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FACTORS AFFECTING THE ACCEPTANCE OF DAIRY FARMING STANDARDS BY MODERNIZED FARMERS FOR AGRICULTURAL EXTENSION IN THAILAND

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ABSTRACT
Milk production in compliance with dairy farm standards (DFS) assists farmers in improving the quality of local raw milk, facilitating more efficient farm management, and potentially increasing raw milk prices. In addition, it helps consumers to consume milk that is safe for their health. This study aimed to investigate the factors affecting the acceptance of DFS among modernized farmers in Sakon Nakhon and Udon Thani, Thailand. A total of 201 respondents were selected using the cluster sampling method. A structured questionnaire was utilized to collect data. The data were analyzed using binary logistic regression with 12 variables: age, education, experience in dairy farming, types of labor, size of dairy farming land, farm size, amount of raw milk yields, processing cost of raw milk, the profitability of raw milk production, access to and use of information on dairy farming, number of attended dairy farming workshops, and farmer satisfaction towards their dairy cooperative administration. The results indicate that modernized dairy farmers with more experience, medium-sized farms (21-100 dairy cows/farm), combined family and hired labor, and higher raw milk yield were more willing to accept DFS. This result is relevant in the context of agricultural extension according to government policies to raise the quality of raw milk in Thailand.

Contribution/Originality: This study contributes to the existing literature by defining the role of government agricultural extension in modernized farmers' acceptance and implementation of dairy farming standards to raise the quality of raw milk.

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1. INTRODUCTION

Dairy products are an important segment of the world's livestock economy. The range of dairy products varies from region to region and among countries in the same region, depending on dietary habits, the milk processing technologies available, market demand, and social and cultural situations. Over the past decade, developing countries have expanded their shares of milk production worldwide. Smallholder farmers are an essential part of milk production in developing countries, and milk production contributes to the livelihood of households, food security, and nutrition (Food & Agriculture Organization of the United Nations (FAO), 2018).

In Thailand, the government has promoted dairy cattle farming for farmers to minimize the need to import milk and dairy products and to substitute for the cultivation of crops with production and marketing difficulties. In 2018, Thailand had 17,925 dairy farms and a total dairy cow population of 623,427. More than half, 56.38 percent, were raised in the north of the country, while 32.04 percent were raised in the northeast. Sakon Nakhon and Udon Thani, in the northeast of Thailand, accounted for approximately 25.28 percent of the dairy cows in the northeastern farms. There were 151 farms with 3,746 dairy cows in Sakon Nakhon and 184 farms with 6,199 dairy cows in Udon Thani (Department of Livestock Development, 2019). Government policies have been implemented to advance the Thai dairy industry globally by improving production quality, developing raw milk, transferring innovations to farmers, establishing new market channels domestically and internationally, and educating farmers to enhance the standing of Thai raw milk quality. In addition, the government encourages dairy farmers to become "Smart Farmers" to increase the efficiency of raw milk production, targeting an increase in small dairy farmers' incomes to at least 180,000 baht per person per year. Moreover, to strengthen farmers' stability and sustainability in their occupation, the government focuses on high-efficiency farming in which technology is applied to control production (Dairy Farming Promotion Organization of Thailand, 2017).

The Thai dairy industry plays a role in assisting farmers to generate income as well as in developing improvements in the commercial processing of dairy products to create value for the domestic market and increase export value. The primary dairy export markets are in neighboring nations such as Cambodia, the Philippines, and Singapore (Food Intelligence Center, 2016). Dairy processing gives small dairy producers a higher cash income than raw milk sales. Moreover, it provides better opportunities to access regional and urban markets. Processed milk helps to manage seasonal fluctuations in the milk supply. Transforming raw milk into processed milk and its products can benefit communities by creating off-farm jobs in milk collection, transportation, processing, and marketing (Food & Agriculture Organization of the United Nations (FAO), 2018).

In terms of raw milk production in Thailand, farmers encounter a quality issue of producing milk with low milk mass and excessive microorganisms and somatic cells; this has affected their competitiveness in both global and domestic markets. The absence of quality standards impedes industry growth (Godfrey et al., 2019). Therefore, the Thai government emphasizes the quality of raw milk production by promoting production standards for modernized dairy farmers. The farmers are encouraged to have standardized and quality milk processing procedures in place, from farming to raw milk products' transportation and manufacturing. The standards cover farm components, dairy cow feed, water, farm management, animal health, animal welfare, the environment, raw milk production, and data recording. The government also motivates dairy farmers to adhere to the standards by increasing the price of raw milk based on its quality. However, raw milk production in Thailand faces the same problem as in some countries in East Africa, such as Kenya; in raw milk production, farmers still have negative beliefs and lack knowledge about the effects of antibiotic residues in animals that affect humans. This is reflected in the farmers' lack of acceptance and compliance with milk production standards. Therefore, government agencies, the private sector, and supply chain operators must collaborate and encourage farmers to achieve their goals by rewarding them, such as by compensating them based on milk quality (Nyokabi et al., 2021). Supporting activities for farmers is necessary for the intensive development of dairy farms (Bazarragchaa, Luvsandorj, & Qian, 2015).

Producing milk according to dairy farm standards will help farmers improve the quality of local raw milk and the efficiency of their farm management, as discussed by Mukson, Isbandi, Santosa, Sudjadmogo, and Setiadi (2012). Environmental factors significantly affect milk production, and Suleiman, Mdegela, and Karimuribo (2016) indicated that appropriate farm hygiene practices play a significant role in high-quality raw milk yields. Suriya (2015) also claimed that standardized dairy farms could raise raw milk prices.

Although the Thai government has encouraged dairy farmers to raise farm standards, they fail to register as they perceive the process to be complicated, with high investment costs and a lack of data on agricultural standards. In addition, personal factors, such as age and education, and production factors, such as labor, area, productivity, cost, profitability, and access to information, training, and workshops, influence farmers' decision-making concerning the acceptance of DFS. Furthermore, farmers' satisfaction with cooperative management tends to lead to higher levels of compliance with DFS. Research on DFS in Thailand has mainly concerned farmers' attitudes toward farm management standards, farmers' readiness to adopt farming standards, dairy farmers' need for extension services to achieve good dairy farming practices, factors influencing dairy farm improvement, and farm management under farm standards. However, there is a lack of documented research on factors affecting farmers' acceptance of dairy farming standards. Therefore, this research investigates factors affecting the acceptance of DFS by dairy farmers. It will then formulate recommendations and ideas to promote modern dairy farming among dairy farmers, which will help improve the quality of raw milk produced in Thailand.

2. LITERATURE REVIEW

Dairy farming standards (DFS) specify the criteria for good agricultural practices of dairy cattle farms, covering everything from dairy cattle rearing on farms to the transportation of raw milk to collecting centers or processing

plants. The objective is to produce healthy dairy cows that produce milk that is safe and suitable for human consumption or further processing without impacting the environment (National Bureau of Agricultural Commodity and Food Standards, 2009). The production of raw milk in compliance with DFS enables farmers to sell raw milk at higher prices, reduce raw milk production costs, and improve raw milk production efficiency and quality to support competition with trade liberalization (Suriya, 2015). Each farmer is uniquely equipped to raise farm standards, which are influenced by factors such as milk production and the number of dairy cows raised (Eddy, Roessali, & Marzuki, 2012). According to Kariyasa and Dewi (2013), yield level is crucial to farmers' decisions to adopt technology that increases farm productivity. In addition, factors such as age, education level, and farm size influence farmers' behavior and decision-making to switch farm production patterns, as well as their utilization of farm management tools (Alexopoulos, Koutsouris, & Tzouramani, 2010; Corner-Thomas et al., 2015; Mittal & Mehar, 2016). Shimahata, Farghali, and Fujii (2020) found a statistically significant positive correlation between farm size, productivity, and gross margin and farmers' intention to expand their businesses in the future to increase their farm income. The correlation between farm size, productivity, and gross margin was also statistically significant (Datta, Haider, & Ghosh, 2019). Farmers' knowledge, experience, and income level are crucial factors influencing their attitudes toward and adoption of agricultural technology (Dehinenet, Mekonnen, Kidoido, Ashenafi, & Bleich, 2014; Shams & Fard, 2017). Rodthong, Kuwornu, Datta, Anal, and Tsusaka (2020) and Bui and Nguyen (2021) also indicated that farm labor and the number of training sessions influenced the farmers' adoption of new practices on their farms. In addition, land holding size is a factor that affects farm income (Sharma, Bangarva, & Sharma, 2016). This factor is significant if a farmer allocates land use to maximize profit. Farmers' satisfaction with dairy cooperatives is a factor that helps farmers comprehend DFS and increases their adoption. Ritter, Adams, Kelton, and Barkema (2019) discovered a positive relationship between farmers' satisfaction and veterinary recommendations. This suggests government officials should provide information to farmers. Nevertheless, the key to a successful cooperative is performing functions and providing services to members' satisfaction (Liebrand & Ling, 2014).

3. MATERIALS AND METHODS

3.1. Method of Analysis

Based on the previous research and findings, farmers' acceptance of DFS is influenced by age, education, experience in dairy farming, types of labor, size of dairy farming land, farm size, amount of raw milk yields, processing cost of raw milk, the profitability of raw milk production, access and use of information on dairy farming, number of attended dairy farming workshops, and farmer satisfaction with their dairy cooperative's administration. These variables were included in the research model and are shown in Table 1.

Table 1. Definitions of independent variables in the research model.

Variables	Definitions	Symbols
$ß_1$: Age of farm owner	Age (years)	AGE
$ß_2$: Education of farm owner	Years of education (years)	EDUC
$ß_3$: Experience in dairy farming	Experience (years)	EXPER
$ß_4$: Labor force for dairy farming	1 = Household labor 0 = Household labor and hired labor	LABOR
$ß_5$: Size of dairy farming land	Land size (square meters)	LAND
$ß_6$: Farm size	1 = Medium size (21-100 dairy cows/farm) 0 = Small size (not more than 20 dairy cows/farm)	FARM_S
$ß_7$: Produced raw milk	Amount of produced raw milk (kg/day)	RAW_M
$ß_8$: Raw milk production cost	Cost (baht/kg)	COST
$ß_9$: Profit from raw milk production	Profit (baht/kg)	PROFIT
$ß_{10}$: Access to information on dairy farming	1 = Consistent access (≥ once a month) 0 = Inconsistent access	NEWS
$ß_{11}$: Number of training and workshops on dairy farming	Participation in training and workshops (number of training and workshops)	TRAIN
$ß_{12}$: Dairy farmers' satisfaction with the administration of the dairy cooperative they join	1 = Very satisfied to extremely satisfied 0 = Satisfied to not at all satisfied	SATIS

Descriptive statistics analysis, including averages, frequencies, and percentages, was used to describe farmers' profiles, while binary logistic regression analysis (Vanichbuncha, 2012) was employed to determine which factors affected dairy farmers' acceptance of DFS. The study model's formula is represented as the following equation:

$$Y = ß_0 + ß_1AGE + ß_2EDUC + ß_3EXPER + ß_4LABOR + ß_5LAND + ß_6FARM\_S + ß_7 RAW\_M + ß_8COST + ß_9PROFIT + ß_{10}NEWS + ß_{11}TRAI N + ß_{12}SATIS$$

where Y refers to dairy farmers accepting and following the DFS;

when Y = 1 farmers accept the DFS (achieve the dairy farming standard certification);

Y = 0 farmers refuse the DFS (fail the dairy farming standard certification).

3.2. The Sample and Data Collection

This study was conducted in Sakon Nakhon and Udon Thani, Thailand. 151 Sakon Nakhon dairy farmers who were members of Phu Phan Sakon Nakhon Dairy Cooperative Limited and Waritchaphum Dairy Cooperative Limited, as well as 184 Udon Thani dairy farmers who were members of Udon Thani Dairy Cooperative Limited, Srithat Dairy Cooperative Limited, and Thung Fon Dairy Cooperative Limited, comprised the study population (Department of Livestock Development, 2016). Cluster sampling in accordance with the cooperatives the farmers had joined was used as the sampling method. The cooperatives with the most members in each province were selected. 113 members of Waritchaphum Dairy Cooperative Limited and 88 members of Srithat Dairy Cooperative Limited in Sakon Nakhon and Udon Thani were selected as the sample in this study. The total number of participants was 201. A structured questionnaire was utilized for data collection between October 2017 and September 2018.

4. RESULTS AND DISCUSSION

4.1. Descriptive Results

Table 2 shows that 82.30% of dairy farms in Sakon Nakhon were DFS-certified. Most farms were small-sized, with an area of 10,176 square meters and an average of 15 dairy cows per farm. 13.83 kg of raw milk was produced per cow. This was higher than the country's average raw milk yield of 11.60 kg per cow in 2017 (Office of Agricultural Economics, 2018). The farmers had an average accounting cost of 10.21 baht/kg. They earned an accounting profit of 7.87 baht/kg. The accounting cost was low, and the selling price was higher than the country's average, where the average costs of raw milk production and the raw milk price were 14.31 baht/kg and 18.01 baht/kg, respectively. Most of the costs were associated with concentrated feed, roughage, and labor costs. This is in agreement with the findings of Mohamed, Abd Latif, and Chizari (2014), Saleh et al. (2016), and Odero-Waitituh (2017), who stated that animal feed comprised the largest proportion of milk production costs. Non-certified farmers were required to spend 219,495.58 baht on average to renovate their houses to meet the standards.

Regarding production in Udon Thani, 28.41% of dairy farms in Udon Thani were DFS-certified. Most of the farms were medium-sized, with an area of 20,000 square meters and an average of 21 dairy cows per farm. 11.62 kg of raw milk was produced per cow, which was higher than the country's average raw milk yield. The farmers had an average accounting cost of 10.94 baht/kg, earning an accounting profit of 7.29 baht/kg. The accounting cost was low, while the selling price was higher than the country's average. Non-certified farmers were required to spend 262,465.75 baht on average to renovate their houses to meet the standards.

Table 2. Profile of dairy farmer and production information.

Items	Provinces	
	Sakon Nakhon	Udon Thani
Certification of farming standards (no. of farms/%)	93 / 82.301	25 / 28.409
Ages (year)	49.94	47.33
Formal education (%)		
Primary school	62.88	54.55
Secondary school	27.43	30.68
High school or more	9.69	14.78
Experience in dairy farming (years)	16.08	12.86
Size of farm area (square meters)	10,176	20,000
Farm size (%)		
Small-sized	76.10	39.78
Medium-sized	23.90	60.22
Production of raw milk per day (kilogram per cow)	13.83	11.62
Price of raw milk (baht per kilogram)	18.08	18.23
Accounting cost of raw milk (baht per kilogram)	10.21	10.94
Accounting profit of raw milk (baht per kilogram)	7.87	7.29
Average capital required by farmers to renovate their houses to standard (baht)	219,495	262,465

4.2 .Factors Affecting the Acceptance of DFS

The statistics were analyzed to determine whether independent variables correlated with the dependent variables. The Chi-square value of 52.6 (sig = 0.00) indicated that at least one factor affected the dairy farmers' acceptance of DFS (see Table 3). The correlation determined by the value of Pseudo R^2 and the Nagelkerke R^2 of 0.31 demonstrated that the independent variables in the formula predicted the possibility of the farmers' acceptance of DFS at 31.1%, and the values of Cox & Snell R^2 = 0.23 indicated that the independent variables were used to define the possibility of the farmers' acceptance of DFS at 23% (see Table 4). Hosmer and Lemeshow tests were used to determine the goodness of fit formula, and the critical value of chi-square distribution $\chi^2_{(0.05,8)} = 21.0$ that $\chi^2_{(H-L)}$ equaled 4.40, which was lower than 21.02, and the significance value was 0.82, which was higher than 0.05. These

values indicated that the formula fit to show the correlations and the formula accuracy that was analyzed using the classification table showed a prediction accuracy percentage of 79.66.

Table 3. Omnibus tests of model coefficients.

Tests	Chi-Square	df	Sig.
Hosmer and Lemeshow Test	4.401	8	0.819
Omnibus Test of Model Coefficients			
Step	52.662	12	0.000
Block	52.662	12	0.000
Model	52.662	12	0.000

Table 4. Model summary.

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	219.857[a]	0.230	0.311

Note: [a] estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

According to the findings, the factors that significantly affected farmers' acceptance of DFS included their experience in dairy farming, labor type, farm size, and amount of raw milk produced, as demonstrated in Table 5.

Table 5. Logit model analysis results.

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
AGE	-0.010	0.021	0.216	1	0.642	0.990	0.951	1.032
EDUC	0.027	0.054	0.251	1	0.617	1.027	0.925	1.141
EXPER**	0.085	0.025	11.657	1	0.001	1.089	1.037	1.143
LABOR*	-0.903	0.422	4.568	1	0.033	0.405	0.177	0.928
LAND	0.019	0.020	0.881	1	0.348	1.019	0.980	1.059
FARM_S**	2.401	0.522	21.111	1	0.000	11.029	3.961	30.710
RAW_M*	0.004	0.002	5.887	1	0.015	1.005	1.001	1.008
COST	-0.007	0.022	0.091	1	0.763	0.993	0.952	1.037
PROFIT	0.014	0.032	0.181	1	0.671	1.014	0.952	1.079
NEWS	0.290	0.516	0.316	1	0.574	1.336	0.486	3.671
TRAIN	0.002	0.004	0.396	1	0.529	1.002	0.995	1.010
SATIS	0.105	0.413	0.065	1	0.799	1.111	0.495	2.494
Constant	-3.358	1.484	5.119	1	0.024	0.035	-	-

Note: * significant at p <0.050;** significant at p <0.010.

In terms of dairy farming experience, it is evident that farmers with one more year of dairy farming were 1.089 times more likely to accept the DFS as they gained more learning experiences through their daily occupation. Experience helps farmers to have a better understanding and a more positive attitude towards farming business development. Maniriho, Musabanganji, and Lebailly (2021) discovered that farmers' experience was a positive and significant factor in yields and incomes. This finding corresponds with Hansen and Jervell (2015), who found that farmers with experience in consistent transformation processes could manage farms effectively, and Haloho, Santoso, Marzuki, Roessali, and Setiadi (2013), who claimed that experience in dairy farming was significantly associated with profit.

In terms of labor in dairy farming, farmers with only household labor tended to accept the DFS 0.405 times less than those with both household and hired labor. Household labor is generally limited and mainly includes older workers. This limitation, combined with several regulations and complicated processes, results in difficulties in improving standards. It was found that an increase in hired labor was associated with a significant increase in the number of cattle and products, which resulted in a higher employment rate. An increased proportion of farm-hired labor is thus significantly related to an increase in dairy herd size and production (Deming, Gleeson, O'Dwyer, Kinsella, & O'Brien, 2018; Júnior et al., 2016). Not only does hiring labor provide sufficient labor for standardized farming, but it also contributes to higher profits. Maina, Mburu, Gitau, and VanLeeuwen (2020) described how farmers' proper utilization of hired labor for dairy farming increased economic efficiency. Krpalkova, Cabrera, Kvapilik, and Burdych (2016) reported that a higher proportion of dairy cows per worker correlated with a higher raw milk yield, herd size, and increasing profits. However, the amount of hired labor will likely decrease as the use of highly functioning farming machines increases, e.g., automatic milking systems; there will then be less need for human labor (Gargiulo, Eastwood, Garcia, & Lyons, 2018).

In terms of farm size, the farmers with medium-sized farms (21-100 dairy cows) were 11.029 times more likely to accept the farming standards than those with small-sized farms (up to 20 dairy cows) because medium-sized farms produce more raw milk. Hence, it is more beneficial to invest with fixed factors. Hanrahan et al. (2018) claimed that farm size significantly correlates with the safety of raw milk production. As larger farms have adopted the safety

measures governing raw milk production, the milk production structure has shifted towards the expansion of these farms (Yang, Chen, & Kong, 2019). However, the larger the farm, the higher the production costs (Moreira & Bravo-Ureta, 2016). Modernized farmers need to consider these factors.

In terms of the amount of raw milk, the results show that if one more kilogram of raw milk is produced per day, the farmer is 1.005 times more likely to accept the DFS as more raw milk means more income. Eddy et al. (2012) emphasized that an increased amount of raw milk has an impact on farm economic efficiency; similarly, Datta et al. (2019) emphasized the statistically significant correlation between farm size, produced amount of milk, and gross profit margin.

5. CONCLUSION AND RECOMMENDATIONS

This research has investigated factors affecting the acceptance of DFS among dairy farmers. The data were collected from 201 dairy farmers in Sakon Nakhon and Udon Thani, Thailand. A binary logistic regression was conducted to examine the factors affecting the acceptance of DFS among dairy farmers. The results revealed that farmers with more dairy farming experience tended to accept DFS more due to their better understanding of the dairy farming business or a more positive attitude that encouraged them to follow the standards. The dairy farms using only household labor were less likely to accept the standards than those with both household and hired labor. The limited nature of household labor can explain this as it results in difficulties in farm management complying with the standards. Moreover, the farmers that owned medium-sized dairy farms were more likely to accept the standards than those with small farms because, on medium-sized farms, fixed-factor investment offers more value when elevating farming standards. Finally, higher raw milk yields motivate farmers to be more accepting of the standards.

Based on the results, the Thai government should focus on this group of farmers to drive their raw milk development policy. The policy should center on promoting knowledge among farmers to improve the quality of raw milk, creating added value for raw milk, and identifying new domestic and international sales channels. The government should encourage dairy farmers to become "Smart Farmers" to increase the efficacy of raw milk production to meet higher standards and criteria. That could help farmers increase their income and strengthen stability and sustainability in their occupation, which is fundamental for agricultural extension and will result in benefits for farmers and an improvement in Thailand's sustainable dairy farming.

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