urban areas- Rajbati and Gunjabari of Dinajpur town and Laxmipura and Chandona were selected according to the advice of the DLS officials since small scale dairy farmers exist there.

2.2 Selection of Sample, Sampling Technique and Data Collection

A list of dairy farm household was prepared with the help of the concerned department. Then from the list a total of 100 dairy farm households (having one or more dairy cows) were selected taking 50 sample farms from each of the selected district. Random sampling technique was adopted to select the sample. A farm survey method was adopted to collect required data for the present study. An interview scheduled was prepared in accordance with the objectives set for the study. Afterward the interview schedule was pre-tested. After finalizing the interview schedule, required data were collected by the researcher and his team through direct interview with the dairy owners. Collected data were scrutinized, summarized and entered into the computer and analyzed. Besides collection of primary data, secondary data and information were collected from various published and unpublished sources.

2.3 Analytical Technique

Both descriptive and statistical analysis was used to analyze the data. For descriptive analysis such as mean, percentage, graphical presentation was done based on various income groups in two study sites. In fact, the descriptive analysis was used to illustrate the whole scenario of the small scale dairy farming in both study sites- Dinajpur and Gazipur. More importantly, statistical technique was used to estimate the effect of different variables.

2.3.1 Analytical model

Cobb-Douglas production function model was used to determine the effects of key variables. To identify the most important variables in the production process of milk of small scale dairy farms, the following specification of the model was adopted.

$Y= X_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}\ X5^{b5}X_6^{b6}U_i$

The Cobb-Douglas production function was transformed into following logarithmic form so that could be estimated by the Ordinary Least Squires (OLS) method.

$\text{In } Y= \text{In } a + b_1 \text{ In } X_1 + b_2 \text{ In } X_2 + b_3 \text{ In } X_3 + b_4 \text{ In } X_4 + b_5 \text{ In } X_5 + b_6 \text{ In } X_6 + Ui$

Where,

Y= Milk yield;	X_4= Labor cost;
A= intercept;	X_5= Veterinary cost;
X_1= Straw cost;	X_6= Housing cost;
X_2= Green grass;	$b_1, b_2, b_{3...} b_6$= Production co-efficient of the respective variables; and
X_3= Concentrate feed;	U_i= Standard error.

3. Results and Discussion

3.1 Socio-economic characteristics of the dairy farm owners

3.1.1 Distribution of respondents according to different income groups

The dairy farm holders were categorized into four different groups according to their monthly income from different sources. The income groups were categorized in such a way group -A). income up to Tk. 4000; group -B) income Tk. 4001-Tk.12000; group-C) income Tk. 12001 to Tk. 20000, and group- D) Tk. 20001 to Tk 28000. The major portion of the dairy farm holders both at Gazipur and Dinajpur (48% and 71%) belonged to income group "B". The dairy farm holder having monthly income (up to Tk. 4000) was 17% of the total respondent of Dinajpur whereas only 6% of the respondent of Gazipur belonged to this income group. About only 7% of the dairy farm holders of Dinajpur belonged to income group "C" whereas 18% of the dairy holders of Gazipur belonged to the same group. The lowest percentage of the respondent of Dinajpur (5%) belonged to the highest level of income group "D" whereas 28% of the respondent of Gazipur belonged to this income group. The distribution is shown in Figure 1.

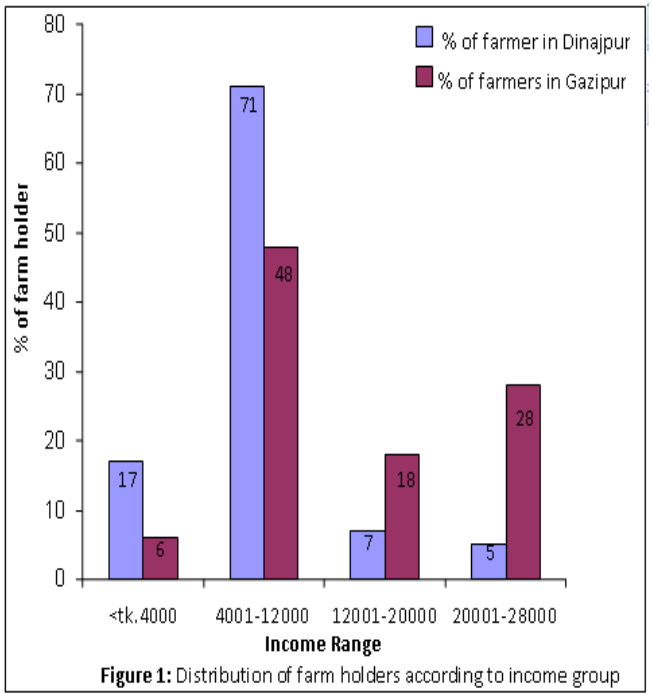

Figure 1: Distribution of farm holders according to income group

3.1.2 Educational status of the dairy holders

The respondents were categorized according to their educational attainment. It was evident from the following table (Table 1) that 10 % of the respondents of Dinajpur area was illiterate as against no illiterate dairy farm holder at Gazipur. About 12% of the respondents of Dinajpur could sign only as against 4% of the respondents of Gazipur. About 20% of the respondents of Dinajpur and 18% of the respondents of Gazipur area were observed to have the education up to class V. About 18 % of the respondents of Dinajpur had the education level of class- VI to X whereas 20% of the respondents of Gazipur belonged to the same education level. About 12 % of the respondents of Dinajpur

and 10% of the respondents of Gazipur had passed SSC examination. About 10 % of the respondents of Dinajpur and 22% of that of Gazipur had the education at HSC level. Highest percentage of the respondents (26%) of Gazipur had graduated whereas 18% of the respondents of Dinajpur had the same level of education.

Table 1: Educational status of the respondents

Level of Education	*Respondent (%) Dinajpur*	*Respondent (%) Gazipur*
Illiterate	10	-
Sign Only	12	4
Up to class V	20	18
Class VI-X	18	20
SSC	12	10
HSC	10	22
Graduate	18	26

Source: Field Survey, 2012

3.2 Economics of Dairy Farming

The purpose of this section is to determine the costs and returns of rearing animals. The cost items consist of feed, labor, veterinary services and medicine, housing, electricity etc. Returns from dairy farming included returns from milk, cow dung, inventory changes.

3.2.1 Cost of Cow Rearing

Cost of animal rearing was calculated taking the entire costs stream on daily basis. There were two kinds of cost viz. fixed cost and variable cost. It revealed from table (Table 2) that cost of animal rearing was Tk. 169.91/day/farm in Dinajpur and Tk. 262.90 in Gazipur. The cost items are discussed below.

A). Feed cost: Feed cost was one of the principal cost items for dairy farming. The cost of feed included expenses on concentrate (rice bran, wheat bran, oil cake, lentil bran, molasses, broken rice, maize salt etc.) roughage (paddy straw, green grass). The purchased feeds were valued according to price actually paid by the dairy farm holders. It reveals from the table (Table 2) that feed cost comprised 80.9% of the total cost. The feed cost items composed of different types of feed such as roughage (green grass and straw) and concentrate. Among the feed items, straw was the highest cost item (18.71% of total cost) followed by wheat bran (15.43%), rice bran (12.98%), lentil bran (11.67%), green grass (8.99%), broken rice (8.80%) and molasses (2.54%). In Gazipur, straw cost was the highest cost item followed by lentil bran, broken rice, and rice bran.

B) Labor cost: Labor cost was composed of both hired labor and family labor. It was evident from the table 2 that labor cost was Tk. 25.92 in Gazipur and Tk.17.86 in Dinajpur that represented 9.86 % of the total cost of dairy rearing in Gazipur urban areas and 10.51% of the total cost of dairy farming in Dinajpur urban areas.

C) Veterinary cost: This cost item includes the cost of medicine and doctors. Proper veterinary care is essential for a profitable dairy enterprise. The veterinary cost was Tk. 13.42 for the dairy farm holders in Gazipur area whereas in Dinajpur area it was almost half of that cost in Gazipur. The veterinary cost accounts for 5.10% of the total cost in rearing cow in Gazipur which accounts for 4.42% of the total cost in Dinajpur.

D) Milking cost: The cost involves in collection of milk from the dairy cow. Most of the dairy holders in both areas collected milk from the dairy cows themselves or with the help of their female members. Sometimes milk was collected with the help of the hired milk man (Goala). The cost item represents only 1.76 % of the total cost in the case of dairy farm in Dinajpur and 1.12% of the total cost in Gazipur.

E) Cleaning cost: To maintain healthy environment of the cowshed, the dairy farm holder cleaned their shed every day. For cleaning the cowshed it requires some cleaning materials such as – savlon, dettol etc. The cost item represents 1 % of the total cost for dairy farming in Dinajpur and Gazipur (see the Table 2).

F) Electricity cost: It was Tk. 2.96/day for dairy farm holders in Gazipur and Tk.1.44/day for dairy farm holders in Dinajpur urban areas. In terms of percentage, the cost represents 1.02% of the total cost of dairy farming in Gazipur and 0.84% of the total cost of dairy farming in Dinajpur.

Table 2: Cost of dairy cow rearing (Tk./farm/day)

Items of cost	*Average Cost*	
	Gazipur	*Dinajpur*
I. Fixed Cost:		
Shed cost	1.98	1.16
II. Variable Costs:		
a. Roughage:-		
Green grass	21.29	15.39
Straw	43.02	32.01
Total Roughage	**64.31**	**47.40**
b. Concentrate:-		
Wheat bran	41.60	26.38
Rice bran	29.80	22.20
Lentil bran	32.64	19.96
Broken rice	31.82	15.06
Molasses	7.42	4.35
Maize	2.01	1.08
Salt	3.96	1.66
Oil Cake	1.45	0.27
Total concentrate	**150.70**	**90.96**
Total feed cost	**215.01**	**138.36**
c. labor cost	25.92	17.86
d. Veterinary cost	13.42	7.51
e. Milking cost	2.95	3.00
f. Cleaning cost	2.64	1.74
g. Electricity cost	2.96	1.44
III. Total Variable Cost	**47.89**	**31.55**
Total Cost/day/farm	**262.90**	**169.91**
No. of Animal(Average)	2.8	2.25
Total cost/day/animal	**93.89**	**75.52**

Source: Field Survey, 2012

3.2.2 Returns from dairy farming

It was evident from the table (Table 3) that the total milk production was 1435 liter/year/farm in Dinajpur urban areas. Total return from milk sale was estimated at Tk. 64575 in the study areas of Dinajpur. Return from by- product was Tk. 14020/farm/year in Dinajpur urban areas. The Benefit - Cost Ratio (BCR) was calculated at 1.67 implies that the dairy farm had a return of Tk. 1.67 per taka investment

which also implied that the enterprise was profitable. On the other hand, in Gazipur urban areas- the total milk production was 1775 liter/year/farm. Total return from milk sale was estimated at Tk. 124250. Return from by- product was Tk. 21025.25/farm/year in Gazipur urban areas. The Benefit Cost Ratio (BCR) was calculated at 1.84 implied that the dairy farm had a return of Tk. 1.84 per taka investment also stated that the enterprise was profitable in urban areas of Gazipur. The BCR of the dairy holders in Gazipur urban areas was higher (1.84) than that of the dairy holders in Dinajpur urban areas (1.68) due to higher price of milk in Gazipur area.

Table 3: Return from dairy farming

Items	Gazipur	Dinajpur
Milk production/year/farm (liter)	1775	1435
Return from milk sale (Tk.)	124250	64575
Return from by-product/year/farm (Tk.)	21025.25	14020.64
Return from animal sale /year/farm (Tk.)	31700	25750
Gross Return/year/farm (Tk.)	176975.25	104345.64
Gross Return/day/cow (Tk.)	173.17	127.05
Gross Cost/day/cow (Tk.)	93.89	75.52
Net Return/day/cow (Tk.)	79.28	51.53
BCR	1.84	1.68

Source: Researcher's own calculation based on field data

3.3 Discussion of results from the Cobb-Douglas model

The estimated coefficients and related statistics of Cobb-Douglas production function of dairy farm in Gazipur and Dinajpur are shown in Table 4.

Straw cost (X_1)
The estimated coefficient of paddy straw cost was 1.327 for dairy farm in Gazipur and statistically significant at 1 percent level which implies that one percent increase in paddy straw cost would significantly increase milk yield by 1.327 percent keeping other factors constant. The value of coefficient of paddy straw cost was 1.576 for dairy farm at Dinajpur and statistically significant at 1 percent level implies that one percent increase in paddy straw cost would significantly increase milk yield by 1.576 percent keeping other factors constant.

Green grass cost(X_2)
The estimated coefficient of green grass cost was 1.625 for dairy farm in Gazipur and statistically significant at 5 percent level which implies that one percent increase in paddy straw cost would significantly increase milk yield by 1.625 percent keeping other factors constant. The estimated coefficient of green grass cost was 1.514 for dairy farm at Gazipur and statistically significant at 5 percent level which implies that one percent increase in green grass cost would significantly increase milk yield by 1.514 percent keeping other factors constant.

Concentrate feed cost (X_3)
The estimated coefficients of concentrate feed cost were statistically significant at 1 percent level for both the dairy farms in Gazipur and Dinajpur. This implies that one percent increase in concentrate feed cost would significantly increase milk yield of dairy farm in Gazipur and Dinajpur by 0.847 percent and 1.024 percent respectively keeping other factors constant.

Labour cost (X_4)
The estimated coefficient of labour input cost was positive and significant at 5 percent level for dairy farm in Gazipur and significant at 1 percent level for dairy farm in Dinajpur which implies that one percent increase in labour input cost would significantly increase milk yield by 1.436 percent and 1.621 percent for dairy farm in Gazipur and Dinajpur respectively keeping other factors constant.

Veterinary cost (X_5)
The estimated coefficient of veterinary cost was 0.813 for dairy farm in Gazipur and 0.172 for dairy farm in Dinajpur and was statistically significant at 1 percent level in the former case implying that one percent increase in veterinary cost would significantly increase milk yield by 0.813 percent and 0.172 percent for the dairy farm in Gazipur and Dinajpur respectively keeping other factors constant.

Housing cost (X_6)
The estimated coefficients of housing cost were 0.321 and 0.201 for the dairy farm in Gazipur and Dinajpur respectively and were insignificant for both the areas. It is revealed that one percent increase in housing cost would increase milk yield by 0.321 and 0.201 percent for the dairy farm in Gazipur and Dinajpur, respectively, keeping other factors constant.

Value of R^2
The coefficient of multiple determinations R^2 (adjusted) was 0.765 and 0.893 for dairy farm in Gazipur and Dinajpur respectively. The value of R^2 of 0.765 for dairy farm in Gazipur implies that about 76.5 percent of the variations in value of milk yield of dairy farm were explained by the explanatory variables included in the model. On the other hand, value of R^2 of 0.893 indicates that about 90 percent of the total variations of value of milk yield of dairy farm in Dinajpur were explained by the explanatory variables included in the model and other 10 percent was the effect of other variables which are not included in the model.

Table 4: Estimated coefficients and related statistics of Cobb-douglas model

Explanatory Variables	*Dairy farm in Gazipur*	*Dairy farm in Dinajpur*
Intercept	1.520	2.413
Straw cost (X_1)	1.327** (0.568)	1.576** (0.635)
Green grass (X_2)	1.625* (0.402)	1.514* (0.457)
Concentrate Feed (X_3)	0.847** (0.382)	1.024** (0.462)
Labor cost (X_4)	1.436* (0.523)	1.621** (0.720)
Veterinary cost(X_5)	0.813** (0.269)	0.172 (0.086)
Housing cost	0.321 (0.239)	0.201 (0.074)
R^2	.765	0.893
R^2 Adjusted	.742	.869
F- Value	20.192	69.913

Figures in the parenthesis indicate SE (Standard Error); **= Significant at 1 percent level; * = Significant at 5 percent level

3.4 Marketing of milk

Gazipur urban areas Dairy farm holders in urban areas produce milk to sell for an additional income to supplement their family in most of the cases. In the study areas of Dinajpur, the quantity of milk sold by the dairy farm owners accounts for about 96.8% of their total milk production. It reveals (from the figure-2) that 3.2% of the total milk production was consumed by the family members of the dairy farm owners. Of the total sold milk, 22% was sold to the milk traders (goala) at the farm gate, 72 % was sold to the consumers directly and only 6% was sold to the sweat meat shop directly.

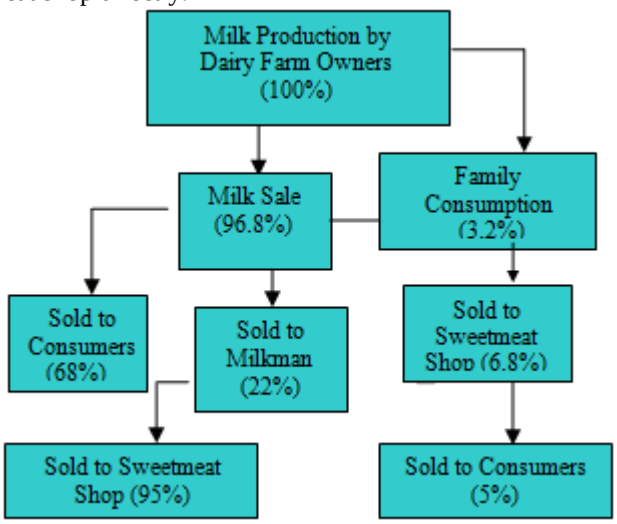

Figure 2: Disposal pattern of milk in Dinajpur urban area

Dinajpur urban areas

It is evident (from the Figure-3) that in the urban areas of Gazipur, small dairy holders sold their milk to the consumer directly ((94%) and kept about 6% for their home consumption. In Gazipur area small dairy farm holder did not sell milk to the sweetmeat shop or to the milk man.

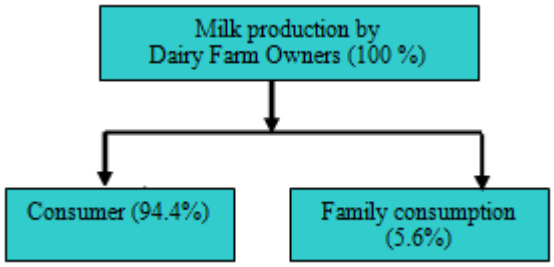

Figure 3: Disposal pattern of milk in Gazipur urban area

4. Constraints Faced By The Small Dairy Farm Holders

The major constraints identified in relation to dairy farming in the urban areas include paucity of green grass and fodder, lack of grazing land, high price of concentrate feed and fodder, inadequacy of veterinary services, high price of veterinary medicine, lack of training and technical know how, lack of institutional credit facilities. Respondents were asked about the problem that they faced in operating dairy farm. The answers of the respondents in the two districts were analyzed here taking all the samples. The multiple answer given by the small dairy respondents are presented in the Table 4.

Lack of grazing land

Lack of grazing land was one of the main constraints faced by the dairy farm holder. Due to the urbanization, infrastructural changes, needs for housing for rapid growing population in urban areas, grazing land has been occupied and no land was left for grazing at both the urban areas. So it is very difficult to manage green grass that is essential for dairy cow and for this reason dairy holders had to depend on concentrate feed. All the respondents (100%) reported this as a major problem.

Paucity of green grass

Green grass is one of the principal feed items contributing to the milk production. As it was stated earlier that the grazing land is not available in the urban areas and due to the population increase, there exists a competition of allocating land for food production for human being and feed for animal. The dairy farm holders always lack with the adequate supply of this important roughage. About 91% of the farm holder reported this as a major constraint (Table 4).

High price of feed and its scarcity

Unavailability of feed especially concentrate was identified as one of the severe constraints for the development of dairy industry. This unavailability makes a high demand for the feed caused to the high price of feed. About 98 % of the dairy owners reported this problem as a major one. High price of concentrate feed was the major cause for higher cost of milk production which leads to the price hike of milk.

Inadequate veterinary services

The dairy farm owners claimed that when they felt the services of veterinary doctors was very much urgent they did not get their care and services from the local veterinary offices. In the case of emergency the farm owners failed to bring them at their houses. The farmers had to pay high charges to the veterinary doctors for every calling. About 76 % of the dairy owners reported this problem as an important one.

High price of veterinary medicine

In the study areas, local livestock office supplies vaccine, tablet etc. which are not sufficient to meet the demand for the animals for controlling diseases. The farm owners had to purchase the essential drugs from the market at a higher price that was quite unaffordable. About 89% of the dairy farm owners claimed this as a major constraint.

Lack of training and technical know how

The farm owners felt that dairy farming is a scientific and technical activity that needs training on this technical aspect. No one dairy farm holders were observed to have training on dairy animal rearing and technical know how. About 87% of the dairy farm owners reported this as one of the major

constrains for the development of dairy industry in the small scale.

Lack of institutional credit

Most of the small-scale dairy farm holders (87%) reported that they needed credit or capital to run the farming activities smoothly. In the study areas no dairy owners had the access to the formal credit institution for loan. They did not get any loan from any commercial bank or financial institutions. Due to lack of adequate capital, the respondents could not be able to give adequate feed, necessary veterinary services and especial care to the animals which leading to lower milk production resulting lower return from this industry.

Table 5: Constraints faced by the diary owners

Nature of constraints	*% of respondents faced constraints*
Lack of grazing land	100
Paucity of green grass	91
High price and unavailability of feed	98
Inadequate veterinary services	76
High price of veterinary medicine	89
Lack of training and technical knowledge	87
Lack of institutional credit	97

Source: Field survey, 2012

5. Conclusion

Based on the results of the study it may be concluded that small scale dairy industry is profitable enterprise, though this enterprise faces many constraints for its rapid development and growth. The demand for milk in the urban areas is very high and dairy owners can not fulfill the demand for milk with their limited milk production. Paucity of green grass, high price and unavailability of feed and medicine, lack of grazing land, inadequate veterinary services, lack of training and technical know how and lack of institutional credit facilities were identified as the major constraints faced by the small scale dairy holders in the study areas. There is an ample scope to increase the production of milk from the existing level if the dairy farm owners are provided necessary facilities like adequate feed supply at reasonable prices, necessary drugs, adequate veterinary services, technical training, and access to credit at an easy terms and conditions. Government should provide free medicine and veterinary services to the small scale dairy holders that would minimize their cost of production. Government should arrange especial credit program for the small-scale dairy holders at an easy term to encourage the dairy industry. This industry could be flourished if the government could formulate appropriate policy to support the small scale dairy holders.

6. Acknowledgement

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