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Characteristics and role of Shahabadi sheep in elevating the socio-economic status of farmers in Bihar*

P C CHANDRAN[1], S B VERMA[2], K G MANDAL[3], R K SINGH[4] and BIRENDRA KUMAR[5]

Bihar Agricultural University, Patna, Bihar 800 014 India

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ABSTRACT

A survey was conducted by visiting 105 flocks of Shahabadi breed of sheep in their breeding tract of Buxar, Bhojpur and Rohtas districts in Bihar to study physical characteristics, environmental conditions in which the breed is prevailing and the role of Shahabadi sheep in the socio-economic status of sheep farmers. Shahabadi sheep are of medium size with light brown coat colour and long tail. More than 60% adults in an average flock of Shahabadi breed are more than 6-teeth old. The area of permanent pastures and grazing land in the breeding tract have reduced and subsequently population of Shahabadi sheep has declined. The literacy rate of the farmers rearing Shahabadi sheep was 28.6%. More than 80% of small flock holders and 70% of medium flock holders practiced sheep rearing as a primary occupation. The imputed cost of family labour was 64.2 and 58.6% of total cost of expenditure of Shahabadi sheep rearing whereas income from animal sales was 92.5 and 93.2% of gross annual returns of Shahabadi sheep farmers under small and medium categories respectively. The regression of various factors on the farm income of Shahabadi sheep farmers was also studied. The strategies for improving the economy of Shahabadi sheep farmers for enhancing their livelihood status were discussed.

Key words: Characteristics, Socio-economic status, Shahabadi sheep

India possesses 74.0 million of sheep and ranks second in the world in sheep population, as per the FAOSTAT production data 2010 (BAHS 2012). Indian sheep are well known for their hardiness, and ability to strive with coarse and scarce feed materials and hot weather conditions. Though the productivity of Indian sheep is low, it is not regarded as inefficient when the environmental condition in which they are reared is considered. Among the 42 recognized breeds of sheep in India, Bihar possesses only one, viz. Shahabadi breed of sheep. Though sheep rearing is not very common in Bihar, it is very active in certain pockets of State, especially in Shahabadi region. This region alone possesses 60% of total sheep population of the State (Directorate of Economics and Statistics 2006). The Shahabadi breed of sheep plays a pivotal role in improving livelihood status of farmers living in this region. However, no work has been done in the breed for the last 3 decades since Mishra *et al.* (1970) and Acharya (1982) made preliminary study on the morphometric characteristics and body weight of Shahabadi sheep. Hence, this work was undertaken to study the basic physical characteristics of the breed, environment in which the breed is reared and its role in the economics of sheep rearing in the Shahabadi region.

MATERIALS AND METHODS

The study was undertaken in lower Gangetic plains of Bihar including Buxar, Bhojpur and Rohtas districts where the Shahabadi breed is distributed. A total of 105 farmers' flocks were visited to ascertain morphological characteristics of the breed, detailed flock structure and the environmental conditions in which the breed is reared by the farmers. The data on weather in the breeding tract for 49 years from 1960 to 2008 was collected from the databank of ICAR Research Complex for Eastern Region, Patna. As most of the Shahabadi sheep farmers were marginal and landless, they were categorized into small flock holders (flock size of 1 to 50), marginal flock holders (flock size of 51 to 100) and large flock holders (flock size of more than 100) for studying socio-economic status and costing in Shahabadi sheep farming. The fixed cost of depreciation on the items like housing and fencing components and feeding utensils were calculated at

*Part of Ph.D. research work of first author, Bihar Veterinary College, Patna.

Present address: [1]Ph.D. Scholar (vetchandran@gmail.com). [2]Professor and Chairman (profsbv_bvc@yahoo.com), [3]Associate Professor (drkgmandal1957@yahoo.com), [4,5]Assistant Professor (ramesh.kumarvet@gmail.com, drkbirendra@yahoo.com), Department of Animal Breeding and Genetics, Bihar Veterinary College, Patna.

5% depreciation rate whereas interest on fixed capital was computed at 10% of animals' value after considering the age, sex and condition of animals. The imputed cost of labours for rearing the Shahabadi sheep was worked out based on man-days engaged in sheep rearing. The cost on medicines, feed and fodder, sales of animals and wool was taken on actual basis. The cost of manure and returns from milk and milk products were computed per flock basis. The effect of independent variables such as flock size, cost of rearing and mortality of sheep on the income generated from Shahabadi sheep across various categories of farmers was analysed. The following linear form of function was fitted:

$$Y = \mu + a_1X_1 + a_2X_2 + a_3X_3$$

where Y is gross annual returns from a single Shahabadi flock per annum, μ is the general mean, X_1 is flock size of sheep, X_2 is cost of rearing of Shahabadi sheep, X_3 is mortality rate of Shahabadi sheep, and a_1, a_2 and a_3 are respective regression coefficients. The mortality percentage in each flock was converted into Arcsin value before subjecting the data for analysis of regression coefficients, where angle, Arcsin" percentage, as given by Bliss (Leningrad 1937).

RESULTS AND DISCUSSION

Characteristics of Shahabadi sheep: The Shahabadi sheep are medium sized animals. Coat colour is generally light brown with dark brown patches on the head, neck and back regions. Many animals also have pure white patches along with dark brown patches in the head (Figs 1–5). However, there were also animals in the flock with varying coat colours. In the survey, it was found that 9.2% of total Shahabadi sheep had complete dark brown coat colour whereas 15.4% of animals had complete black coat colour. However, the sheep with light brown coat colour are preferred among the farmers. This may be due to the fact that wool shorn from these sheep had better market value than other animals. The characteristic feature of Shahabadi sheep, first reported by Mishra *et al.* (1970), is that only in rare cases black patches were observed in the body. The extensive black patches and complete black coat coloured animals observed in the present study may be due to the reason that the black phenotype is manifested in heterozygotic condition and the gene survives in the population without being eliminated.

The ears were drooping and generally both the sexes are polled. However, 17% of males has horns with an average length of 12.3±0.87cm. The horns are generally oriented slightly backward and downward and remained very closer to the body. This report is first of its kind in reporting the presence of horns in Shahabadi sheep.

The development of horns and extensive black patches over the years may be due to the mixture of Shahabadi breed with Chottanagpuri sheep whose breeding tract is located very closely. Incidentally, more than 66.2% of Chottanagpuri sheep has either black or brown coat colour and all the males in the breed are horned (NBAGR 2008). The legs are neither bony nor so fleshy. The texture of fleece is very coarse. The young lambs, up to 6 months of age, has fleece fully covered over the body except the head region whereas animals with above 6 months age are devoid of wool in neck and belly regions. The peculiar characteristics of this breed are possession of long tail, which is more than 40cm long in adult ewes, and considerable number of twinning, 15% during the study period as reported by owners, in the flock. Similar observation on the length of tail was also made by Mishra *et al.* (1970).

Flock structure of Shahabadi sheep: The detailed age-wise flock structure including 2-teeth (2T), 4-teeth (4T), 6-teeth (6T) and full mouth (FM) sheep of Shahabadi breed studied in the survey area are given in Table 1. The study revealed that an average flock of Shahabadi breed had 2 rams of various ages and 42 ewes including 8 two-teeth, 9 four-teeth, 10 six-teeth and 15 full mouth ewes. More than 60 per cent of total adult ewes in an average flock of Shahabadi sheep were above 6-teeth old. This indicated that selection and culling of animals did not happen vigorously in the flocks. Most of the ewes were allowed to mature to the maximum age. Apart from adults, an average flock of Shahabadi breed also had 11 male and 19 female lambs. Acharya (1982) reported bigger flock size of 75 to 85 adults and their lambs for Shahabadi sheep. Comparatively smaller flock size found in our study might be attributed to the changes in the socio-economic conditions of sheep farmers over the years.

Table 1. An average flock size of adult Shahabadi sheep in Bihar.

Name of the	Average Ram Size				Average Ewe Size			
District	2T	4T	6T	FM	2T	4T	6T	FM
Patna	0.9	0.3	0.8	0.3	7.1	8.6	10.4	13.2
Bhojpur	0.7	0.6	0.2	0.5	8.2	8.3	10.8	17.6
Buxar	1.1	0.1	0.3	0.9	8.6	9.1	9.5	15.4
Average	0.9	0.3	0.4	0.6	7.8	8.7	10.2	15.4

Figs 1–5. **1.** Ewe of Shahabadi sheep **2.** Polled ram **3.** Horned ram **4.** Shahabadi lambs **5.** Shahabadi flock.

Weather in the breeding tract: The breeding tract of Shahabadi sheep falls under Bihar agro climatic zone IIIB, which is a southwest alluvial plain of the State and adjacent to southern bank of river Ganges. The general climate of the region is hot and humid in most part of the year. The average maximum and minimum temperature and rainfall received in the breeding tract for the last 49 years from 1960 to 2008 is depicted in Table 2. The tract recorded 47.0°C maximum temperature and 1.9°C minimum temperature. The tract received maximum rainfall during Southwest monsoon in July, August and September with the annual precipitation ranged from 618.5 to 1734.4mm. Though, water receded generally after rainfall in the tract, certain regions especially in Rohtas district, experience severe flood during the rainy season due to low land.

Livestock scenario in the breeding tract: The presence of various livestock species reared in a location depends on the resources available for livestock, social status of livestock farmers and their interest. The population of various species of livestock in the breeding tract (Table 3) indicated that livestock rearing was one of the major occupations in the region and various species of livestock complemented each other very well in the locality for their survival. It was also found that farmers in Shahabadi breeding tract, unlike in other districts of Bihar, were interested in sheep rearing as total sheep population including Shahabadi sheep in the breeding tract alone accounted for 60% of total sheep population of the State. Apart from this, 28.7% of buffaloes and 40.3% of pigs of entire Bihar were available in the breeding tract of Shahabadi sheep indicating that environmental factors in the region may favour the survival of these species.

Table 2. Meteorological data in Shahabadi sheep breeding tract.

Weather particulars	From 1960 to 2008
Average maximum temperature	38.5°C
Maximum temperature range	10.0°C –47.0°C
Average minimum temperature	19.3°C
Minimum temperature range	1.9°C –32.2°C
Average annual rainfall	1136.8 mm
Annual rainfall range	618.5 –1734.4 mm

Table 3. Livestock population scenario in Shahabadi breeding tract

Livestock species	Shahabadi tract	Other districts in Bihar
Cattle	2153216 (21.87%)	7694082 (78.13%)
Buffalo	1835244 (28.73%)	4553358 (71.27%)
Sheep	209441 (60.48%)	136884 (39.52%)
Goat	1433803 (14.93%)	8172909 (85.07%)
Pigs	252684 (40.30%)	374315 (59.70%)
Poultry	2646931 (18.95%)	11320836 (81.05%)

Figures in the parenthesis are percentage of total population of the particular species. *Source:* Directorate of Economics and Statistics 2006.

Sheep farming structure: The detailed study on different farming system with the Shahabadi farmers in 105 flocks in their breeding tract has revealed that the Shahabadi sheep farmers, along with their sheep, maintained other livestock including cows, buffaloes, goats and poultry (Table 4). With a total of 5 classes of livestock (including sheep), there were 13 different combinations of above livestock with different farmers. Farmers keeping Shahabadi sheep and poultry were more in number next to the farmers possessing Shahabadi sheep alone. Similar trend of various kinds of farming systems by keeping sheep as a primary component and largest number of sheep and poultry combinations were also reported in Tamil Nadu (Arunachalam *et al.* 2002). Although the breeding tract possessed highest number of pigs in Bihar, the farmers of Shahabadi sheep had neither pigs nor any other species of livestock other than the above four.

Socio-economic status of Shahabadi flock owners: Socio-economic status of the farmers rearing Shahabadi sheep studied under the categories of small, medium and large flock holders is given in Table 5. The study has revealed that the flock size of Shahabadi sheep increased from small to medium with increase in family size of farmers as there would be additional members in a family to take care of sheep rearing. The farmers keeping large flock of Shahabadi sheep also possessed large area of land and their livelihood did not solely depend on income from sheep rearing. They reared the sheep by employing hired labours. The overall literacy rate among the Shahabadi farmers was 28.6%. The flock size of Shahabadi sheep increased with the increase in average investment on sheep and literacy rate of sheep farmers. Unlike large flock holders of Shahabadi sheep, most of the small and medium holders lived in *kachcha* house.

Relatively higher literacy rate and higher land holding were reported for Mecheri sheep farmers in Tamil Nadu (Thiruvenkadan *et al.* 2004), sheep rearers in rain fed region of Haryana (Bhatia *et al.* 2005) and sheep farmers in

Table 4. Different sheep farming systems with Shahabadi farmers

Different combinations	per cent
Shahabadi sheep alone	20.0
Shahabadi sheep and cows	11.4
Shahabadi sheep and buffaloes	7.6
Shahabadi sheep and goats	4.8
Shahabadi sheep and poultry	15.2
Shahabadi sheep, cows and buffaloes	0.9
Shahabadi sheep, cows and goats	2.9
Shahabadi sheep, cows and poultry	6.6
Shahabadi sheep, buffaloes and goats	2.9
Shahabadi sheep, buffaloes and poultry	3.8
Shahabadi sheep, goats and poultry	12.4
Shahabadi sheep, cows, goats and poultry	6.7
Shahabadi sheep, buffaloes, goats and poultry	4.8

Table 5. Socio-economic status of Shahabadi sheep farmers

Factors	Small	Medium	Large
Number of farmers	36	60	9
Range of flock size	35–49	54–98	109–220
Average flock size	44	82	144
Average family size	7.4	8.3	6.4
Adult	3.8	4.0	4.1
Children	3.6	4.3	2.3
Land holding			
No land	26 (72.2)	39 (65.0)	0 (0.0)
< 1 ha	10 (27.8)	21 (35.0)	2 (22.2)
> 1 ha	0 (0.0)	0 (0.0)	7 (77.8)
Primary occupation of farmer's family			
Sheep rearing	29 (80.6)	42 (70.0)	2 (22.2)
Agriculture	7 (19.4)	16 (26.7)	4 (44.5)
Others	0 (0.0)	2 (3.3)	3 (33.3)
Average investment on sheep (in ₹)	88,146	164,452	288,021
Type of house farmers owned			
Kachcha	29 (80.6)	34 (56.7)	0 (0.0)
Pucca	7 (19.4)	26 (43.3)	9 (100.0)
Average literacy rate (%)			
Farmers up to 40 years of age	27.3	38.5	0
Farmers above 40 years of age	14.3	17.6	66.7
Rearing of sheep			
By self	36 (100.0)	60 (100.0)	0 (0.0)
By hired labours	0 (0.0)	0 (0.0)	9 (100.0)

Figures within the parenthesis are percentages.

Table 6. Economics of rearing of Shahabadi sheep in Bihar

Components	Categories of Shahabadi flock holders		
	Small	Medium	Large
Fixed cost (% of total cost)			
Depreciation cost	0.04	0.05	0.23
Interest on fixed capital	30.68	34.83	39.44
Total fixed cost (₹)	8,756	16,358	28,893
Variable cost (% of total cost)			
Family labour (%)	64.17	58.61	0.00
Hired labour (%)	0.00	0.00	50.43
Medicine cost (%)	3.40	3.85	4.35
Feed & Fodder (%)	0.00	1.57	3.55
Maintenance (%)	1.71	1.09	2.00
Total variable cost (₹)	19,742	30,530	43,945
Total cost (₹)	28,498	46,888	72,838
Returns (% of gross annual returns)			
Animal sale (%)	92.48	93.22	89.44
Wool (%)	1.75	1.40	5.04
Manure (%)	2.63	2.35	3.31
Milk (%)	3.14	3.02	2.47
Gross annual returns (₹)	36,055	66,051	121,186
ROVC (₹)	7557	19163	48348
ROVC per animal (₹)	172	234	336
ROVC excluding family labour (₹)	25,844	46,643	48,348
ROVC excluding family labour per animal (₹)	587	569	336

ROVC Returns over variable cost.

Rajasthan (Suresh *et al.* 2008). Though the average family size of farmers reported by Thiruvenkadan *et al.* (2004) was smaller, the findings in the present study was more or less similar to the family size of farmers in Haryana and Rajasthan as reported by Bhatia *et al.* (2005) and Suresh *et al.* (2008).

Economics of sheep rearing: The cost and returns of rearing Shahabadi breed of sheep in Bihar are given in Table 6. The fixed cost included cost of depreciation on items such as housing and fencing materials and feeding troughs, and interest on fixed capital on animals. The variable cost comprised imputed cost of family labour for sheep rearing, cost of hired labours in case of large farmers, medicine cost including de-wormers and expenses on feed and fodder materials. The farmers generated income from sale of animals, wool, manure and other items like milk and its products.

The study revealed that imputed cost of family labour and hired labours in rearing the sheep constituted the major portion of variable cost in rearing of the Shahabadi sheep in all categories accounting more than 50% of total cost. The sheep farmers also spent more than 3% of total cost on purchase of medicines especially de-wormers. The availability of relatively cheap labours in Bihar restricted the large flock holders to spend only 50% of total cost on hired labours, which helped them to generate more returns from Shahabadi sheep. They also spent more than 3% total costs on feeding of Shahabadi sheep.

The major part of income (around 90%) generated by all categories of Shahabadi sheep farmers was from sale of young males and unproductive ewes and rams. Apart from this, sale of wool, manure and milk also fetched some additional income. The returns over variable cost per animal were lower for small flock holders and higher for large flock holders due to availability of comparatively cheaper labours. However, if the cost of imputed family labours is excluded from accounting, per animal income was higher in case of small flock holders than the other categories. However, considering the gross annual returns it is better to rear larger flocks for better support to farmers.

The variable cost and gross annual returns from Mecheri sheep (Thiruvenkadan *et al*. 2004) and from the sheep reared in rain fed region of Haryana (Bhatia *et al.* 2005) were lower than the one found in the present study for Shahabadi sheep. The higher returns in this study might be due to price rise and falling of money value over the years. The ROVC per animal from rearing of sheep in Rajasthan (Suresh *et al.* 2008) was marginally lower than that found in our investigation, which might be due to inclusion of fixed cost component. However, similar income from rearing of Sonadi breed of

Table 7. Regression coefficients of factors influencing income from Shahabadi sheep

Dependents	Regression coefficients on gross annual returns		
	Small (N=44)	Medium (N=82)	Large (N=144)
Flock size	635.204**	781.957**	508.072**
	(53.431)	(25.513)	(50.207)
Cost of rearing	0.914**	1.957**	2.001**
	(0.059)	(0.111)	(0.113)
Mortality rate	–604.649**	–3,537.083**	–12,062.368**
	(198.401)	(415.135)	(1,408.412)

**Significant at P<0.01. Figures in parenthesis are standard errors.

sheep was reported by Tailor and Lokesh (2008). The trend of gross annual return per animal under various categories was in accordance with the earlier findings for sheep in semi-arid region of Rajasthan (Gupta *et al.* 2011).

Most of the small and medium flock holders also generate income through other livestock species they rear. On the basis of calculations made on income generated per cattle unit from various combinations of farming systems with the major component being Shahabadi sheep, the sheep farmers who had goat and poultry in addition to the Shahabadi sheep were earning higher net returns (₹ 58,652.00 per annum) in comparison with farmers practicing other farming systems. This particular farming system allowed the farmers to keep minimum labours for rearing.

Regression of independent variables on income: The regression of various factors including flock size, cost of rearing and mortality of sheep on the income generated from Shahabadi sheep is given in Table 7.

The result of regression analysis indicated that flock size mostly influenced the income of farmers whereas mortality rate negatively affected the income. The findings are more or less similar to the findings of Kumaravelu *et al.* (2008) in which flock size and grazing charges significantly influenced the income and mortality percentage had negative effect on the returns generated from sheep farming in Tamil Nadu.

The present study revealed that Shahabadi breed of sheep in Bihar plays a pivotal role in the livelihood of sheep farmers who earn regular income and employment opportunity round the year from the breed. The environmental conditions prevailing in the State appears to be the most suitable for the survival and better performance of the breed. Farmers of Shahabadi sheep need to be provided adequate knowledge on scientific sheep breeding and rearing methods in order to harvest maximum returns from sheep rearing. Though the income from the breed is marginal, it could be improved through concerted efforts on improved sheep husbandry practices in addition to the genetic improvement of Shahabadi sheep breed.

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