Chapter

Domestic Pig Germplasms of Andaman and Nicobar Islands

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Abstract

Andaman and Nicobar Islands are endowed with immaculate flora and fauna biodiversity. Among the indigenous livestock species, pig occupies 27.26%. Andaman and Nicobar Islands have three different categories of domestic pig groups/breeds. Andaman Local pig is prevalent in Andaman group of Islands (South, Middle and North Andaman); Nicobari pig is in Nicobar group of Islands and long snouted Little Andaman wild pig (Schedule II animal under Forest Act, India). Other than the indigenous pigs, pure and crossbreds of Large White Yorkshire are available in Andaman and Nicobar Islands. Nicobari Pigs are reared exclusively by Nicobari tribes in Nicobar group of islands and create a well defined socio-economic-ecological status of their tribal society. Nicobari pig occupies a prominent place in custom, festivals and socio-economic status of Nicobari tribes. These Andaman local and Nicobari pigs are reared for meat purpose under free range or semi-intensive system. Nicobari pig is appeared as short, black/brownish in colour and living as a family. Andaman local pig is available in Andaman group of islands and body colour differs from rusty grey to black and brown. Neck and dorsal portion hair are long and thick whereas flank and sides hairs are shorter and thinner. Wild pig of Andaman (*Sus scrofa andamanensis*) is a most endangered porcine species of Andaman and Nicobar islands. Jarawa tribes in Andaman Islands prefer this wild pig as a good protein source. It is black in colour, short legged, small to medium sized and a prolific breeder. Litter size varies from 4 to 7 numbers. Another pig group is crossbred, cross between Large White Yorkshire and Andaman local or Nicobari pig. Crossbred pigs are light brown to complete white with different lines of blackish colour. This breed exhibits early maturity, high growth rate and fecundity. The Nicobari pig has high prolificacy as litter size is ranging from 8 to 10 numbers with good mothering ability and body weight of matured pig differs from 115 to 130 kg. Moreover, this crossbred is adapted highly to the local tropical humid environmental conditions and also can adjust with locally available feed resources on the different agricultural produces. This is highly suitable for commercial production of pork in this Andaman and Nicobar islands. However, the domestic pig breeds need to be protected and be conserved in this Andaman and Nicobar group of Islands.

Keywords: Andaman and Nicobar Islands, indigenous pigs, physico-morphological characters, haematological profiles, management, reproductive and productive profiles

1. Introduction

Andaman and Nicobar islands are one of the diversified unique ecosystems in the world. Being away from the main land and less population pressure, the area is

still maintaining almost pollution free virgin environment, harbouring pure and rich germplasm resources. It is situated in the southern part of the Bay of Bengal between 92°12′ E and 93°57′ E longitude and between 6° 45′N and 13° 41′N latitude with 10°N channel dividing the Nicobar group of islands from Andaman group of Islands. Andaman and Nicobar is a group of 576 islands, islets and rocks covering a geographical area of 8293 km^2 and a population of 3.80 lakhs. Andaman and Nicobar islands share the same broad agro-ecological region as South East Asian countries. Majority of the 188 named islands are small in size. Thirty-six of these are inhabited. Only four islands namely North, Middle and South Andaman in the Andaman group and Great Nicobar in the southern group have an area greater than 1000 km^2. Little Andaman with an area of 731 km^2 is the next largest island. Among the rest, 32 islands exceed 10 km^2 while 96 are less than 1 km^2 in area. Of the inhabited islands, 12 have population exceeding 1000 persons. Andaman and Nicobar islands have the annual rainfall of average is 3070 mm covering the month from May to December. The period between January and April is the driest when the number of rainy days in each month hardly exceeds three. During these periods, agricultural crops often suffer severely. The mean temperature (24.3-30.5°C), relative humidity (82.5%) and wind speed (5.8 km/h) almost remains same throughout the year. The seasons were classified into rainy/wet (May to November) and dry/summer (December to April) in Andaman and Nicobar Islands. Average sun light hours per day differed significantly between rainy (4.28 ± 0.89) and dry summer (9.20 ± 0.74) seasons. From the month of December to April in Andaman and Nicobar Islands, the sun shines regularly, whereas the sky is often become cloudy from June to September. Average relative humidity (%) was differed significantly between rainy (84.21 ± 1.93) and dry summer (75.80 ± 2.06) seasons. Average temperature (°C) was differed significantly between rainy (29.71 ± 0.62) and dry summer (31.42 ± 0.80) seasons. Average rainfall (mm) was differed significantly between rainy (444.92 ± 13.62) and dry summer (89.04 ± 8.84) seasons. Average solar direct irradiance (kWh/m^2/day) was differed significantly between rainy (3.47 ± 0.95) and dry summer (6.24 ± 0.56) seasons. Average temperature humidity index (THI) was differed significantly between rainy (84.92 ± 1.59) and dry summer (85.59 ± 1.15) seasons. Average sea surface temperature (°C) was differed between rainy (27.97 ± 0.87) and dry summer (29.94 ± 1.30) seasons.

Livestock farming is considered to be a profitable enterprise in agriculture and constitutes an important activity for income enhancement. As per livestock census of 2012, the cattle, buffalo, goat, pig and poultry population including duck in the island is 45625, 7863, 65324, 35921 and 1165223, respectively. Livestock census, India revealed that the pig population was reduced (25.79%) significantly from 18th (2007: 48406 [1]) to 19th (2012: 35921 [2]) and then increased (5.98%) from 19th to 20th (2017: 40488[3]) livestock census, Government of India (**Tables 1** and **2**). Similarly, Tsunami, 2004 has significantly affected the Nicobari pig population in Nicobar group of Islands. There are four different genetic groups of pigs in the Islands, namely, Andaman local pig (ALP), long snouted Little Andaman wild pig (Schedule II animal under Forest Act, 1972, Govt. of India), Nicobari pig and pure and cross breeds of Large White Yorkshire (**Table 3**). Andaman and Nicobar group of Islands are endowed with immaculate flora and fauna biodiversity [5]. The indigenous livestock germplasm namely Nicobari, Andaman local and Andaman wild pigs, Teressa and Andaman local goats and Nicobari fowl are predominant in Andaman and Nicobar group of islands. Among the indigenous livestock, pig occupies 27.26% of the total livestock in Andaman and Nicobar Islands [6]. However, the Nicobari indigenous pig is under severe threat to endanger from the island, therefore immediate conservation effort is to be taken and its very much necessary [7]. Till 2012, this Nicobari breed received very little attention and no

District	Category	Male			Female			Grand total
		< 6 Months	>6 Months	Total	< 6 Months	>6 Months	Total	
Nicobar	Indigenous	4381	3928	8309	4442	3644	8086	16395
	Exotic/ crossbred	1892	1477	3369	1579	1438	3017	6386
North & Middle Andaman	Indigenous	1725	1513	3238	1604	1544	3148	6386
	Exotic/ crossbred	1004	951	1955	854	870	1724	3679
South Andaman	Indigenous	528	409	937	704	676	1380	2317
	Exotic/ crossbred	134	215	349	167	242	409	758

Table 1.
District-wise livestock census (19th) of pigs in Andaman and Nicobar Islands.

Tehsil wise	Exotic/Crossbred			Indigenous			Total
	Male	Female	Total	Male	Female	Total	
Diglipur	851	713	1564	1682	1823	3505	5069
Mayabunder	571	420	991	625	558	1183	2174
Rangat	553	591	1124	930	765	1695	2819
Middle and North Andaman Dist	**1955**	**1724**	**3679**	**3237**	**3146**	**6383**	**10062**
Ferrargunj	98	109	207	11	29	40	247
Port Blair (Rural)	134	200	334	9	15	24	358
Port Blair (Urban)	117	100	217	27	50	77	294
Little Andaman	0	0	0	890	1286	2176	2176
South Andaman Dist	**349**	**409**	**758**	**937**	**1380**	**2317**	**3075**
Car Nicobar	1	0	1	6369	6240	12609	12610
Nancowry	3056	2719	5775	1583	1528	3111	8886
Campbell Bay	312	298	610	358	320	678	1288
Nicobar Dist	3369	3017	6386	8310	8088	16398	22784
State total	**5673**	**5150**	**10823**	**12848**	**12614**	**25098**	**35921**

Table 2.
Tehsil-wise livestock census (19th) of pigs in Andaman and Nicobar Islands.

systematic documentation was made. This Nicobari pigs were considered as a recognised and distinguished pig breed of Indian Government (INDIA PIG-3300-NICOBARI09005 by NBAGR, Karnal). Genetic diversity was very high as compared to European breeds [7]. Nicobari pig breed is adapted well physiologically and anatomically and has high tolerable capacity to different humid tropical deleterious environmental conditions. Nicobari pigs are natural scavengers and size is from medium to large with low reproductive and growth performance. Nicobari pig breed is highly preferred among the tribals, it is a good source of protein supplement to them and also it helps to improve their family income.

The ALP is associated with the socio-culture-economic-tradition of tribals. Andaman local pig is in general as semi-feral in behaviour and is mostly reared in

Common name	Scientific name	Habitat	Status	Adaptation	Disease resistance	Management
Nicobari pig	*Sus scrofa nicobaricus*	Nicobar group of islands	Not-endangered	Adapted to hot and humid climate of Nicobar islands	Acquired Resistance to common pig diseases	Backyard pig production system
Andaman local pig	*Sus domesticus*	Andaman group of islands	Not-endangered	Adapted to hot and humid climate of Nicobar islands	Acquired Resistance to common pig diseases	Backyard and intensive pig production system
Andaman wild pig	*Sus scrofa andamanensis*	Andaman group of islands	Endangered	Adapted to hot and humid climate of Andaman islands	Acquired Resistance to common pig diseases	Completely scavenging Feral

Table 3.
Status of pigs in Andaman and Nicobar Islands [4].

extensive or free-range system with little amount of management. Mitogenome analysis revealed that this ALP can be evolved as an independent breed in Andaman and Nicobar Islands as merit for registration as a recognised pig breed [8]. This pig group is under the condition of endanger and immediate preservation, conservation and propagation effort is very much needed to save the local breed of pig from extinction [7]. Pig production system is highly economical due to high production potential, fast growth rate, short generation interval, prolific fecundity, highly efficient carcass yield and higher adaptability to the different micro and macro environmental as well as the climatological conditions [9]. ALP is very well adapted and tolerable to the different tropical humid harsh environmental conditions with higher relative humidity, higher temperature as well as higher temperature humidity index. Further, these local indigenous Andaman local pigs are scavengers and also semi-wild in their behaviour or character. Andaman local pigs have very good maternal ability and are aggressive when farrowing or delivery. Although the ALPs have lower in their growth rate and reproductive and productive performances, it is highly liked by the rural tribal communities for supplementation of sufficient protein and income for the family. Pork production is essential especially in the Nicobar Islands than in the other part of the Andaman and Nicobar Islands. People of Nicobar group of Islands consume 70% of the pork produced in Andaman and Nicobar Islands while the rest of the islanders consume 30% of pork [2]. Wild pig of Andaman (*Sus scrofa andamanensis*) is a threatened endangered porcine germplasm of Andaman and Nicobar islands. Jarawa tribes prefer this wild pig as a protein source. It is black in colour, short legged, small to medium sized and a prolific breeder. Another pig group is crossbred, cross between Large White Yorkshire and Andaman local or Nicobari pig. This Nicobari breed exhibits early maturity, high growth rate and fecundity than other pig breeds. The Nicobari pig has high prolificacy as litter size is ranging from 8 to 10 numbers with good mothering ability and body weight of matured pig differs from 115 to 130 kg. This is highly suitable for commercial production of pork in this Andaman and Nicobar islands. However, the domestic pig breeds need to be protected in this Andaman and Nicobar Islands. Reorganisation and rearrangement of these pig breeds is significant for its conservation, preservation and propagation. Efforts have to be made to conserve this breed outside its breeding tract with different managemental condition. The chapter describes the different aspects of pigs namely, Nicobar pig, Andaman local pig,

Andaman wild pig and crossbred pigs, which are available in Andaman and Nicobar Islands.

2. Nicobari pig

Nicobari pig (*Sus scrofa nicobaricus*), locally known as Ha-un and is reared by Nicobari tribes in Nicobar group of Islands. Majority of the pigs in the Nicobar group of islands are Nicobari pigs. The total area of Nicobar group of islands is 1841 square km which lies between 6° and 10° North latitude and it comprises of 19 islands, of which, important islands are Car Nicobar, Chowra, Teressa, Nancowrie, Little Nicobar and Great Nicobar. A small population of Nicobari pig are reared by Nicobari tribes on Little Andaman (Nicobari settlement area at Harminder Bay) Island [10–12]. The registered unique Nicobari indigenous pig is considered as a sign of integrity and wellbeing of the Nicobari tribes in this Andaman and Nicobar island territories. Nicobari pig is considered as an endemic in the island region; however, this pig is still in the domestication process as witnessed by phenotypic expression and are generally believed as it has originated from Eurasian wild boar (*Sus scrofa*) and also believed that *Nicobaricus* as a Nicobar regional specific sub-species and are called generally as "Nicobari Pig" [11]. These pigs are available since immemorial time with primitive tribes of these Andaman and Nicobar islands. Nicobari means 'eating pork'. Pig growing is very common, preferred and custom within the Nicobari tribes and which provides as an essential source of animal rich protein [13]. Nicobari Pigs are reared exclusively by Nicobari tribes in Nicobar group of islands and create a well defined socio-economic-ecological status of their tribal society. Pig rearing has always been an integral part of the rich cultural traditions of the Nicobarese Tribes [14]. Pigs are treated as an asset and bring prestige to the joint family of Nicobarese. In Nicobari society, religion, custom, festivals and social status, the pig occupies a prominent place. Of which, pigs constitute the major portion of their economy. The economic prosperity of a family, village and its position in the island is judged by the number of pigs as they have in a village or lineage. As such *Nicobarese* maintain a large number of pigs that are freely roaming in their settlement as well as in mature coconut plantation. Nicobari pigs have well adapted to the tropical humid island ecosystem in physiological and anatomical over the long period of the times and express their potential very well under the integrated farming (plantation based) production system in Andaman and Nicobar Islands [12]. In overview, the male Nicobari pig is very much temperament (nervousness) than his counterpart of female pigs and to catch the male pigs at least ten people are needed. However, the Nicobari sows are very calm and could be managed easily with the Nicobari tribal women. Ill-treatment or misbehaviour of the same is treated as serious offence. In case, any Nicobari or outsider hit or beat the pig, then their tribal village Council deals the matter sternly and the same treatment was given to the person concerned and impose handsome amount of fine to prevent repeat of the act [15].

2.1 Phenotypic characterisation

Nicobari pig is a registered descriptive domesticated pig breed of India (INDIA_PIG_3300_NICOBARI_09005). Molecular characterisation with use of microsatellite markers on local pig breeds revealed that the Nicobari pig has mean observed heterozygosity of 0.70 ± 0.09 and Andaman local pig has 0.72 ± 0.07 and both were has significantly higher mean observed heterozygosity than in the Large White Yorkshire as 0.56 ± 0.07, the present study result indicated that Andaman

Local pig as well as Nicobari pigs are genetically different from the exotic pig breeds of LWY as well as from other Indian indigenous pig breeds such as Gahuri, North Indian desi and Ankamali [16]. Nicobari pig population was highest in Car Nicobar followed by Chowra, Teressa, Nancowry and Katchal. At present, this indigenous pig breed is under the endangered and threatened category and immediate conservation effort is necessary. In Nicobar and other parts of Islands where the Nicobar tribes are living, there is no commercial pig rearing system or commercial pork production system among the Nicobari tribal community. The pigs are also exchanged as gift between families and islands, bartering within their communities. This porter or exchange practice has significantly reduced the inbreeding among the pigs in the villages. Nicobari pigs are short in stature with compact body, black/brownish or creamy white or reddish brown or blackish brown coat, light brown or pinky and strong muzzle, light brownish creamy-white or light blackish white hooves and small eyelids with brown or creamy white and short, coarse, straight ears and attached with close to the head or body. In some pockets of islands, piglets were shown with dark brownish red stripes in the dorsal part of the body and this appearance of striped piglets is an essential indicator of primitive pig type or marker of origination of this pig from wild group of pigs. The majority of the pigs appears small to medium sized, short legged, short with a long body and their skin colour includes black, grey, brown and blackish brown. Sometime, the ventral side (belly region) were coloured with cream or white and in some pigs the pattern of colouring has extended throughout the whole body. The bristles are dense, coarse with black or brown or creamy in colour. This pig has a marked bristle crest or mane on the dorsal part of the pig which is extending to tail base from mid head/shoulder. Slight downward curvature or arch of the back/low back is considered as the most common feature in this pig breed. There are no facial warts in pigs. These breeds are sturdy and short compared to other desi breeds. Head is short with a strong slightly curved (downward) snout and large jowl. Some pigs inside the jungle are reported with long big head and strong lengthy snout with aggressive indicates wildness. Neck is short, clean and heavy. The shoulders are light, firm and free from coarseness, medium width and well attached to body. The body is medium length, slightly arched (downwards) at back, no uniform breadth/sides, well sprung ribs, strong and slightly wider loin and back; slightly broad hams, well-filled but not up to hocks. Nicobari pigs have large, capacious/heavy and moderately pot-bellied abdomen. The fascial profiles of pigs vary from flat to concave giving a docile nature and rooting behaviour. The legs of pig are short, strong, smooth pattern with or without wrinkles and they are fast runners. The legs are square with body. Tail is generally medium to long in size and the characteristic feature of the tail is that no curling observed and it is straight extending beyond hock. Uncastrated pigs live inside the jungle are heavy weight with well grown tusk, ferocious in nature and attempts to attack the strange people, those enter inside the jungle. This indigenous pig breed is healthy, very active, alert and fast runner and well adapted to the local environment of Nicobar. These parameters mark that the Nicobari pigs are originated or descendent from wild boar i.e. *Sus scrofa*, however, they are still in domestication process [7, 10–12].

2.2 Feeding practice

The pig is managed under open grazing, free range systems in the coconut plantation and inside the dense forest. These pigs have the natural habitats include rain forest, mountain forest and plantation area. During day time, pigs roam freely in jungles in search of food and in evening, they return to their respective owners or remain in the forest. Feed and feeding practices reveal that none of the farmers

provide pigs with commercial feed. Feeding the pigs, both in morning and evening is the important routine of the day and these pigs are very active both in very early morning and late evening and move in batches of 4 to 20 to eat feeds [17]. No feed (ration) is prepared separately for the pigs. The pigs are grown and fattened using locally available feed resources and without any concentrate ration. Nicobari pigs are omnivorous, though largely vegetarian; are opportunists and most will eat a wide range of food of animal origin. The pigs are fed with copra, coconut and its water, ripe pandanus fruit, bread fruit, Nicobari aalu, root crops, both fresh and cooked fish, poor quality fish waste, crab, coconut beetles, kitchen and vegetable waste and other commonly found arthropods. Pigs are also fond of dehusking ripe coconuts and breaking the hard nut to enable them to eat the coconut kernel. Some of these pigs are also found on the sea shore, especially during the low tide, scavenging for snails, shellfish and other sea creatures. This Nicobari pig breed has very good behaviour on rooting and gets sufficient nutrient rice feeds especially on wild palm root and also eats crabs, small insects and also other sea wastes which are in sea shore areas. Four local or indigenously available feed materials such as pandanus, coconut, and Nicobari aalu and bread fruit are commonly fed to pigs by the tribals. Coconut is the main feed for Nicobari pigs and almost one third of the total coconut produce is reserved for feeding their pigs. Pigs are fattened mainly on coconut feeding. In Teressa Island, pigs are fed with poor quality fish, snails and meaty portions of seashells [13]. Although higher market value of coconuts, this Nicobari pigs are fed continuously with coconuts as these pigs are placed in a high position in the minds of the Nicobarese. At the time of feeding, the tribes have very different and distinct ways of calling the pigs, for example, by beating bamboo, producing different sounds by shouting at a peculiar high peak or singing particular songs. These animals soon respond to their owners and come to their respective place of feeding. It is observed that only the pigs of the concerned *tuhet* are turn up after listening such tuned call from his master. The calling the pigs for various purpose is different from one family to another one varying from mild vocal sweet tunes to heavy beating of bamboo pieces in a serially particular sound rhythm [15]. All the pigs gather at the place where the tribal man or woman breaks the coconut, remove the coconut with use of a special instrument from its outer shell and place the coconut with coconut water in the feeding trough or feeder which is locally known as "naam" in their Nicobari language, which is generally made from wood in various sizes as length is from 30 to 100 cm and width is from 15 to 20 cm. All the *Nicobarese* maintain one wooden stilt platform in their horticulture plantation to feed the pig. A lengthy hardwood with the size of 5 feet is removed the central portion till it forms in the shape of food container. It is used to keep sliced raw (*kutcha)* coconut to feed the pigs twice a day on regular basis [15]. After feeding, the animals wander back to the jungle, only to return to the village/household premises during night hours. Stem of big size bamboo is cut into two halves in middle with different length for feeding purposes. Hallow empty space is commonly used for feeding purpose. Other materials viz. old cans, shells of Giant clams (*Tridacna* spp.) and aluminium plates are used for feeding and watering. The pig feeder is most commonly prepared from thick wood, sea shell, bamboo or unutilisable plastic drums. The quantity of feed provided to the pigs is not measured; however, the farmers reported that it differs with presently availability as well as age of pigs. For each adult pig, approximately two to three small raw coconuts (weighing approximately 0.5 kg) are provided daily. The Nicobari tribes lay down on a raised or height of the wooden platform to supply feed to the pigs. Normally they feed 3-5 coconuts to each pig. Both men and women are equally involved in the feeding and management of the pigs. Women pay special attention to pregnant and nursing pigs. Moreover, oil extracted coconut powder, Nicobari aalu, pandanus

fruit (locally known as kevri); tapioca (malayal aalu) and also fish waste are fed in addition to feeding of raw coconut. The tribals do not cook or prepare any rationed feed separately to feed the pigs. However, pigs are still deficiency of balanced nutrition (energy, protein and minerals) and therefore, it is an urgent need to improve the knowledge and skill of technical know-how on feed resource management for the tribal people to enhance the pig/pork production system in Andaman and Nicobar Islands. It is also observed that some pigs never came to the residential area and just lives in the forest. The respective farmer regularly goes to the forest in the evening time to feed their pigs. It is interesting to observe that some tribes carried incense (locally available) sticks while feeding in the forest. By smelling the smoke, the roaming pigs recognised their owners and knew they are going to be fed [7, 10–12].

2.3 Genetic characterisation

The allele size range, observed and effective number of alleles, observed and expected heterozygosity and polymorphic information content (PIC) at 23 loci in Nicobari pig are studied. The allele size range varies from 86 to 116 bp at locus SW936 to 280–296 at locus IGFI. The total number of alleles ranges between 5 (S0178, SW951, SW24 and S0386) and 11 (S0355). The effective number of alleles ranges from 2.97 (SW24) to 7.9 (S0355). The mean observed number of alleles for all 23 loci in Nicobari pigs is 6.96 ± 0.31. The observed heterozygosities are lower than the expected values at all the 23-studied loci in Nicobari pig. The mean expected and observed heterozygosities are 0.75 ± 0.01 and 0.655 ± 0.02, respectively. The mean PIC for all the 23-studied loci is 0.74 ± 0.01 [7].

Herd composition of individual Nicobari pig family is 15.56 ± 2.59, 2.33 ± 0.33, 2.00 ± 0.48, 2.70 ± 0.90 and 1.83 ± 0.31 for herd size, sows, boars, growers and piglets respectively. They can survive with a very low level of management [4, 18]. The herd statistics reveals that the pig herd size per household ranges from 7.5 to 10.0 with a mean of 8.9. The herd size of Nicobari pig in every individual family in Nancowry, Teressa and Car Nicobar varies between 10 and 15 and is higher than on other islands. The overall herd size of the Nicobari pig is 12.46. It is recorded that 33.2% of farmers kept less than 5 pigs, 47.1% of farmers kept more than 10 pigs and 19.7% of farmers kept 5–10 pigs in their house. The herd composition reveals that the adult female population ranged between 9 and 20 percent. The adult breeding populations are important to further propagate the germplasm and there is an immediate need to increase breedable population of female pigs in Nicobar group of islands. 97.2% of household are rearing indigenous Nicobari pigs whereas remaining 2.8% are rearing Large White Yorkshire crossbreeds. Pigs for fattening purpose are reared by 84% of farmers. Black-coloured pigs are preferred by 86.7% of farmers, 6.7% liked white ones and 6.6% had no colour preference. Husbandry practices reveal that the tribal farmers did not rear pigs as a source of income. All the animals are used for domestic consumption during weddings and other festivals [7, 10–12].

2.4 Husbandry practices

Pigs in Nicobar do not have separate house/shelter or sty. Pigs are mainly resting underneath the tribal's hut/shelter. The Nicobari shelters/hut are prepared in sufficient height from the ground floor with approximately 2-3 m to assure a sufficient space/place for pig and piglets to get sufficient rest and also to protect from heavy rainfall in Nicobar islands [7, 10–12]. No separate pig house or sty or any housing pattern is constructed for the pigs. A separate enclosure/shelters for piglet are made using locally available material usually bamboos by the tribes of all the islands. Two

types of night shelter are provided for pigs. In 58% of households, the pigs are housed underneath the tribe's hut. The huts are made in appropriate height from the floor to protect the pigs from heavy rainfall and other inclement weather. Seventy-six percent of shelters have concrete floors and they are cleaned regularly. On the other hand, in 42% of household, separate indigenous pig sties made of bamboo or other indigenous plant material are provided. The size of the sty varies according to the size of the pig and population. The pigs marked for slaughter and feral pigs caught from jungles were kept in separate wooden enclosures with roofs made of wild leaves or long grasses. The shelters are generally made of pieces of wooden planks, tree branches and the roofing is made using leaves/grasses [7, 10–12]. The shelters are made in different sizes depending on the population. Nicobari tribes in Teressa Island are using sea sand as the suitable bedding material for sows as well as old rags; cloths and/or dry big size leaves are used for new born piglets as bedding materials [13].

2.5 Slaughter practices

Adult body weight of Nicobari pig is 175-200 kg. Dressing percentage, live weight at slaughter (kg) and average age at slaughter (months) was reported as 70-80, 112.82 ± 14.26 and 12.76 ± 1.07, respectively. Both growers and adults are slaughtered. Pig slaughter and pork consumption pattern revealed that there is no commercial system of pig rearing or sale of pork prevailed among the tribal people. They rear pigs mainly for consumption during different festivals, ceremonies, village functions and inter village sports. During the functions, all the tribal people of a particular village assemble and take part in a fight between pigs and the tribe popularly known as "pig fight". The tribe members fight the pigs either alone or in a group. After defeating a pig, it is subjected to slaughter. Slaughtering of the pigs is carried out in different locations including the pig farmer's own premise, as there is no organised slaughterhouse. The slaughter procedure is done very systematically. Pigs are killed by direct cardiac puncture using a sharp-ended stick and the entire pig is roasted in a fire for scalding and cut off parts for consumption. Dressing percentage is found high; varied from 70 to 80%. The pig fat is smeared over the meat for long-term storage. Most of the festivals and ceremonies are cantered on pig and the pig festival (Cana-haun in Nicobari language). Mostly, male/boars are preferred for slaughter [7, 10–12].

2.6 Reproductive performances

Pigs are allowed for open range feeding and breeding occurs in the forest area. Reproductive performance reveals that natural mating is occurred in the jungle as in free-range systems of farming. The reproduction of this Nicobari pig stock is very high in comparison to other livestock. In general, the breeding male resides in jungle and also it is difficult to see or collect. The adult mature female pig goes to inside the jungle to cross with the adult boar at the breeding cycle. Reproductive performances of pigs are as age at first farrowing (months), litter size (number) and farrowing interval was 10.91 ± 0.85, 8.06 ± 0.33 piglets and 17.91 ± 0.33, respectively. The age at first farrowing is 10 to 12 months, the litter size is normally 6 to 10, farrowing interval is 8-10 months and the method of mating is natural. It is observed that before farrowing, the pregnant sow goes to jungles and prepares nests with wild leaves, grasses and some other plant materials and this indicates that the Nicobari pig has inherent behaviour for fashioning or building their nest. Pregnant sows and nursing sows are cared by the tribal women with utmost important which is same as traditional pig rearing practices which is followed at Kebar and Manokwari where

pregnant females get top prior attention on feeding and management and they are kept as close to the tribal house and also supplied good quality food, water and shelter to them. It is also reported that sows in their last stage of pregnancy go to the jungle, farrow there and do not return to tribal shelter until 2 to 3 weeks, later bringing along with piglets. As farrowing occurred in the forest, exact litter size and piglet mortality are not known. Based on tribal farmers assumption, it is revealed that the mean age at first farrowing (months), litter size (number) and farrowing interval (months) were 10.8 ± 0.8, 6.8 ± 0.4 and 8.3 ± 0.4, respectively. It is reported that the teat number in Nicobari sows is varied from 5 to 6 pairs indicated that it has higher fecundity. The pigs are observed with good mothering characteristics. No weaning practice is followed. There is no information about the pre or post weaning mortality in pigs [7, 10–12].

The tribes have the knowledge and benefits of castration. It was believed that the castration might improve the body weight gain of pigs and makes the male pig more docile. Castration practices revealed that it was found that 94% of the farmers used to castrate their male pigs at the age of 3–4 months. Among the male piglets, the piglets with better vigour, body weight and health are not castrated; they are kept for breeding purpose. These practices indicate that the tribes have the knowledge of selection of good boar for breeding. Castration is performed in the dry season. The farmers use a surgical method of castration [7, 10–12].

One study was conducted to assess the effect of intensive and extensive system on different reproductive parameters. Results revealed that age at first oestrus (160.10 ± 6.83 vs. 173.6 ± 2.91 days), oestrus duration (66.00 ± 0.44 vs. 88.56 ± 3.57 hrs), age at first mating (160.00 ± 5.77 vs. 188.10 ± 2.41 days), gestation period (114.64 ± 0.23 vs. 116.12 ± 0.11 days), age at first farrowing (301.70 ± 2.4 vs. 319.20 ± 4.25 days), farrowing interval (226.00 ± 6.20 vs. 242.40 ± 4.84 days), litter size at farrowing (6.50 ± 0.34 vs. 7.19 ± 0.18), stillbirth (0.20 ± 0.01 vs. 0.59 ± 0.04 number per sow) and mortality (0.22 ± 0.08 vs. 0.68 ± 0.02 number per sow) are significantly lower in intensive system than free range system in female animals. Similarly oestrus cycle duration (26.09 ± 0.22 vs. 21.01 ± 0.20 days), litter weight at birth (0.83 ± 0.29 vs. 0.79 ± 0.71 kg), litter size at weaning (5.33 ± 0.33 vs. 5.23 ± 0.14), litter weight at weaning (31.28 ± 3.19 vs. 24.52 ± 3.15 kg) and litter weight at weaning (31.28 ± 3.19 vs. 24.52 ± 3.15 kg) are higher in intensive than in extensive system of rearing. In male, age at first mating (156.30 ± 2.08 vs. 143.1 ± 2.11 days) was significantly higher in intensive than in the extensive rearing system [19].

Body measurements (cm) such as chest girth (84.45 ± 3.01 vs. 93.77 ± 3.87), body length (84.88 ± 4.08 vs. 78.56 ± 2.77), height at withers (56.11 ± 2.44 vs. 60.65 ± 2.68) and neck girth (78.10 ± 3.40 vs. 67.64 ± 3.86) were differed between male and female Nicobari pigs in Nicobar group of Islands [20]. Similarly, body weights (kg) were significantly higher in intensive system than in extensive system in male and female animals at birth (0.86 ± 0.05 vs. 0.81 ± 0.06 and 0.81 ± 0.09 vs. 0.79 ± 0.07), weaning (6.56 ± 0.27 vs. 4.95 ± 0.15 and 5.17 ± 0.12 vs. 4.42 ± 0.13), 3 months (8.32 ± 0.14 vs. 6.47 ± 0.10 and 7.17 ± 0.17 vs. 6.15 ± 0.15), 6 months (50.00 ± 0.20 vs. 28.39 ± 0.30 and 42.27 ± 0.32 vs. 26.47 ± 0.22), 9 months (64.00 ± 0.27 vs. 38.39 ± 0.34 and 54.60 ± 1.07 vs. 36.57 ± 0.54) and 12 months (77.50 ± 0.29 vs. 43.06 ± 0.74 and 66.90 ± 1.08 vs. 40.95 ± 0.78). It is concluded that growth and reproductive performances of Nicobari pigs reared under intensive system has significantly higher beneficial than in free-range system [19].

2.7 Identification of pigs

Nicobari tribes identify their pigs in the systematic methods as they create identical cuts on the piglets' ears in such a way to easily identify or differentiate the

piglets from one lineage or joint family to another lineage or family. Generally, markings resemble the symbols of claw and eyes of the crab, circle, half moon and similar identification cuts. It is a locally formatted act which is done by experienced tribal people of that specific lineage or family. In case, the identification cuts are wrong, the particular pig is killed and slaughtered and the particular concern person who marked wrongly is forced to eat the whole amount of pork without dividing with the other fellow *Nicobarese*. Such of different categories of ear cuts are visible in animals of the *Nicobarese* to know or identify the specific pig owner. In case no such identifications are seen on the pig ears, indicated that this is considered as wild boar and any person can hunt it for personnel purpose or consumption. In case mistakenly hunted the domestic one in the forest, it is given back to the concerned family by identifying its symbol on its ear. Pig slaughtering during ceremonial or any other domestic purposes, *Nicobarese* first remove the elongated piece of pork right from the earmarks to tail and displayed in front of the concerned house to prove its identity. Otherwise it is believed that others may mistake of its authenticity [15].

2.8 Pig trapping techniques and tools

Nicobarese generally uses the technique of *hinkuoñn* for catching the pig. In this technique, a tight rope is placed at different locations in the soil dibbled strong sticks and a round rope trap is located on ground close to its feeding trough or drinking water points. Finally it is attached to stick which is in the custody of hunter who hides in the nearby bush or tree, whenever it entangles the prey it tightly pull and caught by the waiting hunting party [15]. Hinkuoñn is a kind of trap used to catch pigs in the forest. An elongated rope is tied to a stick and a knot is made intermittently to facilitate easy tie of the rope to the leg of the pig. It is kept nearer to the regular feeding place and calls their hogs. When the pigs turn up for feeding are caught into trap [15].

2.9 Disease management practices

Lack of feed is found to be the biggest constraint. The main disease constraints are swine fever, parasitic diseases and respiratory problems. Swine fever as the main disease constraint in Nicobar pigs in Nicobar group of Islands. It was reported in the last decade, there was an outbreak of swine fever which caused mortality in young and adult pigs. A vaccination program against swine fever had been implemented by the Veterinary Department of Andaman and Nicobar Administration. Higher prevalence of parasitic diseases has also been observed. Worm infection is diagnosed by discerning of abdomen (67%), unthriftiness (43%) and poor appetite (41%). Only 33% of farmers practiced deworming. Other than diseases, the pigs were killed by the predators like python in the forest and street dogs [7]. There are various conditions such as natural calamities (tsunami and earthquake), predators (Reticulated pythons), outbreak of disease (swine fever) and non-availability of scientific breeding and farming practices leads to severe threat to the Nicobari pigs. Upto date there is three swine fever outbreaks have been observed from these Andaman and Nicobar islands. Nicobari pig breed which is available in Nicobar Islands are very much susceptible to this swine fever disease. The sero prevalence of swine fever was 41.75%, of which Lapathy in Car-Nicobar showed highest Sero-prevalence of 21.87% followed by Diglipur (18.75%), Nancowry (14.28%) and Tamaloo (Car Nicobar, 3.13%). The prevalence of Ascariasis, infestation with tape worm and abnormal nutritional deficiencies were reported in pigs in Andaman and

Nicobar Islands. A mild outbreak of Foot and Mouth Disease (FMD-type O) in pig was reported just after the episode of tsunami, 2004 [5].

2.10 Complete uterine prolapse-a case report

A Nicobari sows aged 2 years with complete prolapsed uterus was presented for treatment. History revealed that farrowing was normal and the hanging of prolapsed uterus was unnoticed for long period in the night time after farrowing. Everted uterine horns were protruded from vulva in clinical examination. The uterine masses which prolapsed were severely congested as well as oedematous. The values of body temperature, pulse and respiration rate were 102°F, 95/minute and 17/minute respectively. The prolapsed mass was cleaned with cold potassium permanganate (1:1000) solution. Ice packs were applied to reduce oedema. The rear part of the animals was elevated by placing gunny bags. After that attempts were given to replace the everted organ by gently pushing to its original position. However, the sow died due to prolonged exposure of complete prolapse in Nicobari pig [21].

2.11 Conservation of Nicobari pigs

Nicobari pig breed is believed as a local/indigenous pig germplasm belongs to this Andaman and Nicobar island territories. The external/phenotypic parameters revealed that this Nicobari pig breed is indigenous/ ethnic to these bay islands and their presence was reported since many decades. Nicobari pig revealed higher prolificacy as litter size varies from 8 to 10 numbers as well as lower preweaning mortality prevailed. Castrated boar and adult sow revealed significantly higher body weight (110-160 kg). The pigs are reared and considered as family asset among the tribal. No commercial farms or sale of meat is practiced. However, most of the pigs are slaughtered mostly during festive seasons or family/community ceremony. Awareness programme on conservation of indigenous pig germplasm and training on scientific pig farming is given for the Tribal and island farmers [11, 12]. Tribal families were identified for maintaining /conserving the pig germplasm.

3. Andaman local pig

3.1 Physical characterisation

Andaman local pig (ALP) has been introduced by settlers in these Islands from mainland India. This ALP is one of the indigenous pig breeds of Andaman group of islands and is mostly found in Baratang and Mayabunder area of Andaman. Its body coat colour differs from rusty grey to black or brown. Neck and back portion hair are very thick as well as long whereas hair on the sides and flank regions are shorter and thinner relatively. The adult male body weight varies from 75 to 80 kg female body weight varies from 60 to 70 kg. Age at first farrowing is about 300 days with litter size of about 7-8. They maintain good health with low plane of nutrition [22].

ALP is very well adapted and tolerable to the different tropical humid harsh environmental conditions with higher relative humidity, higher temperature as well as higher temperature humidity index. Further, these local indigenous Andaman local pigs are scavengers and also semi-wild in their behaviour and character. The Andaman local pigs have good mother caring ability and are more aggressive at farrowing or delivery time. Although the ALPs have lower in their growth rate and

reproductive and productive performances, it is highly liked by the rural tribal communities for supplementation of sufficient protein and income for the family. The ALP is associated with the socio-culture-economic-tradition of tribals. Andaman local pig is in general as semi-feral in behaviour and is mostly reared in extensive or free-range system with little amount of management. Mitogenome analysis revealed that this ALP can be evolved as an independent breed in Andaman and Nicobar Islands as merit for registration as a recognised pig breed [8]. This indigenous local pig is under the endangered position and immediate preservation, conservation propagation effort is need to be taken to safeguard the indigenous pig breed from disappearance [7].

3.2 Genetic characterisation

Microsatellite markers have been used widely for the genetic characterisation of animal breeds including pig [23–26]. The microsatellites are used to assess the genetic diversity at higher level among the large genetic resource pools of pigs throughout the world [25]. Andaman local pig was characterised by 23 FAO recommended microsatellite markers. The allele size range, observed and effective number of alleles, observed and expected heterozygosity and polymorphic information content (PIC) at 23 loci in Andaman local pig is explained. The allele size range varies from 86 to 116 bp at locus SW936 to 280–296 at locus IGFI. The alleles' total number is ranged between 5 (SW122, S0228, SW951, S0178 and SW24) and 12 (S0355). The effective number of alleles ranges from 3.14 (SW24) to 8.1 (S0355). The mean expected and observed number of alleles for all the different 23 loci in Desi pigs of Andaman are 5.09 $\pm$ 0.20 and 7.04 $\pm$ 0.37, respectively [18]. The mean value of effective number of alleles for Andaman local pig is found higher than South-African pig breeds, Mozambique (8.45), Kolbroek (6.18) and Kune-Kune (5.97) but is lower than Duroc (3.98) [27]. The mean effective number of alleles of the Indian pig breeds Desi, Gahuri and Ankamali are 5.00, 5.33 and 5.34 respectively [28]. Higher allele numbers in India populations than in European breeds indicated that isolation and selection effects of these pig populations have been mild or minimum. Andaman local pig has the observed heterozygosities is lower than the expected value at the 22nd loci in S0005. The mean expected and observed heterozygosities are 0.77 $\pm$ 0.01 and 0.69 $\pm$ 0.01, respectively. The mean PIC for all the 23 studied loci is 0.74 $\pm$ 0.01. The genetic diversity in Andaman local pig is higher than the European pig breeds. The PIC is higher than Large White Yorkshire but comparable with other Indian pig breeds like Desi, Gahuri and Ankamali [28]. PIC values of all the microsatellite loci are above 0.5 which indicates that the microsatellite loci are suitable for detection of genetic diversity in Andaman local pig. Mean observed and expected heterozygosities of 23 microsatellite loci of Andaman local pig are found high indicating high genetic diversity of this pig breed. From the microsatellite data, it is also found that this pig breed is distinguishable from other pig breeds. As the pig breed is under the threat of extinction due to extensive cross breeding, serious effort must be initiated to conserve this breed in its breeding tract [18].

3.3 Reproductive profiles

Reproductive parameters such as litter size at birth (no.), total and individual litter weight at birth (kg), litter size at weaning (no.), total and individual litter weight at weaning (kg) and pre and post-weaning mortality (%) are recorded. Growth parameters such as body weights (kg) from month 1 to 9 are recorded. Dressing percentage, fat thickness, percentage of lean, fat, meat: bone ratio and also bone are recorded for Andaman local pigs in separately for male and female pigs [20].

Significantly higher body weights are observed from month 1 to 9 under intensive system in male than in female pigs. The rate of body weight growth in different months revealed that the rate between first and second months was 37.10% and this rate has been increased from second (15.39%), third (17.79%) and fifth months (22.81%) and then decreased from fifth (13.42%), sixth (12.45%), seventh (2.87%), eighth (3.14%) to ninth months (2.34%) in male pigs. Similar trend is also observed in female pigs as in month 1 (37.39%), month 2 (15.96%), month 3 (18.28%), month 4 (21.18%), month 5 (16.56%), month 6 (9.93%), month 7 (4.09%), month 8 (3.21%) and month 9 (1.64%). In overview, the body weight of female pig is significantly lower than the male pig (47.87 vs. 52.12%) with an average of 42.66 and 46.18 kg, respectively for female and male pigs [20].

Weight of total litter size, litter size at birth, and individual at birth, litter size at weaning, weight of total litter size and individual at weaning and pre and post weaning mortality differs significantly between male and female pigs at the rate of 17.72, 9.94, 7.79, 3.41, 5.18, 34.19 and 23.46%, respectively. The male has significantly higher value than in female with respect to all these parameters except the pre and post weaning mortality which are significantly higher in female than in male. However, these values are within the normal range of pigs of indigenous population [20].

One study was conducted to assess the reproductive parameters in Andaman local pigs. Results revealed that these reproductive parameters such as litter size at birth (3.87 ± 0.16 vs. 3.17 ± 0.12), average individual weight at birth (1.66 ± 0.02 vs. 1.42 ± 0.02 kg), litter weight at birth (6.41 ± 0.27 vs. 4.48 ± 0.17 kg), litter size at weaning (3.33 ± 0.13 vs. 3.11 ± 0.11), average individual weight at weaning (10.55 ± 0.09 vs. 9.51 ± 0.06 kg), litter weight at weaning (35.08 ± 0.31 vs. 29.56 ± 0.19 kg), pre-weaning mortality (8.87 ± 0.12 vs. 4.35 ± 0.08%) and post weaning mortality (3.42 ± 0.11 vs. 2.12 ± 0.03%) were significantly higher in male than in female animals. Similarly body weight (kg) at 1st Month (6.67 ± 0.15 vs. 5.96 ± 0.20), 2nd month (14.51 ± 0.18 vs. 13.08 ± 0.18), 3rd month (19.79 ± 0.22 vs. 18.05 ± 0.19), 4th month (28.36 ± 0.24 vs. 26.13 ± 0.29), 5th month (45.13 ± 0.17 vs. 40.77 ± 0.27), 6th month (59.13 ± 0.30 vs. 56.96 ± 0.27), 7th month (75.96 ± 0.29 vs. 69.53 ± 0.39), 8th month (80.45 ± 0.14 vs. 75.47 ± 0.22) and 9th month (85.67 ± 0.23 vs. 78.00 ± 0.37) was significantly higher in male than in female animals in Andaman local pigs [20].

3.4 Semen collection and artificial insemination

Cross breeding with the use of Artificial insemination (AI) can be a tool to upgrade genetically inferior local pigs and avoid inbreeding that usually happens with less number of available breeding boars or small pig population. The purpose of semen preservation for AI is to maximise the use of superior germplasm with extended sperm viability but without much effect on the sperm fertility essential for successful breeding. With the aforesaid vision, semen collection was attempted in Andaman local pigs using gloved hand technique. This is for the first time to be reported in Andaman local pigs.

Preliminary study indicated that Andaman local pig has released total semen volume, gel free semen and gel in semen volume was 220, 30 and 190 ml, respectively, and pH of semen was found to be 7.5. Objective assessment of total and progressive sperm motility was done which were 80 and 75%, respectively. Sperm concentration was estimated with use of haemocytometer chamber and count is $210x10^6$/ml. Morphometric measurements of pig spermatozoa with software enabled microscope were performed. Average head length, head width, tail length and full sperm length was observed to be 9.42, 5.24, 43.93 and 52.37 μm,

respectively. The preserved liquid semen was used for artificial insemination purpose in the organised pig breeding farm, ICAR-CIARI, Port Blair, India and the sow was conceived and farrowed 5 piglets in the year 2019 [29].

3.5 Carcass characteristics

Carcass characters such as dressing percentage, meat: bone ratio and fat thickness are not significantly different between male and female pigs whereas other parameters such as percentage of lean, fat and bone differs significantly between them. Percentage of fat (10.10%) in female and lean meat percentage (4.80%) and bone percentage (7.20%) in male are significantly higher than those in the other sex. Carcass characteristics such as dressing percentage (76.54 ± 0.31 vs. 75.52 ± 0.41), meat: bone ratio (5.53 ± 0.15 vs. 5.69 ± 0.15), fat thickness (5.55 ± 0.18 vs. 5.61 ± 0.16 cm), lean meat percentage (58.79 ± 0.36 vs. 53.4 ± 0.41; $p < 0.05$), fat percentage (30.37 ± 0.25 vs. 37.2 ± 0.20; $p < 0.05$) and bone percentage (10.86 ± 0.24 vs. 9.4 ± 0.23; $p < 0.05$) differed between male and female Andaman local pigs [5].

3.6 Feeding practices

Locally available feed resources such as rice bran, maize, wheat, coconut, taro (*Colocasia esculenta* and *Colocasia antiquorum*), tapioca, kitchen/ hotel waste, vegetable waste and poultry offal are fed to the indigenous local pigs in Andaman and Nicobar Islands [4]. In general, feed, fodder and soil of these Islands are deficient in minerals particularly Zn and is limiting factor for the growth of the pig. Age at puberty, age at first conception, age at first furrowing, litter size at birth, individual and total litter weight at birth, litter size at weaning, individual and total litter weight at weaning and weaning percentage are found significantly increased in pigs treated with 80 ppm zinc as zinc sulphate in Andaman local pig and its crossbred. Similarly, the fortnightly body weight gain (kg), total weight gain (kg) and the average daily weight gains (ADWG) are significantly higher in Zn supplemented Andaman local pigs and its crossbred [6].

3.7 Mastitis-Metritis-Agalactia (MMA) syndrome

Mastitis-Metritis-Agalactia (MMA) syndrome causes huge economical losses in the swine industry. Andaman local sow aged 3 years with the history of farrowing 18 days ago and complaint of anorexia, restlessness and inattentive towards her piglets, agalactia and lameness was presented with the elevated rectal temperature, congested mucus membrane, swollen painful mammary glands with foul smelling muco-purulent vulval discharge. Based on the visible clinical signs, sow was tentatively diagnosed as suffered from mastitis-metritis-agalactia syndrome. The affected sow was treated with ice fomentation, cleaning with liquid soap, application of Lugol's iodine solution and antiseptic ointment on the udder, injection of gentamicin, streptopenicillin, non-steroidal anti-inflammatory drug, prostaglandin F2α, intrauterine infusion of normal saline followed by Lugol's iodine solution along with supportive therapy with multivitamin and hydrotherapy in water bath. The pig was fed with boiled chicken eggs for supports to her health. The piglets were fed with toned cow milk during the treatment regimen along with creep feed. On day 3rd post treatment, the sow was recovered and allowed the piglets to suckle. Thus the quick diagnosis and prompt treatment saved the pigs from the life threatening syndrome along with eliminating the pre-weaning piglet mortality. The MMA prevalence could be reduced through optimization of husbandry, feeding and managemental practices.

This is first report of MMA syndrome in Andaman local pig in Andaman and Nicobar Islands that too affected after 18 days of farrowing [30].

3.8 Foster mother behaviour

Piglet movement from one sow to another is known as fostering which is frequently observed when the number of piglets a sow gives birth to do not match her rearing ability. This practice is very common in Andaman local pigs. Andaman local sow aged 3 years farrowed 6 piglets with good health condition. At the near farrowing room, another Andaman local pig farrowed 8 piglets with good health condition. The second Andaman local sow died due to complete uterine prolapse. These orphan piglets were allowed to suck in another normal sow. The unaffected sow accepted and fostered till the weaning age.

3.9 Coprophagia behaviour

The coprophagy was observed in Andaman local pig is autocoprophagy (eating its own faeces). This may possibly to rebalance their microbiome or to ingest missing nutrients. Coprophagy is thought to be a source of vitamins B and K, produced by gut bacteria.

3.10 Placentophagy behaviour

An Andaman local sow aged 2 years was observed to eat her own placenta after 1-2 hours of farrowing. History revealed that the farrowing was normal with 6 piglets, sow was late attended and the placenta was eaten by dam. Body temperature, pulse and respiration rate were observed within the range. It is advised to attend sow after farrowing along with feeding the pig with good balanced diet enriched with vitamin and mineral supplements.

3.11 Complete mitochondrial genome sequence of indigenous pig germplasm

The complete mitochondrial DNA sequences of Nicobari pig and Andaman local pig were submitted to GenBank with the accession numbers MK248681 and MK248682, respectively. Both the Nicobari as well as Andaman local pigs have the length of the mitogenome of 16,613 bp and are have 37 encoded genes which include protein coding genes (13 PCGs), two rRNAs and 22 tRNAs. In addition, one AþT rich region (D-loop) was present. The orientation and order of the genes was same as to the mitogenomes of similar vertebrate species. Protein coding genes were located on heavy strand except ND6. Start codons for 13 protein coding genes were having ATN codon followed by truncated/ abbreviated stop codon was found in ND1, COX3, ND2, ND4 and ND3. From the phylogenetic tree, it was found that Nicobari pig has close phylogenetic relationship with Banna mini and Breed I pig, whereas Andaman local pig is close to Mong Cai and Jinhua pig. Mitogenome analysis on local indigenous pig breeds revealed that the analysis will be useful to format conservation strategy of the swine breeds in Andaman and Nicobar islands [8].

4. Andaman wild pig (*Sus scrofa andamanensis*)

Long snouted Little Andaman wild pig (Schedule II animal under Forest Act, India) is a threatened and endangered in Andaman and Nicobar Islands. Andaman wild pig is preferred by the local people as a meat source. Wild pig of Andaman is

commonly spread at the Jarawa as well as Onge tribal forest reserve areas of Andaman group of islands. The Jarawa tribes also prefer this wild pig. They are being poached by the primitive Jarawa tribes and are the main source of protein for them from time immemorial. Due to unauthorised poaching, the number of this wild pig is reducing day by day, which needs attention for its conservation. Andaman wild pig was once found all over in the forests of the Andaman group of Islands, but have become extremely rare and currently the last strong holds are the Jarawa Reserve forest area, Rutland and Little Andaman Islands. It is a scheduled animal, black in colour, short legged, small to medium sized and a prolific breeder. As per the literature, Andaman wild pig has the litter size (number) from 4 to 7; however, due to unavailability of food and water and illegal hunting, their numbers has been decreasing very fast in Andaman and Nicobar Islands. Presently, this pig comes under schedule I Part I of the Wild Life (Protection) Act of India, 1972. These wild pigs of Andaman are well adapted physiologically and anatomically to this island ecosystem over the many centuries as they are native of these islands. They are black in colour, short legged, small to medium sized animal and very active, alert and fast runner [22].

4.1 Physical profiles

Body height of Andaman wild pig was measured as 20 inch at the level of shoulder with the compact body. The pig is very active, wild expression and a fast running animal. The RBC concentration, PCV and Haemoglobin concentration were found very high [22]. The phenotypic characters of male pig (in inches) are presented as body length (from shoulder to base of tail): 23, body height at shoulder level: 20, neck width: 15.5, ear length: 3, ear width: 3, Leg length; 9, hoof circumference: 2.5, tail length: 4, abdomen width: 20.5, chest width: 21.5, testis length: 2.5, testis width: 2 and body weight based on chest girth: 16 kg [31]. Boden Kloss [14] observed that the pigs (*Sus scrofa andamanensis*) in Andaman islands appeared were diminutive in stature and the fully grown boar was only 20 inches high at the shoulder.

4.2 Haematological profiles

The blood profiles of Andaman wild male pig revealed that the RBC: 9.72 x 10^6/μL, MCV: 63.1 f1, PCV: 61.3%, MCH: 17.77 pg., MCHC: 28.17 g/dl, Hgb: 17.27 g/dL. The leucocytic parameters of Andaman wild male pig revealed that the WBC: 35.12 10^3/μL, lymphocyte: 62.80%, monocyte: 8.37%, neutrophils: 4.80%, eosinophils: 21.37% and basophils: 0.70%. The thrombocytic parameters of Andaman wild male pig revealed that the platelet: 696.00 10^3/μL, MPV: 6.83 f1, Pct: 0.43% and PDW: 11.90 [22]. The WBC is also found high in Andaman wild pig. WBC count of Andaman wild pig is higher than that reported in wild boar of Croatia [32].

4.3 Comparision study among the wild, indigenous and exotic pigs

This comparision study was conducted in Andaman and Nicobar islands. Blood indices revealed that PCV, RBC and Hgb were significantly higher in Andaman wild pig than in other all pig breeds (Nicobari pig, Large White Yorkshire and Andaman local pig). The RBC, PCV and Hgb of LWY were significantly higher as compared to Andaman local pig and Nicobari pig. No significant differences in RBC, PCV and Hgb were found between Andaman local pig and Nicobari pig. Andaman wild pig has significantly higher Hgb, RBC and PCV indicates that a higher level of oxygen is required for wild pig as it is a fast running animal

Andaman wild and Nicobari pig are not differed significantly in their MCV, however, both these pigs were had significantly higher MCV than in Andaman local pig as well as LWY in Andaman and Nicobar Islands [31]. Higher values of MCV in wild pigs impute an enhanced need for oxygen [33]. Nicobari pigs are too growing in open grazing or free range systems; which also fast running animal. The increased blood profile is due to environmental effect on haematological traits as haematological and biochemical values may be affected by a wide range of factors, including environment, season, diet, age and stress [32]. Whereas, MCH of Nicobari pig was found significantly higher in comparison to all the other pig breeds, the value was lowest in LWY. However, MCHC did not show significant differences within the pig breeds. Wild pig of Andaman is well adapted anatomically and physiologically in the humid tropical climate of Andaman and Nicobar Islands [31].

The blood leukocyte indices revealed that the WBC was significantly higher in Andaman wild pig in comparison to Nicobari pigs and was lowest in LWY. Similarly lymphocyte concentration was significantly lower in LWY than in all the other pig breeds; however, there was non-significant difference between the Andaman wild pig, Andaman local pig and Nicobari pig in Andaman and Nicobar Islands. A significantly higher monocyte was found in LWY as compared to all the other pig breeds. Wild pig of Andaman had lower neutrophils significantly as compared to other all pig breeds available in Andaman and Nicobar Islands; LWY has highest value. Eosinophil was highest in Andaman wild pig followed by Andaman local pig, Nicobari pig and LWY. No significant differences were found in basophils among all the pig breeds studied. The neutrophil and lymphocyte ratio was lowest in Andaman wild pig and was highest in LWY. The MCV of Andaman wild pig was also significantly higher in comparison to Andaman local pig and LWY [31].

Blood thrombocytic values in Andaman wild pigs revealed that no significant ($p < 0.05$) difference was found in PLT between Andaman wild pig and LWY but the values were significantly higher in comparison to Andaman local pig and Nicobari pig. MPV value of LWY was significantly lower in comparison to all the other pig breeds studied. PCT of Andaman wild pig was significantly higher than Nicobari pig and LWY but did not differ significantly with Andaman local pig. PWD of LWY was lowest among all the breeds [31].

The reports on Andaman wild pigs revealed that based on the physical appearance, phenotypic characters and haematological profiles, these pigs are native to these islands and are well adapted to this island ecosystem over the centuries. Extensive survey on population status and studies on characterisation (*in situ* and *ex situ*) measures to protect this protected breed and scientific breeding methods should be implemented [22].

5. Andaman pig crossbred

Andaman cross breed is a cross between Large White Yorkshire and Andaman local or Nicobari pig. They are dark brown to slight white with different lines of black colour. This crossbred pigs exhibit high growth rate, fecundity and early maturity. It has high prolificacy (litter size 8–10 nos.), maternal care and the average body weight of matured animal varies from 110 to 125 kg. Moreover, this crossbred is adapted highly to the local tropical humid environmental conditions and also can adjust with locally available feed resources on the different agricultural produces. This is highly suitable for commercial production of swine meat in the island [16].

Different reproductive parameters like age at puberty (221.67 ± 3.99 days), age at first conception (245.50 ± 3.94 days), age at first farrowing (357.00 ± 4.07 days) and various litter traits like litter size at birth (6.17 ± 0.48), total litter weight at birth (7.26 ± 0.87 kg), individual litter weight at birth (1.18 ± 0.12 kg), litter size at weaning (5.17 ± 0.48), litter weight at weaning (30.46 ± 1.98 kg), individual litter weight at weaning (6.11 ± 0.60 kg) and weaning percentage (84.7 ± 5.51) were reported in Large White Yorkshire x Andaman local crossbred pigs [6].

6. Conclusion

Andaman and Nicobar Islands are completely packed with rich biodiversity. Porcine species occupies 27.26% of total livestock in these islands, of which, 70% pork consumption in Nicobar group of islands. There are three different groups of pig groups/breeds in ANI. Andaman Local is in Andaman group of Islands, Nicobari is in Nicobar group of Islands and Andaman wild pig in Andaman and Nicobar islands. Besides, crossbreds of LWY are prevalent in this ANIs. Nicobari pig plays significant roles in custom, festivals and socio-economic status of Nicobari tribes. Andaman local and Nicobari pigs are reared for meat purpose under free range or semi-intensive system. Andaman wild pig is an endangered pig germplasm of ANI. Another pig group is crossbred of LWY with Andaman local or Nicobari pig. This crossbreed exhibits high growth rate, early maturity and fecundity. In addition, it is highly adapted to the local environmental conditions and can be reared with locally available feed resources. This is highly suitable for commercial pork production in ANI. However, these domestic pig breeds need to be protected and be conserved in this Andaman and Nicobar group of Islands.

7. Outlook work for future work

7.1 Conservation and propagation strategy

The indigenous porcine population is decreasing gradually in ANI. Therefore conservation and propagation strategy needs to be established for domestic indigenous pig breeds/groups with formation of nucleus of elite flocks in farms [5]. This can be performed as follow as

- Survey of natural population: this can be performed by scholars or the people of local community. Survey training would be performed by ICAR-Central Island Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands, India

- Establish shelters and farms for producing young ones for distribution.

- Analysis of recording of the breed performance in different conditions and locations on and off the farm.

- Establishing farms are: With the help of the Tribal Council in Car Nicobar and Hut Bay, Kamorta, ICAR-CIARI, Mayabunder, Diglipur and Port Blair, help from Department of Animal Husbandry and Veterinary Science, Andaman and Nicobar Administration. Creation of multiple centres can help that if one centre is severely affected by a natural calamity or disaster or disease outbreak, other remaining centres could help to restore.

- Caution in conservation of the Nicobari pig: In the Andaman Islands, the Nicobari pigs do not place near the areas where Andaman wild pigs are reported.

7.2 Feeding practices

The pigs are fed with locally available feed resources and agricultural, horticultural and marine by-products or waste without analysing the chemical composition or ration. Therefore, it is needed to survey the available local feed resources and formulate the ration suitable for the pigs for better growth rate and better production and reproduction performances.

7.3 Breeding programme and artificial insemination

The indigenous pigs are reared in free range or semi-intensive system and breeding has been occurred in the jungle or forest with dominant boars. This will create more inbreeding lines which inturn affect the growth rate, reproduction and production performances. This needs to be addressed with formation of suitable breeding strategy and artificial breeding programme with use of elite porcine germplasm.

7.4 Control of diseases

Prevalence of various diseases has been reported in pigs. These diseases should be analysed in season wise, island wise, age group and sex wise and are to be treated accordingly. Time schedule for deworming and vaccination protocol are need to be implemented in different islands of Andaman and Nicobar. As there are many diseases are zoonotic in nature in pork eating community, therefore, prevention and control of the diseases in pigs is very important.

7.5 Slaughtering procedure

Pig slaughtering is need to be modernised and hygienic handling of the pork is need to be improved. There is need to be established the modernised slaughter house, quality control lab, pork processing and preservation chamber in Andaman and Nicobar Islands. Carcass characters, meat quality, chemical composition of pork of different breeds of pigs need to be studied.

7.6 Housing management

Housing facilities need to be improved. Different houses like piglet, grower and adult pen are to be established. Clean and hygienic house and its surrounding are to be maintained.

7.7 Identification of pigs

Identification of pigs is done with cuts on the ears in Andaman and Nicobar Islands. This can be improved with the help of tags or electronic chip method.

7.8 Comparision study

Comparision study needs to be conducted between different indigenous and cross or pure exotic breeds of pigs in island ecosystem on different growth,

production and reproduction parameters. Further detailed study needs to be conducted on effect of free range, intensive and semi-intensive system on different growth, production and reproductive parameters in different breeds of pigs.

7.9 Abnormal behaviour/condition

Abnormal behaviours/conditions like Coprophagia behaviour, placentophagy behaviour and mastitis-metritis-agalactia syndrome are need to be studied thoroughly about the aetiology, pathophysiology, prevention, treatment and control in pigs.

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References

[1] Livestock Census of India (18th). Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India, New Delhi, India, 2007.

[2] Livestock Census of India (19th). Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India, New Delhi, India, 2012.

[3] Livestock Census of India (20th). Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India, New Delhi, India, 2012.

[4] Jeyakumar S, Kundu A, Yadav SP, Sunder J, Balakrishnan M, Kundu MS, Sujatha T, Verma SK, Srivastava RC. Diversity and conservation of farm animal genetic resources (FAnGR) of Andaman and Nicobar Islands, Ecology of faunal Communities on the Andaman and Nicobar Islands, (Springer Publication), 2012.

[5] Kundu A, Sunder J, Jeyakumar S, Verma SK, Kundu MS, De AK, Srivastava RC. Livestock and poultry production policy for Andaman and Nicobar Islands: a scientific perspective. Published by Director, ICAR-CARI, Port Blair, India, 2010; pp: 1-48.

[6] Kundu MS, Sunder J, Kundu A, De AK, Sujatha T. Reproductive and productive performances of crossbred Andaman local pigs under small holder production system at Bay Islands, India. Indian Journal of Animal Research. 2017; **51**(2): 377-381.

[7] De AK, Jeyakumar S, Kundu MS, Kundu A, Jai Sunder, Ramachandran M. Farming practices and genetic characterization of Nicobari pig, an indigenous pig germplasm of Nicobar group of islands, India. Tropical Animal Health and Production. 2014; DOI 10.1007/s11250-014-0547-z

[8] De AK, Muthiyan R, George Z, Perumal P, Sunder J, Kundu A, Malakar D, Bhattacharya D, Kundu MS, Muniswamy K. Mitochondrial landscape of indigenous pig germplasm of Andaman and Nicobar Islands. Mitochondrial DNA Part B: Resources. 2019; **4**: 2, 2808-2810.

[9] Holness DH. The tropical agriculturist (Pigs). CTA, Wageningen, 1991; pp. 1-29.

[10] Jeyakumar S, Sunder J. Conservation and Characterization of Nicobari Pig. AP Cess Project Report, Central Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands, 2009.

[11] Jeyakumar S, Sunder J, Kundu MS, Kundu A, Swapna TP. Traditional pig rearing practices among the Nicobari tribes of Nicobar group of Islands, India. IOSR Journal of Agriculture and Veterinary Science. 2014a; **7**(12): 35-41.

[12] Jeyakumar S, Sunder J, Kundu A, Balakrishnan P, Kundu MS, Srivastava RC. Nicobari pig: an indigenous pig germplasm of the Nicobar group of Islands, India. Animal Genetic Resources. 2014b; **55**: 77–86.

[13] Srivastava N, Ahlawat SPS, Chatterjee RN, Roy MM, Choudhuri NC, Saha SK. Backyard swine rearing practices among Nicobari tribes of Andaman and Nicobar Islands. Indian Journal of Animal Health. 2002; **41**(1): 9-12.

[14] Boden Kloss C. In the Andamans and Nicobars: The Narrative of a Cruise in the Schooner "Terrapin", with notices of the Islands, their Fauna, Ethnology, etc. John Murray, Albemarle Street, W., London, 1903.

[15] Prasad DV. Livestock management among the Nicobarese of Katchal Island. International Journal of Multidisciplinary Research Review. 2016; **1**(17): 147-153.

[16] Sujatha T, Kannan A, Jeyakumar S, Kundu A, Velmurugan A, Sunder J, Swarnam TP, De AK. Livestock and People – The Intimate Relation Under Threat (Chapter 15). In: Biodiversity a nd Climate Change Adaptation in Tropical Islands. Sivaperuman C, Velmurugan A, Singh AK and Jaisankar I (eds). Academic Press, 2008; pp. 433-457.

[17] Tikader BK, Das AK. Glimpses of Animal Life of Andaman and Nicobar Islands, Zoological Survey of India, Calcutta, 1985.

[18] De AK, Jeyakumar S, Kundu A, Kundu MS, Sunder J, Ramachandran M. Genetic characterization of Andaman Desi pig, an indigenous pig germplasm of Andaman and Nicobar group of islands, India by microsatellite markers. Veterinary World. 2013a; **6**(10): 750-753.

[19] Kundu MS, Perumal P, Ravi SK, Sawhney S, Bhattacharya D, Kundu A, Sunder J, Muniswamy K, De AK. Evaluation of reproductive and production performance of Nicobari pig under humid tropical island ecosystem. Indian Journal of animal Sciences. 2019; **89**(3): 73-78.

[20] Kundu MS, Perumal P, Ravi SK, Bhattacharya D, Kundu A, Sunder J, Muniswamy K, Sawhney S, De AK. Reproductive and production performance of Andaman Local Pig of Andaman and Nicobar Islands, India under intensive system of rearing. International Journal of Bio – Resource and Stress Management. 2020; **11**(1): 20-26.

[21] Ravi SK, Perumal P, De AK, Alyethodi RR, Kumari S, Bhattacharya D. Postpartum uterine prolapse in Nicobari sow-a case report. Journal of Andaman Science Association. 2019; **24**(1): 148-149.

[22] De AK, Jeyakumar S, Kundu MS, Kundu A, Sunder J. Andaman wild pig (*Sus scrofa andamanensis*): A preliminary report on phenotypic and haematological characteristics. Zoo's Print 2013b; **XXVIII**(9): 9-11.

[23] Amigues Y, Boitard S, Bertrand C, Sancristobal M, Rocha D. Genetic characterization of the Blonde d'Aquitaine cattle breed using microsatellite markers and relationship with three other French cattle populations. J. Anim. Breed. Genet. 2011; **128**(3): 201-208.

[24] Tamara AJ, Choumane W, Hmeshe M. Characterization and Estimation of Genetic Diversity in Two Syrian Chicken Phenotypes Using Molecular Markers. International Journal of Poultry Science. 2012; **11**(1): 16-22.

[25] Nidup K, Moran C. Genetic diversity of domestic pigs as revealed by microsatellites: a mini review. Genomics and Quantitative Genetics. 2011; **2**: 5-18.

[26] Sollero BP, Paiva SR, Faria DA, Guimarães SEF, Castro STR, Egito AA, Albuquerque MSM, Piovezan U, Bertani GR, da S. Mariante A. Genetic diversity of Brazilian pig breeds evidenced by microsatellite markers. Livestock Science. 2009; **123**(1): 8-15.

[27] Swart H, Kotze A, Olivier PAS, Grobler JP. Microsatellite-based characterization of Southern African domestic pigs (*Sus scrofa domestica*). South African Journal of Animal Science. 2010; **40**(2): 121-132.

[28] Behl R, Sheoran N, Behl J, Vijh RK. Genetic analysis of Ankamali pigs of India using microsatellite markers and their comparison with other

domesticated Indian pig types. Journal of Animal Breeding Genetics. 2006; **123**: 131-135.

[29] Ravi SK, Perumal P, Kundu MS, Bhattacharya D, Jai Sunder, De AK, Alyethodi RR, Kundu A. Physical, biochemical and molecular characterization of semen in pigs of bay islands vis-a-vis study on feasibility of artificial insemination. Annual Report (2018-19), ICAR-CIARI, Port Blair, Andaman and Nicobar Islands, 2019.

[30] Perumal P, Ravi SK, Sarkar G, De AK, Bhattacharya D, Sawhney S, Kundu A. Mastitis-Metritis-Agalactia Syndrome in Andaman Local Pig-First Case Report. Journal of Andaman Science Association. 2020; **24**(1): 14-18.

[31] De AK, Kundu A, Kundu MS, Sunder J, Jeyakumar S. Comparative study on haematological traits of endangered Andaman wild pig and other indigenous pig breeds available at Andaman and Nicobar Islands, India. Veterinary World. 2013c; **6**(10): 794-798.

[32] Harapin I, Bedrica L, Hahn V, Sostaric B, Gracner D. Haematological and biochemical values in blood of wild boar (*Sus scrofa ferus*). Veterinarski Arhiv. 2003; **73**(6): 333-343.

[33] Tusek T, Mihelic D, First L, Janicki Z, Opancar D. Komprativni prikaz crvene krvne slike divljei domace europske svinje. Vet. Stanica. 1994; **25**: 81-84.