



Phenotypic characterization and performance evaluation of Silumkhasi and Masipnar cattle: Unique indigenous germplasm of northeastern region of India

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ABSTRACT

The present study was conducted in different districts of Khasi, Jaintia and Garo Hills division to assess the phenotypic variability, morphometric characteristics and performances traits of Silumkhasi and Masipnar cattle of Meghalaya. The questionnaire was completed by 224 tribal farmers from 28 villages to collect information on different management practices and 1030 animals of different ages and sexes were taken for evaluation of existing production system. It was found that Silumkhasi cattle were small size (70 %), well built, sturdy, well-developed hump with a tuft of hairs, round shape of the body and Masipnar cattle were larger size (85 %), longer neck, greater height, moderate to large size of hump with a cylindrical shape. The body colour of Silumkhasi cattle varied in different colours which included white (60-70 %), greyish black (5-10 %), brown (4-6 %), and mixed with brown and black (21-24 %). The body colour of Masipnar cattle varied in different colours which included brown (40-60 %), white (10-20 %), greyish black (10-20 %), and mixed (5-10 %). The average body length, height at wither, heart girth, horn length, ear length, face length and tail length with switch, switch length, dewlap length, hump size, muzzle circumference, neck length in Silumkhasi cattle were 93.66±0.6 cm, 95.16±0.6 cm, 120.83±0.60 cm, 8.83±0.6 cm, 18.83±0.79 cm, 40.5±0.42 cm, 75.5±0.42 cm, 18.83±0.6 cm, 10.8±0.6 cm, 9.3±0.6 cm, 35.3±0.4 cm and 51.83±0.4 cm, respectively. The measurement of all morphometric traits in Masipnar cattle was higher than the measurements made on Silumkhasi cattle. It may be concluded that Silumkhasi cattle of Meghalaya are comparatively smaller in size and showed uniformity in physical and morphometric traits and differ in their proportion of all traits compared to the Masipnar cattle. The findings of our report for Silumkhasi and Masipnar cattle of Meghalaya would be useful to characterize, breed registration, and conserve them through a suitable breeding programme.

1. Introduction

The North-Eastern region of India is one of the major biodiversity hotspots in the world. This region is not only contributing plant diversity but also represents a huge diversity in animal genetic resources. The unique domestic species like yak, mithun and wild species like one-horn rhino and pygmy hog are the heart throb of this region and well known globally. This region of India lies between 21.5° N to 29.5° N latitude and 85.5° E to 97.5° E longitude and comprises Assam, Arunachal Pradesh, Manipur, Meghalaya,

Mizoram, Nagaland, Sikkim and Tripura. This region has a unique agro ecosystem such as high annual rainfall (2500-3000 mm), subtropical to alpine climate, undulated and hilly terrain with the altitude ranges from 1,000 to 3,000 m above the mean sea level. About 65.59 % of the geographical area is covered by forest (India State of Forest Report, 2015) which is mostly under private or community ownership. This unique geographical location leads to diversity in animal genetic resources and their production system. By and large, this region practices an integrated subsistence low input tribal

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production system where livestock and poultry play a complementary and vital role in improving the socioeconomic status and livelihood of the people.

In Meghalaya, the total milk production has increased from 82.16 thousand tons in 2013-14 to 86.61 thousand tons in 2018-19. However, the per capita availability of milk in Meghalaya is only 84 gm/day (BAHS, 2019) against the ICMR recommendation of 250 gm/day. To meet the deficiency of milk production in the state, crossbred cattle have been introduced to enhance the milk production in the state, besides import of milk from other parts of India. Presently, the crossbred cattle contribute 3.63 % of the total cattle population in Meghalaya (BAHS, 2019). However, crossbred cattle with exotic inheritance have many disadvantages. Based on our studies, the crossbred cattle required high nutritional requirement costs. For example, the minimum concentrate feed requirement for adult crossbred cattle is 3 kg/day besides 25-30 kg green fodder and 4-5 kg dry fodder. The 3.63 % of crossbred cattle in Meghalaya alone requires 102 tons of concentrate feed, 960 tons of green fodder and 128 tons of dry fodder per day. The promotion of fodder cultivation is a major concern due to less cultivable land (12%) in the state. Unlike indigenous cattle, the milk yield of crossbred cattle decline after 4th calving, besides longer calving intervals leads to lower life time productivity. Further, the crossbred cattle require high input and management cost over indigenous cattle which leads to higher production cost of milk per Litre. Although the milk yield of indigenous cattle is lower than crossbred cattle, it produces high quality milk. For example, indigenous cattle can produce an average milk yield of 1.2 L/day/cattle with a low or zero input production system. The milk yield can be increased from 1.2 L to 2.5 L with proper management including nutrition and health care. This will lead to an approximate increase of total milk production by 1.10 thousand tons in addition to the present total milk production in the state, thereby increasing the per capita availability of milk expected to increase 94 g/day in the state (DAHD, 2020).

Around 80 % of Indigenous livestock are distributed in marginal, small and medium land holdings and 81 % of people get their livelihood from the agriculture sector. The cattle in these regions are raised for beef, milk, hides, draft, and their dung is used in manure or as fuel. The total cattle population of India is around 192.49 million (BAHS, 2019) showing an increase of 0.8 % over previous census. Meghalaya has a total of 9,03,570 cattle, of which 8,70,165 (96.30 %) are nondescript indigenous cattle and 33,405 (3.69%) are crossbred cattle (BAHS, 2019). These non-descript indigenous cattle called “Silumkhasi or Khasilum or Khasimasi” and “Masipnar or Masichnong” were maintained by Khasi and Jaintia tribal communities in

Khasi Hills and Jaintia Hills districts of Meghalaya. These cattle were reared by tribal farmers for meat, milk, skin, manure, and draught purposes. These cattle may exhibit late maturity, short lactation duration, long calving intervals, and poor milk production, but they are disease-resistant and can withstand harsh conditions (Kale *et al.*, 2018). Although indigenous cattle play an important role in the household and national economies, their productivity remains low, and populations are under threat (Mapiye *et al.*, 2019).

Locally adapted breeds will continue to be valued in the state since the state cannot afford the inputs necessary to support exotic and crossbred cattle that have evolved in low-stress, high-input production systems over a long period of time. While considering the utility of this breed and some of its important characteristics, the present study was made to assess the phenotypic characteristics of Silumkhasi and Masipnar cattle by evaluating their physical traits, productive performances, breeding habitat and management system under its home tract. Hence, genetic improvement plans may be designed to enhance the productivity, and registration of this breed population can be done.

2. Materials and Methods

2.1 *Study area, sampling pattern and population distribution*

In order to locate their geographical distribution and population status, the survey was conducted in different districts of Khasi, Jaintia and Garo Hills of the Meghalaya. The geographical location of the study place lies between 25°35'N latitude to 91°38'E longitude. The Khasi and Jaintia Hills, which were located in the western part of the plateau at lower elevations, experience high temperatures of 22°C to 30°C for most of the year. Except for winter, the temperature was warm 8.5°C to 22°C and relative humidity varied from 39-66 %. The average annual rainfall was about 2134.5 mm per year.

A total of 1030 local indigenous non-descript cattle from 28 villages were selected to record information on various management practices used by the livestock owners in the state. The farmers were interviewed to determine the habitat, status, management, utility, and performance of the existing cattle population. Furthermore, farmers were asked about the choice of breed, sale and purchase of animals, animal housing, feeding, breeding and prevalent diseases in their area. Through structured questionnaires, farmers were asked questions related to reproductive and productive traits like birth weight, daily milk yield, lactation length, age of first calving, dry period, service period, and calving interval. Information on different body measurements and physical characteristics viz., body length, chest girth, height at withers, paunch girth, face length, horn length, ear length, etc. with shapes and orientations were recorded on 1030 animals of different ages and sex.

3. Results and Discussion

1.1 Distribution and population intensity

The present study revealed that the home tract of Silumkhasi and Masipnar cattle were mostly distributed in different districts of Khasi and Jaintia Hills of Meghalaya (Fig. 1). During the years 2012 to 2019 indigenous cattle declined by 1.03 times and crossbred population increased by 0.207 times than the previous census (BAHS, 2019). As per the structured questionnaire survey, the highest numbers of small type of indigenous cattle (Silumkhasi) were found in the South West Khasi Hills (65%), followed by East Khasi Hills (60%), Eastern-west Khasi Hills (52 %), West Khasi Hills (50%), and Ri-Bhoi (10%) districts (Fig. 2). The large type of indigenous cattle (Masipnar) were found maximum numbers in the East Jaintia Hills (70%) followed by West Jaintia Hills (30%) (Fig. 2).

3.2 Managemental practices

3.2.1 Housing system

The Silumkhasi and Masipnar cattle were reared semi-intensively and also by an extensive system in all studied districts. Bamboo and wood were commonly used as housing materials with soil as flooring. The most common housing materials were bamboo, bricks, wood with tin/thatched roof (94%), and soil being used for the flooring (98%). There were also some tribal farmers (9%) who shelter the animals under their living house, but in most cases (91 %) both cattle houses were separated from the residence of farmers. Almost all farmers' cattle houses did not have an adequate drainage system (99 %).

3.2.2 Feeding system

The cattle were grazed at free-range from morning (9.00 AM) to evening (5.00 PM) in the forest area under an extensive system of management. Cattle rearing farmers typically do not add concentrates, minerals, or vitamins as a

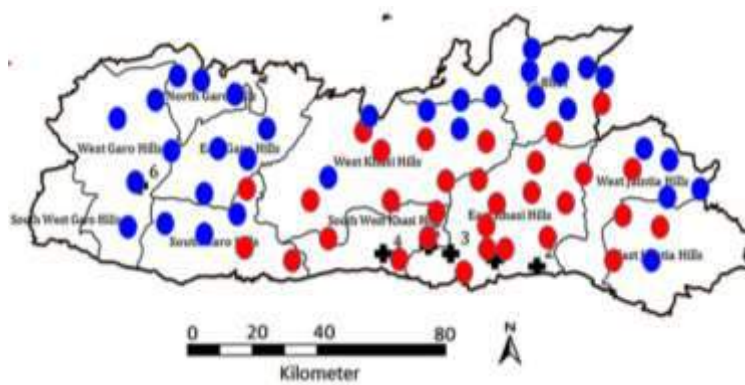


Fig.1 Hotspot area of Silumkhasi and Masipnar cattle of Meghalaya

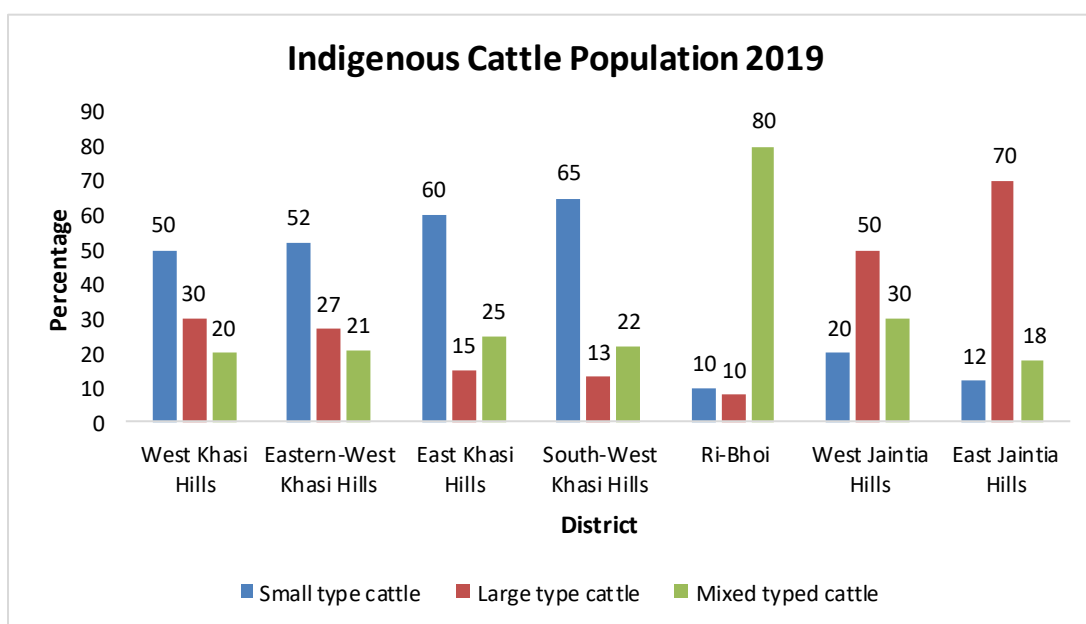


Fig. 2 Distribution of Silumkhasi and Masipnar cattle population (20th livestock census)

supplement to their cattle, but provide common salt (95 %) and paddy straw (48 %). There were various types of animals' fodder available to them, such as broom grass, jackfruit leaves, para grass, parari leaves etc. It was observed that very few farmers provided a small amount of dry fodders at home during the night (12 %). There were no reports of cattle farmers experiencing chaffing of fodder. Suckling and colostrum were the main feeding methods for calves of both cattle populations.

3.2.3 Health Care

All farmers used to clean milking pots and udder thoroughly before milking. The studied cattle were milked twice a day, morning and evening. Vaccinations for prevention of Foot and Mouth Disease and brucellosis were observed (87 %), but deworming was done occasionally and unevenly (31 %). Common diseases observed in the farmers' fields were parasitic infestation in the rainy season, Foot and Mouth disease, skin rashes, bloat, food poisoning, etc. Both cattle populations were not dehorned or dewormed by farmers. Castration was performed on male calves at the age of 6 to 8 months (89 %) for beef purposes.

3.3 Physical traits

The physical traits of Silumkhasi and Masipnar cattle are given in table 2. In Khasi Hills, Silumkhasi cattle were small (70 %), well built, and hardy with cylindrical bodies. The body colour of Silumkhasi varied in different colours which included white (60-70 %), greyish black (5-10 %), brown (4-6 %), and mixed with brown and black (21-24 %). In Silumkhasi cattle, dewlap and hump were small or moderate, however bulls were darker and have well-developed hump with a tuft of hairs. The muzzle was black with brown (85 %), brown

(12%) and white (3%). Horns were very short (5-9 cm) and dark in colour, being mostly black (81 %), grey (12 %), and black with a little of brown (7 %). Orientations of horns were predominantly stumpy, outward and then medially directed. Hoofs were black (78 %), brown (15%), and brown with grey (7 %). The forehead was small and straight, and the ears were small-sized (7-10 cm) and horizontal in orientation. The udder was small (89 %), undeveloped and milk veins (95 %) were not prominent. Fore udder was smaller than the rear udder (83 % vs. 74 %, respectively). The majority of the teats were small (5-12 cm) and round (83 %) shaped, while 17 % were cylindrical shapes. Naval flap was almost absent. There was a small, tucked-up flap on the penis sheath. Tail was up to the hock joint with black (77%) and brown switch (23%). The tail reached the hock with black shading (69 %), brown (24 %) and grey (7%) switch. Their temperament was usually not docile in almost all cattle populations.

Masipnar cattle were medium to large size (85 %), well built, stout, long neck, larger body sizes and greater heights with cylindrical bodies. The body colour of Masipnar cattle varied in different colours which included brown (40-60 %), white (10-20 %), greyish black (10-20 %), and mixed (5-10 %). The dewlap and hump were moderate to large size compared to Silumkhasi cattle; however, bulls were white with brown color and have medium size hump. Muzzle was black (85 %), black with brown (10%), grey (3 %), black with spotted white (2 %). Horns were large (12-16 cm), and mostly black (88 %), grey (7 %), and black with a bit of brown (5 %) in color. Orientations of horns were predominantly upward, outward and then medially directed. Hoofs were black (85 %), brown (10 %), and brown with grey (5 %). The forehead was small and straight, and the ears were moderate to large sized (15-26 cm) and horizontal in



Figs 3. A. Silumkhasi Cattle; B. Masipnar Cattle; C. Silumkhasi Bull; D. Masipnar Bull

orientation. The udder was small to moderate (93 %) with poorly developed milk veins (86 %) being little prominent. Fore udder was smaller than the rear udder (79 % compared to 62 %, respectively). The majority of the teats were small to moderate size (7-15 cm) and funnel (89 %) shaped, while 11 % were cylindrical shape. Naval flap was not prominent. Tail was below to the hock with black (82 %) and brown switch, and up to the hock with black shading (69 %), brown (24 %) and grey (7%) switch. Their temperament was usually not docile in almost both cattle cases. These findings were in agreement with those of Pundir *et al.* (2015) and Saidur *et al.* (2015). The bull of Silumkhasi and Masipnar cattle of Meghalaya are shown in Fig 3.

3.4 Morphometric traits:

Means, standard error (SE) and number of observations of different morphometric traits of the Silumkhasi cattle are given in table 2. The body measurements of the Silumkhasi cattle were done manually and the average body length, height at wither, heart girth, horn length, ear length, face length and tail length with switch, switch length, dewlap length, hump size, muzzle circumference, neck length were 112.73±1.65 cm, 110.92±1.06 cm, 135.66±1.68 cm, 11.6±0.43 cm, 22.46±0.58 cm, 44.46±0.80 cm, 114.8±1.05 cm, 22.46±0.6 cm, 25.53±0.6 cm, 10.06±0.49 cm, 42.26±0.59 cm and 65.86±0.6 cm, respectively. Whereas, the corresponding values for the adult bull/bullock were 105.83±1.12 cm, 112.6±2.45 cm, 133.3±0.73 cm, 13.9±0.48 cm, 21.9±0.43 cm, 44.6±0.6 cm, 102.1±0.48 cm, 21.2±0.46 cm, 27.1±0.52 cm, 19.2±0.60 cm, 44.3±0.59 cm, and 61.4±0.83 cm, respectively. The current study indicated that the estimated horn length, ear length and face length were in close agreement with the reports of indigenous cattle of Meghalaya (Pundir *et al.*, 2018), Mizoram (Pundir *et al.*, 2015a), Tripura (Pundir *et al.*, 2014), Uttarakhand (Pundir *et al.*, 2013) and Siri cattle of Sikkim (Pundir *et al.*, 2016). In contrast, Silumkhasi cattle of Meghalaya have lower corresponding values than the indigenous cattle of Tripura (Pundir *et al.*, 2014) and Uttarakhand (Pundir *et al.*, 2013).

Means, standard error (SE) and number of observations of different morphometric traits of the Masipnar cattle of Meghalaya are given in table 3. The body measurements of the Masipnar cattle were done manually and the average body length, height at wither, heart girth, horn length, ear length, face length and tail length with switch, switch length, dewlap length, hump size, muzzle circumference, neck length were 145.6±1.20 cm, 128.2±0.37 cm, 143.2±0.94 cm, 12.8±0.58 cm, 25.2±0.86 cm, 40.2±0.86 cm, 100.8±1.98 cm, 9.6±0.50 cm, 22.8±1.06 cm, 22.2±0.58 cm, 45.4±1.20 cm, and 83.6±0.92 cm, respectively. Whereas, the corresponding values for the adult bull/bullock were

131.4±1.20 cm, 119.4±0.40 cm, 177.2±1.06 cm, 20.1±0.7 cm, 27.2±0.58 cm, 40.6±0.67 cm, 104.6±1.07 cm, 10.8±0.73 cm, 26.4±0.50 cm, 23.5±0.70 cm, 46.2±1.24 cm, and 69.28±1.28 cm, respectively. The corresponding measures of body length, wither height, heart girth, paunch girth, and switch length were higher than the measurements made on Silumkhasi cattle. Similarly, the estimates of body length, height at wither, heart girth, paunch girth and switch length were higher than those of indigenous cattle from Meghalaya (Pundir *et al.*, 2018), Manipur (Pundir *et al.*, 2015b), Mizoram (Pundir *et al.*, 2015a), and Uttar Pradesh (Gaur *et al.*, 2004). Similarly, Saidur *et al.* (2015) found higher corresponding values for average body length, height at withers and chest girth of adult local indigenous non-descript cattle of Mizoram. Furthermore, Pundir *et al.* (2016) found higher corresponding estimates in Siri cattle from Sikkim and Kumaun cattle from Uttarakhand (Pundir *et al.*, 2013).

3.5 Production characteristics

The average productive traits of Silumkhasi cattle from different districts of Khasi Hills and Masipnar cattle from different districts of Jaintia Hills are presented in table 4. The average birth weights as per the survey report were 15±0.67 kg and 18±0.67 kg, for Silumkhasi and Masipnar cattle, respectively. The average daily milk yields, peak yield, lactation length, as per the survey report were 2.72±0.45 L, 3.44±0.61 L, 142±11.38 days, and 2.84±0.45 L, 3.91±0.61 L, 167±9.42 days, for Silumkhasi and Masipnar cattle, respectively. Breed wise, the mean lactation yield, milk fat % and SNF % were over 285.42±13.73 L, 6.64±0.73, 8.48±0.51 and 328.99±9.66 L, 6.18±0.55, 8.67±0.92 for Silumkhasi and Masipnar cattle, respectively. Generally, both cattle produced 14-19 kg of manure per day, which is applied in fields as organic fertilizer. These local indigenous bullocks were utilised for ploughing agricultural lands up to 1.2 acres in 6-8 hours. The cattle were generally milked twice a day, but it was reported that occasionally Masipnar cattle in the Jaintia Hills region were milked thrice daily. This study shows that the daily milk production was almost similar between cattle breeds in spite of breeds being genetically different. Although the average production characteristics of Silumkhasi cattle were lower than the Masipnar cattle.

To a great extent, the average body weight at birth, daily milk yields, and lactation length of Silumkhasi cattle concurred with the report by Pundir *et al.* (2018), who assessed milk production of the same Indigenous cattle breed to be between 10 to 16 kg, 2.38±0.18 kg (1.50 to 4.0 kg), and 138 days (120-180 days), respectively. However, both measured and survey milk production data from the Silumkhasi and Masipnar cattle were observed higher than those reported by Pundir *et al.* (2014) for the Tripura cows. In terms of daily milk output (2.65±0.18 kg; 2.0 to 4.5 kg) and lactation length (192 days; 120-270 days) of Manipur's

indigenous cattle were comparable to our findings (Pundir *et al.*, 2015). Similarly, the daily milk production and lactation length of Silumkhasi and Masipnar cattle were comparable with Uttara cattle from Uttarakhand Hills (Pundir *et al.*, 2013) but perform lower as compared to the Malnad Gidda cattle in the Western Ghat region of Karnataka (Murugeppa *et al.*, 2020). However, the bullock performance was recorded in both cattle were lower than the Uttara cattle from Uttarakhand Hills (Pundir *et al.*, 2013). In most cases, differences in daily milk yield and lactation yield were attributable to genetic inheritance patterns of breeds, parity, and their body condition.

3.6 Reproductive characteristics

The reproductive traits of studied cattle breeds from different regions are presented in table 4. Puberty for the Silumkhasi and Masipnar cattle occurred at over 33.12 ± 2.64 months and 35 ± 3.81 months, equating to less than 3 years after birth, which is a significant determinant of reproductive efficiency. Attaining puberty at a later age would mean economic loss due to a long non-productive period. Silumkhasi cattle of Khasi Hills regions have a smaller body size than the Masipnar cattle of Jaintia Hills region. Therefore, our results show that smaller cattle breed of Khasi Hills region attains puberty earlier than the Masipnar cattle. The genetic makeup of the breed may account for the contradiction. The age at first calving of Silumkhasi and Masipnar (42.24 ± 1.78 months vs. 43 ± 0.91 months) cattle were similar. Generally, indigenous cattle gave birth to the first calf at the age of 3-4 years. One of the most significant economic traits of dairy animals is age at first calving. The age at first calving of Silumkhasi and Masipnar cattle were compared well with indigenous cattle of Meghalaya (Pundir *et al.*, 2018), Indigenous cattle of Tripura (Pundir *et al.*, 2014), Uttara cattle breed from Uttarakhand Hills (Pundir *et al.*, 2013), but found higher than the Indigenous cattle of Manipur (Pundir *et al.*, 2015) and Malnad Gidda cattle in Western Ghat region of Karnataka (Murugeppa *et al.*, 2020).

The calving interval did not differ significantly amongst the studied population. The mean calving interval of Silumkhasi and Masipnar cattle were 16.5 ± 0.57 months and 17.8 ± 0.62 months, respectively. The calving interval of Silumkhasi and Masipnar cattle were compared well with the indigenous cattle of Meghalaya (Pundir *et al.*, 2018), but it was higher than the Indigenous cattle of Tripura (Pundir *et al.*, 2014), Uttara cattle breed from Uttarakhand Hills (Pundir *et al.*, 2013), and Malnad Gidda cattle in Western Ghat region of Karnataka (Murugeppa *et al.*, 2020). The calving interval of studied cattle was lower than the estimate of Pundir *et al.* (2003), who reported a calving interval of about 19.6 months (12-24 months) for the Indigenous cattle of Manipur. The

gestation period also did not differ amongst cattle breeds. The mean gestation period was about 281 ± 5.89 days, which was similar to the mean gestation period of 282.14 ± 9.03 days reported for Malnad Gidda cattle in the Western Ghat region of Karnataka (Murugeppa *et al.*, 2020). In contrast, dry period, service period, herd life and lifetime productivity of Silumkhasi cattle were estimated lower than the Masipnar cattle. Generally, service period, herd life and lifetime productivity in these studied breeds were much comparable with the Indigenous cattle of Meghalaya (Pundir *et al.*, 2018). However, the dry period, service period and herd life were higher than the Indigenous cattle of Tripura (Pundir *et al.*, 2014), Uttara cattle from Uttarakhand Hills (Pundir *et al.*, 2013), and Indigenous cattle of Manipur (Pundir *et al.*, 2015). The longer service period indicates a poor animal health aspect and poor nutrition. The service period was also influenced by suckling and energy intake during late pregnancy and after calving.

4. Conclusion

Silumkhasi and Masipnar cattle of Meghalaya showed differences in physical and morphometric traits and have a profound and long relationship with the traditional culture and society. Management of the local indigenous cattle across the states in the north-east region is almost similar i.e., semi-extensive and extensive type. Despite being poor milkers, Silumkhasi and Masipnar cattle play a very crucial role in providing a variety of products to the tribal farmers, such as meat, milk, manure, draught, bull fighting and socio-cultural festivals. It was observed that a genetic improvement program was needed to enhance the productivity of indigenous cattle. The documentation of genetic information is of particular importance for the indigenous cattle of Meghalaya, especially in order to not only conserve but also to make tribal farmers prosperous. Hence, selection and conservation programme of Indigenous Silumkhasi and Masipnar cattle of the state may be initiated for upgrading the genetic potential to explore the possibilities of organic livestock farming to enhance the livelihood and nutritional security of the tribal farmers.

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Table 1. Comparative evaluation of physical traits of Silumkhasi and Masipnar cattle at different age group in home tract

Traits	Silumkhasi			Masipnar		
	Male	Female	Calves	Male	Female	Calves
Size	Small to medium (70 %)	Small to medium (70 %)	Small, short	Medium to large (85%)	Medium to large (85 %)	Medium sizes
Shape	Well built, stout, hardy, small neck, and in round shape	Well built, stout and in round shape, small neck, bulged/compact with round bellied	Well-built and in round shape	Well built, long neck, greater height than Silumkhasi and in cylindrical shape	Well built, cylindrical shape, greater height with long neck	Well-built and in cylindrical shape
Body color	White-50-60%, Greyish black- 15-20%, Brown-4-6%, Mixed- 14-21%	White- 60-70%, Greyish black- 5-10%, Brown- 4-6%, Mixed with brown & black- 21-24%	Mostly brown, grey as well as mixed with brown and white	Brown-38-55%, White-15-23%, Greyish black- 12-15%, Mixed- 8-10%	Brown-40-60%, White- 10-20%, Greyish black- 10-20%, Mixed- 5-10%	Mostly darker brown, mixed with grey and white
Skin	Grayish black	Grayish black	Grayish black	Brown black	Brown with gray black	Brown black
Hoofs	Black (65%), brown (23 %), and brown with grey (12%)	Black (78%), brown (15 %), and brown with grey (7%)	Mostly black with brown and grey	Black (75 %), brown (18 %), and brown with grey (7 %)	Black (85 %), brown (10 %), and brown with grey (5 %)	Mostly black with brown and grey
Muzzle	Black with brown (78%), brown (16 %), and white (6 %)	Black with brown (85%), brown (12 %), and white (3%)	Black-85% Spotted- 10% Brown- 5%	Black-79%, Back with brown- 14%, Grey-5%, black with Spotted white- 2 %	Black with brown-85%, brown- 12%, and white- 2 %	Mostly Black-80% and Brown- 20%
Hump	Moderate to large, tuft hair present	Moderate to large, dispersed hair present	Underdeveloped	Small to moderate, tuft hair absent	Small to moderate, tuft hair absent	Under developed
Dewlap	Small to moderate	Small to moderate	NA	Moderate to large	Moderate to large	NA

Horns	Small (8-11 cm) with Black (87 %), grey (9%), and black with brown (4 %), Orientation- upward medially/frontally directed	Small (5-9 cm) with black (81 %), grey (12%), and black with a bit of brown (7%), Orientation- upward medially/frontally directed	NA		Long (12-18 cm), mostly black (83%), grey (12%), black with brown (5%), base-medium to large, Orientation- upward medially directed	Long (11-16 cm), mostly black (88%), grey (7%), black with brown (5%), base-medium to large, Orientation- upward medially directed	NA
Forehead	Small and straight (85 %), Long and straight (15%)	Small and straight (85 %), Long and straight (15%)	Small straight	and	Long and concave with mild depression (89 %)	Long and concave with mild depression (92 %)	Long and concave
Neck	Small to medium	Small to medium	Small medium	to	Medium to long	Medium to long	Medium to long
Ears	Small size (9-13 cm), and Orientation-horizontal	Small size (8-11 cm), and Orientation-horizontal	Small size		Medium size (15-26 cm), Orientation-horizontal	Medium size (15-26 cm), Orientation-horizontal	Medium, Orientation-horizontal
Eyes	Black	Black	Black		Brown with Black	Brown with Black	Brown with Black
Udder and milk vein	NA	Small to medium bowl shaped (89%), underdeveloped milk veins (95%), fore udder vs. rear udder (83% vs. 74%) teats-small size (5-12 cm) and funnel shape with round and pointed tips	NA		NA	Small to Medium round shape (93%), poorly developed milk veins (86 %), fore udder vs. rear udder (79 % vs. 62 %), teats small to moderate (7-15 cm), funnel (89 %) and cylindrical shape with pointed teats (11%)	NA

Naval flap	Small	Almost absent	Almost absent	Small	Almost absent	Almost absent
Tail	Brown-55-60%, Greyish black- 15-20%, white with grey- 8-10 %, Mixed- 10-18 % colors and pattern of switch of tail were disperse and bunched	Upto hock joint with Brown-60-65%, Greyish black- 10-17%, white with grey- 15-20 %, Mixed- 10-14 % colors and pattern of switch of tail were disperse and bunched	Above hock joint, mostly bunched and dispersed	Below hock joint with Black- 48-62%, Greyish black- 19- 23%, white with grey- 5-8 %, Mixed- 5-10 % color switch & bunched	Below hock joint with black (82 %), and brown switch (18 %) and up to hock with black shading (69%), brown (24%), and grey (7%) switch colors, shape is both disperse & bunched	Upto hock joint, mostly bunched and dispersed
Temperament	Aggressive	Aggressive to docile	Docile	More aggressive	Aggressive to docile	Docile

Table 2. Body measurement (cm) traits of Silumkhasi cattle at different age group in home tract

Age	Sex	No.	Body length	Height at wither	Heart girth	Horn length	Ear length	Face length	Tail length with switch	Switch length	Dewlap	Hump size	Muzzle circum.	Neck length
0-3 months	Male	102	61.53±1.75	79.32±2.70	81.33±2.16	NP	13.13±1.50	24.61±1.72	46.4±3.45	9.6±0.50	NP	NP	22±0.70	39.4±1.57
	Female	104	64.58±0.75	81.25±2.64	79.87±2.48	NP	15.87±1.44	30.25±1.75	52.12±2.71	10.5±1.42	NP	NP	29.88±0.71	40.6±1.48
3-6 months	Male	102	65.82±0.66	73.34±0.63	85.1±1.73	NP	18.5±1.45	30.3±0.63	49.8±0.58	9.3±0.51	NP	NP	24.58±1.23	42.5±1.32
	Female	104	69.57±0.45	81.7±0.47	84.6±1.56	NP	16.4±1.33	32.8±0.55	56.9±1.34	11.9±0.37	NP	NP	28.3±0.44	46.8±0.35
6-12 months	Male	102	75.12±1.92	86.72±0.37	105.1±3.56	NP	18.4±1.32	36.7±0.37	62.2±1.41	12.7±0.47	12.6±0.61	12.8±0.55	30.3±0.51	48.2±1.48
	Female	104	71.24±0.4	82.5±0.58	95.1±2.54	NP	20.1±1.52	38.8±2.41	62.5±1.30	18.6±0.47	8.3±1.13	5.8±0.72	27.2±1.36	52.7±1.36
1-3yrs	Male	102	89.33±0.36	99.83±0.94	124.16±3.60	10.1±1.32	20.5±1.76	41.83±1.62	76.16±1.44	19.83±0.6	12.5±0.7	15.5±0.42	38.3±0.6	54.1±2.6
	Female	104	87.66±0.62	95.16±0.6	120.83±0.60	8.83±0.6	21.83±2.12	40.51±0.42	75.5±0.42	21.83±0.6	10.8±0.6	9.3±0.6	35.3±0.4	58.83±1.4
Above 3yrs	Male	102	105.83±1.12	112.6±2.45	133.3±0.73	13.9±0.48	21.9±0.43	44.6±0.4	102.1±0.48	21.2±0.46	27.1±0.52	19.2±0.6	44.3±0.59	61.4±0.83
	Female	104	112.73±1.65	110.92±0.51	135.66±1.68	11.6±0.43	22.46±0.58	44.46±0.8	114.8±1.05	22.46±0.6	25.53±0.6	10.06±0.49	42.26±0.59	65.86±0.6

Table 3. Body measurement (cm) traits of Masipnar cattle at different age group in home tract

Age	Sex	No.	Body length	Height at wither	Heart girth	Horn length	Ear length	Face length	Tail length with switch	Switch length	Dewlap	Hump size	Muzzle circum.	Neck length
0-3 months	Male	102	92.2±1.49	90.6±1.07	83.6±0.50	NP	15.4±0.50	27.2±1.15	60.8±1.01	11±0.7	19.4±0.70	6.9±0.48	24.8±0.58	43.6±0.87
	Female	104	87.8±0.86	86.8±1.06	80±0.70	NP	14.2±0.66	27.6±0.92	52.2±0.86	10±0.70	19.75±1.60	6.25±0.76	21.4±0.92	42.8±1.42
3-6 months	Male	102	98±0.70	92.8±1.01	82.6±0.67	NP	17.4±0.50	30.4±0.50	67±0.70	13.4±0.50	19.4±0.70	6.9±0.48	33±0.70	44.2±1.06
	Female	104	104±0.7	90.8±0.86	70±0.92	NP	14.2±0.66	30.2±0.66	63.4±0.67	11.2±0.58	19.75±1.60	6.25±0.76	28.8±0.86	48.2±1.11

6-12 months	Male	102	109.6±1.16	97.6±0.50	95.6±0.67	NP	17.2±0.37	34.6±0.50	84.2±1.11	14.4±0.50	18.8±0.37	5±0.31	31.8±0.48	50.6±0.50
	Female	104	110.8±1.24	94.2±0.58	90±1.07	NP	15.8±0.66	31.2±0.86	72.2±1.01	11.2±0.58	19.4±0.50	7.25±0.76	29±0.89	52.8±1.71
1-3yrs	Male	102	107.2±0.58	119.8±0.66	157.6±0.81	20±0.70	21.6±0.50	32.8±0.58	90±1.70	11±0.70	20.6±0.50	11.2±0.58	39.6±0.92	60.5±0.50
	Female	104	100.2±0.8	102.4±0.92	132.4±1.50	10.6±0.40	19.4±0.92	31.6±0.74	84.4±0.92	10.8±0.58	22.2±0.58	14.6±0.4	38.4±0.92	65.58±0.58
Above 3 yrs	Male	102	131.4±1.20	119.4±0.40	177.2±1.06	20±0.70	27.2±0.58	40.6±0.67	104.6±1.07	10.8±0.73	26.4±0.50	23±0.70	46.2±1.24	69.28±1.28
	Female	104	145.6±1.20	128.2±0.37	143.2±0.94	12.8±0.58	25.2±0.86	40.2±0.86	100.8±1.98	9.6±0.50	22.8±1.06	22.2±0.58	45.4±1.20	83.6±0.92

Table 4. Productive and reproductive traits of Silumkhasi and Masipnar cattle in Meghalaya

Parameters	Silumkhasi		Masipnar	
	LSM ± SE		LSM ± SE	
Productive traits				
Birth body weight	15.76 ±0.67(104)		18.31±0.67(103)	
Adult body weight	165.49±5.72 (102)		182.77±11.96 (108)	
Average daily milk yield (lt.)	2.72±0.45 (107)		2.84±0.45 (101)	
Peak yield (lt.)	3.44±0.61(110)		3.91±0.61(104)	
Lactation length(days)	142.56±11.38 (108)		167.34±9.42(111)	
Average lactation yield per cow (lt.)	285.42±13.73 (106)		328.99±9.66 (103)	
Fat (%)	6.64±0.73 (101)		6.18±0.55 (102)	
SNF (%)	8.48±0.51(101)		8.67±0.92 (102)	
Reproductive traits				
Age at puberty(months)	33.12±2.64 (105)		35±3.81 (112)	
Age at calving (months)	43.24±1.78 (103)		46±1.91 (107)	
Inter calving interval (months)	16.5±0.57 (110)		17.8±0.62 (106)	
Gestation period (days)	272.33±5.89 (104)		279.62±7.33 (102)	
Dry period (days)	158.63±11.66 (101)		163.57±9.84 (100)	
Service period (days)	120.48±4.33 (103)		125.11±11.79 (102)	
Herd life (yrs.)	17.52±1.26 (107)		18.23±0.96 (109)	
Life Time productivity (No. of calving)	11.27±1.05 (105)		10.93±1.38 (108)	