Farrukhabad, Kannauj, Bahraich, Etawah, Auraiya, Jalaun (4932781, 169.6, 14.9, 4.5) Cluster III: Budaun, Sambhal, Bareilly, Shahjahanpur, Amroha, Moradabad, Rampur (4408006, 200.3, 13.4, 4.0)

State	Clusters of districts with sizable population of buffaloes
	Cluster IV: Kheri, Hardoi, Sitapur, Barabanki, Bahraich, Gonda (3725747, 112.7, 11.3, 3.4) Cluster V: Allahabad, Pratapgarh, Kaushambhi, Rae-Bareli, Fatehpur, Banda (3312499, 137.2, 10.0, 3.0) Cluster VI: Jaunpur, Ghazipur, Azamgarh, Faizabad, Sultanpur, Basti, Ambedkar-Nagar, Amethi (3264674, 140.2, 9.9, 3.0) Cluster VII: Bijnor, Meerut, Saharanpur, Muzzafarnagar, Bhagpat, Ghaziabad, Hapur (2847150, 176.3, 8.6, 2.6)
Rajasthan	Cluster I: Jaipur, Ajmer, Bharatpur, Dausa, Alwar, Jhunjhunu, Nagaur, Sikar, Karauli, Tonk, Dholpur (6875262, 82.2, 50.2, 6.3) Cluster II: Udaipur, Banswara, Dungarpur, Pratapgarh, Chittourgarh, Rajsamand, Sirohi, Jalore (3000150, 56.9, 21.9, 2.7) Cluster III: Bhilwara, Bundi, Kota, Baran, Jhalawar (1653166, 47.7, 12.1, 1.5)
Gujarat	Cluster I: Banaskantha, Kheda, Katchh, Dohad, Mahesana, Gandhinagar, Anand, Panch-Mahals, Patan, Sabarkantha, Mahisagar, Arvali, Ahmadabad, Vadodara (7177404, 69.4, 68.1, 6.5)
Madhya Pradesh	Cluster I: Morena, Bhind, Shivpuri, Sheopur, Datia, Gwalior, Guna, Rajgarh (3062923, 66.4, 29.7, 2.8) Cluster II: Dhar, Sehore, Khargone, Ujjain, Mandsaur, Dewas, Shajapur, Agar-Malwa, Ratlam, Indore (2427536, 43.1, 23.6, 2.2) Cluster III: Chhatarpur, Tikamgarh, Rewa, Satna, Sagar, Panna (1653298, 36.8, 16.0, 1.5)
Bihar	Cluster I: Madhubani, Sitamarhi, Purbi-Champaran, Darbhanga, Sheohar, Muzaffarpur, Pashchim Champaran (2203287, 106.0, 28.5, 2.0) Cluster II: Rohtas, Bhojpur, Patna, Gaya, Nalanda, Kaimur, Aurangabad, Arval, Jehanabad (2175202, 87.0, 28.2, 2.0) Cluster III: Supaul, Arariya, Saharsa, Bhagalpur, Purnia, Madhepura (1479804, 101.9, 19.2, 1.3)
Andhra Pradesh	Cluster I: Prakasam, Guntur, SPSR-Nellore, Krishna, West-Godavari, East-Godavari, YSR, Kurnool (5344191, 52.2, 85.9, 4.9)
Maharashtra	Cluster I: Kolhapur, Solapur, Sangli, Satara, Pune (2184380, 38.1, 39.0, 2.0) Cluster II: Beed, Latur, Nanded, Osmanabad (940459, 26.2, 16.8, 0.9) Cluster III: Jalgaon, Ahmednagar, Nashik (711694, 16.0, 12.7, 0.6)
Haryana	Cluster I: Hisar, Jind, Kaithal, Bhiwani, Sirsa, Fatehabad, Sonipat, Karnal, Panipat (2454271, 97.9, 56.2, 2.2) Cluster II: Faridabad, Palwal, Mewat (920656, 135.3, 11.2, 0.4)
Telangana	Cluster I: Khammam, Nalgonda, Suryapet, Bhadradi-Kothagudem, Rangareddi, Yadadri-Bhuvanagiri (1471341, 47.4, 34.8, 1.3) Cluster II: Nizamabad, Medak, Kamareddy, Siddipet, Sangareddy (920656, 49.0, 21.8, 0.8)
Punjab	Cluster I: Sangrur, Ludhiana, Patiala, Bathinda, Mansa, Moga, Barnala (1820277, 91.9, 45.3, 1.7) Cluster II: Amritsar, Tarn-Taran, Ferozepur, Gurdaspur, Jalandhar, Hoshiarpur (1241841, 78.8, 30.9, 1.1)
Karnataka	Cluster I: Belagavi, Bagalkote, Vijayapura (1255590, 41.2, 42.1, 1.1)

^aTotal population in the cluster, ^bdensity per km², ^cproportion of state population and ^dproportion of national population of buffaloes

Likewise, some of the districts have appreciably high population of buffaloes. Banaskantha district in Gujarat has the highest population (1.501 million) of buffaloes followed by Jaipur (1.214 million) and Alwar (1.144 million) in Rajasthan and Budaun (1.107 million) in Uttar Pradesh. In terms of density per km² Ghaziabad (411.8) followed by Hapur (373.9), Moradabad (323.1)

and Sambhal (289.8), all in Uttar Pradesh, has the highest density of buffaloes. Top twenty-five districts of India with largest population and highest density of buffaloes are given in [table 5](#). For density per km², top twenty-three districts out of these twenty are in Uttar Pradesh.

Table 5 Top twenty-five districts of India having largest population and highest density per km² of buffaloes

Population	Density
Banaskantha (Gujarat*, 1501537#)	Ghaziabad (Uttar Pradesh, 411.8)
Jaipur (Rajasthan, 1214213)	Hapur (Uttar Pradesh, 373.9)
Alwar (Rajasthan, 1144753)	Moradabad (Uttar Pradesh, 323.1)
Budaun (Uttar Pradesh, 1107170)	Sambhal (Uttar Pradesh, 289.8)
Agra (Uttar Pradesh, 1066798)	Kasganj (Uttar Pradesh, 269.9)
Bulandshahr (Uttar Pradesh, 972027)	Firozabad (Uttar Pradesh, 268.2)
Aligarh (Uttar Pradesh, 942498)	Agra (Uttar Pradesh, 264.0)
Prakasam (Andhra Pradesh, 926651)	Aligarh (Uttar Pradesh, 258.2)
Guntur (Andhra Pradesh, 882347)	Etah (Uttar Pradesh, 244.2)
Belgaum (Karnataka, 844171)	Baghpat (Uttar Pradesh, 239.8)
Kheri (Uttar Pradesh, 836358)	Amroha (Uttar Pradesh, 228.8)
Hardoi (Uttar Pradesh, 834750)	Hathras (Uttar Pradesh, 227.1)
Allahabad (Uttar Pradesh, 817058)	Shamli (Uttar Pradesh, 216.9)
Bharatpur (Rajasthan, 760323)	Bulandshahr (Uttar Pradesh, 215.4)
SPSR-Nellore (Andhra Pradesh, 745829)	Mainpuri (Uttar Pradesh, 214.8)
Sambhal (Uttar Pradesh, 710993)	Budaun (Uttar Pradesh, 214.2)
Bareilly (Uttar Pradesh, 707609)	GB Nagar (Uttar Pradesh, 206.7)
Morena (Madhya Pradesh, 685578)	Kannauj (Uttar Pradesh, 205.9)
Sitapur (Uttar Pradesh, 683373)	Kaushambi (Uttar Pradesh, 204.8)
Krishna (Andhra Pradesh, 669773)	Farrukhabad (Uttar Pradesh, 203.4)
Unnao (Uttar Pradesh, 656492)	Meerut (Uttar Pradesh, 201.5)
Fatehpur (Uttar Pradesh, 647503)	Kanpur-Dehat (Uttar Pradesh, 199.5)
Firozabad (Uttar Pradesh, 645558)	Auraiya (Uttar Pradesh, 187.0)
West Godavari (Andhra Pradesh, 627909)	Kheda (Gujarat, 181.7)
Bijnor (Uttar Pradesh, 622405)	Sheohar (Bihar, 177.1)

*State, #Population

In Rajasthan, 92.6 percent districts have more than 0.2 million buffaloes. Similarly, 86.7, 76.9 and 63.6 percent districts of Uttar Pradesh, Andhra Pradesh and Gujarat, respectively, has more than 0.2 million buffaloes. Two hundred districts in India has about 0.2 million

buffaloes. Similarly, one hundred and three districts in India has more than 100 buffaloes per km². In terms of density, 74.7 percent districts in Uttar Pradesh has more than 100 buffaloes per km² followed by Haryana (50.0), Bihar (34.2) and Gujarat (30.3) (Table 6).

Table 6 Number of districts with buffalo population of 0.2 million and density of more than 100 per km² in the states of India

State*	Total number of districts	No. of districts with about 0.2 million buffaloes	No. of districts with > 100 buffaloes per km ²
Uttar Pradesh	75	65 (86.7#)	56 (74.7#)
Rajasthan	33	32 (97.0)	5 (15.2)
Gujarat	33	21 (63.6)	10 (30.3)
Madhya Pradesh	51	19 (37.3)	2 (3.9)
Bihar	38	18 (47.4)	13 (34.2)
Andhra Pradesh	13	10 (76.9)	Nil
Maharashtra	35	11 (31.4)	Nil
Haryana	22	9 (40.9)	11 (50.0)
Telangana	31	4 (12.9)	1 (3.2)
Punjab	22	8 (36.4)	5 (22.7)
Karnataka	30	2 (6.7)	Nil
Uttarakhand	13	1 (7.7)	Nil

*Other states have no district meeting above criteria

#percent of total districts in the state

Population dynamics of buffalo breeds of India

Indian Council of Agricultural Research (ICAR) has developed a mechanism of registration of diversity of Indian livestock and poultry breeds in the year 2008. As per the status of breed registration, India is home to seventeen registered breeds of buffaloes, well adapted to the agro-climatic condition of their habitat (NBAGR 2021). The largest percentage of buffaloes of Haryana (55.97) conform to the registered breeds followed by Gujarat (40.74), Kerala (32.42) and Odisha (26.44) (Table 3). Murrah breed has the largest population (11.686 million) followed by Mehsana (2.677 million),

Surti (1.886 million) and Bhadawari (0.584 million). Only two breeds have population of more than 2 million (Murrah and Mehsana), only one breed between 1-2 million (Surti), two between 0.5-1 million (Bhadawari and Jaffarabadi), five between 0.1-0.5 million (Nili-Ravi, Banni, Pandharpuri, Marathwari and Kalahandi) and one between 50 thousand-0.1 million (Nagpuri). Two breeds (Toda and Chilika) have their population less than 5 thousand (Table 7). Singh and Sharma (2017) has also analysed the data of Breed survey (2013) with respect to their risk status and reported that Toda and Chilika breeds to be in endangered status.

Table 7 Population of major buffalo breeds, their grades, share of the breed in total descript population and major states of their present distribution (Breed survey, 2013)

Breed*	Population of pure animals	Population of grades	Percent of pure-bred buffalo population of India	State (s) holding major population (Percent of total population of the breed)
Murrah	11686198	36568676	63.05	Uttar Pradesh (39.38), Haryana (20.57), Rajasthan (16.41), Punjab (6.78)
Mehsana	2676699	948426	14.44	Gujarat (99.42)
Surti	1886280	2006614	10.18	Gujarat (50.88), Rajasthan (26.68), Karnataka (13.89)
Bhadawari	583599	1170188	3.15	Uttar Pradesh (92.01)
Jaffarabadi	571077	1200421	3.08	Gujarat (76.09), Maharashtra (11.11), Uttar Pradesh (10.01)
Pandharpuri	287751	195987	1.55	Maharashtra (98.96)
Marathwari	278502	98093	1.50	Maharashtra (100.0)
Banni	239572	142550	1.29	Gujarat (100.0)
Nili-Ravi	129411	547834	0.70	Punjab (60.68), Haryana (28.42)
Kalahandi	115213	26802	0.62	Odisha (100.0)
Nagpuri	73584	117410	0.40	Maharashtra (80.80), Madhya Pradesh (14.78)
Toda	3003	5536	0.02	Tamil Nadu (100.0)
Chilika	2599	787	0.01	Odisha (100.0)
Total	18533488	43026321	–	

*New breeds viz. Luit (swamp), Bargur, Chhattisgarhi and Gojri not listed in Breed survey, 2013.

Although, considering only the breeds listed in Breeds survey (2013), only 17.05 percent (18.533 million) of the buffalo population belonged to the recognized breeds. Another 39.58 percent (43.026 million) are the grades of these breeds (Table 7). In the recent past with the efforts of the ICAR-National Bureau of Animal Genetic Resources, Karnal, many new populations of buffaloes have been characterized and some of them like Luit (swamp), Bargur, Chhattisgarhi and Gojri have been registered as new breeds of buffalo (NBAGR 2021).

Murrah has a share of more than 60 percent among the pure-bred buffalo population of India (Table 7). Murrah

and its grades, in fact, now form 45.81 percent of the total buffalo population of India. As it is employed for cross-breeding in many states, it is now distributed across almost all states of India. Besides, Haryana, which is native state of this breed, Uttar Pradesh, Rajasthan and Punjab has large population of this breed. Bhadawari and Nili-Ravi, now have lesser population than Murrah in their respective native states of Uttar Pradesh and Punjab. Although, Murrah is one of the best milch breed of buffalo, however, resource poor landless and marginal livestock keepers may not be able to sustain large breeds like Murrah.

Production dynamics of buffaloes in India

Buffaloes are primarily reared for milk. Besides milk they are an important source of meat, hide, manure and draught power. During 2018-19 buffaloes has produced 91.817 and 1.546 million tonnes of milk and meat, showing an increase of 30.34 and 32.77 percent from 2013-14, respectively. Although buffalo population in only about half of the cattle population they produced 91.817 million tonnes of the milk as compared to 89.834 million tonnes produced by the cattle (BAHS2019). Uttar Pradesh with total production of 19.463 million tonnes, had the largest share of 21.20 percent in the buffalo milk production of the country during 2018-19, followed by Rajasthan (12.682 million tonnes), Andhra Pradesh (9.932) and Punjab (8.988). In term of share of buffalo milk in the total milk production of the state, among the states that has the buffalo population of more than 0.1 million, Haryana has largest percentage (80.95 %) of buffalo milk in total milk production of the state followed by Punjab (71.34), Telangana (71.02) and Andhra Pradesh (66.02). During 2013-14 to 2018-19,

Jammu & Kashmir (69.44 %) has shown maximum increase in buffalo milk production followed by Rajasthan (65.10), Madhya Pradesh (57.36) and Andhra Pradesh (49.65, including Telangana). In terms of productivity per milking buffalo per day, Haryana has maximum productivity of 9.11 kg followed by Punjab (8.44), Andhra Pradesh (7.52) and Rajasthan (6.93). However, in the recent times as the population of buffaloes is either going down or not increasing as fast as exotic/crossbred cattle, even in states like Haryana, the contribution of buffalo milk in the total milk of many states has started coming down. Jharkhand (18.73 %) has shown maximum decrease in the share of buffalo milk in the total milk production of the state followed by Uttarakhand (10.06), Himachal Pradesh (7.74) and Chhattisgarh (7.23) during 2013-14 to 2018-19. Only Punjab, Jammu & Kashmir and Rajasthan has shown some increase in the share of buffalo milk in the total milk production of the state. Overall there is 2.26 percent decrease in the share of buffalo milk in the total milk production of the country (Table 8).

Table 8 Milk production from buffaloes, percent change in buffalo milk production during 2013-14 to 2018-19.

State#	Milk production from buffaloes (million tonnes)	Percent change in buffalo milk production during 2013-14 to 2018-19	Percent share of buffalo milk in total milk production of state	Change in percent share of buffalo milk in total milk of the state during 2013-14 to 2018-19	Productivity (kg/milking female/day)
Uttar Pradesh	19.463a	15.82	63.77e	-5.68	4.53
Rajasthan	12.682b	65.10b	53.58	0.87	6.93d
Gujarat	7.258	17.45	50.08	-5.53	5.15
Madhya Pradesh	7.363	57.36c	46.28	-2.47	4.58
Bihar	3.851	27.72	39.22	-2.67	4.39
Andhra Pradesh	9.932c	49.65d*	66.02d	-4.83*	7.52c
Maharashtra	4.308	12.70	36.96	-5.10	5.12
Haryana	8.683e	37.65e	80.95a	-3.81	9.11a
Telangana	3.847	-	71.02c	-	5.17
Punjab	8.988d	31.31	71.34b	2.97	8.44b
Karnataka	1.869	4.13	23.66	-6.27	3.29
Jharkhand	0.408	-35.85	18.69	-18.73	3.32
Chhattisgarh	0.372	-0.60	23.74	-7.23	4.91
Uttarakhand	0.776	-6.19	43.28	-10.06	4.66
Jammu & Kashmir	0.486	69.44a	19.12	1.37	5.23e
Himachal Pradesh	0.400	-1.11	27.36	-7.74	3.97
West Bengal	0.261	11.07	4.66	-0.13	4.83
Tamil Nadu	0.383	-36.63	4.58	-4.00	4.04
Odisha	0.286	5.18	12.38	-2.24	3.97
Assam	0.117	-4.09	13.28	-1.72	3.43
Kerala	0.012	-79.19	0.48	-1.72	5.04
India	91.817	30.34	48.90	-2.26	5.62

*Change in united Andhra Pradesh and Telangana

^aFirst, ^bsecond, ^cthird, ^dfourth and ^efifth highest value under the respective column heading.

[#]Data not available for Delhi

Besides milk, buffaloes contributed 1.546 million tonnes of meat during 2018-19 which is 19.05 percent of the total meat production of the country. Uttar Pradesh with total production of 688.86 thousand tonnes, had the largest share of 44.46 percent in the total buffalo meat production of the country during 2018-19, followed by Maharashtra (197.75 thousand tonnes), Andhra Pradesh (126.82) and Telangana (112.4). In term of share of buffalo meat in the total meat production of the state,

among the states that has the buffalo population of more than 0.1 million, again Uttar Pradesh (56.14 %) has largest contribution by buffaloes followed by Punjab (40.02), Madhya Pradesh (29.80) and Bihar (27.70). Maharashtra (227.29 %) has shown maximum increase in buffalo meat production followed by Andhra Pradesh (95.28, including Telangana), Assam (87.50) and Karnataka (76.68) during 2013-14 to 2018-19 (Table 9).

Table 9 Meat production from buffaloes, percent change during 2013-14 to 2018-19 and percent share of buffalo meat in total meat production of the state in states with 0.1 million buffaloes

State	Meat production from buffaloes (thousand tonnes)	Percent change in buffalo meat production during 2013-14 to 2018-19	Percent share of buffalo meat in total meat production of state
Uttar Pradesh	688.86 ^a	22.32	56.14 ^a
Rajasthan	41.52	40.51	21.66 ^c
Gujarat	0.87	-19.44	2.61
Madhya Pradesh	29.02	76.52 ^c	29.80 ^c
Bihar	101.05 ^c	66.94	27.70 ^d
Andhra Pradesh	126.82 ^c	95.28b*	16.25
Maharashtra	197.75 ^b	227.29 ^a	19.38
Haryana	7.32	\$	1.43
Telangana	112.4 ^d	\$	14.91
Punjab	92.58	-23.70	40.02b
Karnataka	11.59	76.68d	4.57
Jharkhand	0.22	-95.60	0.35
Uttarakhand	3.03	-25.74	10.38
Jammu & Kashmir	5.4	\$	5.89
West Bengal	14.46	42.74	1.74
Tamil Nadu	2.97	-49.14	0.47
Assam	0.15	87.50 ^e	0.30
Kerala	97.51	4.39	21.32
India	1545.82	32.77	19.05

*Change in united Andhra Pradesh and Telangana

\$ data not available for 2013-14

^aFirst, ^bsecond, ^cthird, ^dfourth and ^efifth highest value under the respective column heading.

[#]Data not available for Delhi, No buffalo meat production in Chhattisgarh, Himachal Pradesh and Odisha

CONCLUSION

Although, the population of buffaloes has not shown declining trend like indigenous cattle and shown consistent increase since 1992, however during 2012-2019 their population have increased only marginally by 1.06 percent compared to exotic/crossbred cattle that have shown a whopping increase of 29.26 percent. Concomitantly, the contribution of buffalo milk in the total milk of many states has started coming down even in the states like Haryana. Further, Murrah and its

grades, now form 45.81 percent of the total buffalo population of India as it is employed for cross-breeding in many states. Although, exotic/crossbred cattle and large sized buffalo breeds like Murrah are better producers of milk, however, resource poor small and landless livestock keepers may not be able to sustain them. In view of deteriorating population of majority of buffalo breeds, it is imperative to formulate suitable programmes of genetic improvement, development and conservation of precious buffalo genetic resources

available in India. Genetically improved germplasm of these breeds may also be used in grading up of non-descript buffalo population in their respective breeding tracts.

REFERENCES

- BAHS. 2019. Basic animal husbandry statistics, Department Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India.
- Banerjee G C. 1998. A Test book of Animal Husbandry, 8th Edition, Oxford and IBH Publishing Company, New Delhi
- Breed survey. 2013. Estimated livestock population breed wise (Based on breed survey 2013), Animal Husbandry Statistics Division, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture.
- Gupta S P. 2011. Statistical Methods, 41st edition, Sultan Chand and Company, New Delhi.
- Livestock census. 1992. 15th Livestock census - 2007, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture.
- Livestock census. 2007. 18th Livestock census - 2007, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture.
- Livestock census. 2012. 19th Livestock census - 2012, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture.
- Livestock census. 2019. 20th Livestock census - 2019, Animal Husbandry Statistics Division, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying.
- NBAGR. 2021. Registration of new breeds, lines and varieties. New breeds and Accession number of registered breeds. ICAR-National Bureau of Animal Genetic Resources, Karnal website. <https://nbagr.icar.gov.in> (accessed on 02.01.2021).
- Singh P, Tiwari C B and Dwivedi V K. 1991. Regional imbalances in population dynamics of pigs in India: An appraisal. *Indian Journal of Animal Sciences* 61: 71-74.
- Singh P K and Sharma A. 2017. Assessment of degree of endangerment of livestock breeds of India. *Indian Journal of Animal Sciences* 87: 316-323