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Garole - A Promising Sheep Breed in Coastal West Bengal

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Garole is a highly prolific micro-sheep breed whose breeding tract falls under the coastal saline zone of Sundarbans in West Bengal, India. Generally, this sheep breed is mainly reared for meat production by the small, marginal and landless farmers. The breed is highly resistant to foot rot disease and has a high mothering instinct for the lambs. Adaptability to hot humid conditions in the saline marshy lands of Sundarbans, survivability under low-input system and grazing capability in knee-deep water makes it the suitable breed in this region. The average weights of Garole sheep at birth, 3, 6, 9 and 12 months of age ranged from 0.06-1.00, 4.1-5.8, 6.0-8.68, 7.81-8.01 and 10.4-14.4 kg, respectively. The average daily weight gain (ADG) of this breed at pre-weaning (0-3 months) age is 32.4 g, while ADGs at post-weaning ages, *i.e.,* at 3-6, 6-9, 9-12 and 3-12 months of ages are 22.11, 20.41, 21.93 and 21.28 g, respectively. On an average, male lambs attain puberty at the age of 8-9 months. The highest average litter size of this breed is observed as 1.94 in the third lambing. The incidence of twining is 66%. The optimum age of slaughter is 12 months of age. The dressing percentage of this sheep is almost 53% at 12 months of age. This breed produces coarse-quality fleece with a staple length of 4.99 cm and a fibre diameter of 53.02 microns. The original source of the FecB gene (Fecundity gene) is proclaimed to be the Garole sheep. In India, this breed is also being utilized to improve the prolificacy rate of non-prolific sheep breeds. The population of Garole sheep has declined from 0.27 to 0.16 million from 2003 to 2013 in its native tract. The breed needs the utmost attention in conservation efforts.

(***Key words:*** *Conservation, Garole sheep, Indian Coastal region, Production performance*)

Garole is a highly prolific and true micro-sheep breed of India. The breeding tract of this sheep breed falls under the coastal saline zone of West Bengal located in the North and South 24 Parganas district (Fig. 1). The breed is well known for its peculiar characteristics such as high prolificacy rate, resistance to foot rot disease and high mothering instinct for the lambs, adaptability to hot humid conditions and in saline marshy land, survivability under low-input systems and grazing capability in knee-deep water (Sahana *et al.*, 2001; Sagar and Biswas, 2008). The incidence of twins and triplets is very common in this breed. The prolificacy trait is regulated by the FecB (Fecundity Booroola) gene (Ghalsasi and Nimbkar, 1993; Wilson *et al.*, 2001), which is the major gene responsible for increasing the prolificacy rate of Australian Booroola Merino sheep (Davis *et al.*, 2002). Despite harsh climatic conditions and lack of established breeding policy, organized farm or improved management system, this sheep breed has proved to be self-sustainable and a constant source of income for the animal keepers in the coastal region for decades.

Origin of the breed

Although much information is not available about the origin of this sheep breed, the domestic Garole sheep (*Ovis aries*) is presumed to have originated from the Urial type (*Ovis vignei*) wild sheep of Asia (Mandal *et al.*, 2017). The Government of Bengal records indicated that sheep were brought to Bengal by traders from Tibet (Rennie, 1866; Firminger, 1914a,b); Hunter, 1879). Different survey works and interactions with the local community revealed that this breed might have moved into the riverine forest area of the Sundarbans region

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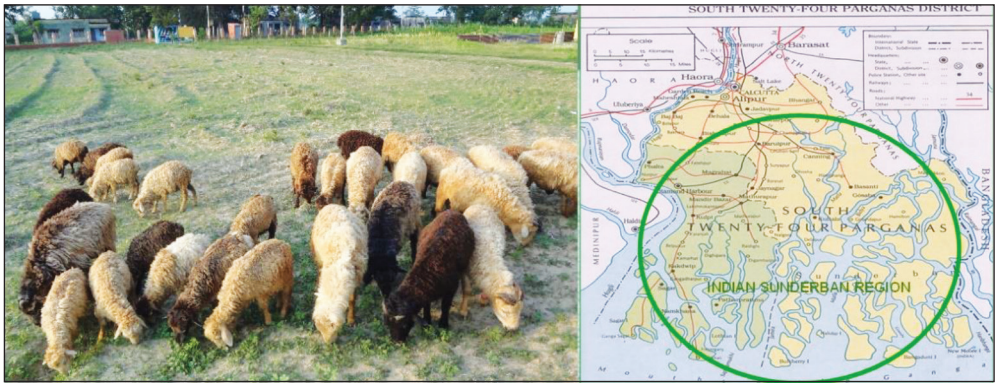

Fig. 1. *Breeding tract of Garole sheep in West Bengal, India*

with their owners for the first time. Garole sheep had not been characterized properly in their natural breeding tract till 1982 as no mention was found of this unique sheep breed in sheep and goat breeds of India (Acharya, 1982). Characteristics of Garole sheep maintained in farm conditions as described by Sharma *et al.* (1999) were different from sheep in the original breeding tract. Garole sheep were imported into Australia from Bengal in 1792 and are assumed to be the contributor of the FecB gene to the Booroola Merino sheep (Turner, 1982). According to Piper and Bindon (1996) and Singh and Bohra (1996), there is a significant similarity between body and fleece characteristics in the Garole sheep of the Sundarban region and the Bengal sheep of Australia.

Breeding tract, distribution and population

The breeding tract of Garole sheep is the coastal Sundarbans, a low-lying region at the delta of the river Ganges, surrounded by other rivers and rivulets. This region comprises 13 blocks of South 24-Parganas and 6 blocks of North 24-Parganas district of West Bengal. The covered area of Sundarbans is approximately 4226 km^2, located between 21° - 23° N latitudes and 87° - 89° E longitudes and its west boundary is formed by the river Hooghly where as the south boundary is formed by Bay of Bengal (Bose and Moitra, 1995). Ghalsasi and Nimbkar (1993), Banerjee and Banerjee (2000) and Banerjee *et al.* (2011) also reported that the breed is prevalent in the districts adjoining the Sundarbans delta region in the state of West Bengal and the abutting districts of Bangladesh. The highest population of this breed can be found in Joynagar-I, Joynagar-II, Kultali, Mathurapur-I, Mathurapur-II, Mandir Bazar, Patharpratima, Namkhana and Kakdwip blocks of the South 24 Parganas. As per the NATP project report on Animal Genetic Resource Biodiversity, West Bengal University of Animal and Fishery Sciences, Kolkata, in 2001, the population of Garole sheep in the Sundarbans region was 0.265 million. However, Pan *et al.* (2004) reported that the population of Garole sheep in the region stood at 0.30 million. According to DAHDF (2013), the approximate population of Garole sheep in West Bengal was about 0.16 million and had declined from that of 0.27 million in the year 2000.

Physical characteristics

The breed name "Garole" is a colloquial Bengali word that means "stupid". Another commonly used name for calling the breed is "Bheda" which means sheep in Bengali. The Garole breed is also locally called "Meda", (In Bengali meaning earless), due to its rudimentary or short ears (Mandal *et al.*, 2017). The Garole sheep is a small-sized breed with a short stature, low-set, compact square body. The head of Garole sheep is small, straight and well-set but it sits a little higher than the body and appears triangular from the front. Males are generally horned and females are polled (Sahana *et al.*, 2001) (Fig. 2). The horns are straight, a little curved at the end and small in size (http://www.leafconagro.com/garole/). The nose bridge is straight and the muzzle is small and pale cream or black in colour. Garole sheep have rudimentary (1-3 cm), medium-sized (4-8 cm) or long (more than 8 cm) ears (Sahana *et al.*, 2001; Mandal *et al.*, 2017). The chest and abdomen of female animals are barrel-like and heavier posteriorly and the back is straight. The legs are thin with black hooves and the tail

Fig. 2. *Garole Ewe (left side) and Garole Ram (right side)*

is short and thin. The coarse fleece covering the coat is not dense but covers almost the whole body and the greater part of the legs. The udder of ewes is not well developed, even during lactation. The breed possesses both pure coat colours such as white, grey, black and brown or mixed colours but the prevalence of light brownish colour is high (more than 90%). The average body weight in adult males and females was reported as 14.43 and 14.14 kg, respectively (Mandal *et al.*, 2017).

Husbandry practices

The natural habitat of Garole sheep is mainly limited to the Sundarbans coastal region and the extremely hot and humid climate, high soil salinity, heavy rainfall and frequent occurrence of cyclones pose significant challenges for rearing animals under normal extensive free-range systems (Mandal *et al.*, 2017). This breed is maintained by small and marginal farmers and landless labourers who are socially and economically less privileged. Mostly females and children are involved in the sheep rearing practices. The sheep keepers in its home tract mainly maintain the sheep in small flocks comprising 3-5 animals (Ghalsasi and Nimbkar, 1993). The sheep are reared under an extensive system and are managed using either free or tethered grazing and flock migration is not practiced. No organized grazing land is available in the region. The grazing area for Garole sheep includes natural pastures such as harvested crop fields, boundaries of crops, roadsides, banks of irrigated channels, waterways, river and water bodies and low land during ebb tides. The common feeds for Garole sheep are mainly ficus (*Ficus bengalensis*), mango (*Magnifera indica*), Babool (*Acacia arabica*), banana and various mangrove species, etc. (Mandal *et al.*, 2017). Garole sheep have adapted the ability to swim and graze in knee-deep waterlogged conditions in marshy land during the rainy season (Fig 3.). Farmers practice supplementary feeding of their animals depending on the need and availability of supplementary feed. Harvested grass, weeds, tree leaves, dry grass, paddy straw and other crop residuesare used as supplementary feed. The majority of Garole sheep drink accumulated rainwater, or even saline water while grazing. Generally, the sheep are not provided separate houses and are kept along with cattle.

Fig. 3. *Garole sheep grazing in knee-deep water*

Production characteristics of Garole sheep

The economically important traits of Garole sheep are presented in Table 1.

Table 1. *Economically important traits of Garole sheep*

Growth traits	Wool yield traits	Reproductive traits	Carcass traits
Average body weight at birth	Average annual greasy fleece yield	Age at puberty	Dressing percentage
Average body weight at 3 months	Fibre diameter (μ)	Age at first service	Average age at slaughter
Average body weight at 6 months	Medullation (%)	Gestation percentage	Carcass weight
Average body weight at 12 months	Staple length (cm)	Prolificacy rate	
Average daily weight gain	Crimp per cm		

Growth traits

Various workers (Ghalsasi and Nimbkar, 1993; Sharma *et al.*, 1999; Sahana *et al.*, 2001; Pan *et al.*, 2004) have studied the growth performance of Garole lambs at the farmer's farm. They reported that the average body weight at birth, 3, 6 and 12 months of age ranged from 0.06-1.0, 4.1-5.8, 6.0-8.68 and 10.4-14.4 kg, respectively, whereas the corresponding figures under the well-maintained farm conditions were 1.00±0.03, 3.67±0.35, 6.25±0.23 and 10.16±0.49 kg, respectively (Karmakar *et al.*, 2018). The average daily weight gain (ADG) of the Garole breed at pre-weaning (0-3 months) age was 32.4 g, while ADGs at post-weaning ages, *i.e.,* at 3-6, 6-9, 9-12 and 3-12 months of age were 22.11, 20.41, 21.93 and 21.28 g, respectively.

Wool yield

The wool of Garole sheep is extremely coarse, hairy and not very dense according to various published studies (Ghalsasi and Nimbkar, 1993; Bose, 1996; Bose *et al.*, 1999; Sharma *et al.*, 1999; Pan *et al.*, 2004). The average annual greasy fleece yield from each sheep of this breed was reported to be low and ranged from 150-400 g (Ghalsasi and Nimbkar, 1993; Bose, 1996; Prasad, 1996, 1997; Bose *et al.*, 1999; Sharma *et al.*, 1999; Pan *et al.*, 2004). The fibre parameters like average fibre diameter (μ), medullation (%), staple length (cm) and crimp per cm of Garole sheep ranged from 53.02-67.82, 75.17-78.70, 4.99-7.13 and 2.08-2.86, respectively (Prasad, 1996, 1997; Pan and Sahoo, 2003; Pan *et al.*, 2004; Banerjee *et al.*, 2009). Farmers, in general, do not shear their animals and are ignorant about the use of wool. The wool has felting properties and is used as bedding material for the lambs.

Reproduction and breeding

Generally, both male and female sheep in the farmer's flock are housed together and grazed collectively. Farmers only allow their animals to be naturally bred through out the year. Maximum lambing takes place between December to February and August to September. On an average, male lambs attain puberty at the age of 8-9 months. A range of 5-12 months, with an average of 8.3±0.05 months, to attain puberty in Garole males in their native habitat has been reported by Pan and Sahoo (2009). The age at first service is 7 to 9 months and the age at first lambing is 12 to 14 months. The gestation period is 150 days and the lambing interval is 8 months (Bose and Moitra, 1995). Multiple birth is common and the incidence of twining is highest (66%), followed by singletons (22%), triplets (11%) and quadruplets (<1%). Some other workers (Ghalsasi and Nimbkar, 1993; Singh and Bohra, 1996; Sharma *et al.*,1999; Pan *et al.* 2004; Banerjee, 2008) reported that the average number of lambs born per ewe (prolificacy rate) of Garole sheep ranged from 1.63-2.27 with 7.3-40% single, 53.3-66.4% twins, 5-21.8% triplet and 0.2-5.45% quadruplet.

Carcass trait

The Garole sheep are reared mainly for meat production in the Sundarbans. Farmers sell surplus sheep and lambs for slaughter before the rainy season to

avoid mortality (Mandal *et al.*, 2017). Some farmers do not sell ewes for slaughter until after it has attained six-seven lambings. Various workers, Bose *et al.* (1999), Das (2000) and Banerjee *et al.* (2009) reported that the dressing percentage (%) of Garole sheep ranged from 48.3 to 66.6. The slaughter age of Garole sheep ranged from 8-12 months in males and was above 24 months in females. The corresponding average slaughter weights for male and female Garole sheep were found to be 10-12 kg and 13 kg, respectively (Pan and Sahoo, 2003; Pan *et al.*, 2004). However, Pan *et al.* (2009) reported that the optimum age for slaughter of Garole sheep was 12 months with a slaughter weight of 12 kg. The carcass weights of males and females were evaluated as 6.6-8.7 and 6.6 kg, respectively.

Common diseases and mortality in Garole sheep

Garole sheep are reported to have a notable tolerance to various diseases, given the conditions in which they thrive. This breed has naturally developed resistance against foot rot, foot and mouth disease (FMD) and reproductive disorders. According to Nimbkar *et al.* (2002), Garole sheep exhibit high resistance against the dreaded roundworm (*Haemonchus contortus*) and the tropical liver fluke. Within the native habitat, the primary cause of health issues in Garole sheep was found to be parasitic infections and instances of diarrhoea during the rainy season. Various parasites, including *Strongyloides* sp., *Moniezia* sp., and *Eimeria* sp., were identified to infect Garole sheep. However, to date, no trematode infections in Garole sheep have been reported. Due to various factors, the lambs are susceptible to mortality. In Garole lambs up to one month of age in field condition, the highest rates of morbidity (38.4%) and mortality (30.8%) were reported by Pan *et al.* (2004), while in the flocks maintained by the farmer, the mortality rate was about 30% (Singh and Bohra, 1996). Higher mortality rates among lambs and adults are observed during the winter and rainy seasons, respectively. Diarrhoea caused due to amphistomiasis (a parasitic disease caused by flatworms), has been reported to be the major cause of death. Bose (1996) reported the mortality of lambs born as single, twin, triplet and quadruplet were 15.5, 36.1, 44 and 50%, respectively. Besides some reproductive disorders like abortion (7.82%), repeat breeding (9.35%), and placental retention (2.62%) were also observed in Garole sheep.

Utility

Garole sheep exhibit remarkable adaptability in the agro-climatic conditions of the Sundarbans and are known for their capacity to survive under low input systems and their utility as meat animals (Mandal *et al.*, 2017). The breed possesses distinctive traits such as high prolificacy, ability to graze in knee-deep water, resistance to foot rot and FMD and capacity to thrive in hot and humid environments. These sheep are primarily raised for their mutton, skin, and manure, with farmers typically not engaging in shearing practices as the fibre is coarse. The faeces and urine collected from night shelters serve as excellent fertilizers due to their high nitrogen content. Various studies have reported that the naturally occurring beneficial mutation in a major gene (FecB) in Indian Garole sheep has contributed to higher prolificacy and lambing frequency in its native habitat (Banerjee *et al.*, 2009). The high prolificacy of the Booroola Merinos has been reported to have been traced back to an early Australian flock known to include prolific Indian Garole sheep (Turner, 1982). Due to its unique characteristics, the Garole sheep is used as an improver breed for improving the fecundity rate of the less prolific sheep breeds like Deccani, Bannur, Pattanwadi and Sonadi (Mandal *et al.*, 2017).

Measures for conservation and improvement

There has been a severe decline in the population of the Garole breed in its original habitat. According to the Livestock Census Report in 2003, the total population of Garole sheep in West Bengal was 0.27 million, and it had gone down to 0.16 million in 2013 (DAHDF, 2013; DAHDF, 2014). Realizing the importance of Garole sheep due to its high fecundity rate and a severe decline in their population, it is crucial to prioritize the conservation and enhancement of this distinctive genetic resource. This can be achieved through an effective breed improvement program at both the national and international levels. The Government of India has initiated a conservation program for Garole sheep, with its execution being carried out by the Government of West Bengal. Under this initiative, the implementation of a Garole breeding and enhancement project is being carried out on an island known as "Machranga," situated within the heart of the breeding zone. Additionally, training for Garole farmers is being provided as part of this effort (Mandal *et al.*, 2017).

At present, Garole breed is being maintained at Ramakrishna Ashram Krishi Vigyan Kendra (RAKVK), Nimpith, South 24 Parganas district, West Bengal and State Livestock Farm, Kalyani, Nadia district, West Bengal with the primary objective to produce superior germplasm (rams) for distribution to the farmers as an *ex-situ* conservation program. Furthermore, organizations such as ICAR-Central Sheep and Wool Research Institute (CSWRI), Avikanagar, Rajasthan and Nimbkar Agricultural Research Institute (NARI), Phaltan, Maharastra, are also playing a significant role in the development of Garole sheep breed in India. While some endeavours have been undertaken for the improvement and conservation of this breed, both at the state and national levels, there remains a need for further development programs that engage all the stakeholders and farmers. These efforts are essential for improving the livelihoods of impoverished farmers in coastal West Bengal.

CONFLICTS OF INTEREST

The authors do not have any conflicts of interest to declare.

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