CHAPTER VI

FACTORS AFFECTING MILK OUTPUT

6.1 The model

In this section, the Cobb-Douglas production function was estimated by using SPSS software. The co-efficient of each individual variable obtained from regression analysis was then used to interpret the relative contribution of each variable in the aggregate output of households. While designing the model in Chapter II, variables were defined with their expected results. The model was specified as follows:

$$Y = a\, Co^{b1}\, Fo^{b2}\, La^{b3}\, Ed^{b4}\, Ex^{b5}\, Fs^{b6}\, Br^{b7}\, e^{b8D} e^{u}$$

or

$$LnY = Lna + b_1 LnCo + b_2 LnFo + b_3 LnLa + b_4 LnEd + b_5 LnEx + b_6 LnFs + b_7 LnBr + b_8 D + u$$

Where:

Y = Total raw milk output of household per year (kg/household/year)

Co = Total expenditure on concentrates for milk cow(s) (thousand VND/household/year)

Fo = Total cost of fodder feed for milk cow(s) (thousand VND/household/year)

La = Total labours taking care of milk cow(s) (man-day/household/year)

Ed = Education level of household head (number of year attending school)

Ex = Experience in dairy farm of household head (number of year raising cow)

Fs = Dairy farm size (number of milk cows/household)

Br = Breed (average percentage of Holstein Friesian blood)

D = Regional dummy variable

D = 1 for Hanoi city

D = 0 for Hatay province

u = error term, e = exponential indicator

a, b_i = co-efficient

The way to interpret b_i in a double-log equation is that if an independent variable changes by one percent while the other variables are held constant, then change on dependent variable takes place by b_i percent (Studentmund.1991)

6.2 Descriptive statistics of the variables

The descriptive statistics *viz.* mean, standard deviation, co-efficient of variation, minimum, and maximum of the variables included in the model are presented in Table 6.1. The data showed that there was a high variation in milk output, expenditure on feeds and herd size among households. Of which, co-efficients of variation (C.V) were about 57%-60%. The C.V for labour and experience variables were around 48%. The lowest co-efficients of variation were found for breed and education factors (24%-29%).

Table 6.1 Descriptive statistics of the variables included in the model

Variables	Unit	Mean	Std. Dev	C.V	Min.	Max.
Y	kg/year/hh	6,867.7	4,012.9	58.4	2,261.0	19,858.0
Co	'000 VND/year/hh	8,313.4	4,984.7	59.9	2,265.9	25,344.0
Fo	'000 VND/year/hh	4,748.8	2,880.6	60.6	1,981.7	13,878.9
La	man-day/year/hh	382.5	186.3	48.7	143.4	863.9
Ed	years	7.6	2.2	28.8	4.0	15.0
Ex	years	5.4	2.6	47.1	1.0	13.0
Fs	head	2.1	1.2	57.3	1.0	6.0
Br	percent	56.9	13.8	24.3	25.0	75.0

Source: Survey, 1999, calculated by SPSS software.

Dairy cow raising was a new occupation for farmers in the study area. On average, a household head had 5.4 years of experience in raising cows. There was not much difference in educational level of household heads. Over half of them had education of secondary school level. Number of years that they attended school ranged from a minimum of 4 years to a maximum of 15 years.

6.3 Test for multicollinearity

Multicollinearity occurs when any single predictor variable is highly correlated with a set of other predictors. As multicollinearity arises, the ability to define any variable's effect is diminished. Thus, it is necessary to detect multicollinearity. The simplest and most obvious means of identifying multicollinearity is an examination of the correlation matrix for the independence variables (Hair *et al.*, 1995, Sriboonchitta, 1983). The presence of high correlation (generally those of 0.90 and above) is first indication of substantial collinearity (Hair *et al.*, 1995). However, they also suggest that each analyst should determine the degree of collinearity that she/he can accept, as most default or recommended thresholds still allow for substantial collinearity. According to Studenmund (1992), correlation co-efficient greater than 0.80 among the explanatory variables was used as a thumb rule to indicate existence of severe multicollinearity.

Multicollinearity was tested in the model. The results indicated that none of the correlation co-efficients were more than 0.80 (Table 6.2). Nonetheless, correlation of herd size to concentrates and fodder was rather high as expected. Other explanatory variables in the model were considered to be free from severe multicollinearity.

Table 6.2: Correlation co-efficients of the explanatory variables

	LnCo	LnFo	LnLa	LnEd	LnEx	LnFs	LnBr	D
LnCo	1.00							
LnFo	0.66	1.00						
LnLa	0.57	0.53	1.00					
LnEd	0.16	0.10	0.17	1.00				
LnEx	0.30	0.21	0.25	0.15	1.00			
LnFs	0.75	0.73	0.61	0.11	0.24	1.00		
LnBr	0.13	0.09	0.23	0.13	0.06	0.05	1.00	
D	0.10	0.07	0.40	0.10	0.11	0.03	0.28	1.00

Source: Survey, 1999, calculated by SPSS software.

6.4 Test for heteroscedasticity

Heteroscedasticity is the violation of classical assumption, which states that the observations of the error term are drawn from a distribution having a constant variation. Heteroscedasticity often occurs in data - sets in which there is a wide disparity between the largest and smallest observed values. The larger the disparity between the size of observations in a sample, the larger the likelihood that the error term observations associated with them will have different variances and therefore be heteroscedasticity (Studenmund. 1991).

The model in this study was cross-sectional, and the dependent variable changed much in size from household to household. Therefore, the problem of heteroscedasticity was likely to be encountered, which entailed the test of heteroscedasticity.

Diagnosis of heteroscedasticity was done by using the Breusch - Pagan test. The test implied the need of regressing squared residuals $(u_i)^2$ on explanatory variables which are thought to be closely associated with variance of error term (Studenmund. 1991). The explained sum of square (ESS) obtained from the regression model was then used to calculate L.

$$L = \frac{ESS}{2\,[\Sigma u_i / n]^2}$$

Where u_i is residual from i^{th} observation of the original equation and n is the sample size. If L is larger than the critical Chi–square value, we reject the null hypothesis of homoscedasticity.

In this study, after obtaining the residuals (u_i) of the estimated regression equation by OLS estimation, the squared residuals $(u_i)^2$ were regressed against two variables, namely LnFo and LnFs with the following form:

$$(u_i)^2 = \alpha_0 + \alpha_1 \text{ LnFo} + \alpha_2 \text{ LnFs} + v_i, \text{ where } v_i \text{ is the error term.}$$

The above regression model was run in the SPSS software package. The results showed that the explained sum of squares equals 0.00127, and then value of L was calculated to be 4.88 which was higher than the tabulated critical Chi-square $\{\chi_{(df=2)} = 4.61\}$ at significant level of 10%. Therefore, the hypothesis of homoscedastic variance can be rejected, which justifies the presence of heteroscedasticity.

Further, test of heteroscedasticity was also made with residual plots as suggested by Hair at al., (1995). After OLS regression was run, residuals were plotted against the independent variables. The results from scatter plots indicated that there was an existence of a triangle-shaped pattern in the graphic of residual and LnFo variable, suggesting the presence of heteroscedastisity in the data.

6.5 Empirical results and discussion

From the test of heteroscedasticity as described above, it was understood that the assumption of homoscedastic variance in the model is no longer valid. Moreover, the violation was found to attribute to LnFo variable. Therefore, procedure of Weighted Least Square (WLS) needed to be applied to remedy heteroscedasticity. The outcomes of regression analysis by using WLS are presented in Table 6.3 (LnFo variable was used as the weighting factor).

Table 6.3: Results of WLS estimation

Variables	Unstandardized co-efficients		Standardized co-efficient (Beta)	T – ratio	Significant level
	B	Std. Error			
Constant	3.479	0.516		6.741	0.000
LnCo	0.201	0.050	0.218	4.003	0.000
LnFo	0.151	0.059	0.151	2.539	0.013
LnLa	0.191	0.067	0.165	2.827	0.006
LnEd	0.101	0.044	0.055	2.278	0.025
LnEx	0.049	0.024	0.051	2.058	0.043
LnFs	0.484	0.068	0.469	7.129	0.000
LnBr	0.130	0.049	0.064	2.654	0.010
D	-0.067	0.036	-0.062	-1.864	0.066

F-statistics (8, 81) = 33.9, significant level of F-test = 0.000

R square = 77.0, and adjusted R square = 74.7

Standardized regression co-efficients (beta) obtained by first standardizing the data so as to make all means equal to zero and all variances equal to one. In which, standardization of the data is accomplished by subtracting the mean from each observation and dividing by the standard deviation (Hair *et al.,* 1995). By the other method, beta co-efficients can be calculated through using unstandardized co-efficients. The relation between them is expressed in following formula (Yamane, 1973):

$$\beta_i = B_i \sqrt{\sum x_i^2 / \sum y^2} = B_i \sqrt{S_{ii} / S_{YY}} \qquad (i = 1, 2, \ldots, n)$$

$$\text{Where: } S_{ii} = \sum(X_i - \overline{X}_i)^2,\ S_{YY} = \sum(Y_i - \overline{Y})^2 = \sum Y_i^{\,2} - n\,(\overline{Y})^2$$

Note: X_i and Y_i denote the measurements on each of n individuals

$\overline{X}$ and $\overline{Y}$ are the means, each based on the n measurements.

Values of beta co-efficients in above table resulted from application of this formula. Standardized co-efficients eliminate the problem of dealing with different units of measurement. Therefore it can be used to determine which independent variable is the most helpful in predicting the dependent variable (Hair *et al.,* 1995).

Results from regression analysis presented in the Table 6.3 indicated that signs of the variables were consistent with underlined expectations of the model. With the exception of dummy, all co-efficients of the remainder variables were found to be positive suggesting that farmers could still increase their milk output by additional use of inputs. The co-efficient of dummy variable showed difference in milk output between households located in Hanoi and Hatay. Negative sign of the variable represented additional average output gained by Hatay households as compared to Hanoi farmers, holding the inputs constant. However, this difference was not significant at 95% of confidence (p= 0.066).

As expected, dairy farm size was the most important determinant of milk output in the study area (β = 0.469), followed by the level of investment in concentrates. Beta co-efficient (0.165) for labour variable stood third in importance order among variables included in the model showing its useful role in predicting the milk output of household. The result might be due to the fact that dairy cows are sensitive to human care and management. Increased number of labour hours contributed to better feeding, sanitation, and proper care of milk cows, etc. which would increase milk output. The outcomes of regression analysis were consistent with the research results of Poudyal (1997). He reported that among concentrates, fodder and labour variables included in his model, relative contribution to milk yield was higher from concentrate, followed by labour and lastly fodder. Beta co-efficients for education and experience variables were found to be not considerably different. This implied that they had similar roles in predicting milk output of households.

Empirically the present results indicated that keeping other variables constant, an increase in 1% of the cow population could raise the milk output within a year by 0.48%. In other words, holding other variables constant, raising one more cow could raise milk output by 1,582.8 kg (at mean level).

The empirical evidence from regression analysis showed a positive and significant effect of concentrates on the milk output of households, suggesting that with the increase in 1% of the total concentrate costs, milk output might be expected to increase by 0.2%. If evaluated at mean level, expending 1,000 VND more on concentrates could raise milk output by 0.17 kg. Similarly, the regression co-efficient of fodder variable was found to be positively significant ($p = 0.013$). The result indicated that if other things remained the same, an addition in 1% of expenditure on fodder might add 0.15% of milk output to the rest. In other words, milk output could rise by 0.22 kg if expenditure on fodder increased by 1,000 VND. Those findings were similar to the results of Poudyal (1997). He reported that both concentrates and fodder feed had positive and high contribution to the milk yield.

The time that farmers devote for raising cows is also considered an important determinant affecting milk yield. Unlike crop production, dairy-farming activities which included feeding, sanitizing, grazing and milking works must be done regularly and occur every day. All these activities influence directly on the health of cows, their reproductiveness, and thus on milk output of households. The regression results revealed significant and positive effects of labour on the dependent variable. The data implied that if the number of man-days a farmer spent raising cows increased by 1%, milk output per household could go up by 0.19%. Stated another way, spending 1 more man-day could raise milk output by 3.4 kg.

The empirical results obtained from regression analysis showed a significant ($p = 0.01$) and positive effect of breed variable on milk output of household. The outcome implied that if the average percentage of HF blood in a household's cow herd increased by 1%, then milk output of household could be expected to increase by 0.13%. In other words, an addition of 1% HF blood in household's cow herd might raise milk output by 15.7 kg.

It was also found that education and experience variables had positive effect on milk output of households. Unstandardized co-efficient for literary variable was significant at level of 0.025 indicating that an increase in 1% of the total years that a household head attended school, could increase milk output of household within a year by 0.1%. In other words, in having 1 more year of attending school, farmers could raise their milk outputs by 91.3 kg. Similarly, regression co-efficient for experience variable was also found to be significant. The data implied that if experience of farmers increased by 1% while the other variables were held constant, then a positive change in their milk output would take place by 0.05%. Stated another way, an increase in 1 year of experience could raise milk output by 62.3 kg.

6.6 Optimization of input use

As mentioned in chapter IV, the main reason for farmers' choices in milk production is to utilize their abundant resources. However, raw milk is a commercial commodity, so the evaluation of input use is necessary. To evaluate efficiency of input use, farmers were assumed to be profit maximizers.

Under profit maximizing assumptions, optimum level of input use will be at a point where marginal value of product (MVP) of an input is equal to its price. In other words, a farmer can increase his/her profit as long as the addition to his/her revenue from application of an additional unit of input exceeds the cost of that input. Marginal value of product is equivalent to the margin product (MP) times the unit output price, so we firstly calculate value of MP.

Marginal product of an input is the change in output arising from using an additional unit of input. It is derived by taking the partial derivative of the output with respect to the input (Mansfiled.1985). Based on results of the previous section, estimated function was:

$$LnY = 3.48 + 0.2\,LnCo + 0.15\,LnFo + 0.19\,LnLa + 0.1\,LnEd + 0.05\,LnEx + 0.48\,LnFs + 0.13\,LnBr - 0.07D$$

In the double-log equation, an individual regression, for example b_k, can be interpreted as an elasticity.

$$b_k = \frac{\Delta(LnY)}{\Delta(LnX_k)} \approx \frac{\Delta Y/Y}{\Delta X_k/X} \approx \eta_{Y, Xk}$$

since $\Delta Y/ \Delta X_k = MP_{Xk}$, the co-efficient can be rewritten as follows: $b_k = MP_{Xk}\ (X_k/Y)$ and then $MP_{Xk} = b_k\ (Y / X_k)$

Based on the above formula, efficiency of input use at mean level is expressed in Table 6.4

Table 6.4: Comparison of MVP to input prices in the study areas

Descriptions	Concentrate	Fodder	Labour
Marginal product (MP_{Xi})	0.17	0.22	3.42
Marginal value of product (MVP_{Xi})	0.51	0.65	10.17
Input price (P_{Xi})	1*	1*	10.0
MVP_{Xi}/ P_{Xi}	0.51	0.65	1.02
	(<1)	(<1)	(≈1)

Note: Prices of concentrate and labour were based on prices in the local market.

Price of labour was calculated from wage of hired labour.

Price of milk was average price received by the farmers in the study area.

* Because concentrates and fodder were measured in terms of value, so their input prices were considered as unit.

Comparison of the ratio between marginal value product of input (evaluated at its mean level) with respective its price showed that both concentrates and fodder were over-utilized. In other words, these inputs could not be employed more in order increase profit of household. The ratios were far from one because feed was not used solely for milk production but for the maintenance of the body, the growth and development of foetus. In the context of this study the author could not determine how much feed was needed to maintain a cow and to feed the foetus. Thus, the findings would have limitations to apply. Distributions of the ratios calculated for all observed farms are expressed in Figures 6.1 and 6.2

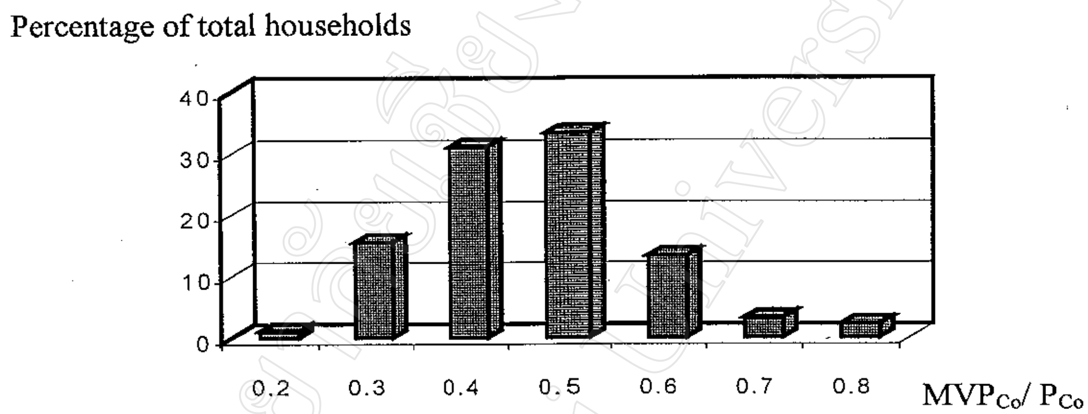

Figure 6.1: Distribution of MVP_x/ P_x ratio for concentrates variable

Note: The ratios were calculated in ranges of data, i.e. >0.2-<=0.3, >0.3- <=0.4, etc.

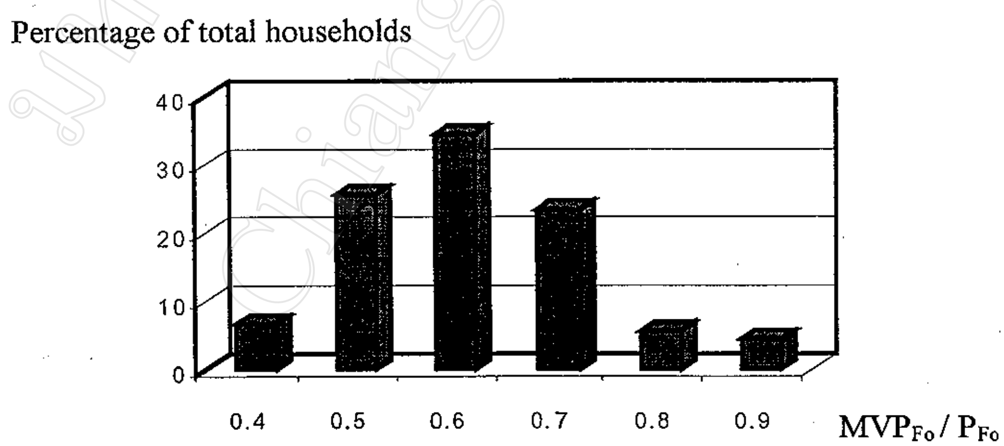

Figure 6.2: Distribution of MVP_x/ P_x ratio for fodder variable

Note: The ratios were calculated in ranges of data, i.e. >0.4 - <=0.5, >0.5 - <=0.6, etc

In case of labour the ratio between MVP of labour and its price (evaluated at mean level) was approximately equal to one, which indicated that it was possible for the farmers to increase their profit by using more labour. However, this result needs to be interpreted carefully. As mentioned in chapter IV, over 94% of the total labour used in dairy farming were family labourers. But the price of labour applied to calculate the ratio was imputed value of hired labour, which might not have truly reflected the opportunity cost of the family labour. However, it could be extrapolated that if the labour can be hired with present wages, it is worth employing more labour. Half of the survey farmers had optimized their labour usage (Figure 6.3). About 28.8% of the total households had the MVP_{La}/ P_{La} ratio being around one (0.9 to 1.1).

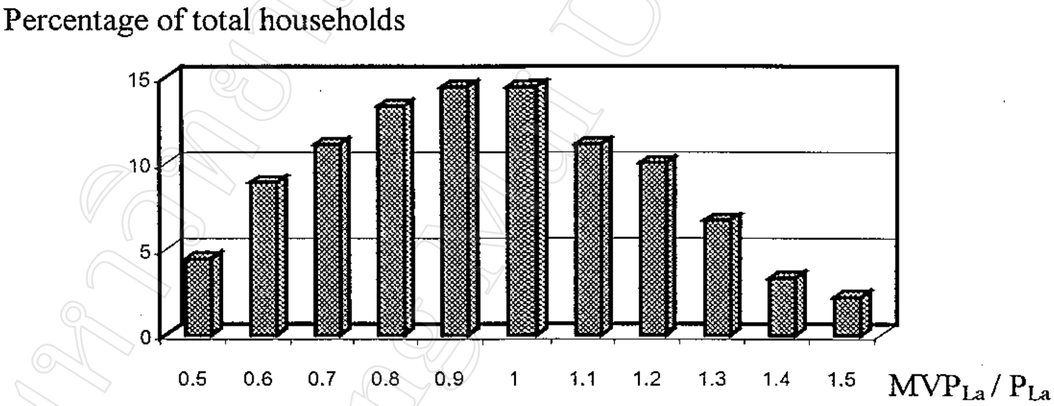

Figure 6.3: Distribution of MVP_x / P_x ratio for labour variable

Note: The ratios were calculated in ranges of data, i.e. >0.5-<=0.6, >0.6-<=0.7, etc.

6.7 Opportunities and constraints in milk production and marketing in the study area

According to Macadam *at al.* (1995), opportunities and constraints are external to the system. While opportunity provides the scope for positive action to achieve the purpose, a constraint is a limitation that has to be accommodated in taking opportunities. Based on the review of past research and on the findings of this study there are both opportunities and constraints in the dairy sector in the RRD, which need to be capitalized/tackled while shaping future dairy promotion activities.

6.7.1 Opportunities for promotion of the dairy sector in the study area

Demand for milk and milk products is forecasted to have an annual growth rate of 10%-15% next decade due to urbanization and increases in the level of a household's income (Center of Vietnamese Extension. 1998). Moreover, the amount of milk produced by the nation at present meets only 8.6% of total milk consumption. Therefore, the potential for the milk market is very large. The RRD is a cultural, economic and political center of Vietnam possessing second position in terms of population. Currently, more than 95% of milk quantity consumed locally are processed in the South of Vietnam or imported. Consequently, there are large opportunities for milk producers in the region to reap benefit from the available potential of the market.

The Vietnamese economy has changed to a market-oriented one. Farmers are now free to decide what to do, how to produce, and how to market their products. Private traders have equal rights to the state-owned enterprises in doing business. The law system has been improved in order to give advantage to business units to operate efficiently (Center of Vietnamese Extension, 1998). Therefore, private sector involving to milk marketing (collectors, owners of fresh milk shops) has more chance to develop. This helps to provide alternative markets for raw milk producers.

Recently, the government has given high priority to the development of dairy cow raising. The policy provides dairy farmers not only with low interest loans and production technology but also access to stable markets. In 1998 there were 29% of the total households in the study area borrowing money from agricultural banks at interest rate of 1.2% per month, and 12% of the total samples borrowing money at interest rate of 0.6% - 0.8% per month from other state financial organizations. The direction of the government is to increase the amount of loans at low interest rates of 0.6%- 0.8% per month to dairy farms next year (Hanoi Agricultural Department. 1998). Moreover, the milk collection network is being improved and set up in the region, which helps dairy farmers to sell raw milk easier.

Farmers living in the RRD are assessed to be better off than those of the other rural regions in Northern Vietnam. According to Nha (1998), numbers of economically active labour graduating secondary school and high school in the region were 56.2 % and 13.0% of the total active labours, respectively. Those indicators were 32.7% and 9.2%, respectively with application to the whole country. Higher literacy rates of farmers in the study area can contribute to the fast dissemination of innovations mainly through participation in training and other extension activities. Also, public infrastructure like roads, electricity and market systems are available in the region which permit farmers and processors to transport and to market milk products comfortably.

Increased income and employment opportunities are linked with dairy farming. It generates regular cash income for farm households. The survey results revealed that raising a cow needs an average of 173 man-days and generates around 2 million VND of net return to family labour in a year. Further, all available physical resources of households like family labour force and on-farm feed stuffs can be transformed into cash quickly (i.e. every day in lactation cycle). From this characteristic, cow raising is considered as ideal occupation to create employment opportunities for rural labours.

Science and practice confirmed that cow breeds such as 50%-75% of HF blood in the crossbred are suitable for the climate and socio-economic conditions of the region, and they can afford to produce a high yield of milk. In addition, there are two centers of cow breeding located in the study area, which helps provide breeds and artificial semen of HF cows to any production unit having demand.

6.7.2 Constraints on promotion of dairy farming in the study areas

As mentioned in chapter IV, incident of diseases is the largest constraint for farm households in the study areas. Unlike some crop production, dairy raising needs high initial capital investment, so cows are said to be the whole assets of farmers. This also means that if a cow dies, the farmer will lose most of their assets. Whereas cows are very sensitive to changes of external environment, any sudden change can also affect their health and milk yields. High risk in business makes farmers hesitate to enter or expand their dairy farm sizes. Besides, the veterinary network in the region was not good enough to prevent and to diagnose many kinds of diseases in time. This feature increased the risk of cow raising.

Difference in prices of raw milk between two locations has been unsatisfactory to Hatay farmers. The survey revealed that there was not much difference in price of inputs between locations (see Appendix Table 2), but milk price in Hatay was about 300 VND/kg (or 10%) lower than that of Hanoi. Therefore, the price policy has not encouraged Hatay farmers to enter or to extend dairy farming.

Lack of fodder, especially in winter season is another constraint for Hanoi farm households. Land size of 11.6 sao or 4,176 m^2 was considered to be small for a household raising dairy cows. Because of limited land, many households do not want to allocate their land to grow grass. Further, since cultivated land is dispersed, farmers usually have difficulty managing their fodder blocks so that adjacent crop fields are not damaged by insect and rat. Also, average homestead land of a household which included areas of houses, yard, cow shed, etc. was only 180 m^2. Limitation of homestead land was one of the reasons causing environmental pollution in the settlement areas. In other words, small and dispersed farmland is another important constraint to the promotion of dairy farming in the study areas.

When farmers start to establish their dairy farms, they want to borrow money from formal sources in the hope of obtaining long term and low - interest loans. However, they have to face a complex lending procedure with the requirements of many documents and approvals. The situation forced some farmers to borrow from informal sources at high interest rate.

Lack of adequate and regular training opportunities for farmers to prepare them for handling improved breeds and modern husbandry practices successfully, is another constraint. Many farmers did not possess enough knowledge of prevention and control of cow disease, thus frequent outbreaks of diseases and higher susceptibility of HF cows to diseases, resulted into losses to dairy farmers.

Although achieving remarkable progress in the improvement of the milk collection network, there are still some communes in the region not having any milk collection station. Farmers have to deliver raw milk themselves to the milk processing factory or other buying points, which are located very far from their houses. High transportation cost and unstable prices did not encourage them to expand dairy farms.