Article AR2055a

DOI: HTTPS://DOI.ORG/10.23910/IJBSM/2020.11.1.2055a

International Journal of Bio-resource and Stress Management

February 2020

Print ISSN 0976-3988
Online ISSN 0976-4038

IJBSM 2020, 11(1):020-026

Research Article

Natural Resource Management

Reproductive and Production Performance of Andaman Local Pig of Andaman and Nicobar Islands, India under Intensive System of Rearing

M. S. Kundu, P. Perumal, S. K. Ravi, D. Bhattacharya, A. Kundu, Jai Sunder, K. Muniswamy, Sneha Sawhney and A. K. De*

Division of Animal Science, ICAR-Central Island Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands (744 101), India

Open Access

Corresponding Author

A. K. De

e-mail: biotech.cari@gmail.com

Citation: Kundu et al., 2020. 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), 020-026. HTTPS://DOI.ORG/10.23910/IJBSM/2020.11.1.2055a.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

Acknowledgement: The authors are thankful to the Director, ICAR-Central Island Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands and This research work was supported by a grant from ICAR-AICRP on Pig. All authors recognize and acknowledge the Head and Staff of Animal Science Division for their efforts.

Abstract

Andaman local pig (ALP) is available in Andaman and Nicobar Islands (ANI), associated with socio-economic of tribal population. ALP is semi-feral, reared in free-range system with low management. However, population of ALP has reduced significantly due to Tsunami in 2004. No systematic study was conducted to explore the potential of ALP. Therefore, a systematic study was conducted on growth and reproductive parameters. Reproductive parameters like litter size, total and individual litter weight at birth, litter size, total and individual litter weight at weaning and pre and post-weaning mortality were recorded. Growth parameters like body weights from month 1 to 9 were recorded. Besides these, dressing percentage, meat: bone ratio, fat thickness and percentage of lean, fat and bone were recorded. Results revealed that significantly ($p \leq 0.05$) higher body weights were observed from month 1 to 9 in male than female. Similarly, significantly higher values in reproductive parameters were observed in male than female. Carcass characters like dressing percentage, meat: bone ratio and fat thickness did not differ significantly between genders whereas percentage of lean, fat and bone differed significantly between them. Fat percentage in female and percentage of lean and bone in male were higher significantly than in other sex. It is concluded that growth, reproductive performances and carcass characteristics of ALP reared under intensive system has significantly higher in male than in female and it is baseline information for conservation and propagation of ALP in ANI. ALP breed is well adapted to the intensive system of rearing.

Keywords: Andaman local pig, reproductive, growth performances, carcass characteristics

1. Introduction

The domestic animal biodiversity acts as genetic manoeuvring room for future generation. But, the livestock diversity is at risk due to intensive or even industrialized production systems that make for impressive outputs of meat, milk and eggs (Pan et al., 2005). Since most of the wild relatives of today's domesticated animals are extinct, the main source of such material now lies with the livestock raised by herders and farmers under extensive, subsistence-oriented production systems in the developing or under developed countries. Andaman and Nicobar group of Islands is one of such underdeveloped area in respect of livestock rearing. These islands are endowed with immaculate flora and fauna biodiversity (Kundu et al., 2010). The indigenous livestock germplasm namely pig, goat and

Article History

RECEIVED in 08th November 2019 RECEIVED in revised form 22nd January 2020 ACCEPTED in final form 14th February 2020

fowl are predominant in Andaman and Nicobar group of islands. Among the indigenous livestock, pig occupies 27.26% of the total livestock (Kundu et al., 2017). The ALP (Figure 1) is associated with the socio-culture-economic-tradition of tribals. ALP is semi-feral in nature and is reared in free-range system with very low level of management. Mitogenome based genetic characterization of the pig breed indicated that this is an independent breed evolved in Andaman and merit registration as a pig breed (De et al., 2019). This indigenous pig breed is under the threat of extinction and immediate conservation effort is necessary to save the indigenous breed from extinction (De et al., 2014; Hmingthanzuala et al., 2016).

Figure 1: Adult Andaman local Pig

Pig production is relatively remunerative due to fast growth rate, high production potential and short generation interval, highly efficient carcass yield, prolific fecundity and high adaptability to different environmental and climatological conditions (Holness, 1991). The ALP is adapted well and highly tolerable to different tropical environments with relatively high humidity and high temperature. Further, these indigenous ALP pigs are natural scavengers and also somewhat semi-wild in behaviour. The indigenous ALP pigs have good mothering ability and become usually aggressive at the time of farrowing. Even though it has low in growth rate and performance, ALP is highly preferred by rural communities to supplement sufficient protein intake and family income. Swine production is important particularly in the Nicobar group of Islands as compared to the rest part of the ANI. Nearly 70 per cent of the pork produced in ANI is consumed in Nicobar group of Islands while the rest of the Islands consume about 30 percent (Livestock Census, 2012). In spite of and ample and high scope for the piggery development in the islands, no proper and systematic study has been investigated on the productive as well as the reproductive performances of these animals, although the native species still represent a highly valuable local animal genetic component in the Islands. The reorganisation of this breed is significant as measures for its conservation, preservation and propagation. Rearing the livestock outside their breeding tract is one way to conserve the genetic material. In this present study, efforts have been made to conserve this precious breed outside its breeding tract and the objective of the present study was to evaluate the different productive and reproductive parameters and carcass characteristics under intensive system of rearing and compared between male and female pigs.

2. Materials and Methods

The present experiments comply with all relevant institutional and national animal welfare guidelines. Andaman local pigs were derived from North and Middle Andaman and reared under intensive condition in the Institute farm of ICAR-CIARI, Port Blair, South Andaman. A total of 20 animals (10 animals each for male and female) were included in the presents study. These animals were selected from the same pig owner and derived from same sow. Standard management practices were followed for these pigs. The experiment was continued till all the gilts farrowed and subsequent weaning of the new born piglets. Reproductive parameters such as litter size at birth (number), total and individual litter weight at birth (kg), litter size at weaning (number), total and individual litter weight at weaning (kg) and pre and post-weaning mortality (%) were recorded. Growth parameters such as body weights (kg) from month 1 to 9 were recorded. Besides, the dressing percentage, meat: bone ratio, fat thickness and percentage of lean, fat and bone were also recorded for ALP. These parameters were recorded separately for male and female pigs. Weight of individual animal was measured with an electronic balance. The information on reproductive parameters was also recorded.

The statistical analysis of the data was done as per standard procedures (Snedecor and Cochran, 1994). Student's t-test was conducted to assess the significant difference between the male and female for mean values of the different parameters (Statistical Analysis System for Windows, SPSS (Version 10) Inc., Chicago, Illinois, USA). Tables present the non-transformed data. Differences with values of $p \leq 0.05$ were considered to be statistically significant.

3. Results and Discussion

Reproductive parameters (Table 1) and carcass characteristics (Table 2) of ALP under intensive system of rearing were depicted in tables. The results revealed that significantly ($p \leq 0.05$) higher body weights were 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 to fifth months (15.39, 17.79 and 22.81%, respectively) and then decreased from fifth to ninth months (13.42, 12.45, 2.87 and 3.14%, respectively) in male pigs. Similar trend was also observed in female pigs as 37.39, 15.96, 18.28, 21.18, 16.56, 9.93, 4.09 and 1.64%, respectively from month 1 to 9. In overall, the male was carrying significantly higher body weight than the female pig (52.12 vs 47.87%) with average body weight of 46.18 and 42.66 kg, respectively for male and female pigs. Reproductive parameters revealed that significant

Table 1: Reproductive attributes of Andaman local Pig (ALP) of Andaman and Nicobar Islands

Litter size at farrowing	Total number of piglets born for each individual female in a farrowing
Litter weight at birth	The sum total weight of piglets in a litter at farrowing by weighing the total born piglets by placing them in pre weighed bag. The former weight was subsequently subtracted from the later weight to express the weight of animal in grams
Individual litter weight at birth	The weight of individual piglet in a litter at farrowing by placing it in pre weighed bag. The former weight was subsequently subtracted from the later weight to express the weight of animal in grams
Litter size at weaning	Number of piglets weaned after completion of 8 weeks (60 days) was recorded and the total number of live piglets weaned in a litter was included in the present study.
Litter weight at weaning	The sum total weight of piglets in a litter at weaning by weighing the total born piglets by placing them in pre weighed bag. The former weight was subsequently subtracted from the later weight to express the weight of animal in grams
Individual litter weight at weaning	The weight of individual piglet in a litter at weaning by placing it in pre weighed bag. The former weight was subsequently subtracted from the later weight to express the weight of animal in grams
Pre-weaning mortality	The percent mortality was calculated as number of dead piglets till weaning divided by the total number of piglets born multiplied by one hundred
Post-weaning mortality	The percent mortality was calculated as number of dead piglets after weaning divided by the total number of piglets born multiplied by one hundred
Weight at different months (1 to 9 months)	The weight of piglet from month 1 to 9 by weighing them in pre weighed bag. The former weight was subsequently subtracted from the later weight to express the weight of animal in grams

Table 2: Reproductive parameters (Mean±SEM) of Andaman Local pigs under intensive system of rearing

Sl. No.	Traits/ characteristics	Male	Female
1.	Litter size at birth (no.)	3.87±0.16^{a}	3.17±0.12^{b}
2.	Avg. Individual weight at birth (kg)	1.66±0.02^{a}	1.42±0.02^{b}
3.	Litter Weight At birth (Kg)	6.41±0.27^{a}	4.48±0.17^{b}
4.	Litter size at weaning (no.)	3.33±0.13	3.11±0.11
5.	Avg. Individual weight at weaning (kg)	10.55±0.09^{a}	9.51±0.06^{b}
6.	Litter weight at weaning (kg)	35.08±0.31^{a}	29.56±0.19^{b}
7.	Pre-weaning mortality (%)	8.87±0.12^{a}	4.35±0.08^{b}
8.	Post weaning mortality (%)	3.42±0.11^{a}	2.12±0.03^{b}
9.	Body weight at different ages (kg)		
	1st Month	6.67±0.15^{a}	5.96±0.20^{b}
	2nd Month	14.51±0.18^{a}	13.08±0.18^{b}
	3rd Month	19.79±0.22^{a}	18.05±0.19^{b}
	4th Month	28.36±0.24^{a}	26.13±0.29^{b}
	5th Month	45.13±0.17^{a}	40.77±0.27^{b}
	6th Month	59.13±0.30^{a}	56.96±0.27^{b}
	7th Month	75.96±0.29^{a}	69.53±0.39^{b}
	8th Month	80.45±0.14^{a}	75.47±0.22^{b}
	9th Month	85.67±0.23^{a}	78.00±0.37^{b}

Figures with same superscript (a, b) do not differ significantly ($p \leq 0.05$) in rows, n=10 each for male and female

differences were observed between pigs of male and female and significantly higher values were observed in male than in female pigs. Litter size at birth, weight of total litter size and individual at birth, litter size at weaning, weight of total litter size and individual at weaning and pre and post weaning mortality differed significantly between male and female pigs

at the rate of 9.94, 17.72, 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 the reproductive parameters except the pre and post weaning mortality which were significantly higher in female than in male. However, these values were within the normal range of pigs of indigenous population.

Carcass characters such as dressing percentage, meat: bone ratio and fat thickness were not significantly different between male and female pigs whereas other parameters such as percentage of lean, fat and bone differed significantly between them. Fat percentage (10.10%) in female and percentage of lean (4.80%) and bone (7.20%) in male were higher significantly than the other sex (Table 3).

Understanding the factors that drive breed richness and turnover across ecological gradients is important for breed conservation planning. Productive and reproductive data are important to explore the potentiality of any breed. Hence, this study was designed to record the productive and productive data in a scientific way. Livestock productivity in tropics is mediocre. Smallholder traditional feeding and management practices are being followed to support subsistence type of livelihood. Livestock farming specially pig farming plays a vital role for improving livelihood and ensuring nutritional security of tribal farmers of Andaman and Nicobar islands. As the tribal people are mostly non-vegetarian and prefer animal based protein sources, pork is very important for meeting their protein requirement. ALP are generally maintained under free range condition and fed with locally available resources like root crops and coconut. As pigs are not fed with energy rich grains and concentrate feeds, the growth rate was found poor. In the present study, productive and reproductive performance of ALP pig was evaluated under intensive system of management for the first time. Growth performances recorded in this experiment were comparable to the performances with exotic breed, when maintained. Several authors have reported the reproductive performances of pigs in local (Shostak et al., 1990; Raju, 1998; Kundu et al., 2011; Nath et al., 2013) as well as exotic breeds of pigs (Phengsavanh et al., 2010). In the present work, the observations were comparable with the earlier report of De et al. (2014). Kadirvel et al. (2013) also reported similar weaning litter size in the non-descript pigs reared under smallholder production system in North-Eastern India. Litter size at birth and weaning varied widely (Prakash et al., 2008; Kumaresan et al., 2009) under small holder production system. In the present experiment, reproductive and productive parameters were found to be lower than the data available with the exotic breed of pigs.

Table 3: Carcass Characteristics (Mean±SEm) of Andaman Local pigs under intensive system of rearing

Sl. No.	Parameters	Male (n=10)	Female (n=10)
1.	Dressing %	76.54±0.31	75.52±0.41
2.	Meat: Bone ratio	5.53±0.15	5.69±0.15
3.	Fat thickness (cm)	5.55±0.18	5.61±0.16
4.	Lean %	58.79±0.36[a]	53.4±0.41[b]
5.	Fat %	30.37±0.25[a]	37.2±0.20[b]
6.	Bone %	10.86±0.24[a]	9.4±0.23[b]

Figures with same superscript (a, b) do not differ significantly ($p \leq 0.05$) in rows, n=10 each for male and female

3.1. Litter size at birth

The variation in litter size at birth of the Indigenous pigs of Andaman Nicobar islands between the male and female indicated significant sex effect. The average litter at birth was in good range with Singh et al. (1990), Mukhopadhayay et al. (1992), Bhowal (1992) and Singh and Devi (1997). However, the result obtained in the present study was higher than the reports of Deka (1988), Shylla (1988), Kumar et al. (1990), Miachie-o (1991), Kalita (1995), Chusi et al. (2015a), Chusi et al. (2015b), Savino et al. (2015) and Savino et al. (2016). On the other hand, contrarily, the result was lower than the reports of Dhingra (1987), Jogi (1989), Lakhani and Bhadouria (1991) and Chauhan et al. (1994). However, the present result was in agreement with result reported in Indian indigenous pigs under different unorganized pig farms (Bendanganger et al., 2008). It was also reported that higher average litter size at birth in pigs than in the present study (Babu et al., 2004). Factors like management practices, type of pigs, mortality & morbidity rate and prevalent of climatic and weather condition might be the reasons for this variation in piggery sectors.

3.2. Litter size at weaning

Sex of piglets did not exert significant effect on litter size at weaning in ALP of ANI. Litter size at weaning stage in present study was within the reported range of Mishra et al. (1985), Miachie-o (1991), Bhowal (1992), Chusi et al. (2015a), Chusi et al. (2015b), Savino et al. (2015) and Savino et al. (2016). However, significantly higher average litter size at weaning stage was observed by Sharda and Singh (1982), Dhingra (1987), Jogi (1995) and Chauhan et al. (1994); lower values were reported by Raina (1982-83), Deka (1988), Lakhani and Bhadouria (1991), Shylla (1988), Kumar et al. (1990), Singh et al. (1990), Das and Mishra (1992), Mukhopadhayay et al. (1992), Kalita (1995) and Singh and Devi (1997). Litter size at weaning stage is determined by various factors such as category of pigs, management practices, morbidity and mortality rate, prevalence of different diseases, sufficient availability of nutrition and prevalent of climatic or weather condition might be the reasons for this variation.

3.3. Litter weight at birth

Statistical analysis revealed that the gender of pig revealed a significant effect on litter weight at birth and individual birth weight as male has higher birth weight than its counterpart. Das and Karunakaran (2000–03) and Singh et al. (1990)

reported significantly higher litter weight at birth. Similarly, Dhingra (1987), Shylla (1988), Das and Mishra (1992), Mukhopadhayay et al. (1992), Chhabra et al. (1996), Singh and Devi (1997), Chusi et al. (2015a), Chusi et al. (2015b), Savino et al. (2015) and Savino et al. (2016) also reported relatively higher values of litter weight at birth. The variation in the total litter weight at birth and individual birth weight may be due to the genetic variation in indigenous pig of different region and also the different management system.

3.4. Litter weight at weaning

The sex of the piglets has shown a significant effect on litter weight at weaning in indigenous pigs of Andaman and Nicobar islands as total litter and individual piglets. Litter weight at weaning of ALP was in good agreement with the values reported by Singh and Devi (1997), Chusi et al. (2015a), Chusi et al. (2015b), Savino et al. (2015) and Savino et al. (2016). The average litter weight at weaning however, was found comparatively lower than the reports made by Dhingra (1987), Jogi (1989), Mishra et al. (1990), Bhowal (1992), Das and Mishra (1992), Chauhan et al. (1994), Kalita (1995) and Chhabra et al. (1996), whereas higher than the reports by Singh et al. (1990) and Mukhopadhayay et al. (1992).

3.5. Mortality rate

Sex has significant effect on mortality rate in indigenous pigs of Andaman and Nicobar Islands. Pre-weaning mortality was much higher (50% more) than the post weaning mortality in the intensively rearing ALP. Out of which, male has significantly higher mortality then the female side. Mishra et al. (1985) and Deka (1988) observed higher mortality percentage than the present study whereas comparable result was obtained in indigenous local pigs of Nagaland (Chusi et al., 2015a; Chusi et al., 2015b; Savino et al., 2015; Savino et al., 2016). The disparity in the mortality rate might be attributed to the differences in system of management and prevailing diseases.

3.6. Growth parameters

Body weight at birth differed significantly, followed by it was differed significantly ($p \leq 0.05$) at month 1 to 9 between the male and female in intensive system for the ALP. Comparatively lower (Deo et al., 1992; Phookan, 2002) and higher (Pandey et al., 1997; Kalita et al., 2001) birth weight than the present findings were reported. Comparatively higher body weight at weaning was reported by Singh et al. (1990). However, same values were observed by Mukhopadhayay et al. (1991) and Phookan (2002). Nevertheless, higher weaning weight was observed by Deo et al. (1992) and Pandey et al. (1997) and was lower slightly than the observed reports of Phookan (2002). Moreover, Deo et al. (1992) observed higher average body weight of adult than in the present findings. The average lower body weight which might be due to the differences of genetic makeup and genetic variation and also due to management system. Animals belonging to male gender had significantly higher adult body weight than in gender of female. The body weight differences in indigenous ALP pigs belonging to different gender indicated that there are possibilities of existence of disparity in genetic combination between two genders of pigs. It has been reported that the dressing percentage, meat: bone ratio, fat thickness, lean meat percentage, percentage of fat and bone were within the range of standard values for indigenous local pigs (Dube et al., 2013; Muth et al., 2017; Chinnamani et al., 2008; Borah et al., 2016; Abdul-Rahman et al., 2016).

The mean low live weight with growth parameters reported in the present samples revealed that the indigenous Andaman local pigs are generally smaller than imported exotic pigs and their crossbreds. Similar kind of observation was observed in Indian indigenous such as Ghoongroo pigs (Pan et al., 2005) and in Tanzania indigenous pigs (Mbaga et al., 2005). The variations may be due to the different environmental factors like climate, feed and nutrition and other managemental practices. However, the results of the present study were in agreement with the observations of Holness (1991). In general, indigenous pig breeds are smaller with shorter legs than the imported exotic pig types and its crossbreds. Smaller size of these pigs may have a greater ability to survive under the harsh environmental conditions and have greater disease resistance than the larger size as an evolutionary adaptation to the situation of low-input production system in the village areas (Lekule and Kyvsgaard, 2003). Moreover, Andaman local pig is similar to other indigenous pigs like Mexican hairless pigs (Lemus et al., 2003), Tanzania indigenous pigs (Mbaga et al., 2005) and India's Ghoongroo pigs (Pan et al., 2005). Indigenous pig of Andaman and Nicobar has the great potential to contribute significantly to the indigenous pork industry based on their valuable source of meat and secondary income to the rural household economy due to their hardiness and ability to adapt to harsh climatic conditions and disease conditions. These growth performances may be useful in selection of breeding stock for improvement of pork production in its home tract of Andaman and Nicobar group of islands. Moreover, the detailed characterization of productive and reproductive performance of Andaman Local pig will be helpful for formulation of breeding strategy for conservation of this native pig breed, which is need of the hour.

4. Conclusion

ALP has great potential to contribute significantly to indigenous pork industry of ANI based on their positive qualities like valuable pork source, disease resistance and ability to withstand to harsh environment. Reproductive attributes analyses are very useful in selection of breeding stock for higher pork production and selection of suitable rearing methods will potentiate the conservation and propagation. It is concluded that ALP is well adapted to intensive system and has potential to contribute significantly to livelihood security of tribal farmers of ANI.

5. Acknowledgement

The authors are thankful to the Director, ICAR-Central Island

Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands. All authors recognize and acknowledge the Head and Staff of Animal Science Division for their efforts.

6. Reference

Abdul-Rahman, I.I., Semaha, P., Yaro, M., 2016. Pre and post-weaning growth performance of Ashanti Black pigs under Guinea Savanna conditions. Livestock Research for Rural development 28(2), Article no: 14. http://www.lrrd.org/lrrd28/2/rahm28014.html

Babu, G.N., Venugopal Naidu, K., Seshagiri Rao, A., Singh, V., 2004. Certain reproductive parameters in large white Yorkshire pigs maintained with garbage feeding in rural areas. Indian Journal of Animal Sciences 74, 438–440.

Bendanganger, V.B., Sharma, V.K., Vidyarthi, N.N., Bora, J., Saharia, S.P., Sarmah, B.K., 2008. Reproductive traits of indigenous pigs of Nagaland. Indian Veterinary Journal 85, 1200–1202.

Bhowal, A., 1992. Genetics studies on the performance of indigenous pigs and their crosses with Hampshire. M.V.Sc. Thesis submitted to Assam Agricultural University, Guwahati.

Borah, P., Bora, J.R., Borpuzari, R.N., Haque, A., Bhuyan, R., Hazarika, S., 2016. Effect of age, sex and slaughter weight on productive performance, carcass characteristics and meat quality of crossbred (Hampshire×Assam local) pigs. Indian Journal of Animal Research 50(4), 601–605.

Chauhan, V.P.S., Deo, S., Chhabra, A.K., Bhat, P.N., 1994. Production and reproduction traits and their inheritance in Indigenous pigs. Indian Journal of Animal Sciences 71, 452–455.

Chhabra, A.K., Gaur, G.K., Bhatia, S.S., Raheja, K.L., Pal, S., 1996. Studies on litter traits in Desi and crossbred pigs. Indian Journal of AnimalResearch 30, 134–136.

Chinnamani, K., Sivakumar, T., Tensingh Gnanaraj, P., Murugan, M., 2008. Carcass characteristics of crossbred large white Yorkshire pigs under different feeding regimens. Tamilnadu Journal of Veterinary and Animal Science 4(6), 211–214.

Chusi, Z., Savino, N., Dhali, A., Perumal, P., 2015a. Phenotypic morphometric parameters of indigenous pig of Nagaland (*Votho*). Indian Journal of Animal Sciences 85(12), 1334–1337.

Chusi, Z., Savino, N., Dhali, A., Perumal, P., 2015b. Reproductive attributes of local pig of Nagaland (*Votho*). Indian Journal of Animal Research 50(6), 862–866.

Das, A., Karunakaran, M., 2000-03. National Agricultural Technology Project: Improvement of pig of NEH Region. ICAR Research Complex for NEH Region, Nagaland Centre, Jharnapani, Nagaland.

Das, A.K., Mishra, R.R., 1992. Reproductive traits of indigenous pigs. Indian Veterinary Journal 69, 133–135.

De, A.K., Jeyakumar, S., Kundu, M.S., Kundu, A., Sunder, J., Ramachandran, M., 2014. Farming practices and genetic characterization of Nicobari pig, an indigenous pig germplasm of Nicobar group of islands, India. Tropical Animal Health and Production 46, 655–661.

De, A.K., Ponraj, P., Kundu, M.S., Muthiyan, R., Muniswamy, K., Kundu, A., Malakar, D., Sunder, J., George, Z., Bhattacharya, D., 2019. Mitochondrial landscape of indigenous pig germplasm of Andaman and Nicobar Islands. Mitochondrial DNA part B 4, 2808–2810.

Deka, A.C., 1988. Performance of local, exotic and crossbred pigs under farm and village conditions. M.V. Sc. Thesis submitted to Assam Agricultural University, Guwahati.

Deo, S., Chhabra, A.K., Arora, R.L., Paul, S., Bisiit, G.S., 1992. Genetic and non-genetic factors affecting growth performance in desi pigs and its crosses. Indian Journal of Animal Sciences 62(11), 1107–1108.

Dhingra, M.M., 1987. Genetic improvement of indigenous pig in India. Livestock AdvisorXII (XI), 13–17.

Dube, B., Mulugeta, S.D., Dzama, K., 2013. Genetic relationship between growth and carcass traits in Large White pigs. South African Journal of Animal Science 43(4), 482–492.

Hmingthanzuala, Das, S.K., Rahman, S., Tolenkhomba, T.C., Saikia, P., 2016. Impact of SHG on income of pig farmers in Mizoram of North East India. International Journal of Bio-resource and Stress Management 7(3), 485–488.

Holness, D.H., 1991. The tropical agriculturist (Pigs). CTA, Wageningen, 1–29.

Jogi, S., 1995. Factors affecting some of the reproductive traits of native sows (*sus scrofadomesticus)*. Indian Veterinary Medical Journal 19, 216–217.

Kadirvel, G., Kumaresan, A., Das, A., Bujarbaruah, K.M., Venkatasubramanian, V., Ngachan, S.V., 2013. Artificial insemination of pigs reared under smallholder production system in North-Eastern India: Success rate, genetic improvement and monetary benefit. Tropical Animal Health and Production 45, 679–686.

Kalita, D., Das, D., Goswami, R.N., 2001. Body weight of indigenous pigs of Assam and their crosses with Hampshire as affected by various factors. Indian Veterinary Journal 78, 1027.

Kalita, D., 1995. Genetic studies in some of the economic traits of indigenous pigs and their crosses with Hampshire. M.V.Sc. Thesis submitted to Assam Agricultural University, Guwahati.

Kumar, S., Singh, S.K., Singh, R.L., Sharma, B.D., Dubey, C.D., Verma, S.S., 1990. Effect of genetic and non genetic factors on body weight efficiency of feed utilization, reproductive performance and survivability in Landrace, desi and their half breeds. Indian Journal of Animal Sciences 60, 1219–1223.

Kumaresan, A., Bujarbaruah, K.M., Pathak, K.A., Das, A., Bardoloi, R.K., 2009. Integrated resource-driven pig production systems in a mountainous area of Northeast India: production practices and pig performance. Tropical Animal Health and Production 41, 1187–1196.

Kundu, A., Sunder, J., Jeyakumar, S., Verma, S.K., Kundu, M.S., De, A.K., Srivastava, R.C., 2010. Livestock and poultry production policy for Andaman and Nicobar Islands: A scientific perspective. Published by Director, ICAR-CARI, Port Blair, 1–48.

Kundu, M.S., Kundu, A., Jeyakumar, S., Sujatha, T., Sunder, J., Verma, S.K., 2011. Effect of feeding Colocasia on Growth performance of large white yorkshire Pigs reared under back yard system at Bay Islands. Environmental Ecology 29, 337–338.

Kundu, M.S., Sunder, J., Kundu, A., De, A.K., Sujatha, T., 2017. Reproductive and productive performances of crossbred Andaman local pigs under small holder production system at Bay Islands, India. Indian Journal of Animal Research 51(2), 377–381.

Lakhani, G.P., Bhadouria, S.S., 1991. Studies on performance of indigenous pigs at Livestock Farm, Jabalpur. Indian Journal of Animal Research 26, 56–58.

Lekule, F.P., Kyvsgaard, N.C., 2003. Improving pig husbandry in tropical resource-poor communities and its potential to reduce risk of porcine Cystercosis. Acta Tropica 87, 111–117.

Lemus, F.C., Alonso, M.R., Alonso, S.M., Ramirez, N.R., 2003. Morphologic characteristics in Mexican Native Pigs. Arch Zootech 52, 105–108.

Livestock Census (19th), 2012. All India Report. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Govt. of India, Krishi Bhawan, New Delhi.

Mbaga, S.H., Lymo, C.M., Kifaro, G.C., Lekule, F.P., 2005. Phenotypic characterization and production performance of local pigs under village settings in the Southern Highland zone. Tanzania Animal Genetic Resource Information 37, 83–90.

Miachie-o, V., 1991. Studies on certain aspects of reproduction in Hampshire, Indigenous pigs of Assam and their crosses. M.V.Sc. Thesis submitted to Assam Agricultural University, Guwahati.

Mishra, R. R., Dash, P., Acharya, S., 1985. A Study on economic traits and mortality in Large White Yorkshire, indigenous pigs and their crosses- A note. Indian Journal of Animal Production and Management 1, 41–44.

Mukhopadhayay, A., Singh, R.L., Sharma, B.D., 1991. Factors affecting performances of pigs. Indian Journal of Animal Sciences 61(4), 438–442.

Mukhopadhayay, A., Singh, R.L., Singh, S.K., 1992. A comparative study on the effect of genetic and non genetic factors of Landrace. Tamworth and desi pigs and their crosses on some reproductive characters. Indian Journal of Animal Sciences 62, 482–484.

Muth, P.C., Huyen, L.T.T., Markemann, A., 2017. Tailoring slaughter weight of indigenous Vietnamese Ban pigs for the requirements of urban high-end niche markets. Wageningen Journal of Life Sciences 80, 27–36.

Nath, B.G., Pathak, P.K., Ngachan, S.V., Tripathi, A.K., Mohanty, A.K., 2013. Characterization of smallholder pig production system: productive and reproductive performances of local and crossbred pigs in Sikkim Himalayan region. Tropical Animal Health and Production 45, 1513–1518.

Pan, S., Misra, S.K., Kundu, M.S., 2005. Ghoongroo pig: A new found animal genetic resource of sub-Himalayan West Bengal, India. Animal Genetic Resources Information 37, 91–96.

Pandey, R.N., Singh, S.K., Singh, R.L., Dubey, C.B., 1997. Genetic study of weight at different ages in exotic, desi and their half breed of pigs. Indian Journal of Animal Sciences 67(12), 1086–1090.

Phengsavanh, P., Ogle, B., Stur, W., Frankow-Lindberg, B.E., Lindberg, J.E., 2010. Feeding and performance of pigs in smallholder production systems in Northern Lao PDR. Tropical Animal Health and Production 42, 1627–1633.

Phookan, A., 2002. Studies on certain growth, reproduction and biochemical traits in indigenous pigs of Assam. M.V.Sc. Thesis submitted to Assam Agricultural University, Khanapara, Guwahati, India.

Prakash, M.G., Ravi, A., Puniakumari, B.P., Rao, D.S., 2008. Reproductive and productive performance of cross bred pigs. Indian Journal of Animal Sciences 78, 1291–1297.

Raina, B.L., 1982–83. Annual Progress Report of the Project Coordinator during the years 1980-83. AICRP on Pigs, Indian Veterinary Research Institute, Izatnagar, U.P.

Raju, K.G.S., 1998. Study on reproductive traits of indigenous pigs. Indian Journal of Animal Research 32, 145–146.

Savino, N., Chusi, Z., Perumal, P., 2015. Effect of sex on growth parameters of Naga local pig. Indian Journal of Animal Production and Management 31(1-2), 78–81.

Savino, N., Chusi, Z., Dhali, A., Perumal, P., 2016. Body growth performance of Naga indigenous pig. Indian Veterinary Journal 93(05), 19–21.

Sharda, D.P., Singh, P., 1982. Note on the size, sex ratio, mortality and average daily gain of Middle White Yorkshire and Indigenous pigs and their Crosses form birth to weaning at 8 weeks of age. Indian Journal of Animal Sciences 52, 1140–1141.

Shostak, B., Benkov, B.I., Slanev, K., Benkov, I., 1990. The effect of genotype, parity, season and year on the reproductive traits of sows. Zhivomor dui Nauki 27(1), 17–23[c.f. Animal Breeding Abstract 59, 1229].

Shylla, B., 1988. Genetic Studies on some of the economic traits of Indigenous pigs of Assam. M.V.Sc. Thesis submitted to Assam Agricultural University, Guwahati.

Singh, K.L., Singh, R.L., Sharma, B.D., Dubey, C.B., 1990. Reproductive traits and mortality rate in pigs. Indian Journal of Animal Sciences 60, 886–887.

Singh, S.K., Devi, A., 1997. Performance of reproductive traits in various genetic groups of pigs. Indian Journal of Animal Sciences 67, 1021–1022.

Snedecor, S.W., Cochran, W.G., 1994. Statistical methods. Eighthed. Ames, IA: UniversityPress.