การศึกษาต้นทุนการผลิตนมและการตอบสนอง ต่อความเปลี่ยนแปลงของราคาปัจจัยการผลิตในจังหวัดพัทลุง

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บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาต้นทุนการผลิตนมดิบ ประเมินขนาดฟาร์มที่เหมาะสมที่จะให้ฟาร์มมีกำไรสูงสุด และสังเกตการเปลี่ยนแปลงของกิจกรรมในฟาร์มเมื่อมีการเปลี่ยนแปลงราคาของปัจจัยการผลิตที่สำคัญบางชนิด

การวิจัยนี้ได้แบ่งเกษตรกรผู้เลี้ยงโคนมออกเป็นสองกลุ่ม กลุ่มแรกคือเกษตรกรที่เป็นสมาชิกของธนาคารเพื่อการเกษตรและสหกรณ์การเกษตร ส่วนกลุ่มที่สองก็คือเกษตรกรที่ไม่ได้เป็นสมาชิกของธนาคารดังกล่าว หลังจากนั้นก็ใช้วิธีการสุ่มตัวอย่างแบบธรรมดาเพื่อคัดเลือกตัวอย่างที่เป็นตัวแทนในการสัมภาษณ์เก็บรวบรวมข้อมูลที่เกี่ยวข้อง

การวิเคราะห์ข้อมูลได้ใช้วิธีการร้อยละ ความถี่ และความสัมพันธ์เชิงฟังก์ชั่น ซึ่งได้แก่ฟังก์ชั่นต้นทุนและฟังก์ชั่นการผลิต ซึ่งในการประมาณฟังก์ชั่นนั้นใช้วิธีการแบบกำลังสองน้อยที่สุด

จากการศึกษาพบว่า ลักษณะทางเศรษฐกิจสังคมของเกษตรกรทั้งสองกลุ่มนั้นมีความแตกต่างกันไม่มากนัก ดังนั้นจึงรวมเกษตรกรทั้งสองกลุ่มเข้าด้วยกัน เพื่อศึกษาต้นทุนและความสัมพันธ์ต่าง ๆ นอกจากนี้ยังพบว่ากำไรที่เกษตรกรได้รับจากการผลิตน้ำนมดิบ 1 กิโลกรัมนั้นมีไม่มากนัก ทั้งนี้อาจจะเป็นเพราะว่าการใช้ปัจจัยการผลิตนั้นยังไม่มีประสิทธิภาพดีพอและราคาที่ขายได้ก็เป็นราคาที่ควบคุม แนวทางหนึ่งที่จะทำให้เกษตรกรมีกำไรเพิ่มขึ้นก็คือการเพิ่มการใช้อาหารข้น และลดการลงทุนทางด้านทรัพย์สินถาวรที่เกี่ยวข้องกับการเลี้ยงโคนมลง และเพื่อที่จะทำให้เกษตรกรได้กำไรสูงสุดภายใต้โครงสร้างและปัจจัยการผลิตที่มีอยู่นั้น เกษตรกรควรจะเพิ่มจำนวนโคที่ให้นมในฟาร์มให้มากขึ้น

คำสำคัญ : การผลิตนม ขนาดฟาร์มที่เหมาะสม อัตราผลกำไร ฟังก์ชั่นต้นทุน ฟังก์ชั่นการผลิต

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A Study of Costs of Milk Production and their Responses to Changes in Input Prices in Phatthalung Province

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Abstract

The objectives of this study were to study the costs associated with milk production, to evaluate optimum farm size that gave maximum profitability and to observe changes in farming practices in response to changes in some significant input prices.

Dairy farmers in Phatthalung Province were categorized into two groups, those who were members of the Bank of Agricultural and Agricultural Co-operative (BAAC) and those who were independent farmers. A simple random sampling was used to identify samples for personal interviews.

The analysis of the data involved percentage, frequency and functional analysis. Cost and production functions were estimated using the ordinary least square regression.

It was found that most important socio-economic characteristics of the two groups of dairy farmers were not significantly different. Therefore, functional analyses were carried out using pooled data.

The study found that the dairy farmers in Phatthalung province had a marginal profit from producing a kg of milk. This was because of an inefficient use of inputs and controlled prices of milk. One way to improve this situation was to increase the use of concentrate feed and to invest less in assets. The farmers were suggested to increase their stock of milkable cows in order to attain the point of maximum profitability.

Key Words : milk production, optimum farm size, profitability, cost function, production function

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A Study of Costs of Milk Production and their Responses to Changes in Input Prices in Phatthalung Province

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Introduction

Milk consumption in Thailand has been steadily increasing from 150,918 tons in 1988 to a quantity of 342,367 tons in 1993, with an annual average growth rate of 18 per cent over this six-year period. On the other hand milk production's average growth rate was approximately at 14 per cent over the same period. These figures indicated clearly that Thailand had to import milk from overseas. (Ministry of Agriculture and Agricultural Co-operatives 1993). As shown in Table I, an annual average of about 28 per cent of Thailand's demand for milk is fulfilled by import production. Since 1988 the percentage of milk imported has continuously increased from about 29 per cent to 41 per cent in 1993.

The above increased demand is the result of the cooperation between the government and private campanies' campaign since 1986 to induce public awareness of milk consumption. It is expected that milk consumption increases at the rate of 10-20 per cent per year which is valued at approximately 6000 million baht.

It is expected that dairy farming will play an important role in the Thai economy because of increasing awareness of milk consumption and the need for milk import substitution.

Currently, Phatthalung Province is a major milk producing province in the South. It has an advantage of having a well-established dairy co-operative and a royal project. The Bank of Agriculture and Agricultural Co-operative (BAAC) also has made a project to encourage dairy production in Patthalung. To the best knowledge available, dairy production can be incorporated into farming systems based on agricultural crops. However, appropriate methods are still to be investigated.

Table I : Milk Production and Consumption in Thailand during 1988-1993.

Year	(1) Milk production		(2) Milk consumption		(3) Deficit (2)-(1) (tonnes)	(4) Percent imported (3)/(2)(%)
	Quantity	Growth rate (%)	Quantity (tonnes)	Growth rate (%)		
1988	106,709	-	150,918	-	44,209	29.29
1989	132,228	23.91	163,730	8.49	31,502	19.24
1990	163,851	23.92	194,886	19.03	31,035	15.92
1991	178,640	9.03	250,600	28.59	71,960	28.72
1992*	195,519	9.45	289,851	15.66	94,332	32.54
1993*	201,698	3.16	342,367	18.12	140,669	41.09
Annual average	163,108	13.89	232,059	17.98	68,951	27.80

*Preliminary data

Source : Agricultural Economic Research Division, Ministry of Agriculture and Agricultural Cooperative (1993).

Because of the importance of dairy farming to the national and provincial economies presented above, this study was initiated and progressed with the support from the Agrarian System Research and Development Project, Faculty of Natural Resources, Prince of Songkla University, Hat Yai campus.

Objectives of the Study

The general objective of the present study is to evaluate economics of dairy production in Phattalung Province so that policies for the development of this enterprise can be framed. The specific objectives of the present study are :

(i) to study the costs of milk production and the ways to reduce them.

(ii) to evaluate optimum farm size that gives maximum profitability, and

(iii) to observe changes in farming practices in response to changes in some imput prices.

This study, in itself, is useful in producing basic information for dairy development planning especially in Phatthalung Province. As explained earlier, daity enterprises are relatively new. There is a basic requirement for economic investigations that provide ways to improve their profitability and integration with other existing enterprises in the study area. Government and private institutions may, hopefully, be able to use this information for further development of the dairy enterprises.

Materials and Methods

Respondents and Data Collection

Discussion with the Manager of Phatthalung Dairy Co-operative was conducted in early March 1993. Basic information on milk production in Phatthalung and name list of dairy farmers who are also members of the co-operative were obtained. The discussion also revealed that almost all dairy farmers were concentrated in districts and villages close to the co-operative for the benefit of milk transportation and processing. Based on this information, a probability sampling design was adopted and the proportional sample allocation is shown in table 2

These dairy farms are distributed in several districts in Phattalung such as Muang, Kuan Khanun, Kongrha, Khao Chaison and Pak Prayoon. However, most farmers are situated in Muang, Khao Chaison and Kuan Khanun. Kongrha district has most of the dairy farmers who are members of the Bank of Agriculture and Agricultural Co-operative (BAAC)'s dairy promotion project.

The cross-sectional data concerning socio-economic characteristics, farm assets, production and costs of milk production and other necessary aspects were obtained through questionnaire techniques.

Socio-economic Analysis

Data concerning socio-economic characteristics of dairy farmers, separated into two groups, viz., BAAC and independent dairy farmers, were analysed using average and percentage values. Test of statistics used in the present study is the Chi-square (χ^2) to compare the differences between the above two groups in terms of some selected parameters.

Costs of Production Analysis

The study of costs of milk production includes fixed cost and variable cost analyses. Both fixed and variable costs per kg of milk were calculated using monthly averaged data. These data consist of all expenditure on cows, monthly milk production, and prices of inputs and output. All cows of the sampled farmers were investigated for their ages, hybrid lines and their initial values. Calculation of costs of milk production was based on all expenditure milkable cows in each month. However, these expenditures were calculated using animal unit equivalence. Technique of transforming cattle and cows to the animal unit equivalence is presented in Table 3.

Table 2 : Total Number of Dairy Farmers and Sampled Farmers who are members of the BAAC's Project and Independent Farmers.

Sr. No.	Particular	Total number as at March 1993	Sample size
1	Member of the BAAC's Project	13	5
2	Independent farmers	169	37

Table 3: Conversion Factors Used in the Present Study to Transfrom Cattle and Cows to Animal Unit Equivalence.

Sr. No.	Age of Cattle and Cows (years)	Animal Unit Equivalence
1.	>2	1
2.	1.51-2.00	0.75
3.	1.01-1.50	0.67
4.	0.51-1.00	0.50
5.	>0.50	0.25

Source: Agricultural Economics Division (1987).

This study adopted a theory of cost of production to analyze average costs of producing a kg of milk. In general, costs of production are categorized into two main components, (i) fixed costs which are the costs that do not vary with production levels in the short run and (ii) variable costs which are the costs that vary with quantity of output produced. The details of the fixed and variable cost components used in the present study are presented below.

Fixed Costs

The component of fixed costs are :

(i) Land. Rent is used if the farmers do not own land, otherwise the land's opportunity cost as equivalent to the rent is used.

(ii) Depreciation. Depreciation of farm equipments, farm sheds and cows are calculated based on the straight-line method.

(iii) Opportunity costs. This cost items is calculated based on the farms'

opportunity foregone for all equipments, farm sheds and cows. Interest rate of a saving deposit is used for the calculation.

Variable Costs

The components of variable cost are

(i) Labour. The labour costs include hired and family labours. The family labour costs are imputed values which vary between farms. Wage rates as indicated by farmers are 15 to 20 baht per hour. Labour activities are feed mixing, feed and water preparation, feeding, farm sheds and equipment maintenance medication, milking, foraging, and other farm inspection and repairs.

(ii) Materials. These variable costs are costs of feed (roughage and concentrate feeds), water and electricity, farm tools (valued less than 100 baht or those that have short economic life), petrol and lubricants, and medicines.

(iii) Other expenses. These variable costs are fertilization, repairs to farm equipment and sheds, transportation and opportunity costs of capital.

Functional Analysis

Two functions namely cost and production functions are studied in the present study. The cost and production functions exhibit relationships between cost and output, and output and inputs used in the production process, respectively. The following subsections show specification of the cost and production functions and the use of these functions for policy recommendation.

Cost Function Analysis

Cost functions is usually a bivariate relationship associating output with total cost. Specific cost function may assume different shapes. One possibility which exhibits properties often assumed by economists is that total cost is a cubic function of output.

The cubic form is given by Handerson and Quandt (1977) as;

$$C = a_0+a_1y+a_2y^2+a_3y^3 + e$$

where

C is total cost of producing milk in baht/month,

Y is total milk production in kg/month,

a_0, a_1 a_2 a_3 are estimated coefficients, and

e is disturbance term.

This is the short-run cost function where a_0 is the fixed cost. Average cost (AC) and marginal cost (MC) can also be found by dividing total cost by output, and by taking first-order derivative of the cost function with respect to output, respectively.

Production Function Analysis

The production function describes a relationship between inputs and output. It gives the maximum output obtainable with given quantities of inputs or the minimum amounts of various inputs necessary to

produce a given level of output. In the case of dairy farming, the production function is as follows:

$$Y = f(X_1, X_2, X_3, X_4 \ldots X_n)$$

Where, Y is milk production in kg/month,

X_1 is amount of concentrate feed used in kg/month,

X_2 is amount of roughage feed used in kg/month,

X_3 is amount of assets invested in baht,

X_4 is amount of labour used in personday/month, and

X_n are other inputs used in the milk production process.

Estimated coefficients obtained from the regression analysis on inputs are used to calculate elasticities of production and returns to scale. If the Cobb-Douglas production function is consistent with the data, the function can be written as:

$$Y = a_0 X_1^{b1} X_2^{b2} \ldots X_n^{bn} e^u$$

Where a_0 is a constant term,

$b_1, b_2, \ldots b_n$ are the estimated coefficients, and

e^u is the disturbance term.

The production elasticity of an input indicates the percentage change in the quantity of output resulting from a percentage change in the input. It is directly obtainable from the Cobb-Dounglas production function.

Similarly, the extent of economics of scale, i.e., the percentage increase in output due to a percentage increase of all inputs simultaneously, is conveniently obtainable as the sum of the estimated input coefficients,

$$\lambda = \sum_{i=1}^{n} b_i$$

If $\lambda > 1$, increasing returns to scale prevail, i.e.,output increased by a larger percentage than the increase of all inputs.

If $\lambda = 1$, constant returns to scale prevail.

If $\lambda < 1$, decreasing returns to scale prevail.

The concept of efficiency of input use is also introduced, Farmers' have different levels of fixed inputs and face cartain prices of variable inputs. Farmers are efficient in their input use if they use such variable input to the extent that the added return from the last unit yields as much value as it would have done in the next best alternative use. Under competitive conditions, the inputs' value in other alternative uses (their opportunity costs) are approximated by their marker prices. The condition for efficient input use behavior, therefore, is one of equality between the value of the marginal product (the added return) and the price of each variable input (Dillon 1977) as ;

$$VMP_i = P_y.MPP_i = P_i$$

Where, P_y is the price of output,

P_i is the price of input (i=1,2,3...).

This condition may be written as:

$$\frac{VMPi}{Pi} = 1$$

If $\frac{VMPi}{Pi}$ is greater than one, it indicates under use and hence input i should be increased.

If $\frac{VMPi}{Pi}$ is equal to one, it indicates input i is used efficiently.

If $\frac{VMPi}{Pi}$ is less than one, it indicates over used and hence input i should be decreased.

Results and Discussion

Socio-economic Characteristics of the Sampled Farmers

This section incorporates four subsections, viz, general characteristics, socio-economic characteristics, land use and distribution, and opinions toward the local dairy co-operative of the sampled farmers. Comparisons between farmers who join the Bank of Agriculture and Agricultural Co-operative's project and farmers who are independent are also presented.

General Characteristics of the Sampled Farmers

As is shown in Table 4, the sampled farmers are middle-age with an average age of 38 and 42 years old in the case of the BAAC and independent farmers, respectively. Overall characteristics of the farmers in these two groups are not significantly different. They are all buddhists and more than 70 per cent have completed primary education. There are 4-6 members in most families with an average number of days of active members woking on farms of 750 persondays per year.

Socio-economic Characteristics of the Sampled Farmers.

As shown in Table 5, most of the BAAC dairy farmers state their main occupation as rubber growers while most of the independent dairy farmers insist that thay are rice growers. However, a majority of the total farmers classify themselves as rice farmers. Using the main occupation as the sole criterion, the difference between these two groups of dairy farmers is statistically different. Most of the farmers identify themselves as having dairy production as their minor occupation. Corresponding to the above statement, incomes obtained from main and minor occupations are considered to have a large margin in the case of the BAAC dairy farmers whilst they are marginal for the independent dairy farmers. It is clearly seen that the farmers do not consider incomes as the sole criterion in determining the main or minor occupations. Perhaps they use multiple criteria such as labour involvement, income, assets, attitudes, culture and psychological characteristics as the determining factors. Most farmers own their own land, with proper land-right title (Nor Sor 3). The independent farmers' began their dairy production after 1981 and the percentages have been increased up to 24 per cent in 1988. All of the BAAC dairy farmers started their dairy operation in 1989, a year later than most of their

independent counterparts. This may be because of the success of the independent dairy farmers and the foundation of the Phatthalung Dairy Co-operative that encouraged the other dairy farmers as well as the BAAC to support the farmers to join the BAAC dairy project. Most of the farmers have 6-10 cattle and cows in their farms.

Table 4: General Characteristics of the Sampled Dairy Farmers in Phatthalung Province.

Sr. No.	General Characteristics	Farmers who are		Total n=42	Statistic
		BAAC's Profect participants n=5	Independent n=37		
1.	Age (year)	38	42	41	
2.	Religion (%)				
	Buddhist	100	100	100	
3.	Education level (%)				
	No formal education	0	3	2	
	Primary	80	73	74	χ^2=0.61
	Secondary	20	16	17	p>0.05
	Certificate	0	3	2	
	Universtiy	0	5	5	
4.	Members in family (%)				
	1-3	20	14	14	χ^2=0.38
	4-6	60	72	72	p>0.05
	> 6	20	14	14	
5.	Numbers of days working on farm of total active family members (persondays)	766	748	750	

Source : Authors' survey (1993).

Table 5: Socio-economic Chracteristics of the Sampled Dairy Farmers in Phatthalung Province.

Sr. No.	Socio-economic Characteristics	Farmer		Total	Statistics
		BAAC	Independent		
1.	Main occupation (%)				
	Rice	20	51	48	χ^2=19.50
	Dairy	20	43	40	p<0.05
	Rubber	40	0	5	
	Govermment employee	0	3	2	
	Others	20	3	5	
2.	Minor occupation (%)				
	Dairy	40	48	46	
	Rubber	40	27	26	χ^2=0.14
	Rice	40	20	24	p>0.05
	Others	0	5	4	
3.	Income from main occupation (baht/year)	49 800	31 265	33 472	
4.	Income from minor occupation (baht/year)	30 000	30 243	30 479	
5.	Land ownership (%)				
	Own land	100	97	98	χ^2=0.14
	Rent Land	0	3	2	p>0.05
6.	Land-right title[a]				
	None	0	11	10	
	NS.3	100	81	83	
	STG	0	8	7	
7.	Beginning year of dairy farming (%)				
	1981	0	5		
	1982	0	5		
	1983	0	9		
	1984	0	5		
	1985	0	5		
	1986	0	14		
	1987	0	17		
	1988	0	24		
	1989	100	11		
	1990	0	5		
8.	Persuasion started by (%)				
	BAAC	100	5	17	
	Neighbours	0	54	47	χ^2=28.48
	Own initiation	0	22	19	p<0.05
	Government officials	0	19	17	
9.	Number of cattle and cows				
	1-5	40	22	24	
	6-10	40	46	45	χ^2=1.10
	11-15	20	24	24	p>0.05
	>15	0	8	7	

a NS3 stands for Nor Sor 3 which is considered as a proper land title. STK stands for Sor Thor Kor which is a title that certifies the land for livelihood.

Source : Authors' survey (1993)

Land Use and Distribution

Table 6 presents land use and distribution of the BAAC and independent farmers. It is clearly seen that almost all farmers keep their land for rice and pasture cultivation. These two agricultural activities are expected to go hand in hand because rice is considered essential and has become an established culture. Some dairy farmers have their rubber plantations which are evident especially in the case of the BAAC dairy farmers where 80 per cent of the farmers sampled have rebber plantations with an average size of 6.5 rais. The percentage is less in the case of the independent dairy farmers.

A few independent farmers (11 per cent) have developed and intercropping with pasture and other horticultural crops such as coconut, rubber and fruit trees. The pasture-coconut and pasture-fruit tree combinations appear to be the most favorable in the intercropping system of the Phatthalung dairy farmers.

The majority of the dairy farmers (52.4 per cent) allocate their land to rice and pasture in ration of 1.0 : 0.53 for rice : pasture. The independent dairy farmers prefer to cultivate more land in rice while the opposite is true in the case of the BAAC dairy farmers. About 35.7 per cent distribute their lands to three activities : namely rice, pasture and rubber, with an average ratio of 0.93 : 0.64 : 1.0, respectively. Only 4.8 per cent have rubber and pasture while about seven per cent of all dairy farmers distribute their lands to pasture alone.

Opinions of the sampled farmers towards the Phatthalung Dairy Co-operative.

As shown in Table 7, all of the BAAC dairy farmers joined the Phatthalung Dairy Co-operative in 1990 while most of the independent farmers joined it.

Table 6: Land use and Distribution of the Sampled Dairy Farmers in Phatthalung Province

Sr. No.	Land use and distribution	BAAC farms			Independent farms			Total		
		No. of farmers	% of total	Average area (rai)	No. of farmers	% of total	Average area (rai)	No. of farmers	% of total	Average area (rai)
	Land use									
1	Rice	5	100	5.0 (2-8)	32	86.5	12.53 (2-50)	37	88.1	11.51 (2-50)
2.	Pasture	5	100	4.40 (3-6)	35	94.6	7.14 (1-40)	40	95.2	6.80 (1-40)
3.	Rubber	4	80	6.50 (2-10)	13	35.1	9.77 (1-30)	17	40.5	9.00 (1-30)
4.	Pasture+fruit trees	2	40	3.0 (2-4)	1	2.7	7.0	3	7.1	4.3 (2-7)
5.	Pasture+coconut	0	0	0	2	5.4	12.0 (6-18)	2	4.8	12.0 (6-18)
6.	Pasture+rubber	0	0	0	1	2.7	20	1	2.4	2.0
	Land distribution									
7.	Land dstribution for rice : pasture	1	20.0	0.4:1.0	21	56.8	1.0:0.52	22	52.4.	1.0:0.53
8.	Land distribution for rice : pasture : rubber	4	80.0	0.88:0.65: 1.0	11	29.7	0.95:0.64: 1.0	15	35.7	0.93:0.64:1 .0
9.	Land distribution for rubber : pasture	0	0	0	2	5.4	1.0:0.91	2	4.8	1.0:0.91
10.	Land distribution for pasture alone	0	0	0	3	8.1	11.00	3	7.1	11.0

[a] Figures in parenthesis are minimum-maximum values

Source : Authors' survey (1993).

Table 7: Opinions of the Sampled Farmers towards the Phattalung Dairy Co-operative.

Sr. No.	Opinions	Farmers who are		Total	Statistics
		B A A C n=5	Inpendent		
1.	Beginning year membership (%)				
	1983	0	3		
	1984	0	0		
	1985	0	6		
	1986	0	32		
	1987	0	16		
	1988	0	24		
	1989	0	11		
	1990	100	8		
2.	Price of milk paid by the co-operative (baht/kg)	7.43	7.87	7.82	
3.	Means of payment (%)				
	Through the co-operative	100	100	100	
4.	Time of payment	fortnightly	fortnightly	fortnightly	
5.	Opinion about the price offered by the co-operative (%)				
	Satisfactory	0	22	19	χ^2=1.33
	Unsatisfactory	100	78	81	p>0.05
6.	If unsatisfactory, appropriate prices (%)				
	8-8.5	0	48	41	
	8.6-9.0	20	35	32	χ^2=9.08
	10	80	17	27	p<0.05
7.	Opinion on the price difference between co-operative and local merchants (%)				
	Local merchants offer higher prices	0	51	45	
	Co-operative offer higher prices	0	22	19	χ^2=10.78 p<0.05
	No difference	20	3	5	
	No opinion	80	24	31	

Source : Authors'survey (1993).

Four years earlier, almost all milk production in the areas was sold to the Co-operative and the farmers received an average price of 7.82 baht per kg of milk. The Co-operative pays every fortnight through the BAAC. However, most of the farmers are dissatisfied with the price. They expect to get more than 8 baht per kg. Comparing the BAAC and the independent farmers, it is found that the expectations of milk price are significantly different. The BAAC dairy farmers prefer the price higher than 8.6 baht per kg while most of the independent farmers prefer the price between 8 to 9 baht per kg. When asked to compare the price differences offerred by the local merchants and the co-operative, most of the BAAC farmers state no opinion while the local merchants are considered to offer higher price than the Co-operative by the independent farmers.

Costs of Production

The cost of production analysis uses fixed and variable cost concepts to find components of expenditure incurred in the production of milk. This analysis does not take into account the differences in costs between the BAAC and independent dairy farmers due to the facts that there are a few BAAC farmers and some of them do not have milkable cows during the investigation. The results from the analysis are presented as follows.

Fixed Costs

The fixed costs are cos s that are fixed no matter how large the milk production is. The major fixed cost components are depreciations and opportunity foregones. As shown in Table 8, in order to produce a kg of milk, the farmers pay about 0.68 baht for all fixed costs. About seven and two per cent of total cost are accounted for depreciations and opportunity costs, respectively. The rent of land is marginal because most farmers have their own lands.

Table 8: Costs of Production per kg of Milk in Phatthalung Province (baht).

Sr. No.	Cost	Dairy farmers in Phatthalung		Percentage of total cost
	Fixed cost (baht/kg)			
1.	Depreciations of			
	- vehicles ans farm machineries	0.10	-	-
	- farm equipment	0.05	-	-
	- cattle pens	0.03	-	-
	- cows	0.35	-	-
	Total depreciation costs	-	0.53	7.04
2.	Opportunity costs of	-		
	- vehicles and farm machineries	0.08	-	-
	- cow	0.06	-	-
	Total opportunity costs	-	0.14	1.86
3.	total rent of land	-	0.01	0.13
	Total fixed cost	-	0.68	9.03
	Variable costs (baht/kg)			
4.	Feeds			
	- Concentrate	1.48	-	-
	- Roughage	2.16	-	-
	Total feed costs	-	3.64	48.34
5.	Labours for			
	- Tending of cows	0.61	-	-
	- Milking	0.54	-	-
	- Feed preparation	0.31	-	-
	- Tending of grass	0.28	-	-
	- Cutting grass	0.46	-	-
	Total labour cost	-	2.20	29.22
6.	Water and electricity	0.05	-	-
7.	Fuel	0.11	-	-
8.	Medication	0.04	-	-
9.	Equipments	0.47	-	-
10.	Maintenance of equipments	0.04	-	-
11.	Transportation	0.16	-	-
12.	Opportunity costs	0.14	-	-
	Total other costs	-	1.01	13.41
	Total variable costs	-	6.85	90.97
	Total cost	-	7.53	100.0
13.	Price of milk (bath/kg)	-	7.82	-
14.	Net revenue (baht/kg)	-	0.97	-
15.	Profit (baht/kg)	-	0.29	-

Variable Cost

The variable costs are costs associated with levels of milk production. About 6.85 baht are needed to pay for variable inputs such as feeds, labour activities and other expenses for every kg of milk produced. In terms of disaggregated cost items, to produce a kg of milk requires 3.64, 2.20 and 1.01 baht for feeds, labour activities and other variable imput, respectively.

Feeds are the major variable costs as they account for about 48 per cent of the total cost. The second major costs are labours for feeding and feed preparation, tending of cows and milking. These costs account for about 29 per cent of the total cost, Other variable costs such as water and electricity, fuel, medication, equipment. maintenance, transportation and opportunity costs are the third important cost items. They account about 13 per cent of the total cost.

Total Cost

The total cost is the sum of total fixed and variable costs. It requires about 7.53 baht of the total cost to produce a kg of milk In this, variable costs are the major costs accounted for more than 90 per cent while there are only nine per cent of the total cost in the case of fixed cost.

Net Revenue and Profit

Net revenue is revenue over variable costs while profit is the revenue over total cost. If the farmers are paid an average of 7.82 baht per kg of milk, they will have the net revenue and profit of 0.97 and 0.29 baht per kg, respectively.

Presented in Table 9 is the regrouping of costs into two cost components, namely, cash and non-cash costs. The cash costs are explicit in terms of money expenses while the non-cash costs are imputed costs mostly implicit in terms of money expenses. The cash costs are summed to 2.36 baht while the non-cash costs are summed to 5.17 baht per kg of milk produced. The margin over cash costs which is the money that the farmers explicitly obtain from sale of milk is 5.46 baht per kg. If the average farmer can produce about 60 kg of milk per day, then he/she will receive approximately 328 baht of cash margin per day. This amount is attractive enough to stimulate non-dairy farmers to enter in the dairy production enterprise.

Cost Function Analysis

The cost function in the present study takes a cubic functional form with total variable cost in baht/month as dependent variable. Milk production in kg/month is an explanatory variable. Estimation problems of multicollinearity, heteroscedasticity and autocorrelation were tested. It was found that the multicllinearity was not serious since the function was used for prediction. On the other hand, the heteroscedasticity was the problem as it often occurs in the cross-sectional data. The Goldfeld-Quant Test was

tested and the null hypothesis of homoscedasticity was rejected. The problem was later solved by transforming the original function into a new function that the disturbance term satisfied the assumption. The Ordinary Least Square (OLS) estimators obtained from applying the OLS on the transformed function gained more efficiency. The problem of autocorrelation was not present as the Durbin-Watson Statistic falls in the no autocorrelation region.

Table 9: Cash and Non-cash Costs of Milk Production in Pattalung Province.

Sr No.	Particular	Cash	Non-cash	Total
	Fixed cost (baht/kg)			
1.	Depreciations of			
	- vehicles and farm machineries	-	0.10	0.10
	- farm equipment	-	0.05	0.05
	- cattle pens	-	0.03	0.03
	- cows	-	0.35	0.35
2.	Opportunity costs of			
	- vehicles and farm machineries	-	0.08	0.08
	- cows	-	0.06	0.06
3.	Rent of land	0.01	-	0.01
	Variable costs (baht/kg)			
4.	Feeds			
	- concentrate	1.48	-	1.48
	- Roughage	-	2.16	2.16
5.	Labours for			
	- Tending of cows	-	0.61	0.61
	- Milking	-	0.54	0.54
	- Feed preparation	-	0.31	0.31
	- Tending of grass	-	0.28	0.28
	- Cutting grass	-	0.46	0.46
6.	Water and electricity	0.05	-	0.05
7.	Fuel	0.11	-	0.11
8.	Medication	0.04	-	0.04
9.	Equipments	0.47	-	0.47
10.	Maintenance of equipment	0.04	-	0.04
11.	Transportation	0.16	-	0.16
12.	Opportunity costs	-	0.14	0.14
	Total Cost	2.36	5.17	7.53
13.	Price of Milk (baht/kg)	7.82	-	-
14.	Margin over cash costs (baht/kg)	5.46	-	-
15.	Margin over total costs (baht/kg)	-	-	0.29

The cost function exhibiting the relationship between total variable cost and total production is shown in Table 10.

Table 10: Functional Relationship between Total Variable Cost and Production of Milk per Month in Patthalung Province.

Sr. No.	Independent variable	Regression Coefficients	Standard error	t-value
	Production of milk (kg/month)			
1.	Y	7.99	0.81	9.85***
2.	Y^2	-0.0021	0.0016	-1.38
3.	Y^3	0.00000061	0.00000062	0.97
	R^2=0.70	N=34	D-W Statistics=1.87	

***Significant at one per cent level.

The coefficient of multiple determination (R^2) is found to be 0.70 implying that variation in the total variable cost of milk production is well explained by the total milk output

From the cubic cost function, profit maximizing level of output, given the prices, or optimal price level, given the output level, can be obtained by equating marginal cost to marginal revenue. The optimal output level is 2240 kg/month which is higher than the actual output level of 743.24 kg/month indicating the existing under production level. The profit at the optimum output level is 1776.91 baht/month and whereas the profit at actual level of output is 277.85 baht/month. This indicates that by producing the milk at optimum level, an increase in the production level by about three folds will increase the overall profit by about six folds.

Production Function Analysis

Production function analysis is attempted to study the relationship beteen milk output and several inputs used in production process. A scrutiny of the scatter diagrams suggests a log-log or Cobb-Douglas production function to explain the milk output (Y) in kg/month, as a function of concentrate feed (X_1) in kg/month, roughage feed (X_2) in kg/month, assets invested in milk production (X_3) in baht, and amount at labour used (X_4) in persondays/month.

Through model specification and testing processes, the independent variables that are important in determining variation in milk production are concentrate feed (X_1) and assets (X_3) variables. The production function incorporating these two independent variables is presented in Table 11.

The regression coefficient for concentrate feed is found to be significant at one per cent level showing that a one per cent increase in concentrate feed used,

cetaris paribus, will result in an increase in milk output by 0.43 per cent.

The regression coefficient for assets is found to be significant at one per cent level that a one per cent increase in assets invested in milk production, *cetaris paribus*, will result in an increase in milk output by 0.51 per cent.

The sum of regression coefficients shows the decreasing returns to scale (λ = 0.94) implying that a percentage increase in these two inputs will result in a smaller percentage (0.94) increase in milk output.

The coefficient of multiple determination (R^2) is found to be 0.78 implying that 78 per cent of the variation in the milk output could be the two independent vriables included in the production function

The Durbin-Watson statistics of 1.66 falls into the inconclusive region which implies that the autocorrelation is not a problem. However, as the data are from the cross-sectional farm survey, so the autocorrelation problem is assumed to be negligible.

Efficiency of Input Use

In order to study the efficiency of input use, the value of marginal products (VMP_i) of the significant inputs in the function were calculated and compared with the prices of these inputs. The results are reported in Table 12.

All inputs included in the production function are inefficiently used as the VMP_i/P_i values are different from unity. In the case of concentrate feed, the use of this input is under-used, while the use of the asset input is over-used. Therefore, profits will increase if the farmers are to increase the level of concentrate feed, and also decrease the level of assets. However, adjustments of inputs use must be made simultaneously until optimal solution is reached.

Responses to Changes in Input Prices

In an assumed perfectly competitive market, profit maximizing condition is attained when value of marginal product (VMP_i) equals to prices of inputs (P_i). If these values are not equal, they suggest that the use of inputs in the production process is inefficient. The prices of these inputs may be changed to observe the levels where these inputs are efficiently used.

Changes in Concentrate prices.

The average market price of concentrate feed is 4.30 baht/kg while the VMP_i is 9.46 It is suggested that the farmers should increase the use of concentrate feed. The price of concentrate feed that brings the point of input-use efficiency is 9.46. baht/kg i.e., the maximum level that the farmers would turn from under-used to over-used levels of the input.

Table 11: Functional Relationship between Milk Production and Number of Independent Variables in Phatthalung Province.

Sr. No.	Independent variable	Regression coefficient	Standard error	t-value
1.	Concentrate feed	0.43	0.07	5.78***
2.	Assets	0.51	0.12	4.43***
3.	Regression Constant	-1.38	1.11	-1.25
	R_2 = 0.78	N = 34	D-W Statistic=1.66	

***Significant at one per cent level.

Table 12 : Efficiency of Input Use in Milk Production in Patthalung Province.

Sr. No.		Efficiency in the use of[1]	
		Concentrate feed	Assets
1.	MPP_i	1.21	0.0063
2.	VMP_i	9.46	0.049
3.	VMP_i/P_i	2.20	0.575
4.	Input use	increase	decrease

[1]Efficiency in input use = VMP_i/P_i ; where $VMP_i = MPP_i \times P_y$

VMP_i = Value of marginal product of input i,

MPP_i = Marginal product of input i,

P_y = Average price of milk = 7.82 baht/kg,and

P_i = Price of input i, price of concentrate feed = 4.30 baht/kg

Price of assets is assumed equal to interest rate of 8 percent.

Changes in Asset Prices

Price of assets used in the present study is interest rate obtained from fixed bank deposit. This price is considered appropriate because it reflects opportunity foregone of the farmers in the least risky alternative. Changes of the asset prices can be traced in order to observe the response of the VMP_i. This input is used efficiently if VMP_i is equal to unity. Therefore, the price or interest rate that stimulates the farmers to move from using this input inefficiently to using it efficiently is 4.9 per cent. This dramatic lowering of current interest rate of 8 to 4.9 per cent may be practically impossible, other production strategies may be suggested as follows :

a) The use of assets should be reduced. This indicates that, in order to obtain the profit maximizing level, the farmers need not invest as much as in the present situation to the farm infrastructure such as sheds, cattle pens, and other capital facilities.

b) Number of cows should be increased. Given the amount of capital that has been invested, it is difficult for the present dairy farmers to adjust this investment to attain the efficient level. On the other hand, the number of cows should be increased. Using an average milk production per cow and average number of present cows, the number of cows that should be kept is five, whereas the current number of milkable cows was three.

Summary and Conclusions

Dairy farmers in Phatthalung Province may be classified as small farmers with herd size of 6-10 per farm of which three were milkable cows. The average milk production was about 743 kg per month. Most of the dairy farmers were middle-age with an education at the primary level. There were four to six members in a family contributing about 750 persondays of active labour per year. Most of the farmers considered themselves as rice or rubber farmers, and dairy production as their minor occupation. However, their obtainable incomes from main and minor occupations were not remarkably different. Using incomes as the criterion, these dairy farmers had higher income per capita than the country's average. Their attempts to practise dairy farming therefore have brought them to become above average income earners.

In terms of assets, the dairy farmers characteristically owned sufficient land and capitals for further development. However, their returns on investment depended largely on market prices of rice, rubber, milk and other farm products. They did not satisfy with the price of milk offered by the Phattalung Dairy Co-operative. They expected to have a comfortable margin if the price per kg of milk is over 8 baht per kg. Many of the dairy farmers, however, indicated that local milk merchants offer higher prices than the co-operative.

The average cost of producing a kg

Many of the dairy farmers, however, indicated that local milk merchants offer higher prices than the co-operative.

The average cost of producing a kg of milk was relatively high at 7.53 baht per kg of milk. If the milk price was 7.82 baht per kg, the dairy farmers obtained only 0.29 baht per kg of milk as profit. The calculation of costs took into account imputed non-cash costs which were considered to be important if the enterprise is to be viable in the long run. It appears in the present study that profit obtained from the dairy production is not really attractive. However, if only cash costs were used to find out about explicit costs and returns, the margin over cash expenditures was averaged at 5.46 which was considered attractive.

The cubic cost function with total cost per kg of milk as a dependent variable and production of milk per month as an independent veriable was examined to find out the optimal level of production that gave maximum profits. The profit maximizing output as derived in the function was 2240 kg/month while the observed average production was only 743.24 kg/month. This indicated that the dairy farmers were operating in the lowering segmentof the average cost curve. There were ways to bring the cost of production down to its minimum level. This led to the study of production function which input-used adjustments could be suggested.

The Cobb-Douglas production function was attempted to examine the relationship between factors of production and milk output.The production was specified with the yield per month as dependent variable and there were two significantly independent variables, namely, concentrate feed in kg/month and value of assets in baht. The sum of regression coefficients showed the decreasing returns to scale. When the independent variable was individually examined, it indicated that the concentrate feed input should be increased while the opposite was true in the case of value of assets.

By observing the prices of input, the optimal level of price that the farmers faced the turning point was 9.46 baht/kg of concentrate feed. Similarly in the oase of assets the interest rate as low as 4.9 per cent was the most favorable rate.

References

Agricultural Economic Division (1987). Dairy Policy and Dairy Products, Agricultural Economic Division, Ministry of Agriculture and Agricultural Co-operative, Bangkok.

Chakartpanyawai, V. (1993). "Ready -to-dring milk : high competitive market", Business News Summary 24(6), Thai Farmers Bank Publication, Bangkok, 33-40.

Foley, R.C., Baht, D. L., Dickinson, F. N. and Tucker, H.A. (1972). Dairy Cattle: Principles, Practices, Problems, Profits, Lea and Febiger, Philadelphia, 20-37.

Dollon, J. L (1977). The Analysis of Response in Crop and Livestock Production, second edition, Pergamon Press, Oxford.

Handerson, M.J. and Quandt, R.F., (1977). Microeconomic Theory : A Mathematical Approach, McGraw-Hill Book Co., New York.

NESDB (1993), 'Economic report of the first quarter', 1993. Development News Bulletin, June 1993.

Parry, M. (1990). Climate Change and World Agriculture, Earthscan Publications Ltd., London.

Phatthalung Provincial Office (1986). Summary Report, Phattalung Provincial Office.

———. (1993) Summary Report, Phattalung Provincial Office.