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Current status and changing national scenario of goat population: A review

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ABSTRACT

Goats have been associated with man since dawn of agriculture and domestication of animals, making them socioeconomically, a very important animal providing products (meat, milk, fibre, hair) and service to man throughout the world, especially in developing countries. In India, the total numbers of goat breeds that have been recognized till date is 26 and most other still remain unexplored. According to 19th livestock census a sharp decline in goat population was found over the previous census, suggesting the need of sustainable management for preserving goat breeds and population. A number of factors are found to be responsible for this continues decline in goat population. Efforts have been made through different conservation planning in different region of India. The present review focuses on the current status of goat population in India and its states that stresses out the necessities to protect this species for our own benefits.

Key words: Breeds, Conservation, Decline, Goat, Reproduction.

Livestock in developing countries like India have a considerable role in its rural area population as it provides labour for land cultivation and employment to huge number of people. For any livestock industry, reproduction is the major area to be taken into consideration Sharma (2000), where reproduction rate is the primary factor of economic importance Shelton and Willingham (1992).

Goats are farmed throughout the world for being important source of milk, meat, fibre as well as of proteins along with their capability of adapting in different environmental conditions. It has been also proved in several studies that people could tolerate goat's milk, who got allergy from cow's milk Restani (2004). Domestic goats are seasonally polyestrous and their breeding activity is influences by different environmental factors. India is contributing 11.6% of total livestock in world and 17.93% of which is contributed by goats. The credit for largest milk producing country goes to India, followed by Bangladesh and Sudan. The maximum goat milk producing state in India is Uttar Pradesh followed by Rajasthan BAHS (2014). Good quality milk is produced by Indian goat breed such as Jamunapari, Barbari, beetle, Surti and Jakhrana.

Although, goats are so beneficial and human friendly but still their reproductive area not getting much attention except few reports only Zarazaga *et al*., (2012). India is having 26 well recognized and a number of an unexplored goat breeds of local areas Mandal *et al*., (2014). According to recent census by Govt. of India in 2012 the Goat population has declined by 3.82% over the 2007 census and the declining rate varies among male and female in both rural and urban areas BAHS (2014); GOI (2012). Due to lack of selection scheme and breeding organization most of the goat breeds are genetically not exploited and characterization of a limited number of breeds is done so far Gall (1996). A number of studies have been documented suggesting different pesticides despite of being integral part of agricultural system, affects goat reproductive system considerably like Endosulphan Sharma *et al*., (2010), Malathione Bhardwaj and Saraf (2014b; 2016a), MXC Bhardwaj and Saraf (2017) etc. . Thus, recognized breeds of Indian goat population are facing a greater threat due to lack of enforcement of proper breeding policy, inadequate number of breeding bucks, indiscriminate crossbreeding, intermixing among breeds with local animals and toxicity Mandal *et al*., (2014). It is the time to consider and pay attention to the value and capacity of goats reproduction at both micro and macro level. Efforts have been made to conserve the indigenous goat breeds for their unique characteristics in their home tracts through in-situ and ex-situ conservation Mandal *et al*., (2014).

Origin and taxonomic status of goat: Linnaeus for the first time provides recognition to goats as genus *Capra* in 1958. Around 11000 years ago, from hunter-gatherer to agriculture-based societies at the beginning of the revolutionary transition in the near east, goats were the first wild herbivores to be domesticated. This family is the most diverse group of living ungulates, even-toed hoofed mammals, and approximately 140 other living species, including sheep, cattle, antelopes and gazelles, with more than 300 fossil taxa, first appeared in the Miocene approximately 20 Mya, Fernandez and Vrba (2005). Goats are the member of the

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family Bovidae, within subfamily of Caprinae, of genus Capra, whose origin and composition are highly controversial in the worldwide. The common ancestor of extinct caprines most likely was found to be originated during the late Miocene experienced periods of rapid radiation in alpine habitats in Asia or in the Mediterranean islands according to the Fossil and molecular data suggested Fernandez and Vrba (2005); Ropiquet and Hassanin (2005). The difficulties in pursuing authentic archaeological and phylogenetic inferences were explained by many gaps in the fossil record and the rapid diversification of *Capra* taxa. As a result, the taxonomic position of Capra remains under debate, and the number of proposed species and subspecies was found to be constantly changing. Several categorization was done to classify goats like according to their geographical origin Epstein (1977), height at the withers and their region and productivity Devendra, (2007), size and shape of the horns Mason (1981), morphological parameters CSIR (1970).

The species with neighbouring geographical distributions tend to be closely related was revealed by phylogenetic analysis (e.g. *Capra* caucasica and *Capra* cylindricornis or *Capra* pyrenaica and *Capra* ibex). However, the discordance between various genetic markers is common and has been interpreted as a result of ancient hybridisation between their ancestral types Pidancier *et al*., (2006). *Capra hircus* and *Capra aegagrus* are closely related as per studies of various genetic markers Luikart *et al*., (2001), indicating that the gene pool of domestic goats has been contributed by the bezoar goat. With both archaeological and morphological studies the conclusion is consistent Zeder and Hesse (2000). The goat closely resembles the sheep and both are belonging to tribe *Caprini*. The differentiation of wild goats from wild sheep is now well established genetically.

The goats comprise two genera, *Capra* and *Hemitrugus*, based on horn-form Berry and Warwick (1948). It has been suggested that Caprini may have diverged from an ancestral gazelline form in the middle Miocene, but the earliest fossil record of a distinctively goat-like creature Tossunoria from the lower Pliocene of eastern China Pilgrim (1947). By Pleistocene times remains of goats become abundant in Europe and Asia where specimens closely related to living species of both *Capra* and *Hemitragus* are found (Figure 1).

GOAT BREEDS AND THEIR DISTRIBUTION

Global scenario: Goat numbers were increased by 33.8%, with Asia to keep continually the first rank with a contribution of 59.4% in the world during the period 2000-2013. But in Greece and India during the same period goat number was declined significantly Skapetas and Bampidis (2016). Food and Agricultural Organization of the United Nations FAO (2009)' enlisted more than 1,153 breeds of goat, the inventory of domestic animal diversity database. FAO reported that worldwide 850 million goats exist but more than 95 % of

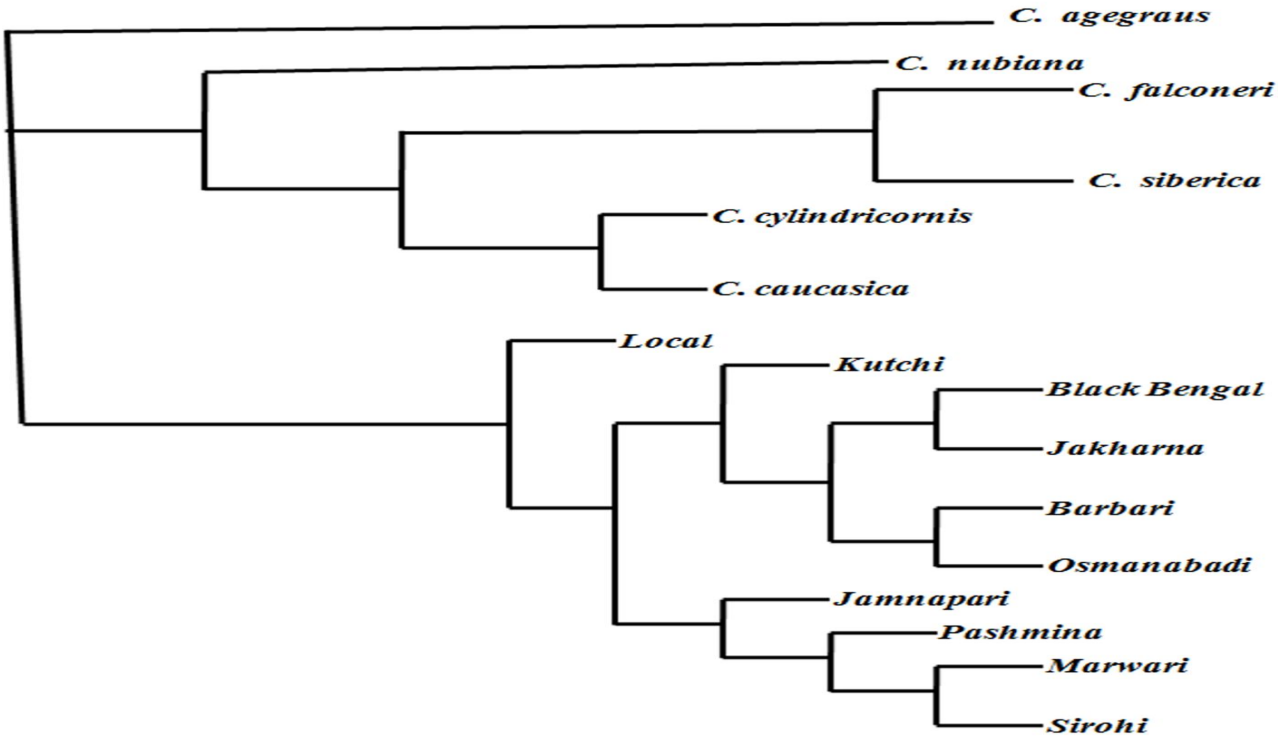

Figure 1

Fig 1: Evolution pattern of different goat breeds (Joshi *et al*., 2004).

the goats were found in the developing countries. There are 68 herdbooks or breed societies listed, out of which 21 are for the original breeds. In various developing countries the efforts to establish the purity of breed and the improvement of preexisting breed is lacking. The number of goat breeds in the world has been reported to be 562 by Devendra (2007), 136 by Gall (1996), 565 by Mason (1996), and then 1,153 by FAO in 2009 but their numbers are based on different classification methods.

National Scenario: In India, after several attempts, 26 breeds have been recognized till date (Table 1) and among which 62% remains non-descriptive. The number, however, varies from 20 to 29 depending upon the reports available in the published literature.

Distribution of goats in different agroclimatic regions throughout the country (2.4%in the temperate Himalayan region, 39.3% in the northwestern region, 32.1% in the eastern region and 26.2 % in the southern region) and their nutritional importance and population size in millions has been represented in Table 1. Goat population is moderate in west coast and less intensified in east. Most of the goats are non-descript with fusion of Osmanabadi, Sangamneri, Kanni Adu, Malabari and Attapati breeds. Goat meat, milk and various by-products provides important nutritional components of a human diet. Meat of the goat was found to be a low-fat, iron-rich source of protein. According to United States Department of Agriculture the goat meat is 50 to 65 percent lower in fat than similarly prepared beef, and also has comparable protein. Goat also provides us milk and dairy products which in the human diet are also a major source of protein, as well as calcium. Goat milk is easier to digest than cow milk due to its smaller fat globules, and is good for babies, children and adults too. However, lack of awareness to adopt supplementary feeding, proper housing, prophylaxis, poor marketing infrastructure for goat rearing, non-availability of good breeding males and their excessive use are the major concerning problems Peacock (2005).

Reproduction in goat: Goats are considered to be one of the most prolific among domestic animals. For continuation of the species, rate of reproductive efficiency is important in this mammalian species. Understanding the reproductive physiology of *Capra hircus* is important for proper planning to enhance reproductive management. In most of the goat breeds, the does attain puberty in 5-7 month of age Jainudeen *et al*., (2000). In males, when complete separation of the prepuce and the penis occurs and motile spermatozoa are first detected in the ejaculate, representing puberty onset.

Table 1: The habitat and population size of different goat breeds of India (Source: Official websitehttp://dahd.nic.in/Default1.aspx,(DAD-IS) online database (dad.fao.org); GOI, 2007, 2010).

Breed	Agroclimatic Regions	Broad habitat	Population (in million)
Dual-purpose breeds (milk and meat)			
Barbari	**Northwestern region**	Agra, Mathura, Etah and Aligarh districts in Uttar Pradesh	3.15
Beetal	**Northwestern region**	Gurdaspur, Amritsar and Firozpur districts in Punjab	0.30
Gohilwadi	**Northwestern region**	Bhavnagar, Amreli and Junagarh districts in Gujarat	0.32
Jakhrana	**Northwestern region**	Jakhrana village in Alwar district of Rajasthan	1.95
Jamunapari	**Northwestern region**	Chakarnagar Block in Etawah district of Uttar Pradesh	1.05
Kutchi	**Northwestern region**	Kutch district in Gujarat	0.66
Malabari	**Southern region**	Kozhikode, Kannur and Malappuram districts in Kerala	0.71
Marwari	**Northwestern region**	Western Rajasthan	7.57
Mehsana	**Northwestern region**	Mehsana and Banaskantha districts in Gujarat	0.59
Sirohi	**Northwestern region**	Sirohi and Ajmer districts in Rajasthan	2.91
Surti	**Northwestern region**	Surat and Vadodara districts in Gujarat	0.67
Zalawadi	**Northwestern region**	Surendranagar and Rajkot districts in Gujarat	0.82
Meat breeds			
Black Bengal	**Eastern region region**	West Bengal, Jharkhand, Odisha, Bihar and Assam districts in Himachal Pradesh	20.92
Gaddi	**Temperate Himalayan**	Chamba, Kangra, Kulu, Bilaspur, Kinnanaur and Lahul-Spiti	0.47
Ganjam	**Eastern region**	Ganjam district in Odisha	0.15
KannaiAdu	**Southern region**	Ramanathpuram and Tirunelveli districts in Tamil Nadu	2.09
Osmanabadi	**Southern region**	Osmanabad district in Maharashtra	1.55
Sangamneri	**Southern region**	Ahmednagar district in Maharashtra	0.21
KonkanKanyal	**Southern region**	Konkan region of Maharashtra	-
Berari	**Southern region**	Vidarbh region of Maharashtra	-
Attappady Black	**Southern region**	Palakkad district of Kerala	0.007
Pashmina breeds			
Changthangi	**Temperate Himalayan region**	Ladakh district in Jammu and Kashmir	0.21
Chegu	**Temperate Himalayan region**	Uttarkashi, Chamoli and Pithoragarh districts in Uttaranchal	0.01

Estrous cycle and behaviour: The estrous cycle is mainly divided into- shortest estrus phase (1-2 days) where final growth and ovulation of 1-2 preovulatory cycles occurs and cervical mucus becomes thinner and more copious, cloudy towards ovulation, metestrus (3-4 days) with functional organization of corpus luteum, diestrous (5-18 days)- luteal phase and longest proestrus phase (19-21 days) showing growth of preovulatory follicles. Goats are seasonally polyestrous and their breeding activity is affected by photoperiods Pineda and Dolley (2003). With average duration of 21 days, the length of estrous cycle is determined which is the time interval between two successive estrus or two successive ovulations. The environmental factors such as photoperiod and nutrition may alter duration of these estrous cycles Haldar and Ghosh (2015). Photoperiodic control of reproductive patterns is mediated through circadian rhythmic secretions of melatonin by pineal gland during dark, which influences the Gonadotropin-releasing hormone pulse generation and the hypothalamic pituitary gonadal feedback loop. Animals bred in tropical and equatorial regions subjected to less change in photoperiod and temperature, display a longer breeding season than those bred in temperate and Polar Regions, exhibiting more distinct seasonal effects Haldar and Ghosh (2015). The temperate regions goat breeds are seasonal or ''short-day breeders'' indicating that the period of cyclicity is controlled by photoperiod Delgadillo *et al*., (2004).

Estrous behaviour comprises two phases, proceptivity consists in seeking out and to stimulate the male partner and receptivity consists in the expression of the immobilization reflex in response to male nudges, inducing serial mounting and copulation. The avedcrage duration of estrous behavior is around 36 h but it varies from 24 h to 48 h depending on age, individuals, breeds, season and the presence of a male. For example Angora goats and Mossi goats are known to have a short estrus, lasting only 22 h and 20 h, respectively Shelton (1978) whereas Creole goats exhibit 27 h of estrous behaviour. Continuous presence of a male during the estrus period may reduce the duration of

Table 2: State wise details of goat by age, sex and use in rural and urban areas combined in 2012 census.

State /UT	Male			Female				Total Female	Total Goats
	Under 1 year	1 year and above	Total Males	Under 1 year	1 year and above				
					In milk	Dry	Not calved once		
ANDAMAN &NICOBAR ISLANDSd	11928	11940	23868	13463	14320	11139	2534	41456	65324
ANDHRA PRADESH	1191660	1009120	2200780	1909268	2891237	1415738	654198	6870441	9071221
ARUNACHALPRADESH	65114	60992	126106	64806	57837	33474	23315	179432	305538
ASSAM	958761	1641988	2600749	1027717	1136444	870665	533618	3568444	6169193
BIHAR	2072248	1450303	3522551	2269007	2969362	1888941	1503659	8630969	12153520
CHANDIGARH	92	206	298	120	321	58	8	507	805
CHHATTISGARH	448379	499615	947994	561580	587988	751883	375862	2277313	3225307
DADRA & NAGAR HAVELI	908	757	1665	747	957	581	223	2508	4173
DAMAN & DIU	202	306	508	297	695	358	197	1547	2055
GOA	1895	2489	4384	2177	3491	2018	888	8574	12958
GUJARAT	615002	504442	1119444	891363	1702163	922851	323151	3839528	4958972
HARYANA	47634	24895	72529	73573	128543	81164	13307	296587	369116
HIMACHALPRADESH	132251	177681	309932	176689	235931	327016	69923	809559	1119491
JAMMU & KASHMIR	232200	275449	507649	387168	599892	422476	100715	1510251	2017900
JHARKHAND	1039065	1172943	2212008	1207038	1573848	1046396	542159	4369441	6581449
KARNATAKA	576480	511723	1088203	964334	1442957	1055078	245575	3707944	4796147
KERALA	211670	83647	295317	407668	358297	155510	29285	950760	1246077
LAKSHADWEEP	7428	6735	14163	9431	8060	8383	6460	32334	46497
MADHYA PRADESH	1159474	859500	2018974	1527726	2187336	1893080	386820	5994962	8013936
MAHARASHTRA	1278924	620849	1899773	1717312	2641128	1871351	305743	6535534	8435307
MANIPUR	12578	13394	25972	13105	13270	6436	6375	39186	65158
MEGHALAYA	99661	89868	189529	91175	80826	65768	45772	283541	473070
MIZORAM	3859	4463	8322	3896	3436	3741	2811	13884	22206
NAGALAND	19167	19167	38587	17237	20199	12330	10997	60763	22206
NCT OF DELHI	5115	6744	11859	5503	7365	3055	2688	18611	30470
ODISHA	1077872	1224081	2301953	1167236	1305935	1313564	424399	4211134	6513087
PUDUCHERRY	7997	4439	12436	13411	17701	10020	1382	42514	54950
PUNJAB	39968	30672	70640	61188	115230	67983	12231	256632	327272
RAJASTHAN	2917310	1342826	4260136	4201700	7006860	4930805	1266438	17405803	21665939
SIKKIM	22208	30895	53103	20586	15545	19869	4261	60261	113364
TAMIL NADU	1216823	1091202	2308025	1814009	2190473	1247766	583068	5835316	8143341
TRIPURA	116380	79237	195617	132288	114308	105236	63473	415305	610922
UTTAR PRADESH	2346554	2037128	4383682	3222189	4242904	2664516	1072324	11201933	15585615
UTTARAKHAND	164140	208781	372921	231894	333789	340687	88122	994492	1367413
WEST BENGAL	2348021	2069423	4417444	2338144	2243694	1755164	751504	7088506	11505950
Total	2338144	**17168153**	**37617121**	**26545045**	**36252342**	**25305100**	**9453485**	**97555972**	**135173093**

estrous without affecting ovulation times/rates in Nubian dairy goats Romano and Abella (1997).

Fertilization and gestation: During the heat period, does tend to decrease in milk yield, with less appetite, frequent bleeding and show a characteristic nervousness. There will be much wagging of the tail from side to side; the external genital organs (vulva) get swollen and become red. If heat recurs in 18 to 21 days, means the doe did not conceive Haldar and Ghosh (2015). It is generally believed that the "male effect" is responsible for accelerating occurrence of estrus and can shorten the duration of estrous period in doe. The buck effect is when non-cycling (anestrous) ewes are stimulated to ovulate by the sudden introduction of a ram or "teaser" ram. Production of androgen- dependent pheromone by rams stimulates the onset of estrus. The site of fertilization is ampullae of the oviduct and takes place few hours after ovulation and the fertilized ovum moves down to oviduct while undergoing successive divisions. The embryo reaches the uterus 4-5 days after estrus at an early morula stage. Implantation of the embryo is observed 18-22 days after the onset of estrus. In goats, the presence of a functional corpus luteum is indispensable throughout gestation. Gestation period is about 149 days but it may vary little from 145 to 152 days Haldar and Ghosh (2015). The variation in gestation length could be due to breed type, litter weight and breeding season. Granadina goats has the shortest gestation (149.0±0.31 days), whereas Toggenburg (151.7 ± 0.28 days) and Alpine (151.4 ± 0.46 days) has the longest. Boer goats also have a short gestation period of 148.2 ± 3.7 days Greyling (2000). Parturition in goats is preceded by a drastic decline in progesterone 12-24 h before the beginning of labor Mellado *et al*., (2000).

Goats' population status in India: India with a geographical area of 3287263 sq. km. GOI, (1997); GOI (2003) has been contributing effectively to the livestock gene pool and improvement of animal production internationally Mandal *et al*., (2014). As per report of the working group on animal husbandry and dairying, 11th five year plan 2007-12, the livestock sector employs 8% of the countries labour force, including many small and marginal farmers, women and landless agricultural workers. Starting from 1951 till date there are 19 livestock census for various commercial useful animal group have been conducted by BAHS India. There has been important changes made for 18th and 19th livestock census that data collection is done breed wise which make it very easy to understand GOI (2007); GOI (2012).

Goat contribution in Livestock of country: As per 19th Livestock census, 2012 BAHS (2014) India's livestock sector is one of the largest in the world having huge livestock population of 512 million, which mainly includes cattle, buffaloes, goats, sheep and pigs. Contribution of cattle, buffalo, sheep, goat, pig and others in total livestock population is 37.28, 21.23, 12.71, 26.4, 2.01 and 0.5%, respectively. Livestock population in India has increased substantially in Gujarat (15.36%), Uttar Pradesh (14.01%), Assam (10.77%), Punjab (9.57%), Bihar (8.56%), Sikkim

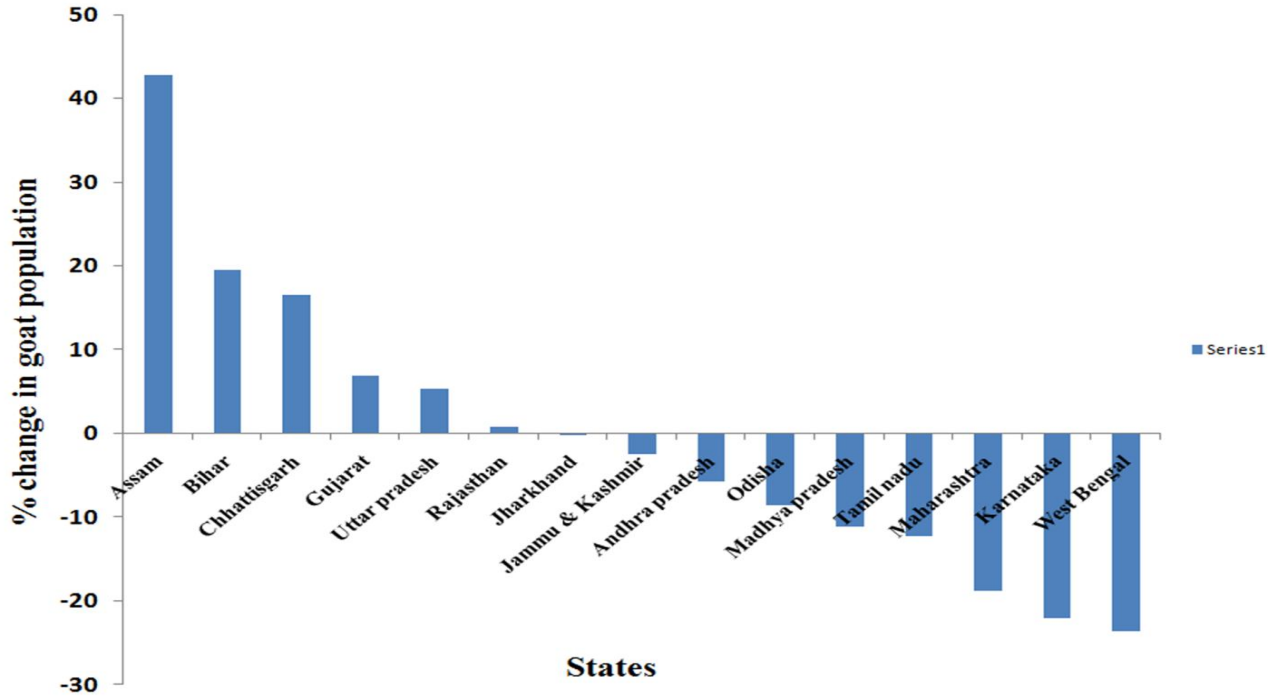

Figure 2

Fig 2: Percentage changes in goat population over previous census state wise.

(7.96%), Meghalaya (7.41%) and Chhattisgarh (4.34%). During the last inter-censual period (2007-2012), there was decrease in the population of cattle, sheep, goats and pigs by 4.1, 9.07, 3.82 and 7.54 per cent, respectively while the population of buffalo and poultry increased by 3.19 and 19 per cent over the previous census (2007) per cent, respectively. The total livestock population in India has decreased by 3.33.

Total meat production including goat meat was 5.9 million tonnes in 2012-13 as compared to 1.9 million tonnes in 2001-02. Buffalo, Goat, Pig, Sheep and Cattle contribute 19, 16, 8, 7 and 5 per cent of total meat production, respectively BAHS (2014). With annual milk production of 132.4 million, Uttar Pradesh produced maximum goat milk followed by Rajasthan. The share of milk production in 2012-13 was highest by buffaloes followed by exotic/crossbred cows, indigenous/nondescript cows and goats with 51, 24, 21 and **4** per cent of total milk production, respectively. India ranks first in the world and contributes about 16per cent to the world milk production. The growth in the milk production remained almost same for more than two decades after independence (1% per year) whereas the population growth was almost 2 per cent BAHS (2014). The gap between demand and production was huge. Increase in milk production was achieved with the launch of a nationwide dairy development programme (operation flood) in the year 1970 Gautam *et al*., (2010). It has been estimated that demand of milk will rise to 156 million tons by 2020. Estimates by the Planning Commission of India indicate still higher demand increases (182 million tons by the year 2021–22) BAHS (2014).

Statistics of Goat in India: India is a rich repository of goat genetic resources having 23 well-recognized goat breeds Mandal *et al*., (2014). Out of 135.04 million of Indigenous Goats (Including Non-descript), 26.97 per cent are pure breed, 11.77 per cent are graded breeds and remaining 61.26 per cent are non-descript breeds GOI (2013). Attapati Black having the minimum and Black Bengal having maximum sharing of total goat population with 0.02 per cent and15.28 per cent respectively BAHS (2013) (Figure 3).

Although India ranked 1st in world goat population showing more population of goat in India than china who was holding 1st position from many years BAHS (2014); Islam *et al*., (2016) but Population of goat has been decreased by 7.79 per cent in male, 2.19 per cent in female and a total of 3.82 per cent from 2007-2012. The Goat population has declined by 3.82 per cent over the previous census and the total Goat in the country is 135.17 million numbers in 2012.

One important point is to note that decline in male numbers is much more than that of the female. There is negative growth in goat by 3.18 per cent and 15.66 per cent in rural and urban areas respectively from 2007-2012 GOI (2012). It shows that decline in urban area is quite large as compare to rural areas. The total Goat contributes around 26.40 per cent of total livestock population in India and the total number of Goats in India as per 2012 Census is 135.17 million numbers. Rajasthan and Chandigarh sharing maximum and minimum goat population respectively. Between 2007-2012 there is maximum increase in goat population in Assam and maximum decrease in West Bengal. There are 33014 household and 25000 enterprises/ institutions holding goats in India BAHS (2014); BAHS (2015). Female population shows a continuous increase from 1992 to 2007 with maximum increase from 2003-2007 but there is a decline from 2007-2012. Buck population also shows the same trend except there is small decrease in male population between 1997-2003 GOI (2012).

STATE WISE GOAT POPULATION

In Rural Area: According to report submitted by government of India for 2007-2012 livestock census, the total male population (35785440) is maximum in west Bengal (4287358) and minimum in Chandigarh (87).There are total 19521627 male goats under 1 year with minimum and maximum in Chandigarh (15) and Rajasthan (2828083), respectively. Total male goats of 1 year and above 1 year are 16263813 with Chandigarh having minimum (23) and west Bengal having maximum (2005484). The total female population is 93295368 and it is maximum in Rajasthan (16929986) minimum in Chandigarh (15).

In India, there are total 25352089 doe's under 1 year with minimum in Chandigarh (120) and maximum in Rajasthan (4087735). Total female goats in milk are 34447783 with Chandigarh having minimum (53) and Madhya Pradesh having maximum (20641463).

In Urban Area: As per recent census the total male population (1831681) is maximum in Uttar Pradesh (389590) minimum in Lakshadweep. There are 927341 total male goats under 1 year with minimum in Lakshadweep and maximum in Uttar Pradesh (180199). Total male goats of 1 year and above 1 year are 904340 with Lakshadweep having minimum and Uttar Pradesh having maximum (209391). The total female population (4260604) is maximum in Uttar Pradesh (834339) minimum in Lakshadweep. There are total 1192956 female goats under 1 year with minimum in Lakshadweep and maximum in Uttar Pradesh (218939). Total female goats in milk are 1804559 with Lakshadweep having minimum and Uttar Pradesh having maximum (385008). Besides this, statistics of total goat population in India has been listed in Table 2.

There is no goat species recorded in urban area of Lakshadweep GOI (2012).

Year wise goat population: Table and graph given below has clearly shown that there is decline in goat population for the very first time in India after 1951. According to 19th livestock census there is a sharp decline of 3.82 per cent in goat population from 140.5 to 135.2 million between 2007-2012 (Table 4a and 4b).

Table 3: Population of goat from 1951-2012 in India (In million numbers, National dairy development board).

Year	1951	1956	1961	1966	1972	1977	1982	1987	1992	1997	2003	2007	2012
Population in million	47.2	55.4	60.9	64.6	67.5	75.6	95.3	110.2	115.3	122.7	124.4	**140.5**	**135.2**

According to data available BAHS (2014); GOI (2012), there is maximum increase and maximum decrease in goat population of Assam and west Bengal respectively during the period of 2007-2012 (Figure 2). Which goat breed and age group show decline or increment not calculated as data available for different breeds in different state is not comparable from 2007-2012 because in 2007 not all breeds calculated in every state that is major breeds of every state taken into account.

Animals in milk mean the animals who contribute towards production of milk. There are 116.77 Million goat animals in milk in the country. According to 19th livestock census goat share 31 per cent of total milk production in the country GOI (2012).

According to data available from 1951-2012 there is continuous increase in goat population with a shrap increament from 1977-1982 and from 2003-2007 due to awareness about their useful products, increasing food demands, their easy handling and maintenance even by poor people of rural areas. There is also a first time decline in goat population from 2007-2012 due to various reasons discuss later on (Table 3).

Declining status of goat breeds: 19th livestock census indicates that directly or indirectly reproductive potential of goat has been affected in last few years significantly. Although India rank first BAHS (2014) but goat population has shown a decline of 3.82% per cent from 2007-2012 BAHS (2014); GOI (2012).The buck population decline by 7.11 per cent in rural and 19.2 per cent in urban areas. The doe's population in rural area decline by 1.57% per cent and in urban area by 14.04per cent from 2007-2012. Population of goat decreased by 7.79 per cent in male, 2.19 per cent in female and a total of 3.82 per cent from 2007-2012. One Important point to note that decline in male numbers is much more than that of female. There is negative growth in milch goat population by 3.18 per cent in rural and by 15.66 per cent in urban areas from last census which was held in 2007. It shows that decline in urban area is quite large as compare to rural areas. During 2007-2012 there is maximum decrease in west Bengal BAHS (2014); GOI (2012). According to Mandal *et al*., 2014, the threatened goat breeds of India are Jamunapari, Beetal, Jakhrana and Surti in the northwestern region, Sangamneri, Osmanabadi, Malabari and Attappati Black in the southern region, Ganjam in the eastern region, and Chegu and Changthangi in the temperate Himalayan region.

FACTORS RESPONSIBLE FOR DECLINING GOAT POPULATION

Fertilizers and pesticides: A number of toxicological studies have shown that fertilizers and pesticides like organochlorides, organophosphates etc. tremendously

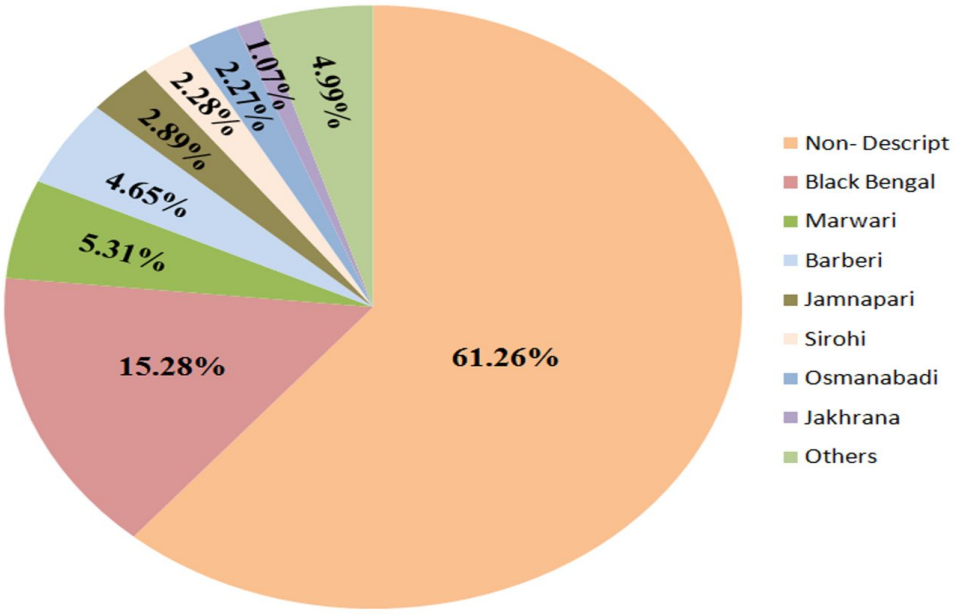

Figure 3

Fig 3: Percentage share by different goat breeds in India (BAHS, 2013).

Table 4a: Comparative view of different goat breeds in 2007 and 2012 state wise (GOI, 2007; 2012).

Breeds	Attapadi Black		Barbari		Beetal		Black Bengal		Changthangi		Chegu		Gaddi		Ganjam		Gohilwadi		Jakhrana		Other grades and non discriptive	
States	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**
ANDAMAN &NICOBAR ISLANDS	_	_	_	_	_	_	2071	4009	_	_	_	_	_	_	_	_	_	_	_	_	60805	60844
ANDHRA PRADESH	_	_	_	_	_	_	_	1624	_	_	_	_	_	_	_	_	_	_	-	2036	9561445	8537332
ARUNACHALPRADESH	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	292121	305538
ASSAM	_	_	_		_	60467	9548	63982	_	_	_	_	_	_	_	_	_	_	_	_	4236492	6098661
BIHAR	_	_	_	71780	_	29673	1184587	4715457	_	_	_	921	_	1599	_	_	_	_	_	5567	8982422	6910611
CHANDIGARH	_	_	_	_	154	146	_	_	_	_	_	_	_	_	_	_	_	_	_	_	335	659
CHHATTISGARH	_	_	_	4849	_	_	_	10642	_	_	_	_	_	_	_	_	_	_	_	_	2712743	2901829
DADRA & NAGARHAVELI	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	22532	4173
DAMAN & DIU	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	69	_	_	_	750	1830
GOA	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	10966	12958
GUJARAT	_	3414	_	_	_	_	_	_	_	_	_	29894	_	_	_	_	321565	260881	_	_	1565487	2692447
HARYANA	97	242	33399	38845	119497	79024	00	_	00	_	00	_	_	_	_	_	_	1103	30314	4507	331092	230136
HIMACHALPRADESH	_	_	_	3404	72131	58530	1623	8617	_	_	6778	5435	404065	401733	_	_	_	_	_	_	756239	612707
JAMMU & KASHMIR	_	_	_	_	_	112103	_	1321	205640	196179	_	1432	_	93502	_	_	_	_	_	_	1859167	1613363
JHARKHAND	_	_	50715	742	31470	54998	2298187	2787243	_	_	_	_	_	_	_	_	_	_	_	1706	4161349	3720137
KARNATAKA	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	5888868	4279651
KERALA	7641	15495	_	673	_	1667	_	_	_	_	_	_	_	_	_	_	_	_	_	_	932887	157652
LAKSHADWEEP	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	23743	26631
MADHYA PRADESH	_	_	232585	160143	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	8657684	7537794
MAHARASHTRA	_	_	_	7093	_	_	_	_	_	_	_	_	_	_	_	1636	_	_	_	_	8835226	6051611
MANIPUR	_	_	_	_	_	179	_	2885	_	_	_	_	_	_	_	_	_	_	_	_	49473	62094
MEGHALAYA	_	_	_	_	_	341	_	1694	_	_	_	_	_	_	_	_	_	_	_	_	365306	471035
MIZORAM	_	_	_	_	_	_	4542	3845	_	_	_	_	_	_	_	_	_	_	_	-	11168	18361
NAGALAND	_	_	_	_	_	_	142021	12784	32	_	_	_	_	_	_	_	_	_	_	_	32990	86385
NCT OF DELHI	_	_	366	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	20500	24844
ODISHA	_	_	_	_	_	8738	1822772	1682868	_	_	_	_	_	_	148319	411373	_	_	_	_	4463455	4402776
PUDUCHERRY	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_		54677
PUNJAB	_	508	470	21520	66446	218295	11	2301	41	31	_	_	83	2269	_	_	_	1874	_	_	222935	78059
RAJASTHAN	_	1980	_	167047	_	_	_	_	_	_	_	_	_	_	_	_	_	_	1922732	1431802	8879914	9644388
SIKKIM	_	_	_	_	_	_	_	_	_	_	3319	_	_	_	154	_	_	_	_	_	88522	113090
TAMIL NADU	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	6884220	7087616
TRIPURA	_	_	_	_	_	_	622471	608811	_	_	_	_	_	_	_	_	_	_	_	_	5581	2111
UTTAR PRADESH	_	_	2808852	5,77,734	05_	78869	_	18050	_	_	_	_	_	734	_	913	_	_	_	1037	9393248	7424676
UTTARAKHAND	_	_	29366	23463	_	_	_	_	45	9	_	_	68257	1117042	_	_	_	_	_	_	1204286	1207353
WEST BENGAL	_	_	_	4848	_	11952	1483471	810725191	_	_	_	_	_	283	_	_	_	_	_	_	-	603270
Total	7738	21639	3155723	628171	2304223	714982	20927557	20651324	205758	196219	10097	37682	472405	617162	148473	413922	321634	263858	1953046	1446655	90513951	83036599

Table 4b: Comparative view of different goat breeds in 2007 and 2012 state wise (GOI, 2007; 2012).

Breeds	Jamnapari -		Kannaiadu		Kutchi		Malabari -		Marwari		Mehsana		Osmanabadi		Sanganeri		Sirohi		Surti		Zalwadi	
States	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**	**2007**	**2012**
ANDAMAN & NICOBAR ISLANDS	_	_	_	_	_	_	1448	471	_	_	_	_	_	_	_	_	_	_	_	_	_	_
ANDHRA PRADESH	_	77537	_	_	_	_	_	_	_	_	_	_	64577	452692	_	_	_	_	_	_	_	_
ARUNACHALPRADESH	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
ASSAM	32380	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
BIHAR	_	362393	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	1602	_	_	_	_
CHANDIGARH	_	_	_	_	_	_	_	_	166	_	_	_	_	_	_	_	_	_	_	_	_	_
CHHATTISGARH	29340	301810	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	6177	_	_	_	_
DADRA & NAGARHAVELI	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	2215	_	364	_
DAMAN & DIU	_	_	_	_	298	20	_	_	_	_	176	_	_	_	_	_	_	_	307	174	966	31
GOA	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
GUJARAT	_	383	_	_	661198	443355	_	_	_	_	596667	609541	_	1789	_	_	_	_	671494	384816	821726	532407
HARYANA	23921	15259	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
HIMACHALPRADESH	_	27384	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	1717	_	_	_	_
JAMMU & KASHMIR	3460	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
JHARKHAND	21289	11349	_	_	_	_	_	_	-	2530	_	1504	_	_	_	_	_	1240	_	_	_	-
KARNATAKA	51169	51411	_	_	_	_	_	_	_	_	_	_	208566	456503	_	_	4365	8582	_	_	_	_
KERALA	_	74296	_	1113	_	_	656984	994252	_	_	_	_	150	_	_	_	650	929	_	_	_	_
LAKSHADWEEP	_	_	_	_	_	_	51840	19866	_	_	_	_	_	_	_	_	_	_	_	_	_	_
MADHYA PRADESH	123418	263081	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	52918	_	_	_	_
MAHARASHTRA	_	14142	_	_	_	_	_	_	_	_	_	_	1276886	2154853	211135	185242	_	106	_	21324	_	_
MANIPUR	_	_	_	_	_	_	_	-	_	_	_	_	_	_	_	_	_	_	_	_	_	_
MEGHALAYA	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
MIZORAM	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
NAGALAND	_	181	_	_	_	_	_	_	_	_	_	-	3029	_	_	_	_	_	_	_	_	_
NCT OF DELHI	_	5626	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
ODISHA	_	201	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	7131	_	_	_	_
PUDUCHERRY	_	40	_	_	_	_	251	233	_	_	_	_	_	_	_	_	_	_	_	_	_	_
PUNJAB	36	2287	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	128	_	_
RAJASTHAN	_	256414	_	_	_	_	_	_	7574466	7179036	_	_	_	_	_	_	2904271	2985272	_	_	_	_
SIKKIM	_	274	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
TAMIL NADU	2094297	_	_	1055725	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
TRIPURA	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
UTTAR PRADESH	646559	2271929	_	_	_	_	_	1043	_	954	_	759	_	_	_	_	_	9346	_	_	_	_
UTTARAKHAND	11412	17212	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	2334	_	_	_	_
WEST BENGAL	113649	160072	_	_	_	_	_	334	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Total	1056633	3913245	2094297	1056838	661496	443375	710523	1016199	7574632	7182520	596843	611804	1553208	3065837	211135	185242	2909286	3077354	674016	406487	823056	532438

affecting the goat reproductive parameters which leads to drastically decline in their population and economy of the country GOI (2012). The most important cause of decline in reproductive efficiency of *Capra hircus* is the continuous use of highly toxic pesticides for crop enhancement. As these ruminants are herbivorous a number of pesticides directly or indirectly enter their food chain and affecting different reproductive organs as well as their physiology (Nishant and Upadhyay, 2016). The normal functional morphology of testis, epididymis, vasa efferentia, ovaries, oviducal segments and uterine tube have been found to be altered Bhardwaj and Sharma (2011); Sharma *et al*., (2013). Pesticides like Endosulphan induce changes in goat spermatogonia histomorphology like chromolysis, cytoplasm shrinkage Sharma *et al*., (2010) Malathione leads to apoptosis in granulosa cell Bhardwaj and Saraf, (2016b); Sharma and Bhardwaj (2007) and Atrazine Sharma *et al*., (2012) in last decade.

Diseases: A number of stress related cases which cause diseases have been shown out in the literature. Corbera *et al*., (2009) reported a case of transient tracheal collapse associated with bronchopneumonia in a three week old goat, but the pathogenesis remains unclear. Vilar *et al*., (2010) observed a case of dystocia and mummification of a twin foetus in a nine-year-old pregnant goat.

Increasing human demands, Lack of enforcement of proper breeding policy, Inadequate number of breeding bucks, Indiscriminate crossbreeding, Indiscriminate crossbreeding are other reason for declining goat population Haldar and Ghosh (2015).

Management and preventive strategies: There is no Breed Registration Society in India to ensure breed purity in goats and to provide identity to the enlisted animals, no attention given to valuable traits, such as fecundity, disease resistance, grazing habit, cheese quality, meat quality, skin characteristics, although these are crucial for the development programme of goats. For planning domestic animal diversity conservation plans, determination of the status and characterization of indigenous goat genetic resources are essential DAD-IS (2010).

A programme for the conservation of the Beetal goat breed in Punjab was jointly implemented from 2005 to 2008 by the NBAGR with the Krishi Vigyan Kendra (KVK). This programme was operated by the Society for Creation of Heaven on Earth, an NGO working in Tepla, Ambala Pundir (2010). Breed improvement and conservation programmes of different goat breeds under field condition were launched under the AICRP on Goats by establishing several field units of different goat breeds of India Swarup and Singh (2011). Some preliminary work on ex situ conservation of goat genetic resources has already been started at CIRG, Mathura, India. The breeds covered in this programme were mainly Jamunapari and Barbari goats.

Health Management, Diseases, and Parasites: In reference to infectious diseases, Tripathi and Stevenson (2010) focused on Mycobacterium avium subspecies para-tuberculosis. These authors studied the genetic relationship between cow and goat strains in India related to European strains. Nowadays, the relationship between nutrition and pathology plays a central role in the goat research trends. Celaya *et al.*, (2010) observed how the inclusion of heather and/or oats affects the parasite resistance and performance in goats. These authors conclude that the combination of both supplements contributes to reduced gastrointestinal nematode parasitism and increases goat performance.

Breeding policy for Goat: Along with the provisions of the National Policy of Farmers, (2007) for improving productivity of the livestock sector in a sustainable manner, The National Livestock Policy (2013) was formulated. It was aimed to improve growth, reproductive efficiency, meat quality and quantity, and to reduce death rate. Main focus was to produce and distribute good quality male of useful breeds which can survive in different environmental conditions. Artificial insemination encouragement was also considered. Cross-breeding with high yielding exotic and other native breeds of goats was also a part of this policy. Useful genes identification, conservation and utilization for breeding and research were also considered.

Conservation of threatened breeds in India: According to Mandal *et al*., (2014) generally two approaches of conservation methods i.e. ex situ and in situ may be adopted for the goat breeds in India. Generally, embryos are considered to be the best material for ex situ conservation. Sperm and embryos of goats like other farm animal species can be frozen and subsequently used to produce a normal offspring. Moreover, cryogenic storage of DNA of different goat breeds may be done as an alternative approach for conservation of goat genetic resources in India.

Current researches: The Central Institute for Research on Goats (CIRG), Mathura and the National Bureau of Animal Genetic Resources (NBAGR), Karnal, Haryana, India carried out physical characterization of a number of goat breeds such as Jamunapari, Barbari, Jakhrana, Marwari, Sirohi, Zalawadi, Gohilwadi, Beetal, etc. Roy *et al*., (2009) described the detailed physical characterization of different goat breeds of India. Molecular characterization of ten Indian goat breeds including Jamunapari, Barbari, Marwari, Sirohi, Jakhrana, Black Bengal, Pashmina, Osmanabadi, Kutchi and local goats has been successfully done at CIRG, Mathura Rout *et al*., (2008). The maximum genetic variability was observed in Jakhrana, Sirohi and Pashmina goats. BM4621 marker is the best suitable marker for fecundity traits of Indian goat breeds. Beside this, NBAGR, Karnal, Haryana also started molecular characterization of different Indian goat breeds using microsatellite markers Dixit *et al*., (2011); Mishra *et al*., (2013).

Few studies on Reproduction efficiency have been done. Gaddour *et al*., (2009) use the gamma function to fit the lactation curve of local goat pure breeds and crosses them under southern Tunisian conditions. Wang *et al*., (2010) cloned the cDNA encoding the hnRNP K gene in goats. This indicates that the hnRNP K gene may influence the reproductive ability of goats. Khalil *et al*., (2010) studied the meat and growth composition in Damascus goats and Saudi Arabian crossing animals. Several efforts are being made to reduce toxicants induced reproductive toxicity. Antioxidants like N-acetyl L-Cysteine Bhardwaj and Saraf (2017) Vitamin C Fazeli *et al*., (2010) Catalase, glutathione etc helps in reducing the oxidative stress caused by pesticides generated reactive oxygen species.

CONCLUSION

In developing countries like India livestock plays a significant role in its rural area population as it provide employment to huge number of people and also labour for land cultivation. India's livestock sector is one of the largest in the world with a holding of 11.6 per cent of world livestock population. Among different domestic animals (Goat, sheep, cow and buffalo), goats being multipurpose animal belong to family bovidae of mammals provides meat, milk and fibre. Although there are 351 breeds of goats in the world, out of which 23 well-recognized breeds are found in India but due to several factors like pesticides, increasing human demands and harsh environment, population of goat is declining in recent past considerably. Thus, there is an immediate need of management and planning for goat conservation. Although efforts have been made to conserve the indigenous goat breeds for their unique characteristics in their home tracts through in-situ and ex-situ conservation in different agroclimatic regions of India but due to improper implementation of these programs, there is not much improvement in goat population from last one decade.

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REFERENCES

18th Livestock Census (2007). All India report based on quick tabulation plan –village level totals (Provisional). Government of India, Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries., **64** : 127 – 131.

Basic Animal Husbandry Statistics. (2013). Ministry of Government of India (GOI).

Basic Animal Husbandry Statistics. (2014). Ministry of Government of India (GOI).

Basic Animal Husbandry Statistics. (2015). Ministry of Government of India (GOI).

Berry, R.O., Warwickb, L. (1948). Genetic relationship of domestic and wild species of sheep and goats based upon comparative chromosome complexes and on embryo studies. *Proceedings of the National Academy of Sciences*. **30:** 63-64.

Bhardwaj, J.K., Saraf, P. (2016a). Granulosa cell apoptosis by impairing antioxidant defense system and cellular integrity in caprine antral follicles post malathion exposure. Environmental Toxicology. 31(12): 1944-1954.

Bhardwaj, J.K., Saraf, P. (2017). N-Acetyl Cysteine-Mediated Effective Attenuation of Methoxychlor-Induced Granulosa Cell Apoptosis by Counteracting Reactive Oxygen Species Generation in Caprine Ovar**y.** Environmental Toxicology**. 32 (1)***:* 156-166.

Bhardwaj, J.K., Saraf, P. (2014b). Malathion induced granulosa cell apoptosis in caprine antral follicles: An ultrastructural and flow cytometric analysis. *Microscopy and Microanalysis*., **20** (6): 1861-1868.

Bhardwaj, J.K., Saraf, P. (2016b). Transmission electron microscopic analysis of malathion-induced cytotoxicity in granulosa cells of caprine antral follicles. *Ultrastructural pathology*. **40** (1): 43-50.

Bhardwaj, J.K., Sharma, R.K. (2011). Scanning electron microscopic changes in granulosa cells during follicular atresia in caprine ovary. *Journal of Scanning*. **33**: 21-24.

Celaya, R., Ferreira, L.M.M., Moreno-Gonzalo, J., Frutos, P., Hervas, G., Ferre, I., Garcia. U., Ortega-Mora, L.M., Osoro, K. (2010). Effects of heather and oat supplementation on gastrointestinal nematode infections and performance of grazing Cashmere goats. *Small Ruminant Research*., **91**:186-192.

Corbera, J.A., Vilar, J.M., Gutierrez, C. (2009). Transient tracheal collapse associated with bronchopneumonia in a kid goat. *Journal of Applied Animal Research*.., **36**: 53-54.

Council of Scientific and Industrial Research. (1970). The Wealth of India. Raw Materials VI. Suppl. Livestock (including poultry). Published Information Directorate, CSIR, New Delhi, India.

Delgadillo, J.A., Fitz-González, G., Duarte, G., Véliz, F.G., Carrillo, E., Flores, J.A., Vielma, J., Hernández, H., Malpaux, B. (2004). Management of photoperiod to control caprine reproduction in the subtropics. Reproduction, *Fertility and Development*. **16**: 471- 478.

Devendra, C. (2007). Goats: biology, production and development in Asia. Goats Academy of Sciences, Malaysia.

Dixit, S.P., Verma, N.K., Aggarwal, R.A.K., Vyas, M.K., Rana, J., Sharma, A., Chander, R. (2011). Genetic variability and bottleneck analyses of Kanniadu goat breed based on microsatellite markers. *Journal of Animal Sciences*., **81**: 40-43.

Domestic Animal Diversity Information System (DAD-IS). (2010). Food and Agriculture Organization of the United Nations.

Epstein, H. (1977). Domestic animals of Nepal. Homes and Meier Publishers, New York. Food and Agriculture Organization.

Fazeli, P., Zamiri, M.J., Farshad, A., Khalili, B. (2010). Effects of vitamin C on testicular and seminal characteristics of Markhoz goats. *Iranian Journal of Veterinary Research*. **11**(3): 32.

Fernandez, M.H., Vrba, E.S. (2005). A complete estimate of the phylogenetic relationships in Ruminantia: a dated species-level supertree of the extant ruminants. *Biological Reviews*. **80** (2): 269–302.

Gaddour. A., Najari, S., Ferchichi, A. (2009). Lactation curve of local goat, pure breeds and crosses in Southern Tunisia. *Journal of Applied Animal Research*., **36**: 153-157.

Gall, C. (1996). Goat breeds around the world. CTA, Margraf/ FAO, Weikersheim, Deutschland.

Gautam., Dalal, R.S., Pathak, V. (2010). Indian Dairy Sector: Time to revisit operation flood. *Livestock Science*. **127**: 164-175.

Government of India (GOI). (1997). National Dairy Development Board livestocks population in India by species. 16th livestock census.

Government of India (GOI). (2003). National Dairy Development Board livestocks population in India by species. 17th livestock census.

Government of India (GOI). (1997; 2007). National Dairy Development Board livestocks population in India by species. 18th livestock census, 19th livestock census.

Government of India (GOI). (2012). National Dairy Development Board livestocks population in India by 19th livestock census.

Halder, C., Ghosh, S. (2015). Dynamics and regulation of goat reproduction. *International Journal of Current Research and Academic Review*. **3** (8): 20-36.

Islam, M.M., Modi, S.R.J., Wadhwani, K.N. (2016). Scenario of livestock and poultry in india and their Contribution to national economy. *International Journal of Science Environment and Technology*. **5** (3): 956-965.

Jainudeen, M.R., Wahid, H., Hafez, E.S.E. (2000). Sheep and goats. In: Reproduction in farm animals, Lippincott Williams and Wilkins, Philadelphia, Baltimore.

Joshi, B., Rout, P.K., Ajoy K., Mandal, A.K., Tyler-Smith,C., LaljiSingh, L., Thangaraj, K. (2004). Phylogeography and origin of Indian domestic goats Manjunath. University of Oxford, Oxford, U.K.

Khalil, M.H., Mohamed, K.M., Al-Saef A.M., Zeitoun, M.M., El-Zarei, M.F. (2010). Crossbreeding components for growth, carcass and meat composition traits in crossing Saudi Arabia with Damascus goats. Small Ruminant Research., **94**:10-16.

Luikart, G., Gielly, L., Excoffier, L. (2001). Multiple maternal origins and weak phylogeographic structure in domestic goats. Proceedings of the National Academy of Sciences USA. **98** (10): 5927–5932.

Mandal, A., Karunakaran, M. P.K., Rout, P.K., Roy, R. (2014). Conservation of threatened goat breeds in India. *Animal Generation Resolution*., **55**: 47-55.

Mason , I.L. (1996). A World Dictionary of Livestock Breeds, Types and Varieties. C.A.B. Wallingford, Oxon., UK.

Mason, I.L. (1981). Breeds. In: Goat production, Academic Press, London, England.

Mellado, M., Amaro, J.L., García, J.E., Lara, L.M. (2000). Factors affecting gestation length in goats and the effect of gestation period on kid survival. *Journal of Agricultural Sciences*. **135**: 85- 89.

Mishra, P., Ali, A.S., Dixit, S.P., Aggarwal, R.A.K., Dangi, P.S., Tyagi, N., Dash, S.K., Verma, N.K. (2013). Microsatellite based genetic evaluation of Ghumusar goats of Orissa, India. *Animal Genetic Resources*., **52**: 59-64.

Nishant N., Upadhyay R. (2016). Presence of pesticide residue in vegetable crops: A review. *Agriculture Reviews.*, **37** (3): 173-185.

Peacock, C. P. (2005). Goats-A pathway out of poverty. *Small Ruminants Research*., **60** (1): 179-186.

Pidancier, N., Jordan, S., Luikart, G. (2006). Evolutionary history of the genus Capra (Mammalia, Artiodactyla): discordance between mitochondrial DNAand Y-chromosome phylogenies. *Molecular Phylogenetics and Evolution.*, **40** (3): 739–749.

Pilgrimg, E. (1947). The evolution of the buffaloes, oxen, sheep and goats. *Zoological Journal of the Linnean Society*. **41**: 272-286.

Pineda, M.H. and Dolley, M.P. (2003). Veterinary endocrinology and reproduction (5th edition). Lowa state press, pp. 435-458.

Pundir, R.K. (2010). Goat farmer's participation: a success story on conservation of Beetal goat. National Bureau of Animal Genetic Resources, Karnal, Haryana, India.

Restani, P. (2004). Goat milk allerginicity. *Journal of Pediatric Gastroenterology and Nutrition*. **39**: 323-324.

Romano, J.E., Fernandez Abella, D. (1997). Effect of service on duration of oestrus and ovulation in dairy goats. *Animal Reproduction Science*., **47**: 107-112.

Ropiquet, A., Hassanin, A. (2005). Molecular phylogeny of caprines (Bovidae, Antilopinae): the question of their origin and diversification during the Miocene. *Journal of Zoological Systematic and Evolutionary Research*. **43**(1): 49-60.

Rout, P.K., Joshi, M.B., Mandal, A., Laloe, D., Singh, L., Thangaraj, K. (2008). Microsatellite based phylogeny of Indian domestic goats. *BMC Genetics*. **9**: 11.

Roy, R., Roy, U., Mandal, A. (2009). Goat breeds of India. In: Goat enterprise,. Central Institute for Research on Goats, Makhdoom, Mathura, UP, India, pp. 28–41.

Sharma, R.K., Bhardwaj, J.K. (2007). Granulosa cell apoptosis in situ in caprine ovary. *Journal of Cell and Tissue Research*., **7**(2), 1111-1114.

Sharma, R.K., Chauhan, P.K., Fulia, A. (2010). Endosulphan induced changes in fine morphology of goat spermatogonia *in vitro*. *Research Journal of Environmental Toxicology*., **4** (4): 214-222.

Sharma, R.K., Singh, R., Bhardwaj, J.K., Saini, S. (2013). Topographic and ultrastructural variations in isthmus segment of oviduct during oestrous cycle in *Caprines*. *Scanning*. **35**: 344-348.

Sharma, R.K. (2000). Follicular atresia in goat: a review. *Indian Journal of Animal Sciences*. **10**: 1035-1046.

Sharma, R.K. (2012). Antioxidant Attenuation of Atrazine Induced Histopathological Changes in Testicular Tissue of Goat *In Vitro*. *Toxicology International*. **19** (3): 260-266.

Shelton, M., Willingham, T. (1992). Management of reproduction in the buck and doe under extensive conditions. Proc. VIIIth Reunion Nacional de Caprinocultura, October 14-16, Oaxaca, Mexico.

Shelton, M. (1978). Reproduction and breeding of goats. *Journal of Dairy Science*., **61**: 994-1010

Skapetas, B., Bampidis, V. (2016). Goat production in the World: present situation and trends. Livestock research for Rural development.

Swarup, D., Singh, S.K. (2011). All India Coordinated Research Projecton Goat Improvement. Project Coordinator's Report. 2009-10 and 2010–11. Mathura, UP, Central Institute for Research on Goats, Makhdoom, pp. 60.

Tripathi, B.N., Stevenson, K. (2010). Molecular characterisation of Indian strains of Mycobacterium avium subspecies paratuberculosis by pulsed-field gel electrophoresis. *Journal of Applied Animal Research*. **37**: 247-251.

Vilar, J.M., Corbera J.A., Ramirez, G.A. (2010). Dystocia and paraparesis associated with intra-pelvic space-restricting hematoma in a Spanish ibex (Capra pyrenaica hispanica). *Journal of Applied Animal Research*., **37**: 89-91.

Wang, Y., Fang, H.B., Cao, Y., Liu, L.S., Jiang, M.F. (2010). Jintang Black Goat (Capra hircus) hnRNP K: molecular cloning, sequence analysis and expression detection. *Journal of Applied Animal Research*., **38**: 159-164.

Zarazaga, L.A., Gatica, M.C., Celi, I., Guzman, J.L. (2012). Reproductive performance is improved during seasonal anoestrus when female and male Murciano-Granadina goats receive melatonin implants and in Payoya goats when females are thus treated. *Reproduction in Domestic Animals*., **47**: 436-442.

Zeder, M.A., Hesse, B. (2000). The initial domestication of goats (*Capra hircus*) in the Zagros Mountain 10,000 years ago. *Science.* **287**: 2254-2257.