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Constraints of native cattle genetic resource conservation and features of breeding system in representative areas of Bangladesh

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Abstract

The study was undertaken to identify the constraints of native cattle genetic resource conservation at the farm level along with their features of breeding system and profitability. Five different study sites like south-west, northern hills, industrial zone, north-west and mid-region were selected representatively from all over the country. A total of 280 cattle farmers from the selected regions were interviewed. A multiple regression model was fitted to know the impact of contributing factors on lactation characteristics of cows. The double log linear model was also used to explore the input-output relationship of milk production. Average milk yield was 1.78 and 5.64 liter per day per cow respectively for native and crossbred cow. Contribution of age, order of lactation and stage of lactation were predictable in native cattle but not in crossbreds. Livestock farming contributed 36.4 percent of total income of the farmers studied. A crossbred cattle farming was profitable but native cattle farming was non-profitable. Indigenous cattle were preferred over crossbred due to their superior adaptability to local environmental stresses, rearing ease, low input, lesser proneness to disease and availability of native bull for mating. Per farm average number of milch cow was found to be reduced day by day and maximum number was 4 in a farm during the period 2006-07. Major causes of reduction were the non-profitability, crisis of feed, lack of investment, introduction of exotic breed etc. Responded farmers had no clear idea on conservation of native cattle.

Keywords: Genetic resource, Conservation, Breeding system, Profitability assessment

Introduction

Indigenous cattle play a crucial role in the livelihood system and well-being of the traditional rural farmers of Bangladesh and thereby taking part significantly in meeting the Millennium Development Goal (MDG). Local cattle are integral contributor of food, agricultural power, agrarian culture and heritage and biodiversity as well (FAO, 2007a). But as they are low input low producing animal, they are being gradually substituted by high producing exotic cattle or crosses thereof with a trend toward monoculture animal production. It is reported that almost one breed of domestic species was disappeared per month within the period from 2000-2006 (FAO, 2008) over the globe. Around 20 percent of the reported breeds are classified at risk (FAO, 2007b). Breed substitution or withdraw of indigenous stocks currently in force all on a sudden will likely cause a linear rise of unemployment with the people associated with traditional farming leading to an inevitable catastrophe in the rural economy. Furthermore, a degradation of agro-ecosystem is very likely to occur if well balanced biodiversity gets interrupted in which native cattle genetic resource is a vital component. Considering the severity of the malady FAO through its daughter organizations already gathered country driven reports for risk status assessment and developed action plan on benefit-sharing management and sustainable use of Farm Animal Genetic Resources (FAnGR) all over the world (FAO, 2007b, Gibson *et al*., 2005). Small holder farming system, as it predominantly prevailing in our country, support mostly subsistence and not market orientation. Indigenous livestock breeds, despite having valuable adaptive traits, low productivity diminishes their survival value necessitating conservation (Sahai, 2001). Therefore, development of strategies for conservation of animals like local cattle needs consideration of multiple factors involved in biology of animals, agro-ecology of the environment, husbandry system of the animals, purpose of rearing and affordability of the owners duly to be addressed (Bayer *et al*., 2001).

Not enough field works on this aspect have been accomplished all over the world (Annonym, 2006 and Annonym, 2007). It is only recently, with the FAO's initiatives a number of researchers have taken programme to evaluate and conserve FAnGR. Hodges (2002) demonstrated the need of conservation of farm animals for maintaining biodiversity. According to Bhuiyan (2001) a thorough economic and biological appraisal of native animal genetic resource for their relative importance and appropriateness *in situ* has yet to be attempted in Bangladesh. Farm level situations of breeding status, preference of native cattle by the small holder cattle farmers, causes of reduction of native cattle and profitability differences

between native and crossbred cattle should be taken into account while developing sustainable conservation strategy. Envisaging the perspectives highlighted so far the current research was undertaken to focus insights of indigenous cattle husbandry in rural community with particular reference to constraints and options for conservation *in situ*. Therefore, the objective of the present study is to identify the constraints of native cattle genetic resource conservation with particular reference to features of their breeding system and profitability assessment.

Materials and Methods

Five representative study sites were selected from all over the Bangladesh in order to economize time and labour. These were (i) south-west region (Jessore district) (ii) northern hill sties (Sherpur district) (iii) industrial zone having high employment opportunity (Gazipur district) (iv) resource poor area and north-west region of the country (Bogra district) and (v) region between two extremes or mid-region of the country (Mymensingh district). These five regions were considered as the five strata of the whole sampling technique. For convenient mode of selection, one random upazila from each of the regions was selected. Three adjacent villages from each upazila were selected using random sampling technique. A total of 280 cattle farmers from the selected villages were interviewed through an interview schedule. The data collection was started from November 2006 and ended in October 2007 and the study was ended in December 2008.

To know the impact of different contributing factors of lactation characteristics on cow the following multiple regression model was used:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + U_i \quad \text{..... (1)}$$

Where,

Y = Milk production (L/cow/day)
b_0 = Inercept
X_1 = age of milch cow (in year)
X_2 = Order of lactation
X_3 = Stage of lactation in a particular lactation order
b_1, b_2 and b_3 are the regression coefficients of respective variables, and
U_i = Error term.

The double log linear multiple regression model was used to explore the input-output relationship of milk production. The general specification of model is shown as follows:

$$LnY = LnB_0 + b_1LnX_1 + b_2LnX_2 + b_3LnX_3 + b_4LnX_4 + U_j \quad \text{..... (2)}$$

Where,

Y = milk output (in taka per household per day)
X_1 = length of experience of cow owner in farming (year)
X_2 = year of schooling of cow owner
X_3 = farm size based on cultivated land (ha)
X_4 = time devoted in dairy farming (hours per day)
b_1 to b_4 are the respective regression coefficients
U_j is the random term.

Benefit cost ratio (BCR) was calculated as follows according to Singh (1977):

$$BCR = \frac{\text{Net return per cow per day}}{\text{Total cost per cow per day}}$$

Results and Discussion

Of the farm house surveyed cattle herd size averaged 4.19 and in it 1.37 cows were in milk (Table 1). In addition to non milkier cattle farmers were found to own one or more milch cows. Men employ their labour more than do women both in number and time per day. Some 65.7% cattle were produced in farmers own herd and 34.3 percent were bought. More than 76 percent farmers still relish native bovines probably because of their affinity to traditional farming system. Highest coat colour preference is Black-white (60%) for local cow and White-Black (41%) for crossbred cow (Table 1).

Table 1. Farm house characteristics

Characteristics	Mean	S. D.	Characteristics	Percent
Number of cattle/household			Source of milch cow procurement	
Milch cow	1.37	0.680	Own herd	65.7
Dry	0.33	0.586	Bought before puberty	21.8
Bull	0.61	0.909	Bought during pregnancy or in milk	12.5
Calf	1.88	0.939	Preference on cow type (0-100 score)	
Total cattle	4.19	1.925	Native	76.4
Man power involved in farming			Crossbred	20.4
Man	1.14	0.489	Mixed	3.2
Women	0.94	0.373	Preference on coat colour (0-100 score)	
Children	0.31	0.550	Local : Black-white	60.0
Overall	2.23	0.788	Brownish	18.0
Labour (Man-hour/day/farm)			Red	22.0
Man	2.20	1.990	Cross : Light red	27.2
Women	2.10	1.850	Deep red	31.8
Children	0.14	0.405	White-black	41.0
Hired	0.31	1.180		
Total	4.74	4.038		

Source: Own calculation from the surveyed data

Farmers' source of breeding bulls was from their own, neighbour's herd, rent or exchange. Cows mated with bulls available in the neighbour's herd figured more than 85 percent and other sources shared only nearly 15 percent. Around 76.4 percent cases were pure breeding among the natives, 20.4 percent were crossbreeding and only 3.2 percent cases had no option (Table 2). Three quarter of the cow population was being mated still naturally and AI coverage remains close to 23%. Among the AI services, around 25% of cows were provided service by the private sector (mostly BRAC) and Government sub center and points share about 27 and 39 percent respectively (Table 2).

Table 2. Options for breeding and mating system

Breeding management	Percent		Breeding management	Percent
Source of breeding bull			Mating system	
Own herd	9.3		Natural uncontrolled	1.4
Neighbour's herd	85.1		Natural controlled	75.4
Rent / Exchange / DLS	5.6		Artificial insemination (AI)	23.2
Breeding system option			Place of AI	
Pure breeding	76.4		AI Centre	9.2
Crossbreeding	20.4		AI Sub-Centre	27.2
No choice	3.2		AI Point	38.5
			BRAC / Private	24.6

Source: Own calculation from the surveyed data

Milk production of a cow depends on genetic make up of the cow, nutritional status and environmental interaction with genotypes. Lactation length of cow was considered as the most important determinant of profitability of dairy farm. Farmers in the study area do not keep records but rely on their memory. This is common situation in developing countries (Nuru and Dennis, 1976) resulting in a major handicap to breed improvement. Milk yield (L) per cow per day ranged between 1.5 and 2.0 with an average of 1.78 in native

and ranged between 5.0 and 9.0 with an average of 5.64 in crossbred cows from 1st to 8th lactation. Native cows gave peak yield during 2nd and 3rd month while crossbred cows gave peak yield in 7th month of lactation (Table 3). No distinct calving season was observed in cows of both native and crossbred types. This is common with most communities found in tropical Africa (Wilson and Clarke, 1975; de Leeuw and Wilson, 1987). Lactation length of 85 percent cows studied was 7 month and in few cases it extended up to 15 months, especially, for crossbred cows.

Table 3. Lactation characteristics and milk yield of the cow surveyed

Lactation order	Percent	Average milk yield (L)		Month of lactation	Percent	Average milk yield (L)	
		Native	Crossbred			Native	Crossbred
1	14.6	1.6 (36)	5.1 (05)	1	7.5	1.9 (13)	5.3 (8)
2	35.0	1.9 (72)	6.3 (26)	2	9.6	2.0 (22)	4.7 (5)
3	25.4	1.7 (50)	5.2 (21)	3	20.4	2.0 (41)	5.4 (16)
4	10.0	1.9 (18)	4.6 (10)	4	15.7	1.9 (36)	6.3 (8)
5	5.7	1.7 (14)	9.0 (02)	5	12.5	1.7 (30)	4.5 (5)
6	4.6	2.0 (11)	5.0 (02)	6	11.4	1.6 (27)	6.3 (5)
7	3.2	1.7 (09)	-	7	7.5	1.8 (16)	8.0 (5)
8	1.4	1.5 (04)	-	8	5.0	1.4 (11)	5.7 (3)
				9	6.4	1.4 (11)	5.4 (7)
Overall milk yield/cow		1.78	5.64	10-15	4.0	1.2 (07)	4.9 (4)

Source: Own calculation from the surveyed data
Figures in the parentheses indicate number of milch cow.

Table 4 shows that cow age (positively), order and stage of lactation (negatively) all affected milk production significantly (0.001) in native cows which meant that productivity declined with the progress of cow parity and milking stage within a lactation. Increased age lowered milk production ($p<0.05$) in crossbreds but lactation order and stage did not influence ($p>0.05$) milk yield. Results interpret that contribution of age, order of lactation and stage of lactation are predictable in native cows but not in crossbreds. It might be because of variable environments in which crossbreds were kept and also for their variable degree of inheritance level as well as health condition.

Table 4. Estimated values of regression coefficients and related statistics of milk production

Independent variables	Native cattle N = 214	Crossbred N = 57	Both native and crossbred N = 271
Intercept	1.983** (0.133)	7.047** (1.426)	2.690** (0.438)
Age of milch cow (X_1)	0.165** (0.054)	-0.708* (0.339)	0.197 (0.153)
Order of lactation (X_2)	-0.238** (0.081)	1.067 (0.617)	-0.372 (0.235)
Stage of lactation (X_3)	-0.115** (0.019)	0.050 (0.124)	-0.038 (0.054)
R^2	0.156	0.078	0.011

Figures within parentheses indicate standard error.
* and ** indicates significant level at 5 and 1 percent respectively.

The main sources of income of the cattle holders studied were the livestock and crop cultivation. The secondary sources were the non-farm activities like service and business. Total income of the cattle owners ranged from Tk.350 to Tk.26,200 with an average income of Tk.5,453 per month. Livestock farming contributed 36.4 percent of their total income. Highly significant positive correlation ($r = 0.465$) between total income and income from livestock indicate that income from livestock had significant contribution to the cattle owner's family expenditure. Only 24.3 and 27.5 percent of the sample households respectively had source of service and business. The detailed pattern of income of the sample households is shown in Table 5.

Table 5. Monthly income distribution of the cattle owners

Source of income	Farmers		Item-wise income of per farm household (Taka)			Average income of all households (Taka)
	Number	%	Minimum	Maximum	Average	
Total	280	100	350	26,200	5,453	5,453
Livestock	280	100	330	21,000	1,984	1,984
Crop	178	63.6	300	25,000	2,919	1,855
Service	68	24.3	700	6,000	2,932	712
Business	77	27.5	900	12,000	2,896	790
Others	11	3.9	300	800	527	021

Source: Own calculation from the surveyed data

The coefficient of multiple determination, R^2 for three groups of cattle holders were 0.478, 0.967 and 0.983 respectively (Table 6) which indicates that the variables included in the model explained lower variability in case of native cattle. Five explanatory variables contributed 69.5 percent variability of the income from milk for all cattle holders. Experience in dairy farming had positive contribution to income from milk yield for all the cases of cattle farming and overall farming. Farm size had significant negative effect on milk yield in case of native and overall cattle holders because landless and marginal farmers usually preferred farming with native cattle. On the other hand, farm size had insignificant positive effect on milk yield incase of crossbred indicating that higher land owners rear crossbred cattle in many cases. The results highlight that per cow milk yield in native cow increases with the increase of number of milch cow in the herd. In contrast, in crossbred herd size does not affect milk yield per cow. The coefficient of time spent in cattle farming was statistically significant ($p < 0.01$) for native cattle, crossbred cattle and also for overall farming. In fact, the magnitude of the coefficient was the highest for crossbred cattle farming (2.004) indicating that if the time spent in crossbred cattle farming would have increased by 1 percent keeping others factor constant, milk value would have increased by 2 percent. Similarly, if the time spent in native cattle farming would have increased by 1 percent keeping other factors constant, milk value would have increased by 1.3 percent.

Table 6. Estimated values of coefficients and related statistics

Independent variables	Native N = 214	Crossbred N = 57	Mixed N = 9	Overall N = 280
Intercept	2.062** (0.403)	0.571 (1.127)	1.912** (0.341)	1.895** (0.350)
Experience (X_1)	0.240* (0.113)	0.027 (0.156)	0.115 (0.066)	0.236* (0.096)
Year of schooling of household head (X_2)	-0.022 (0.098)	-0.559 (0.233)	-	-0.026 (0.089)
Farm size based on cultivated land (X_3)	-0.116* (0.054)	2.004 (0.121)	-	-0.114* (0.049)
Time devoted in livestock farming (X4)	1.293** (0.215)	2.004** (0.458)	1.447** (0.105)	1.492** (0.150)
R^2	0.478	0.967	0.983	0.695

*Significant at 5% level probability, **significant at 1% level of probability and '–'indicates error due to insufficient number of observations

The gross cost per cow per day was Tk.82 for native cows whereas Tk.175 for crossbred cow (Table 7). Concentrate feed cost per cow per day was Tk.48 for crossbred cow and Tk.12 for native cow i.e. crossbred cows were fed four times higher amount of concentrate to produce more milk (Table 3). The cost of green and dry fodder was almost double for crossbred cow and the labour cost was also higher. To determine the gross returns from dairy cows, returns from milk yield, value of cow-dung and value of calf were added. On the basis of the three sources of dairy returns there was much difference among the two types of cows. The overall gross returns indicate that milk yield provided 78 per cent of the total gross returns and cow-dung and calf provided 2 and 20 per cent returns respectively. Net return from crossbred dairy enterprise was Tk.28 per cow per day (16% of the gross cost) whereas this figure is negative for native cow. This means that crossbred cattle farming is profitable but native cattle farming is not profitable. Farmers do not purchase labour and in some cases they do not purchase fodder specially,

green grass and hence by dairy farming they earn more money than the above mentioned figures. The data of this research show that per day average labour was 4 hours of which only 0.3 hours (7.5%) hired labour was purchased. Net return per cow per day was Tk.0.92 and the coefficient of concentrate feed (0.895) and labour (0.179) had a positive and significant effect on dairy return (Sikder *et al*., 2001).

Table 7. Per day cost and return of dairy cows (Taka) according to types

	Items	Native		Crossbred		Overall	
	Cost						
	Interest of fixed capital	9	(11.0)	21	(12.0)	11	(10.9)
	Green fodder	16	(19.5)	30	(17.1)	19	(18.8)
	Dry fodder	15	(18.3)	28	(16.0)	18	(17.8)
	Concentrate	12	(14.6)	48	(27.4)	19	(18.8)
	Labour	30	(36.6)	48	(27.4)	34	(33.7)
A	Gross cost	80	(100)	175	(100)	101	(100)
	Return						
	Value of milk	54	(73.0)	168	(82.8)	81	(77.9)
	Value of cow-dung	2	(0.27)	3	(01.5)	2	(01.9)
	Value of calf	18	(24.3)	32	(15.7)	21	(20.2)
B	Gross return	74	(100)	203	(100)	104	(100)
C	Net return (per cow per day)	-08		28		03	
D	Benefit cost ratio (C/A)	-0.10		0.16		0.03	

Source: Own calculation from the surveyed data

* Figures in the parentheses are the percentages of total

Estimated at prices: Interest of fixed capital = (Total cost x 16%) 365; green fodder @Tk. 2 per kg; dry fodder @ Tk. 3 per kg; concentrates @ Tk. 20 per kg; labour @ Tk. 10 per hour.

Out of 280 respondents 223 used to rear native cattle and all of them preferred native cattle because of lesser price of the animals to purchase and low input required. Most of them (91%) claimed that rearing of native cattle was easy, 78 percent claimed easy to graze them and 65 percent gave opinion on their usefulness in draught purpose. About 45 percent of them claimed that native cattle were less prone to disease and 41 percent claimed high adaptability to local condition. Sixty eight percent of the respondents emphasized the easy accessibility of native bulls to mate their cows in time (Table 8).

Table 8. Proportion of respondents ranking of each preference of native cattle (N = 223)

Preferences	Respondents		Extent of causes			
			High		Low	
	Number	%	Number	%	Number	%
Less purchase price	223	100	172	77	51	23
Low input required	223	100	181	81	42	19
Easy to rear	203	91	160	79	42	21
Easy to grazing and grass land is available	174	78	128	74	45	26
Use of duel purposes	145	65	96	66	49	34
Native bull is available for mating	112	68	59	53	53	47
Less prone to disease	101	45	36	36	65	65
High adaptability	92	41	67	73	25	27

Source: Own calculation from the surveyed data

Out of 280 respondents surveyed (household) 223 used to rear indigenous milch cow and all of them could recall the number of milch cow per farm for the period 2006-2007. Out of these 214 respondents, 189, 117 and 98 respondents could state the actual number of milch cow for the period 2001-2005, 1996-2000 and 19991-1995 respectively. No other respondent was able to recall the actual number of milch cow for the period 1986-1990 and 1981-1985. Per farm average number of milch cow were 6, 4.7, 2.8 and 1.4 during the period 1991-1995, 1996-2000, 2001-2005 and 2006-2007 respectively. Maximum number of milch cow per farm was observed to be 25, 20, 8 and 4 respectively, during the above period (Table 9).

Table 9. Number of indigenous milch cow in different time periods

Period	Number of respondents	Maximum number in a farm	Average number of milch cow per farm					
			Mid-region	Industrial	North-west	Northern hills	South-west	Overall
2006-2007	223	4	1.7	2.5	1.1	1.3	1.0	1.4
2001-2005	189	8	3.0	3.8	2.7	2.5	2.4	2.8
1996-2000	117	20	3.5	6.0	4.5	4.1	8.0	4.7
1991-1995	98	25	4.3	8.3	5.4	4.6	10.6	6.0

Source: Own calculation from the surveyed data

Farmers surveyed were asked about the causes of reduction of native cattle. Major opinions were the low growth of the animals and hence not profitable (68%) was on rank 1, low milk production (65%) was on rank 2, crisis of feed and or high price of feed (62%) was on rank 3, lack of source of investment (48%) was on rank 4 and introduction of exotic breed (43%) was on rank 5. Lack of labour (40%), lack of grass land due to increasing homestead and cultivated land (37%) and crisis of straw due to the introduction of high yielding rice varieties (25%) were important causes also. Causes of reduction of native cattle according to the percentage of respondents, their rank and the extent of causes are shown in Table 10.

All the farmers were asked to know their opinion on conservation of native cattle and about the constraints behind the conservation. Only 36 farmers were responded and most of them were from river-side and northern region. Responded farmers educated and well experienced on dairy farming but none of them had clear idea on conservation of native cattle. They wish to have improved native cattle instead of crossbred and they agreed that bio-diversity is affected due to rearing of crossbred cattle. Majority came up with the opinion that (i) to increase consciousness of rearing native cow and (ii) to run with crossing of purebred cows with local bulls. Some of them suggested (i) introduction of exotic breed should be stopped and (ii) native bull and cow should be promoted.

Table 10. Causes of reduction of native cattle

Causes of reduction		Respon-dents		Rank of the causes	Extent of causes			
					High		Low	
		No	%		No	%	No	%
	Low growth and not profitable	190	68	1	167	88	23	12
	Low milk production	181	65	2	154	85	27	15
	Introduction of exotic breed	119	43	5	94	79	25	21
	Lack of source of investment	135	48	4	82	61	53	39
	Crisis of feed and or high price of feed	174	62	3	145	83	29	17
	Crisis of straw due to high yielding rice production	71	25	9	40	56	31	44
	Lack of grass land due to increasing homestead and cultivated land	103	37	7	73	71	30	29
	Lack of labour	112	40	6	80	71	32	29
	Absence of native bull	45	16	11	33	73	12	27
	Dairy farming is considered as an industrial enterprise	95	34	8	70	74	25	26
	Changing trend of animal draught power to mechanization	63	23	10	52	82	11	18
	Used for dual (dairy and ploughing) purposes but now expensive	45	16	11	24	53	21	47
	Brought land / selling cattle	42	15	12	25	60	17	40

Source: Own calculation from the surveyed data

As regards to constraints of native cattle genetic resource conservation data reveal that number of native cows gradually had been declined from 1991 to 2007. The major causes as came out from the opinion of respondents are switching over mechanized power instead of animal power in agricultural production, less profitability from native cows compared to crossbreds, lack of native breeding bulls in the community and lack of grass land due to increasing homestead and cultivated land. Some other constraints of reduction of native cattle keeping are low growth and milk production, introduction of exotic breed, lack of source of investment or credit support, limited coverage of veterinary services etc. Limited availability and lack of quality feed, especially, high price of concentrate feed is a serious constraint to keeping native cattle in the study areas. Land is a scare resource and it is rarely available for cultivation of green fodder

and also grazing lands are limited due to extension of cereal crop production. Credit support to small native dairy farmers is limited and veterinary services such as disease diagnostic facilities and vaccines are inadequate and in most of the cases are not affordable.

Conclusions and Recommendations

It appears from the study that indigenous cattle genetic resource is declining in number day by day. This has been happening mostly because of indiscriminate crossbreeding through artificial insemination programme and gradual giving up of cattle husbandry by the rural poor farmers. Although crossbreds are high producing but they demand heavy initial investment as well as high maintenance cost which is unaffordable to majority farmers. Further, insufficiency of technical know how of the resource poor farmers is another obstacle for rearing crossbred cattle apart from biological adaptability issue of exotic inheritance. Situation described above dictates that indiscriminate breed substitution (with drawl of indigenous cattle) in our cattle population has been an incredible loss to our rural traditional agriculture. If immediate and appropriate measures are not taken to conserve our indigenous bovine genetic resources, an irrecoverable damage is likely to occur in the subsistence agriculture system of Bangladesh. The speculated damage includes loss of valuable FAnGR, loss of rural employment opportunity, loss of valued livestock products from indigenous animals, a decline in agricultural power system and degradation of many other allied issues.

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