



Original Research

A Comparative Analysis of Economic Returns and Resource Productivity between Crossbred Cattle Adopter and Non-Adopter Farmers in North-East Indian State of Assam

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Abstract

Based on a randomly selected sample of 245 smallholder dairy farmers the present study seeks to assess the comparative economic returns and resource productivity of crossbred cattle adopters and non-adopters in Assam. Given that crossbred cattle are superior in terms of lactation milk productivity and other reproductive characteristics, economic returns from milk production is higher for crossbred cattle adopter farmers. The study shows that since most of the farmers are found to use family labour and meet part of the fodder requirement from domestic supply, this may incentivize these farmers to adopt crossbred cattle for raising dairy income. The study finally suggests that feeding of concentrate to the crossbred cattle is more important for raising its milk production; while green fodder is not as important as feeding of dry fodder for both the cattle groups (crossbred and indigenous) for efficient milk conversion of the same.

Key words: Assam, Crossbred Cattle, Economic Returns, OLS Regression

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Introduction

Dairying in Assam, an economically backward state in north-east India, is an important component of rural livelihood strategies for a vast segment of the population as more than 82% of the total rural population keep cattle or buffalo in a singular or mixed farm system (Kumar and Staal, 2010; ILRI, 2007, Bayan, 2018). But the productivity of the indigenous dairy animal stock in the state is remarkably low and the state also does not have any recognized indigenous breed to conserve. It is again noted that even though people in the state is by and large non-vegetarian in their consumption habit requiring lesser milk in their diet, home production hardly suffices 34% of the total milk demand in the state (Govt. of Assam, 2012). This necessitates crossbreeding of low productive indigenous cattle stock in a wider scale using superior



germplasm to improve the productivity of the cattle stock and overall milk production of the state. Recent studies also indicate that due to higher productivity of crossbred cattle, adoption of the same in Assam has the potential to raise employment (Bayan and Dutta, 2018), income and consumption of self-produced milk (Bayan and Dutta, 2017). However, it is noted that albeit, the efforts for cattle crossbreeding at field condition was started way back in 1963 with the introduction of Intensive Cattle Development Project (ICDP), but the diffusion of cattle crossbreeding is found to be inadequate. According to 19th Livestock Census, 2012, proportion of crossbred cattle in the total cattle population in the state is only 3.84%. Crossbred cattle population is mostly concentrated in the pockets of peri-urban parts of the state. Deshetti *et al.* (2017) have further pointed out that the dairy enterprise in the recent period has aimed at effective management of our natural resources to enhance milk production. Many of the farmers are found to use partly the home based feed and fodder resources and family labour which are not reflected in the accounting of economic returns of dairying.

Given that there is lack of studies to demonstrate the superiority of crossbred cattle in terms of milk production and gain in economic returns resulting from higher productivity and resource use efficiency in crossbred cattle, the present study is an attempt to bridge the gap and to understand the importance of cattle crossbreeding so that milk production can be increased and resources are efficiently managed in the state.

Materials and Methods

The study is carried out based on the analysis of information from 245 dairy farmers in three districts of Assam namely Barpeta, Sonitpur and Karbi Anglong. Multistage sampling techniques are followed for selection of the sample farms. In the first stage, all the districts are stratified into high, medium and low based on density of crossbred cattle population per hundred hectare of geographical area and coverage of breedable cattle population using artificial insemination (AI). Following this, one district is randomly selected from each stratum to represent the farm and animal characteristics with respect to crossbreeding technology diffusion in the state. In the second stage, two development blocks (one with high and one with low diffusion of crossbreeding technology) are selected from each district considering the information from some key informants. In the third stage, three sample villages from each district are purposively selected with the understanding that the villages have a mix of farmers rearing indigenous and crossbred cattle. Finally, 30-40% sample farmers are selected from each village from a list of farmers prepared through discussion with village head man and veterinary field assistant (VFA). Thus, 245 farmers (137 crossbred cattle adopters and 108 non adopters) is the sample size from which primary information on farm and animal characteristics were elicited using structured and pre-tested questionnaire. For empirical analysis of the data simple tabular analysis such as mean, percentages and t-tests are used. Again, for the empirical estimation of the production function using input-output data of milk production among the sample farmers separately

for crossbred and indigenous cattle, linear form of the Cobb-Douglas (CD) production function has been considered. The CD model's major strengths over models like CES or Translog PF (Translog production function's potential problem of collinearity among the production factors) are its ease of use and seemingly good empirical fit across many data sets (Miller, 2008, Pavelescu, 2011). The log linearised CD model is as shown below:

$$Y_{i1} = \beta_0 + \beta_{1i}X_{1i} + \beta_{2i}X_{2i} + \beta_{3i}X_{3i} + \beta_{4i}X_{4i} + \beta_{5i}X_{5i} + \mu_i \quad (1)$$

Where,

Y_i = value of milk production per day per milch SAU

β_0 = constant

β_{1i} - β_{5i} = coefficients of the variables

X_{1i} = Value of green fodder fed per day per milch SAU

X_{2i} = Value of dry fodder fed per day per milch SAU

X_{3i} = Value of concentrate fed per day per milch SAU

X_{4i} = Value of labour hour spent per day per milch SAU

X_{5i} = Miscellaneous cost incurred per day per Milch SAU

μ_i = Standard error term

Results and Discussion

Distribution of Sample Farms

Table 1 presents the sample respondents according to various herd size categories in the three sample districts of the state and according to crossbreeding technology adoption status. Standard Animal Unit (SAU)¹ is derived from Kumbhare *et al.* (1983) to standardize production characteristics of different farms with different species of animals. Different herd size category farms (small, medium and large) are post-stratified on the basis of milch SAUs using cumulative frequency of the square root technique. Sample households that have herd size from 1 to 2.99 are considered as small; 3 to 5.99 as medium and 6 and above are considered as large farms (Table 1).

Table 1: Distribution of different herd size category sample households across groups and across districts

Herd Size Category	No. of Households		
	Barpeta	Sonitpur	KarbiAnglong
Adopter			
Small	29 (31.5)	23 (28.0)	6 (8.4)
Medium	20 (21.7)	18 (21.9)	11 (15.4)
Large	5 (5.4)	2 (2.4)	23 (32.4)
Overall	54 (58.7)	43 (52.4)	40 (56.3)
Non-adopter			
Small	29 (31.5)	18 (21.9)	12 (16.9)
Medium	9 (9.7)	20 (24.3)	12 (16.9)
Large	0 (0.0)	1 (1.2)	7 (9.8)
Overall	38 (41.3)	39 (47.5)	31 (43.6)
Total	92 (100)	82 (100)	71 (100)

Figures in parentheses indicate percentage to column total; Field survey, 2015-16

Milk Productivity

Lactation productivity difference between breeds based on *t*-tests (two tailed) is presented in Table 2. There is found to be significant difference in milk productivity per lactation between the two breeds for all size category farmers pointing out that crossbred cattle yields approximately 537 liters ($P < 0.01$) of more milk per lactation than the non-descript cattle. Table 2 again shows that according to different size class farmers milch cattle (indigenous and crossbreds) owned by small farmers are relatively high milk yielding compared to the milch cattle owned by medium and large farmers. This may be due to the fact that undertaking care and management in the smaller farms are easy compared to large farms.

Table 2: Lactation productivity of the dairy animals for different herd size categories across groups

Farm Type	Crossbred (litre/milch SAU)	Indigenous (litre/milch SAU)	Difference
Overall	860.76 (48.13)	324.09 (21.41)	536.67*** (57.46)
Small	1029.22 (86.05)	402.71 (33.21)	626.51*** (91.65)
Medium	697.19 (56.14)	223.09 (18.78)	474.10*** (63.78)
Large	802.25 (97.1)	324.09 (21.41)	536.67*** (57.46)

Figures in parentheses indicate standard error; *** indicate significant at 1% probability level

Lactation and Reproductive Characteristics of Crossbred and Indigenous Cattle

Apart from productivity difference between crossbred and indigenous cattle, there are other factors which may help us to consider crossbred cattle as superior breed over indigenous one. Table 3 reports these differences between the two breeds under consideration with respect to age of first calving, calving interval and lactation length.

Table 3: Lactation and reproductive characteristics of the dairy animals for different herd-size categories across groups

Farm Type	Age of First Calving		Calving Interval		Lactation Length	
	(Months)		(Days)		(Days)	
	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous
Overall	30.9	45.69	427.71	530.56	277.23	233.06
Small	31.82	46.73	416.48	530.56	284.22	231.86
Medium	30.45	44.15	444.49	520.98	275.2	238.54
Large	29.87	46	422	581.25	267	213.75

In Table 3 it is seen that age of first calving of crossbreds in the study sample is relatively much lower than the indigenous breeds. This indicates that farmers with crossbreds have to wait relatively lesser time to get the first calf compared to the farmers with indigenous cattle. The age of first calving for crossbreds, on average, across size groups of farmers is 31 months compared to almost 46 months. This implies that a farmer with crossbreds has to rear on average around 15 months less to get the first calf than a farmer rearing indigenous cattle which may have implications on conservations of feed and fodder resources and economy in farm management activities. Some of the studies such as Lalwani (1987), Rao *et al.* (1995)

provide similar justification for the superiority of crossbreds over indigenous breeds. However, there is not any notable difference in the age of first calving between the two breeds across groups (Table 3).

Differences between the two breeds in terms of calving interval and lactation length explain that the calving interval is shorter for crossbred cattle compared to indigenous ones, while lactation length of crossbred cattle is relatively much longer than indigenous cattle. It is found from Table 3 that calving interval for the overall crossbred cattle is 427.71 days against 530.56 days of indigenous breed. With respect to lactation length, crossbreds give milk for an average period of 277.23 days compared to 233.06 days. It is noted that for the large farmers the differences in calving interval and lactation length between the two types of animals is more acute with 159.25 and 53.25 days respectively. Interaction with the farmers during the field survey makes the researcher know that the balanced feeding and effective management of the animals, especially crossbreds are the important determining factors to gain efficiency even within groups with regards to lactation and reproduction characteristics of the animals.

Economic Returns from Milk Production

The economics of dairying based on operational cost and value of milk production among the sample farmers of various farm size categories with and without imputations of costs and returns are presented respectively in Table 4 and Table 5. In Table 4, various operational costs and income from milk production are presented by taking the imputed value of domestically available feed and fodder, imputed cost of family labour and imputed value of cow dung and on the income side the imputed value of domestically consumed milk. This is compared with the dairy business based on actual costs (without imputations) presented in Table 5, where only paid out cost components are incorporated following Kassie et al. (2012) along with the income received from the milk sale. It is seen from Table 4 that operational costs incurred per standard animal unit/day is Rs. 82.44 for overall adopters and Rs. 54.54 for non-adopters. Adjusting the total operating costs for the imputed value of cow dung produced in the farm, we arrived at net operating costs which are estimated at Rs. 75.61/day/milch SAU for adopters and Rs 47.95/day/milch SAU for non-adopters. For both adopters and non-adopters the net operational costs decreased with increase in farm size. It is seen from Table 4 that in case of adopters, 51.20 per cent of the total operating costs per standard animal unit/day are constituted by the labour cost (hired+family labour), while for non-adopters this figure is even higher (68.01 per cent). It is to note that the imputation of family labour cost is done based on the prevailing wage rate of the hired labour in the dairy farm. Following this, feed and fodder cost is the next dominant cost component for both adopters (44.20 per cent) and non-adopters (29.35 per cent) across farm size groups. Higher productivity of crossbred cattle realizes much higher net return from milk production for adopters compared to non-adopters. It is found that net return from milk production for adopters is Rs. 37.02/day/milch SAU compared to Rs. 2.62 for non-adopters (Table 4).

Table 4: Cost and return of milk production for different herd size categories across groups

Particulars	Adopter				Non-adopter			
	Small (N=58)	Medium (N=49)	Large (N=30)	Overall (N=137)	Small (N=59)	Medium (N=41)	Large (N=8)	Overall (N=108)
Operational Cost (Rs/day/milch SAU)								
Green Fodder	2.55 (2.41)	2.01 (2.95)	2.18 (3.58)	2.27 (2.75)	1.32 (1.87)	1.28 (3.63)	0.76 (2.16)	1.27 (2.33)
Dry fodder	11.45 (10.82)	7.32 (10.75)	6.41 (10.54)	8.87 (10.76)	8.74 (12.37)	4.06 (11.52)	4.13 (11.72)	6.62 (12.14)
Concentrate	28.58 (27.02)	21.67 (31.83)	24.9 (40.95)	25.3 (30.69)	9.67 (13.69)	5.95 (16.89)	7.89 (22.39)	8.12 (14.89)
Feed and fodder	42.58 (40.25)	31 (45.54)	33.49 (55.07)	36.44 (44.2)	19.73 (27.93)	11.29 (32.05)	12.78 (36.28)	16.01 (29.35)
Labour cost	58.35 (55.16)	34.14 (50.15)	24.3 (39.96)	42.21 (51.2)	49.1 (69.51)	22.94 (65.11)	21.11 (59.92)	37.09 (68.01)
Cost on AI/NS	0.49 (0.46)	0.51 (0.75)	0.62 (1.02)	0.53 (0.64)	0.006 (0.008)	0 (0)	0 (0)	0.004 (0.007)
Veterinary expenses	4.36 (4.12)	2.42 (3.56)	2.5 (4.11)	3.26 (3.95)	1.8 (2.55)	0.91 (2.58)	1.33 (3.78)	1.43 (2.62)
Total veterinary cost	4.85 (4.58)	2.93 (4.3)	3.12 (5.13)	3.79 (4.6)	1.81 (2.56)	0.91 (2.58)	1.33 (3.78)	1.43 (2.62)
Total operational Cost	105.78 (100)	68.07 (100)	60.81 (100)	82.44 (100)	70.64 (100)	35.23 (100)	35.23(100)	54.54 (100)
Return from cow dung (Rs)	6.88	6.91	6.76	6.83	6.45	6.51	6.78	6.59
Net operational cost (Rs)	98.9	61.16	54.05	75.61	64.19	28.72	28.45	47.95
Return from Dairying								
Daily milk production (litres)	8.01	11.99	34.07	15.14	2.3	3.32	8.19	3.12
Average sale price of milk (Rs/litre)	36.38	37.26	36.17	36.65	38.49	36.7	34	37.47
Return from milk production (Rs/day/milch SAU)	134.7	91.56	104.33	112.63	63.64	33.27	42.77	50.57
Net return from milk production (Rs/day/milch SAU)	35.8	30.4	50.28	37.02	-0.55	4.55	14.32	2.62

Figures in parentheses indicate percentage to total operational cost

According to farm size category, large farmers have higher net returns for both adopters (Rs. 50.28/day/milch SAU) and non-adopters (Rs. 14.32/day/milch SAU) group. It can be estimated that for the average size of cattle holdings of adopters (5.69 milch SAU), the annual income is expected to be Rs. 76,884.99 against the income of non-adopters (Rs. 2534.20) for the average size of cattle holding of 2.65 milch SAU.

Based on actual value of operational cost and return from milk sale, the economics of milk production is presented in Table 5. It is found that the total paid out operational cost is Rs 36.50/day/milch SAU for adopters against Rs. 14.37 for non-adopters. Table 5 also shows that of the total operational costs incurred for each standard animal unit, cost on feed and fodder constitute the highest share for both adopters (86.36 per cent) and non-adopters (83.58 per cent). Among the remaining cost components, share of total veterinary costs (Costs on AI, medicines, vitamins and calcium, minerals and doctor's fees) incurred on

standard animal unit is ranked as second with 10.38 per cent for adopters and 9.98 for non-adopters. Hired labour cost constitutes a very minute share of 3.29 per cent for adopters and 6.40 per cent for non-adopters. It has also been seen that the percentage share of labour cost decreased with increase in herd size for both the adoption groups. The pattern is consistent with the finding of the study carried out by Bardhan and Sharma (2012) on comparative cost of milk production between members and non-members of cooperative in Kumaon region of Uttarakhand. The net return from milk sale per standard animal per day is estimated at Rs. 61.60 for adopters and Rs. 19.22 for non-adopters. According to farm size category, small farmer adopters have net return of Rs. 69.62/day/milch SAU which is higher than the average net return of overall adopters. Similar is the case for non-adopters as well. Thus, given the actual net return per standard animal per day of adopters and non-adopters, the annual income for the average farm size households is estimated at Rs. 1,27,933.96 for adopters and Rs 18,590.55 for non-adopters.

Table 5: Cost and return of milk production for different herd size categories across groups

Particulars	Adopter				Non-adopter			
	Small (N=58)	Medium (N=49)	Large (N=30)	Overall (N=137)	Small (N=59)	Medium (N=41)	Large (N=8)	Overall (N=108)
Operational cost (Rs/day/milch SAU)								
Green Fodder	0.02 (0.05)	0.04 (0.13)	0.13 (0.38)	0.05 (0.14)	0 (0)	0.84 (8.41)	0 (0)	0.03 (0.21)
Dry fodder	7.83 (17.98)	4.5 (15.18)	5.68 (16.67)	6.17 (16.9)	4.61 (26.24)	2.79 (27.93)	3.78 (28.64)	3.86 (26.86)
Concentrate	28.58 (65.63)	21.67 (73.09)	24.9 (73.06)	25.3 (69.32)	9.67 (55.04)	5.95 (59.56)	7.89 (59.77)	8.12 (56.51)
Feed and fodder	36.43 (83.65)	26.21 (88.4)	30.71 (90.11)	31.52 (86.36)	14.28 (81.27)	9.58 (95.9)	11.89 (90.08)	12.01 (83.58)
Labour cost (hired labour only)	2.27 (5.21)	0.51 (1.72)	0.27 (0.79)	1.2 (3.29)	1.48 (8.42)	0.26 (2.6)	0.2 (1.52)	0.92 (6.4)
Cost on AI/NS	0.49 (1.13)	0.51 (1.72)	0.62 (1.82)	0.53 (1.45)	0.007 (0.04)	0 (0)	0 (0)	0.004 (0.03)
Veterinary expenses	4.36 (10.01)	2.42 (8.16)	2.5 (7.34)	3.26 (8.93)	1.8 (10.24)	0.91 (9.11)	1.33 (10.08)	1.43 (9.95)
Total veterinary cost	4.85 (11.14)	2.93 (9.88)	3.12 (9.15)	3.79 (10.38)	1.81 (10.3)	0.91 (9.11)	1.33 (10.08)	1.434 (9.98)
Total operational Cost	43.55 (100)	29.65 (100)	34.08 (100)	36.5 (100)	17.57 (100)	9.99 (100)	13.2 (100)	14.37 (100)
Return from cow dung (Rs)	2.03	2.56	2.34	2.33	1.94	1.76	2.05	1.93
Net operational cost (Rs)	41.52	27.09	31.74	34.17	15.63	8.23	11.15	12.44
Return from Dairying								
Daily milk Sale (litres)	6.69	10.14	31.82	13.43	1.42	2.34	7.13	2.19
Average sale price of milk (Rs/litre)	36.38	37.26	36.17	36.65	38.49	36.7	34	37.47
Return from milk sale (Rs/day/milch SAU)	111.14	77.03	96.66	95.77	37.09	22.74	37.38	31.66
Net return from milk sale (Rs/day/milch SAU)	69.62	49.94	64.92	61.6	21.46	14.51	26.23	19.22

Figures in parentheses indicate percentage to total operational cost

The comparison of Table 4 and Table 5 explains that imputed value of family labour estimated at par with cost on hired labour brings the major differences in the net returns from dairying for the two different cases (with and without cost/return imputations). During the primary survey it is observed that sizable sample farmers carry out dairying activities by engaging family labor leading to underestimation of operational costs. In other words, if cost of family labour is excluded from the total operational costs then there is significant increase in net returns from dairying. This finding is consistent with several studies such as Bardhan and Sharma (2012), Saha and Gupta (2000), Kumar and Dhaka (1999) etc. Again, in a mixed-farm system, internal input flow also reduces actual costs if the imputed value of the domestically available fodder resources (green and dry fodder) is excluded. From Table 4 and Table 5, it is found that the share of green fodder cost in the imputed total operational cost decreased from 2.75 per cent to 0.14 per cent in the actual cost for overall adopters and from 2.33 per cent to 0.21 per cent for non-adopters. Likewise, in case of dry fodder also there is decline in absolute cost of Rs. 2.7 per standard animal unit/day for both adopters and non-adopters. Thus, based on the finding it can be summarized that internal flow of input in a mixed farm system and operating dairy business using family labour may incentivize farmers to go for dairying due to higher net returns.

Milk Production Function

The result of the OLS estimates of production function is presented in Table 6 separately for crossbred and indigenous cattle. Table 6 reports that the models have a good fit with high R^2 value (coefficient of determination). To check if there is any multicollinearity problem among the explanatory variable variance inflation factor (VIF) and tolerance level have been seen.

Table 6: OLS estimates of milk production functions

Variable	Crossbred cattle		Non-descript Cattle	
	β - value	"t" Value	β - value	"t" Value
Intercept	1.038*** (0.830)	12.51	0.934*** (0.109)	8.54
Green fodder	0.042 (0.035)	1.21	0.02 (0.059)	-0.33
Dry fodder	0.195*** (0.044)	4.41	0.250*** (0.064)	3.88
Concentrate	0.402*** (0.045)	8.88	0.133** (0.055)	2.44
Labour	0.082 (0.063)	1.3	0.276*** (0.089)	3.09
Miscellaneous	0.228*** (0.049)	4.64	0.217*** (0.055)	3.97
R^2	0.8079		0.6487	
F-value	110.17***		37.67***	
Number of observation	137		108	

Figures in parentheses indicate standard error; ** and *** indicate significant at 5% and 1% probability level respectively

A VIF value less than 5 indicates absence of multicollinearity problem. For the estimated VIF value of CD model refer to Table A. Based on the regressions it is found that concentrate is the most important input to

significantly affect the productivity of crossbred cattle. It shows that one per cent increase in the value of concentrate fed to the animal leads to 0.40 per cent increase in the value of milk production per day per standard animal unit of crossbred cattle. This indicates that feeding of concentrate has higher positive elasticity of milk production. This is, however, not found significant for indigenous cattle. Dry fodder is the next important factor to have statistically significant ($p < 0.01$) relationship between the value of dry fodder fed to the animal and rise in milk productivity. A one per cent increase in the value of dry fodder fed to the animal leads to 0.19 and 0.25 per cent increase in the value of milk production for crossbred and indigenous cattle respectively. Imputed value of the labour hour spent for indigenous cattle exerts a positive and statistically significant relationship with the productivity of cattle. However the same is not found to be significant to influence productivity of crossbred cattle. The reason may be that since the average herd size of standard milch animal unit of crossbreds is higher than the average herd size of the indigenous cattle (5.69 milch SAU of crossbreds compared to 2.65 milch SAU of Indigenous breed), labour hour spent per crossbred milch SAU on farming operations is proportionately less compared to indigenous cattle in the study sample.

Value of miscellaneous factors such as expenditures on medicine, doctor's fee, cost on vitamin, calcium and minerals and artificial insemination (AI)/natural service (NS) are found to affect significantly and positively the productivity of both crossbred and indigenous cattle with an extent of 0.23 and 0.22 per cent respectively. Value of green fodder fed per milch SAU is not found to be statistically significant to affect productivity of crossbred cattle and it is negatively associated with the productivity of indigenous cattle (see Table 6). The reason may be that for a large number of farmers in the sample households access to green fodder is constrained by seasonality due to flood and non-availability of land due to sowing of paddy fields for which productivity is affected in case of crossbred cattle. On the other hand, negative association implicates prevailing problem of overfeeding in case of indigenous cattle. The finding of the study is consistent with Paul and Chandel (2010), Rais Uddin *et al.* (2007) and Kumar (2001).

Conclusion and Policy Implications

The study presents that crossbred cattle in Assam are superior over indigenous cattle in terms of lactation milk productivity, age of first calving, calving interval and lactation length. The study has again shown that computation of economic returns based on actual operational cost of milk production and actual return from milk sale indicate that crossbred cattle adopters earn Rs. 61.60/day/milch SAU while non-adopters earn Rs. 19.22/day/milch SAU. Since dairy activities are carried out using family labour and part of the feed and fodder requirements is met from domestic supply, a relatively higher net return is possible. Imputation of these inputs as per market value lowers the net returns from milk production to Rs. 37/day/milch SAU and Rs. 2.62/day/milch SAU for crossbred and indigenous animal respectively. The study, thus, suggests that

adoption of cattle crossbreeding through diffusion of AI or deployment of pure-breed exotic bull is important in the context of Assam for generating higher net dairy income in farms using family labour and partly the home grown fodder. The study also recommends feeding of concentrate to the crossbred cattle for raising milk production and green fodder is not as important as feeding of dry fodder for both the cattle groups (crossbred and indigenous) for efficient milk conversion of the same.

Note

¹ Milch cattle is standardized as

1 crossbred cattle = 1.40 SAU

1 Indigenous cattle = 1.00 SAU

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Appendix

Table A: Variance inflation factor and tolerance level of the explanatory variables

Variable	Crossbred Cattle		Indigenous Cattle	
	VIF	Tolerance	VIF	Tolerance
Green fodder	1.66	0.6	1.29	0.77
Dry fodder	1.04	0.96	1.23	0.81
Concentrate	1.07	0.94	1.1	0.9
Labour	1.3	0.77	1.06	0.94
Miscellaneous	1.66	0.73	1.04	0.96

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