

Profitability and Factors Affecting Milk Supply: An Empirical Study on Dairy Farms in Chittagong District of Bangladesh

ABSTRACT

It was an attempt to examine the profitability and factors affecting milk supply of dairy farms in selected areas in Chittagong District. Primary data were collected from both milk producers and traders during the months of August to September 2015. Simple descriptive method and stepwise multiple regression models were used to analyze the data. The return over investment indicates that dairy farming is a profitable business in Chittagong District. Stepwise multiple regression models were specified and estimated to identify the factors affecting of milk supply of dairy farmers. Regression analysis revealed that three variables i.e., number of milking cows, theage of household head and experience of dairy farming, as important factors affecting sale volume of milk. The survey result identified that the supply of milk trading was predominantly traditional, fragmented and only one cooling plant which has limited capacity but no other formal agreement either collectors or farmers. As a result, most of the surplus milk absorbed by the sweetmeat shops.

Keywords: Profitability, Marketing costs, and margin, Milk Supply

1. INTRODUCTION

Dairy farming is an integral farming system in Bangladesh. It is an activity involving investment for milk production and marketing. Dairying plays a vital role in respect to nutrient, generation of income and employment. It is more efficient and intensive system in terms of nutrient and protein production for human consumption from a given quantity of resources than beef or sheep farming. Dairy farming also supports substantial employment in production, processing, and marketing [1]. Bangladesh is a country of rural based subsistence agriculture. About 47.6% of total labour force is engaged in this sector [2]. Livestock sector contributes 1.78% of GDP out of the 16.33% contribution of the agriculture sector in the economy [3]. The total production of milk in Bangladesh in 2006-07 was 2.28 million tons

28 which were increased to 6.09 million tons in 2013-14 [2]. In this context as dairy farming stands a
29 profitable business everywhere in the world, so dairying in the recent decades has been considered a
30 vital component in the diversification in Bangladesh.

31 Dairying in Bangladesh has been practiced for a long time at a small scale. Some
32 noticeable developments has also taken place in breed improvement. In Bangladesh cross-breeding of
33 local cows with Australian, Sahiwal, Holstein-Friesian, Jersey, etc. are often seen in the rural areas.
34 These cross breeds are found as higher in terms of milk and meat. Milk is also considered as an ideal
35 and a completed food for the people of the whole world. There is no more complete food than milk yet
36 known to mankind. Moreover, milk today is a rare commodity for many children. Both population
37 growth and rising income are contributing to rapid expansion in the demand for milk and its products
38 as it has the high-income elasticity of demand [4]. As a result of the development of modern civilization
39 and culture, particularly the emergence of high-income urban population group has changed the
40 pattern of milk consumption. They prefer packaged milk over ordinary raw milk. With the alarming
41 growth of population, the demand for milk and dairy products rises faster than the demand for crops
42 both in developing and developed countries. There are some milk pocket areas in the country where
43 dairy farming has been traditionally an important and major component as mixed farming system.
44 These areas are particularly located in Pabna, Sirajgonj, Manikganj, Faridpur, Kishoreganj, Rangpur,
45 Tangail districts and now it is extended to Chittagong districts, as one of the dairies producing
46 emerged areas. The numbers of cross breed private dairy farms have been increasing in the study
47 area over the last few years. As it is labour intensive farming and support employment in production,
48 processing, and marketing, so, development of a dairy enterprise is essential to create the employment
49 opportunity of the people in the country in general and Chittagong region in particular. Development of
50 this sub-sector may be considered as an important strategy for poverty alleviation which is an
51 objective of the government of Bangladesh. Several studies conducted by different researchers [5, 6,
52 7, 8, 9, 10, 11] influenced to analyze the profitability and factors affecting of milk supply on dairy farms
53 in Chittagong District. The present study was undertaken with the specific objectives of examining the
54 profitability of dairy farms, estimating the marketing cost and margin of milk traders and analyzing the
55 factors affecting of milk supply to the market.

56

57 2. METHODOLOGY

58 On the basis of specific objectives of the study and taking into consideration with associated
 59 limitations, two Upazila (Patiya and Banshkhali) and Chittagong metropolitan city in Chittagong District
 60 were purposively selected as the study area because of that comparatively higher concentration of
 61 high yielding cross breed dairy cow. A sample of 55 milk producers and 35 milk traders were selected
 62 by using simple random and convenience sampling technique respectively. Required data were
 63 collected through the direct personal interview during the month of August to September 2015. The
 64 collected raw data was carefully checked to detect errors and omissions and to avoid irrelevant
 65 information. In order to achieve the objectives, descriptive statistics and the following analytical
 66 techniques were used.

67 **Net Profit of Milk Producer:** To analyze the costs and revenue of the milk producers or dairy farms
 68 by tabular analysis following profit equation were used.

$$\pi = (P_m \times Q_m) + P_c + V_{bp} - \sum (P_{xi} \times X_i) - TFC$$

69 Where,

70 Π = Profit of milk producer per cow per year

71 P_m = per unit price of milk (Tk. /litre)

72 Q_m = Quantity of milk (Litre/year)

73 P_c = Price of the calf (Tk. /year)

74 V_{bp} = Value of by-product (cow-dung) (Tk. /year)

75 TFC = Total fixed cost of milk producer per cow per year

76 P_{xi} = per unit price of i-th inputs (Tk. /kg)

77 X_i = quantity of the i-th inputs per cow per year (kg)

78 $i = 1, 2, 3, \dots, n$ (number of input)

79 The BCR (undiscounted measure) was calculated by using the following formula:

80 Benefit cost ratio (BCR) = $\frac{\text{Gross revenue}}{\text{Gross cost}}$

81

82 The marketing margin and net margins of milk traders were estimated by using following
83 formula:

84 i) Gross marketing margin (Tk. /litre) = Sale price (Tk. /litre) – purchase price (Tk. /litre).

85 ii) Net margin (Tk. /litre) = Gross marketing margin (Tk. /litre) - marketing cost (Tk. /litre)

86 **Market Supply Model:** Following multiple regression models were used to analyze the factors affecting
87 farm level milk supply [12].

$$Y = X'\beta + U$$

88 Where,

89 Y = quantity of milk supplied/marketed volume to market

90 X' = a vector of explanatory variables (number of milking cows, the age of household head, the gender
91 of household head, education of household head, family size, experience, distance to market, market
92 information, the price of milk, veterinary training and off-farm income.)

93 β = a vector of parameters to be estimated, U = disturbance term.

94 **Hypothesis, Variable Selection, and Definition:**

95 The marketable surplus may differ from region to region, within the same region, and even from
96 commodity to commodity. In order to identify determinants or factors influencing milk marketable
97 supply both continuous and discrete variables were hypothesized based on economic theories and
98 the findings of different empirical studies. Accordingly, in order to investigate the determinants of milk
99 supply, the following variables were constructed.

100 **Dependent variable**

101 **Total volume of Milk sale (litres)**

102 It is a continuous variable that represents the marketable supply of milk by individual farm-
103 households, which is measured in litres per day per farm.

104 **Independent/explanatory variable**

105 The explanatory variables expected to influence the dependent variable are the following:

106

107

108 **Age of Household Head (Age of HHH)**

109 It is a continuous variable and measured in years. Age of household head is believed to be wise in
110 resource use, on the other hand, young household heads have long investment horizon and it is
111 expected to have either positive or negative effect on the volume of milk sales.

112 **Sex of the Household Head (SEX of HHH)**

113 A dummy variable taking value zero if female and one if male is considered. It is expected to have
114 either positive or negative effect on the volume of milk sales.

115 **Education of the Household Head (EDU of HHH)**

116 It is a dummy variable measured in terms of whether the household has a formal education (literate) or
117 not (illiterate) which takes a value one if a household has formal education and zero otherwise.
118 Education broadens farmers' intelligence and enables them to perform the farming activities
119 intelligently, accurately and efficiently. Moreover, better-educated farmers tend to be more innovative
120 and therefore more likely to adopt the marketing systems. Formal education enhances the information
121 acquisition and adjustment abilities of the farmer, thereby improving the quality of decision making
122 [13]. Therefore, this variable is hypothesized to influence the volume of milk sales positively.

123 **Total Milk Production (TMP)**

124 It is a continuous variable that represents the production of milk by individual farm-households, which
125 is measured in litres per day.

126 **Family Size**

127 Family size is a continuous variable measured in terms of a number of family members in the
128 household. As dairying is labour intensive activities, dairy production in general and marketable
129 surplus of dairy products, in particular, is a function of labour. It is expected to have either positive or
130 negative effect on the volume of milk sales.

131 **Dairy Farming Experience (DFEXP)**

132 It is the total number of years a farmer stays in the production of milk. A household with a better
133 experience in dairy farming is expected to produce more amounts of milk and, as a result, he is

134 expected to supply more amounts of milk to market. Farmers with longer farming experience are
135 expected to be more knowledgeable and skillful [14]. Therefore, this variable is hypothesized to
136 positively influence milk marketable surplus.

137 **Number of milking cows/herd size (NMC)**

138 This variable is continuous and is measured in a number of milking cows owned. The marketable milk
139 volume of dairy farming is assumed to be positively influenced by the number of milking cows owned.

140 **Access to Extension Training (ACEXT)**

141 This variable is measured as a dummy variable taking a value of one if the dairy household has
142 access to dairy production extension service and zero otherwise. It is expected that extension service
143 widens the household's knowledge with regard to the use of improved dairy production technologies
144 and has positive impact on milk market participation decision and sale volume of milk. A number of
145 extension visits improve the household's intellectual capitals, which improves milk production and
146 divert dairy production resources. Therefore, a number of extension visits are hypothesized to impact
147 dairy household milk market entry decision and marketed volume of milk positively.

148 **Distance to Market (DMKT)**

149 This is the location of the dairy household from the nearest milk market and is measured in kilometer.
150 The closer the dairy market to the dairy household, the lesser would be the transportation charges,
151 loss due to spoilage and better access to market information and facilities. This improves return to
152 labour and capital; increases farm gate price and the incentives to participate in the economic
153 transaction. In that case, distance from nearest milk market is hypothesized to be negatively related to
154 market participation decision and marketable milk surplus. On the other hand, distance from the dairy
155 household to market might be positive that indicates a direct relation of distance with a marketed
156 surplus. In a sense that, when lucrative prices are offered by some of the agencies than farmers are
157 ready to travel longer distances in order to sell their surplus amount. So, it is expected to have either
158 positive or negative effect on the volume of milk sales.

159

160

161

162 Market Information (MIF)

163 Farmers marketing decisions are based on market information, and poorly integrated markets may
 164 convey inaccurate information, leading to inefficient product movement. Therefore, it is hypothesized
 165 that market information is positively related to the marketable surplus.

166 Off-farm income (OFFI)

167 It is a continuous variable and measured in taka. This variable hypothesized a positively related to
 168 sale volume of milk.

169 Table 1: Descriptions of the dependent and independent variable

Variables	Types	Values
Total Milk Marketed /Sales Volume(TMMV)	Continuous	liters
Age of Household Head(AHH)	Continuous	Number of years
Sex/Gender of Household Head(SHH)	Dummy	Male=1, Female=0
Education of Household Head(EHH)	Dummy	Literate=1, illiterate=0
Total Milk Production(TMP)	Continuous	liters
Family Size(FS)	Continuous	Number of Family Member
Experience(EXP)	Continuous	Number of years
Number of Milking Cows(NMC)	Continuous	Number of Cows
Veterinary Training(VT)	Dummy	Yes=1, No= 0
Price of Milk(PM)	Continuous	Taka per liter
Distance to Market(DMT)	Continuous	Kilometer
Market information(MIF)	Dummy	Yes=1, No=0
Off-farm income(OFFI)	Continuous	Taka

170

171 3. RESULT AND DISCUSSION

172 3. 1 Costs and Revenue of Rearing Cross-breed Dairy Farm

173 The gross annual costs and revenue per farm per cow of rearing cross-breed milching cows are
 174 presented in Table 2. The gross cost per year per cow was estimated at Tk.74, 209. The feed was
 175 one of the major cost items (60percent) of rearing cross-breed milching cows. The cost of feed

176 included expenses on paddy straw, green grass, rice bran, salt, vitamin, maize bran, pulse bran,
 177 molasses, oil cake, and wheat bran and others. The total feed cost per year per farm was estimated at
 178 Tk. 44,658. The gross revenue of dairy farm consisted of revenue from milk production, cow dung,
 179 and calf. The total gross revenue was Tk. 1, 04,471 and the net margins per cow per year were Tk.
 180 30,262. The BCR (undiscounted) is a relative measure is used to compare benefits per unit of cost.
 181 The table shows that benefit-cost ratio of the dairy farm was 1.41 (this result conformity with the
 182 references number 8), which indicates that investment in dairy farming was profitable for individual
 183 producers' point of view (Table 2).

184 Table 2: Profitability analysis of raising Cross-breed dairy farms (per cow per year)

Items	Tk./year
Variable Costs:	
Feed cost	44,658 (60)
Labour cost	14,180 (19)
Electricity charge	796 (1)
Veterinary Cost	1,553 (2)
Miscellaneous cost	269
Fixed Costs:	
Housing Cost	5,258 (7)
Costs of capital	4,462 (6)
Interest on operating capital	3,033 (4)
Gross cost	74,209 (100)
Gross Revenue:	
Milk	91,531
Cow dung	1,409
Calf	11,536
Gross Revenue	1,04,471
Net Profit	30,262
BCR	1.41

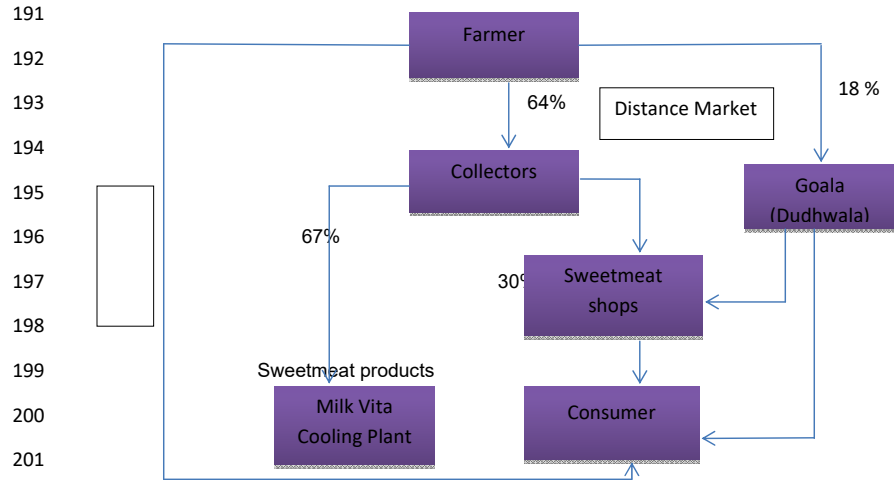
185 Source: Field survey (2015)

186 Note: Figures within parenthesis indicate percentage of total costs

187 1 USD = BDT 81 (Bangladesh Bank, July 15, 2017)

188 3.2 Milk Marketing Channels

189 In the study areas, a number of marketing channels were observed. A sketch of overall milk marketing
190 channels for the study area is shown in the following figure;



202 Figure 1: Marketing channels of raw milk in the study area

203 Marketing channels of raw milk in the study area moves from the producer to the ultimate consumer
204 through direct and indirect marketing channel. The main and most important twomarketing channel,
205 which accounts for 64% of total milk marketed. This was the case reason this two channel can absorb
206 a large amount of surplus milk in the region while the local demand for milk is much less than supply
207 in the study area. The study found thatmost of the surplus milk absorbed by the sweetmeat shops
208 because Milk Vita has only one cooling plant which has limited capacity (5,000 litres).The percentage
209 of total supplied milk to the sweetmeat shops was variedduring the month of May to August because
210 of summer or fruits season. So, the main and most important two marketing channel are shown in
211 below;

212 Farmer Collectors Sweetmeat shops Consumer →

213 Farmer Collectors Milk Vita-cooling plant

214

215

216 3.3 Marketing Cost and Margin of Milk traders (Collectors)

217 Marketing cost of milk collectors (i.e., that middleman who purchase the large quantities of milk from the
218 producers and also they maintain their good relationship with the dairy plant and sweetmeat
219 shops.) includes labour, transportation, milk container, spoilage, rent, electricity and personal
220 expenses etc. The average estimated marketing cost per litre of milk incurred by the milk collector
221 was Tk. 3.39. The gross margin was Tk. 6. So the net margin by milk collector was Tk. 3 per litre
222 (Table 3). The total marketing costs of milk collectors were low because of that, per day raw milk
223 transaction of collectors was 1371 litres (on average) and market concentration ratio of milk collector
224 was highest in sampled area.

225 **Table 3: Marketing costs and margin of milk traders (collectors)**

Particulars	Tk./litre
Labour	2.28
Transportation	0.56
Milk container	0.02
Spoilage	0.01
Rent	0.12
Electricity	0.17
Mobile costs	0.09
Personal Expenses	0.14
Total Marketing Cost	3.39
Average purchase price	45
Average sales price	51
Gross margin	6
Net margin	3.00
Volume of milk trading per day (liters on an average)	1371

226 *Source: Field survey (2015)*

227

228

229 3.4 Marketing Cost and Margin of Goala(Dudhwalla)

230 Marketing cost of Goala (farmer called dudhwalla i.e,that middlemanwho purchase the small
231 quantities of milk from the producers and sells their commodity to consumer and sweetmeat shop.)
232 includes labour, transportation, milk container and personal expenses etc. the average estimated
233 marketing cost per litre of milk incurred by the milk traders was Tk. 12.39. The gross margin was Tk.
234 18. So the net margin by milk traders was Tk. 6 perlitre (Table 4).

235 Table 4: Marketing costs and margin of milk traders(Goala)

Particulars	Tk./litre
Labour	6.52
Transportation	3.64
Milk container	0.13
Spoilage	0.59
Personal expenses	1.51
Total marketing cost	12.39
Average purchase price	46
Average sales price	64
Gross margin	18
Net margin	6.00

236 Source: Field survey (2015)

237 3.5. Econometric Analysis

238 Before running the regression of the study,the correlation was tried to find out the relationship between
239 total production of milk and number of milking cows for thebest-fitted model. Correlation coefficient
240 showsthatthesetwo variable arestrongly positively correlated with statistically significant ($r = 0.94$,
241 $P=0.00$) and reject the null hypothesis. According to the result and review the several studies [15, 16,
242 17, 18] the study used the number of milking cows for avoiding the multicollinearity problem and
243 autocorrelation.

244

245 3.5.1Regression Results of Factors Affecting Milk Supply

246 The results of the econometric analysis (stepwise multiple regression models) examine the
 247 characteristics of milk producers and its impact on marketed supply of milk to the market. Different
 248 variables were expected to influence the volume of marketed surplus of milk like age of household
 249 head, sex of household head, education level of household head, family size, experience of dairy
 250 farming, number of milking cows, access to extension services (veterinary training), market
 251 information, price of milk, off-farm income and distance from the market. Stepwisemultiple regression
 252 models were employed to analyze the factors that affect the supply of milk. A VIF for continuous
 253 variables and contingency coefficient values for discrete variables were computed to check the
 254 existence of multicollinearity problem. The results revealed that no significant problems of
 255 multicollinearity and the high degree of association among continuous and discrete variables were
 256 detected. Durbin-Watson (2.17) test used to detect the autocorrelation. The result reveals there is no
 257 autocorrelation among the variables. Among the eleven hypothesized factors affecting marketed
 258 surplus of milk, three variables (number of milking cows, Age of household head and experience of
 259 dairy farming) were found significant. The coefficient of multiple determinations (R^2) was estimated
 260 0.91 and adjusted R^2 was 0.90. This means that 91% of the variation in the dependent variable is
 261 explained by the explanatory variables included in the model. Furthermore, the adjusted R^2 of 90%
 262 which is significant has further consolidated the goodness of the model, hence, its econometrics
 263 significance and reliability (Table5).

264 Table 5: Stepwise Regression Results of Factors Affecting of Marketed Surplus of Milk

Independent variable	Coefficients	t	Sig	VIF
Constant	-6.67	-3.42	0.001	
Number of milking cows	6.24***	15.29	0.000	1.88
Age of house hold head	0.08**	2.34	0.024	1.02
Experience of dairy farming	0.21**	2.14	0.037	1.90
F-statistics	180.33***			
R Square	0.91			
Adjusted R Square	0.90			
Durbin-Watson	2.17			

265 *Dependent Variable: Total Volume of milk supplied per day per dairy farms (litres)*

266 *** , *** indicates significant at the level of 5% and 1% respectively.*

267 As hypothesized number of milking cows (MCO) has a positive effect on marketed milk volume and is
268 significant at 1% probability level. The model output predicts that the addition of one dairy milk cow
269 causes the marketable cow milk surplus of the dairy household to rise by 6.24 liters per day per dairy
270 household. This result is plausible and suggests that marketable milk surplus of the household in the
271 study areas are more responsive to a number of milking cows. Furthermore, this result illustrates that
272 marketable milk surplus per day increases in responses to the increase in a number of milking cow.
273 In addition to that, the age of household head had a positive and significant impact on milk marketed
274 volume of sampled dairy farms. The positive and statistically significant relationship between two
275 variables indicates that older dairy household head could have more milking cows increasing the
276 possibility of household milk marketed volume. The result also elaborates that when the household
277 age increases by one year, the probability of milk marketable volume increases by 0.08 litres per day
278 per dairy household.

279 The experience of dairy farming has a positive effect on milk sales volume per household and is
280 statistically significant at 5% probability level. The result suggests that as farmers have high dairy
281 farming experience the amount of milk supplied to the market increased through its effect on milk
282 production. The model also confirms that every one year of experience in dairy production leads to a
283 rise in daily milk sales volume by 0.21 litres per day per dairy household.

284 **4. CONCLUSION**

285 Dairy farming is an economic activity involving investment for milk production and marketing. The
286 study aimed to determine the profitability and factors affecting milk supply of dairy farmers. The
287 calculated net profit and the benefit-cost ratio (BCR) indicate that dairy farming is a profitable business in
288 Chittagong district. Econometric results also indicate that number of milking cows, the age of
289 household head and experience of dairy farming, significantly associated with marketed supply of
290 milk. Dairy farming is a profitable business although it has been facing problems in relation to the
291 production and supply of milk. Though the study areas only one cooling plant which has limited
292 capacity but has no formal contract with either collectors or dairy farmers. As a result, most of the
293 surplus milk absorbed by the sweetmeat shops.

294 If proper remedial measures could be taken and formal institutional arrangements could be
 295 established, then milk production and supply could be a viable and more extensively in a commercial
 296 enterprise which in turn would play a vital role to overcome the problems of low income,
 297 unemployment, undernutrition and unfavorable balance of payment situation of the country.
 298 Therefore, the government should provide necessary assistance for the establishment of feed mills in
 299 the private sector for making the quality feed available. The DLS (Department of Livestock Services)
 300 and NGOs (Non-Government Organizations) should strengthen their programs to train the dairy
 301 farmers on dairy management, animal health care, sanitation, and marketing techniques of milk
 302 on a priority basis. In order to improve preservation facilities provision should be made for the supply of
 303 isolated containers to the farm owners at an affordable price.

304

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