

LUIT AN UNEXPLORED BUFFALO GENETIC RESOURCE FROM THE EASTERN HIMALAYAS: A REVIEW

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ABSTRACT

Buffalo farming is mainly in the hand of poor rural farmers of the North-Eastern Hill region. The farming community is ailing by pronounced land scarcity with the ratio of agricultural land to agricultural population and these farmers find buffalo rearing quite convenient for their livelihood. The buffalo population of North-Eastern India is basically of indigenous, or swamp type and the animals are hardy and quite adaptable to the local warm and humid conditions of the region. This type of buffaloes was registered as the 14th breed of buffalo in India named “Luit”. Farmers of North-East India primarily rear the “Luit” for dual purposes i.e. milk and work. The milk of Luit is having great demand in the market. Among the farmers and consumers, it is commonly famous as “Khuti Milk” due to its high-fat percentage. Luit is also used for agricultural operations viz. ploughing and paddling the wet rice fields and carting. Adult male or female Luit is mostly used as a single animal to plough rice fields with locally designed ploughs. Nowadays, the breed is declining in number very fast, whereas these buffaloes are very good source of livelihood

for the nomads and poor farmers, hence immediate steps should be taken to save this precious breed in its natural territory.

Keywords: *Bubalus bubalis*, buffaloes, Luit, swamp buffalo, habitat, population, communal importance, conservation

INTRODUCTION

Buffaloes are the backbone of the rural economy in many developing countries including India. It is of great economic significance in tropical and sub-tropical parts of Asia and in some parts of Europe. It is a triple-purpose animal being used for milk, meat and draft. The buffaloes can utilize the roughages and crop by-products efficiently and convert them into high-quality milk suitable for a wide range of dairy products including butter, milk powder, mozzarella cheese, khoya, curd, yoghurt, shrikhand, dried ice cream mix, dairy whitener etc.

It has been seen last 10 years that the buffaloes have continuous growth at the rate of about 2.1% per annum as against the average

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growth rate of approximately 1.0% in India (Annual Report- 2020, CIRB, Hisar). India possesses a 535.78 million total livestock population and out of which 109.85 million buffaloes (20th Livestock Census, 2019). India ranks top regarding buffalo milk and meat production. Although breedable buffaloes are almost - third in number as compared to cattle it produces more than 50% of the total milk produces in India (Annual Report- 2017-2018, DAHDF, India) that constitute 36% of the milk-yielding bovine population. According to 20th Livestock Census (2019), the total buffalo population in the North-East India region is about 0.57 million, out of which Assam possess more than 90% (4.22 lakh) followed by Manipur with 9.17% (0.65 lakh). There is a decreasing trend in the buffalo population of the NEH region where five out of eight states showed negative population growth of this species. As per the report, there was a trivial increase in the buffalo population in Meghalaya and Mizoram, where buffalo husbandry is not popular as compared to other states (Annual Report- 2020, CIRB, Hisar).

The domestic or water buffalo (*Bubalus bubalis*) has descended from the arni or wild Indian buffalo (Chantalakhana, 1994; Talukdar *et al.*, 2015b). They are members of bovine animals classified into two main species. These are African wild buffaloes (*Syncerus*) and Asian buffaloes (*Bubalus bubalis*), which are the most domesticated (Abd El-Salam and El-Shibiny, 2011). Asian buffaloes are further classified into river and swamp buffalo subspecies (Perera, 2008). Generally, river buffaloes are called as water buffaloes which have high milk yields than swamp buffaloes. They belong to the same species, but they have very different physical characteristics and habits. Presently, there are 72 buffalo breeds in the world, whereas 57 are in Asia. In India, there

are 20 buffalo breeds, the most popular of which are the Murrah and *Nili-Ravi*, noted for their high milk yield performance (Singh, 2013).

Buffaloes play a key animal in the agriculture economy of south Asian countries where buffalo farming is mainly in the hand of poor rural farmers. The farming community of south-east Asian countries is ailing by pronounced land scarcity with a ratio of agricultural land to the agricultural population of 0.23 hac/caput (FAO, 2012). These farmers find buffalo rearing quite convenient for their livelihood. In most south-east Asian countries including India, some poor families earn their livelihood solely by maintaining one or two livestock and selling their products.

The North-Eastern India buffalo mostly have indigenous, or swamp type buffalo and the buffaloes are tough and relatively adaptable to the warm and humid environment of the region. This type of buffaloes was registered as the 14th breed of buffalo in India named “Luit” (NBAGR, 2018). Luit buffaloes are medium in size with conical faces and broad heads. The horns are long, flattened at the bases, somewhat triangular in the middle, running upwards, forwards and backwards, ending in pointed tips (Figure 1). The study of Islam *et al.* (2018) revealed that the body length, height, heart girth and paunch girth for young and adult Luit buffaloes ranged from 70.45±0.82 to 143.62±1.10, 81.34±0.60 to 136.31±1.00, 88.85±0.53 to 186.95±0.95 and 96.04±0.83 to 197.96±0.99 cm, respectively. The skin colours are grey at birth but become slate blue later. Horns, hooves and hairs normally have a lighter shade; the usual description is dark grey (Akhtar, 1997). However, some albinoid individuals are also noticed (Figure 2). River buffaloes are very rarely white. Luit, the swamp buffalo is never brown i.e. grey-brown, as the river buffalo sometimes is, and walleyes and

pigmented irises are rare. The size and degree of curvature of the horn of Luit vary within and between countries. In Malayam buffalo, there is comparatively little variation in either length or shape, whereas, in the Philippines, horns vary in their degree of curvature, some forming a semicircle while others are directed laterally. In South Indochina, horn lengths vary considerably. In China, there is considerable variation in direction and degree of curve. In Thailand, the variation in horn size and shape is even greater. Excessive long horns with similar shapes are available in Indonesia. Hornless animals and loose horns do occur, but they are rare. In river buffaloes, the horn grows downward and backwards and sooner or later curves upward in a spiral with its long axis horizontally. Even long horn swoops backwards, outward and twisted. In river buffaloes, the shape of the horn remains consistent.

The people of Assam have been traditionally rearing swamp buffaloes for milk and draught for the cultivation of paddy and other cereal crops in the embankment and small islands of the mighty river Brahmaputra (Luit); hence these buffaloes are named as Luit. They are especially preferred for ploughing wet paddy fields and low-lying lands inundated by floods. The traction ability of Luit buffalo has been estimated to be 1.2 HP as compared to cattle bullocks (Akhtar, 1997). The average lactation yield of Luit buffalo is 449 kg with an average milk fat of 8.68 % and they are usually milked once in the morning before letting them out for grazing. A large proportion of these buffaloes are reared on river islands, riverbanks and forest land in large groups (Figure 4), locally called Khuti which means nomadic (Talukdar, 2014a).

As per the 20th livestock census (2019), Govt of India; Assam has 4.22 lakh numbers of

Luit buffaloes, which shared only 2% of the total livestock population. If we look at the 2007 and 2012 livestock censuses, Govt of India; the buffalo population in Assam was 5.0 and 4.35 lakh, respectively the population decreased by 16% and 3%, respectively in the 20th livestock census. Since the Assamese buffalo breeders belong to the poor farming community, mostly tribals and nomads and there is shrinkage in cultivable land in its breeding tract, the breed is declining in number very fast, whereas these buffaloes are a very good source of livelihood for the nomads and poor farmers, hence immediate steps should be taken to save this valuable breed in its natural habitat.

Habitat and geographical distribution

The area of distribution of the Luit buffalo in South-East Asia extends northward as far as the Yangteen valley of china and westward as far as Assam (Kalita *et al.*, 2010). These buffaloes are much closer to the wild type than the buffaloes of India. They are sharply distinguished from the other recognised Indian breeds of buffaloes not only in appearance but also in behaviour and use. The natural habitat of these buffaloes is in swampy and marshy land and so-called swamp buffaloes (Amin *et al.*, 2015). The breeds of Indian buffaloes like Murrah and Surti are recognised as river buffaloes since their habitat are river valleys, and they generally prefer the clean water of the river. Besides the use of the term swamp buffalo to cover all the local buffaloes in South- East Asia and the used the term river buffalo for all the types in India and further west. Besides Assam, the rest of India possesses river buffalo only except Chennai, Tamil Nadu where river and swamp buffaloes are available, where the river buffalo has been selected to develop improved breeds with high milk yield and differing horn characteristics. The swamp

buffalo has not been thus separated into types. It has a relation with the low milk yield and primitive horn shape of the wild “Arni” (Kalita *et al.*, 2010).

In Assam, the Luit buffaloes are mainly distributed in the upper, lower and central Brahmaputra valley in the districts of Sibsagar, Dibrugarh, Jorhat, Kamrup, Marigaon, Sonitpur, Golaghat, Barpeta, Nalbari, Darrang, Goalpara, Cachar, Karimganj, Hailakandi (Figure 3). The population of Luit buffaloes in Assam is estimated 421715 numbers (20th Livestock Census, 2019).

These buffaloes are also the natives of the Sikkim state (Figure 3). This is a small-sized hardy buffalo (250 to 400 kg) with a compact body and thick coat, suited for hilly terrain with black and grey colour. The Luit buffaloes are poor milkers.

The swamp buffaloes are also distributed in the hilly as well as valley/plain regions of different parts of Manipur state of India, which is named as Manipuri buffaloes (Singh, 1978). Manipuri buffaloes are found to be of pure domesticated swamp type based on their karyotypic profile (Mishra *et al.*, 2009) but the breed yet to be registered. Based on the habitat and distribution, Manipuri buffaloes are locally classified into two categories viz. hill type termed as “Tamgieroi” mostly found in Chandel, Churachandpur, Ukhrul, Senapati and Tamenglong districts of Manipur and the valley type named as “Chingi-eroi” are speckled in Imphal East, Imphal West, Bishnupur and Thoubal districts of Manipur. Most of the buffaloes of the Manipur are distributed in the Imphal Valley around “Loktak Lake”. The areas surrounding the lake are low lying and plenty of indigenous aquatic grasses such as Dal, Nal, Arali and other indigenous grasses are available throughout the year. In this area, buffaloes are mainly used as plough animals and the area also is wonderfully suitable for buffalo rearing (Singh,

1978). The population of swamp buffaloes in Manipur is estimated at around 0.77lakh (Livestock Census, 2019). The population trend is indicating a staggering decline of about 45% during the last 20 years.

Management system

The Luit buffaloes of North-Eastern India are generally reared under three systems of management i.e. semi-domesticated, nomadic and settled (Sahjahan, 1996). In the semi-domesticated system, the buffaloes graze freely in the jungle during daytime and return in the evening for shelter (Figure 4). After returning from the jungle the animals are provided with fodder, water and a few common salts. In the nomadic system (Khuti), the buffaloes are grazed in a forest reserve or char (small river island) for a limited period till the grasses will be finished and then the animals will be moved to another similar place. In Assam, mostly the buffalo herds are reared in remote forest areas (professional grazing reserves) or in the riverine areas (Char or Chapori) or bank of the river as the “Khuti” system where abundant natural green grasses are available throughout the year. These are migratory. People move “Khutis” from one place to another in search of green grasses and also during the high flood. The cows are milked once in the morning and let loose to graze in the forest or grassland throughout the day. Some owners bring their cows back to the “Khuti” in the evening, but the majority allow their animals to remain at large during the day and night. Those cows having calves in the “Khutis” came to their “Khutis” in the morning to be suckled and milked by the owners. The “Khuti” owner named their animal and by calling their name they recognise their animals (Sahjahan, 1996). In the “Khuti” the buffalo cow is bred by buffalo bulls and let out

with them during grazing. Occasionally “Khuti” owners hire the buffalo bulls from another “Khuti” for breeding purposes. The number of breedable males is a problem in these “Khutis”. Animals are reared primarily under a zero-input system. No housing is provided in the hilly tract while in the valley, animals are provided thatched house open on all sides except for the roof. In the hilly region, buffaloes are largely let loose in the forests for grazing and stay in the forests even at night. During the rice cultivation season only (May to July) buffaloes are kept at home and used for ploughing the rice fields. For the rest of the period, the animals remain in forests and were rarely provided with any additional feed or fodder except for an occasional salt lick. In the valley they are mostly reared in inaccessible forest areas (professional grazing reserves) and so their development through better feeding, management and disease control is still a problem. With the increase in human population and subsequent demand for cultivable land to produce more food by deforestation, the majority of herds became accessible to man, resulting in a change in nature from semi-wild to approachable docility. At this stage, a systematic study was considered worthwhile to utilise them for work and enhanced milk production.

In the settled system of management, the farmers reared 5 to 6 numbers of buffaloes with locally available feed and fodder resources. Despite their profound impact on the rural economy and their significant contribution both in terms of milk and work, the Luit buffaloes of Assam have not received the due attention of scientists and policymakers.

The buffaloes in the flood-affected area depended on grasses like “HARANG” grown naturally even in the flooded water. Concentrate feed was not practised. Chopped grasses were

provided only to calves till 6 to 7 months of age. Newly born calves were allowed to suckle the mother's milk till they were 20 to 22 days of age (Tamuly, 1978). During this period no milking was possible because the mother showed excitement when approached for fear of losing her calf. After 22 days of calving, the female animals were allowed to milk once a day in the morning only. In the afternoon milking was avoided for the reason that the herds were maintained inside inaccessible forest areas, and the cows generally return to the common places late in the evening by which time even if they were milked, marketing of milk was not possible. To avoid fighting among the bull calves; the calves were sold at the age of 10 to 12 months. Adult buffaloes preferred to wallow in stagnant water and muddy places of a swampy area. Bulls preferred to wallow almost throughout the day (Tamuly, 1978).

Productive and reproductive performances

The milk of Luit buffaloes is having great demand in the market and among the farmers and the milk among the consumers is commonly famous as “Khuti Milk” due to its high-fat percentage (Table 1). Due to the higher butter fat percentage in milk, it is preferred for the preparation of curd and ghee etc. which fetches high prices. The mean specific gravity and percentages of fat, solids not fat and total solids in the milk of the Luit buffaloes of Assam were found to be 1.0296 ± 0.0002 , 8.478 ± 0.67 , 9.197 ± 0.039 and 17.675 ± 6.088 , respectively (Zaman *et al.*, 2019). Buffalo milk is mainly sold to the milk vendors. The farmers are also earning money by selling live animals. The marketing pattern of animals was observed maximum from Khuti, weekly market and through a middleman (Das, 2009). As far as the utility of the breed is concerned 82.69% of breeders keep

the buffaloes of this breed for milk purposes and only 17.31% of farmers keep them for milk and meat production (Alam *et al.*, 2017) whereas Das (2009) reported that the Luit buffaloes are used by the farmers both for milk and work purpose and these animals are suitable for many agricultural activities particularly in low lying water merged areas for ploughing paddy fields.

The average milk yield of Luit buffalo is 681.40 ± 22.74 kg per annum and the lactation length is 245.52 ± 0.67 days (Sahjahan, 1996). The dry period was recorded as 268.40 ± 1.07 days (Sahjahan, 1996). Age at first calving for Luit buffalo is 59.09 ± 0.29 months, with a gestation period of 332.96 ± 0.37 days (Sahjahan, 1996).

Deka *et al.* (2018a) reported that the behavioural signs of oestrus were not prominent in Luit buffalo cows. The clinically detectable external signs exhibited by the Luit buffaloes during oestrus were oedematous vulva and hyperemia of the vaginal mucus membrane. The average duration of oestrus in Luit buffalo cows was 19.41 ± 0.97 h with a range of 18 to 30 h. The average age at first calving, post-partum oestrus interval, service period, gestation period and inter-calving period of Luit buffalo is 1841.75 ± 95.18 , 262.90 ± 30.27 , 331.63 ± 65.51 , 304.18 ± 2.05 and 795.39 ± 104.53 days, respectively (Deka *et al.*, 2018b).

The ejaculate volume, sperm concentration, live sperm, live intact acrosome, sperm head abnormality, mid piece abnormalities, tail abnormalities, freezability percentage of Luit buffalo bull semen is 2.21 ± 0.06 ml, 1186.68 ± 15.32 million/ml, $80.57 \pm 0.50\%$, $94.92 \pm 0.16\%$, $0.80 \pm 0.11\%$, $0.50 \pm 0.08\%$, 3.75 ± 0.18 , 61.11 ± 0.67 , respectively (Talukdar *et al.*, 2014b; Talukdar *et al.*, 2016). Talukdar *et al.* (2015a) reported that the effect of seasons was found to be significant for Luit buffalo bull semen volume ($P < 0.01$), initial

sperm motility ($P < 0.05$), sperm concentration ($P < 0.01$), and total head abnormalities ($P < 0.05$). The ejaculate volume and sperm concentration were significantly ($P < 0.01$) higher during the summer season. The initial sperm motility was significantly ($P < 0.01$) lower and the incidence of head abnormalities significantly ($P < 0.05$) higher during the winter season.

Anoestrus is the major reproductive problem in Luit buffaloes with an overall incidence of 45.23% in cows and 83.33 in heifers (Deka *et al.*, 2018b; Kumar *et al.*, 2013). It is due to negative energy balance, mineral deficiency as well as higher environmental temperature affecting folliculogenesis and steroidogenesis (Kumar *et al.*, 2013). Suckling, level of nutrition, loss of body weight during the post-partum period, parity, season of the year and presence and absence of bull were found to be the factors determining the incidence of post-partum anoestrus in buffaloes (El-Wishy, 2007). Silent oestrus might be due to a lack of adequate secretion of oestradiol by mature and secondary follicles or due to the need for a higher threshold of oestrogen in the central nervous system to produce the characteristic nervous symptoms (Roberts, 1971).

Socio-economic importance

Buffaloes are economically and culturally important livestock species especially in developing countries (Arefaine and Kashwa, 2015). It plays a significant role through contributions to social and cultural aspects (Desta, 2012). Buffalo holds the highest potentiality for production with a promising gene pool, which is still not fully used. Buffaloes are good source of meat and milk. Buffalo milk can be transformed into numerous kinds of cheese, primarily mozzarella (Aspilcueta-Borquis *et al.*, 2012). Furthermore,

buffaloes are valuable work animals, commonly used as draught animals in crop fields (Perera, 2008). Due to these reasons, the water buffalo is often called the living tractor of the East since it is relied upon for draught and transportation in many parts of Asia (Chantalakhana, 1994). Leather is another major contribution of buffalo to the world market (FAOSTAT, 2014). Dung is used as organic fertilizer. Buffalo racing and ploughing contests and fighting are among the traditional festivities after the rice harvest in Thailand (Chantalakhana, 1994). The water buffalo is the second most important species in the world in terms of milk production, after dairy cows and is a good source of milk and meat in South Asia (FAOSTAT, 2014). Compared to cow, buffalo milk is higher in protein, fat, lactose and energy. The population of global buffalo is 194.29 million; Asian buffalo dominate the world population, representing 92.52% (179.75 million) of the total buffalo population (FAO, 2012; Coroian *et al.*, 2013). Within the Asian region, about 74.80% of buffaloes are in South Asia, 12.80% in East Asia and only 8.40% are found in South-East Asia. India is the world's 4th meat producing country and the largest buffalo meat exporting country globally. The growth rate of buffalo meat production is 4%, whereas cattle meat is 3.5%.

The milk of swamp buffaloes is physico-chemically different from other livestock species, which having higher content of fatty acids and proteins (D'Ambrosio *et al.*, 2008). Even, the milk composition of swamp and river buffalo also differed (Khan *et al.*, 2007). The buffalo milk contains higher levels of total solids, crude protein, fat, calcium, and phosphorus, and slightly more lactose compared to cow milk. The high level of total solids makes the buffalo milk perfect for processing into value-added dairy products such as cheese (Roychoudhury, 2000). The conjugated

linoleic acid content in buffalo milk ranged from 4.4 to 7.6 mg/g fat (Khan *et al.*, 2007). The buffalo milk is processed into a huge range of dairy products, such as cream butter, ghee etc. The ghee from swamp buffalo milk has a different texture with a bigger grain size than ghee from cow milk (Borghese, 2005). Heat-concentrated milk products include paneer, khoa, rabri, kheer and basundi. Fermented milk products include dahi and yogurt (Borghese, 2005). The poor livestock farmers earn money by saling of these buffalo milk and milk products. In Assam, the buffalo milk is costing around INR 50.00 per litre, dahi 150.00 per litre, yogurt 400.00 per kg, paneer 450.00 per kg, ghee 500.00 per kg, sweet 20.00 per piece. The farmers sold their products either in the daily market or the milk cooperative. Near festive season of Assam like bihu, durga puja, marriage ceremony the prizes of the milk and milk product is higher than the non festive season.

The buffalo meat, called as "carabeef", is often preferred by certain tribal community of Bodo, Rabha, Kasari, Koch etc. In Indian mythology, evil is often represented by the swamp buffalo. The Hindu god of death, Yama, rides on a swamp buffalo (Wiley, 2017). A male swamp buffalo is sacrificed in many parts of India during festivals associated Shaktism sect of Hinduism (Hiltebeitel, 1980; Fuller, 2004). In Assam, the buffalo meat is costing around ₹400.00 per kg. In many Asian countries, the swamp buffalo meat is less preferred due to its toughness; however, it has been observed that recipes have evolved where the slow cooking process and spices not only make the meat palatable, but also preserve it, an important factor in hot climates where refrigeration is not always accessible.

The buffalo hides provide tough and useful leather, often used for shoes. Buffalo bones and

horns are usually made into jewellery, especially earrings. Horns are used for the embouchure of musical instruments, such as ney, kaval and pepa (Buffalopedia). The pepa is a hornpipe folk instrument (Figure 5) found in Assam that is used in traditional music in Assam, India. In Bodo language, it is known as *Phenpha* (Barthakur, 2003). It is also called as ‘Jodia Pepa’ particularly used during the ‘Bihu’ festival of Assam. This kind of pepa is known by different names in different tribal communities of Assam, such as, the Missings call it ‘Pempa’, The Dimasas ‘xuri’ the Rabhas ‘Singra’ and the tea tribe calls it ‘Pepati’. It is generally made with the horn of a swamp buffalo. And in Assam, it is costing around INR

1800 to 2000.00 per piece. As per report, the buffalo population of Assam is declining gradually due to shrinking pastoral lands, and getting a kaval and pepa is presently very difficult.

The Moh juj or swamp buffalo fighting festival is held every year during Bhogali Bihu in Assam (Fig. 5). It is one of the most popular games during Bhogali Bihu of Assam (Dutta, 2008).

Alam and a co-worker did tremendous work on the socio-economic status of the buffalo breeder of Assam and they reported that a large proportion of Assamese buffalo breeders (44.23%) belonged to the age group of 40 to 50 years, followed by 32.85% of the population belonged to less than 40 years and 23.08% belonged to more

Table 1. Performance of Luit, the swamp buffalo of North-East India in regard to production, reproduction and milk quality traits (Government of Assam, 2020).

Trait	Values
Age at first calving (m)	59.03±0.42
1 st lactation milk yields (kg)	509.63±4.20
1 st lactation length (d)	282.87±78
1 st lactation peak yield (kg)	4.09±0.04
Days to attain 1 st peak yield (d)	58.28±0.93
Persistency 1 st lactation	0.88±0.01
Lactation milk yield (kg)	505.95±3.14
Lactation length (d)	283.43±1.44
Peak yield (kg)	4.08±0.03
Days to attain peak yield (d)	57.89±0.68
Dry period (d)	224.58±2.17
Service period (d)	181.75±2.39
The gestation period (d)	325.85±0.42
Inter calving period (d)	507.80±2.39
Birth weight (kg)	32.06±0.10
The specific gravity of milk	1.0296±0.0002
Fat % of milk	8.478±0.069
S.N.F. % of milk	9.910±0.039
Total solids % in milk	17.675±0.088



Figure 1. Luit buffaloes: male, female and calf.



Figure 2. Coat colour of Luit buffalo (A. Grey and B. Albino).

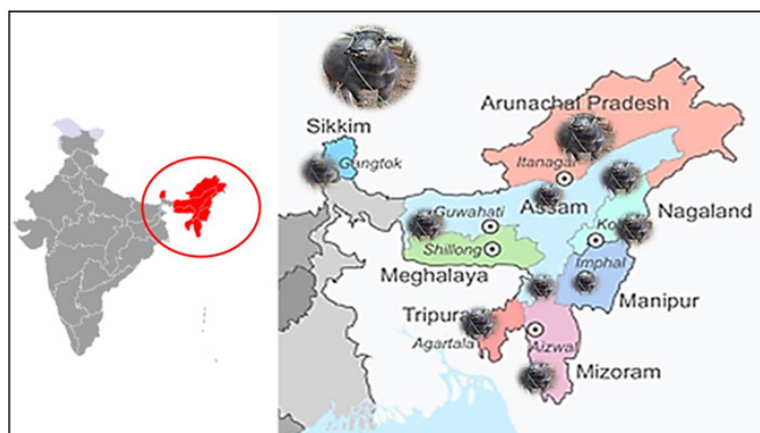


Figure 3. Geographical distribution of swamp buffaloes in the North-Eastern region of India.



Figure 4. Rearing of Luit buffaloes.



Figure 5. Socio-economic relation of Luit with Assamese community (Source: Google).

than 50 years of age. More than half of the breeders had at least basic education with 28.85% having matriculation level education followed by 19.23% primary education and a very small number of breeders (1.92%) had above 12th standard education (Alam *et al.*, 2017). As they reported the land holding size of the majority of the buffalo breeders (51.92%) was 0.86 to 1.43 ha, whereas 28.85% of buffalo breeders had above 1.57 to 2.86 ha of land and none of the breeders found to be landless. The average family size of the buffalo breeders was recorded to be 6.6 with 42.31% of the breeders having 5 to 6 family members and only 13.36% having more than 9 family members. In most of the buffalo khuti (open herds), about 46.15% of buffalo breeders maintained 1 to 2 paid graziers for grazing, feeding, housing and other management practices of the buffalo khuti's (open herds). They found only 26.97% of the buffalo khuti (open herd) were extensively managed by the breeders and their family members only. As for graziers are concerned, a large number (79.74%) of the hired graziers were found to be illiterate and only a small number of graziers (3.85%) had middle standard education. Almost all farmers (breeders) in the breeding tract of Luit buffaloes had a land holding of 0.86 to 2.86 ha, which means they were associated with both agricultural and livestock activities for their livelihood. About 59.62% of breeders were receiving an annual income between INR 20,001 to 50,000, followed by 26.92% (up to INR 20,000) and 13.46% more than INR 50,000 out of agricultural activities, whereas income from livestock ranged from 50,001 to 75,000 per year for more than 40.38% farmers followed by 28.85% (INR 75,001 to 1,00,000) and 19.23% (up to INR 50,000). This breed plays a very important role in earning the livelihood of the farmers on an almost zero input system, especially in the Nagaon,

Kamrup and Darang districts of Assam (Alam *et al.*, 2017).

Conservation strategies

The country's buffalo genetic resources especially the native germplasm need to be developed and used prudently. Unplanned breeding may be the major cause of decreasing the population of such species. It's our term to save the rich biological diversity of this species.

Generally, there are two means of conservation i.e., in-situ and ex-situ. Conserving the live animal in the nature in which they belong is named in-situ conservation. In this conservation, the animals are maintained in their natural and original habitat with no intervention of management, feeding and breeding. The main drawback of this in situ conservation is inbreeding and genetic drift typical of small populations. It was observed in Assam that interbreeding between wild and domestic buffaloes is quite common because the domestic animals run free in "Khuti" system of management. As a result of frequent mating between the wild males and domestic females, the wild and domestic buffaloes are very similar except for the large size of the former.

The ex-situ conservation is to be used to conserve the endangered wild population whose number become cheerlessly low. In ex-situ conservation, we generally preserve sperm, oocytes, embryos, DNA and embryonic stem cell. Now the day is possible to preserve a wide variety of living cells for long periods. The assisted reproductive techniques can be used for the conservation of such species. Though it is a very popular conservation strategy time the animals may suffer from environmental stress due to the unnatural habitat of the species and there may be a maximum chance of disease

transmission. Sometimes we may lose the species if the institutional intervention is weak, besides it is also costly enough for long-term preservations and losing the kinship of the current genotype in the environment when one of these is preserved for a long time.

CONCLUSION

Luit is the only registered swamp buffalo breed of India which originated from the NEH region of India. Farmers rear Luit buffaloes for dual purposes i.e. milk, ploughing and pudlling the wet rice fields and carting. The milk of Luit is having great demand in the market due to its high-fat percentage. Adult male or female buffaloes are mostly used as the single animal to plough fields with locally designed ploughs. Nowadays, the breed is declining in number very fast, whereas these buffaloes are a very good source of livelihood for the nomads and poor farmers, hence immediate steps should be taken to save the precious Luit; the swamp buffalo breed in its natural environment.

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