Factors Affecting the Application of Agricultural Machinery for Harvesting Agricultural Products

By

Pokawin Jeerasak

College of Politics and Governance, Mahasarakham University, Thailand
E-mail :g_1981@hotmail.com

Wongchai Anupong

Department of Agricultural Economy and Development, Faculty of Agriculture, Chiang Mai University, 50200, Thailand
E-mail: anupong.w@cmu.ac.th

Abstract

This study aimed 1) to investigate the behavior of farmers in using agricultural machinery for rice harvesting, 2) to analyze political and economic factors affecting the application of agricultural machinery for harvesting agricultural products, and 3) to propose a guideline for relevant agencies in procuring or recommending suitable agricultural machinery to farmers. The sample group included 450 rice farmers who use agricultural machinery to harvest rice in Chiang Rai Province. The data were collected through interviews and analyzed using descriptive statistics, including variable frequency distribution, percentage, mean, and Chi-Square test to determine the correlation. The study revealed three main findings. First of all, most farmers use agricultural machinery, mostly Kubota brand, for harvesting rice because it saves labor costs. They asked the information about agricultural machinery from their neighbors to make a decision to buy one. Those who did not own any harvesting machine had to rent one from another farmer, which incurred higher costs. Secondly, regarding the factors influencing their decisions to use harvesting machines, farmers prioritized personal factors, followed by the machine efficiency, marketing, and social and cultural factors, with significance levels of 4.22, 4.20, 4.19, and 4.08, respectively. Thirdly, government agencies or other relevant agencies involved with procuring harvesting machinery for farmers should ask about their needs and take a field survey to understand the farm condition to select the machine sizes and types suitable for the area.

Keywords: Agricultural Machinery, Chiang Rai Province, Economic Factors, Political Factors, Rice Harvesting

1. Introduction

In the past, Thailand used to do agriculture by relying mainly on human and animal labor. However, with more technological advancements, the traditional farming style has been adapted to modern techniques. More labor-saving equipment or machinery has been introduced to produce agricultural products. In addition, Thailand has witnessed a constant and rapid increase in the number and proportion of older citizens. More precisely, the agricultural country had 4,011,854 senior citizens or 6.8% of the national population in 1994. In comparison, the figures rose to 11,312,447 senior citizens, accounting for 16.7% of the population in 2017 (National Statistical Office, 2018). The higher percentage of the older populace leads to an increased number of agricultural workers. As a consequence, agricultural machinery has become a crucial factor for the current production.

The rice-growing area in the northern region is spread across the 17 provinces. Chiang Rai is considered one of the major rice-growing areas in the upper northern region. The province has a total area of 7,298,981 rai1, divided into 18 districts, 124 subdistricts, and 1,764 villages. Local administrative organizations included a provincial administrative organization, a city municipality, 72 subdistrict municipalities, and 70 subdistrict administrative organizations. Chiang Rai has a total population of 1,295,026 people, 629,960 males and 665,066 females. The topography and climate are suitable for growing rice. Most of the area is used for agricultural use, specifically 3,017,669 rai (Chiang Rai Provincial Statistical Office). A large proportion of the agricultural area is used for rice farming (1,380,902 rai), followed by other agricultural use (1,636,767 rai). In 2020, the average rice production rate was 655 kilograms per rai for non-glutinous rice and 604 kilograms per rai for glutinous rice. In this study, the researchers are interested in analyzing the factors affecting the decision to use harvesting machinery of rice farmers in Chiang Rai. The findings from this study could be used as a guideline for developing and improving agricultural technology and machinery by the government or related business sectors to suit the needs of farmers. It may also help farmers make informed decisions to choose rice harvesting machinery.

2. Theoretical frameworks and related studies

2.1 Decision making theory

Apipatchayakul (2015, as cited in Sanokham, 2019) states that the purchase decision consists of five steps: (1) recognizing a need or problem, (2) searching for information, (3) evaluating available options, (4) deciding to purchase, and (5) post-purchase behavior or post-purchase evaluation.

2.2 Demographic theory

Chapromma (2017, as cited in Udomtummakul et al., 2020) states that demography refers to the process of studying populations and population dynamics. Demographic characteristics are internal factors that influence decision-making. Demographic factors include gender, age, family characteristics, income, education, and occupation.

2.3 Related studies

Several researchers have conducted studies related to the decision to purchase agricultural machinery. For instance, Durczak et al. (2020) investigated the computer systems used to help decision-making on the purchase of agricultural machinery and tractors on farms in Poland and discovered that the computer systems ranked in order of agricultural machinery brands based on popularity which helped farmers make a purchase decision more easily. Also, buying more expensive agricultural machinery will save costs in the long term. Mottaleb et al. (2016), who studied the factors associated with the adoption of small agricultural machinery in Bangladesh, found that small machinery is inexpensive, and farmers with little production capital can afford to use them for convenience. The Bangladesh researchers also reported that water pumps, threshing machines, and walk-behind rototillers are the most commonly used machinery by farmers. Ruaipom and Buarabat (2015) surveyed the behavior and problems of fruit growers who use agricultural machinery in Thailand and analyzed descriptive statistics, namely frequency, percentage, mean, and standard deviation. The study revealed that most fruit growers own two agricultural machines with a lifespan longer than six years. The reasons for Thai fruit farmers to use agricultural machinery are to minimize labor costs and time. Similarly, Belton et al. (2021) mentioned that using agricultural machinery can increase the speed of farming activities, reduce workflow, manage risks related to weather, and reduce grain loss during harvesting.

---

[1] 1 rai = 1,600 square meters

3. Research methodology

3.1 Population and sample group

This research examines the factors affecting the application of agricultural machinery in harvesting agricultural products. The sample group used in this study consisted of 450 rice growers in Chiang Rai who used agricultural machinery to harvest their rice. Purposive sampling was used to include the samples.

3.2 Data collection

This study was conducted in Chiang Rai Province. Data were collected by interviewing 450 rice growers who used agricultural machinery to harvest rice.

3.3 Data analysis

The collected data were analyzed using the SPSS package and presented using the following statistics: First, descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to summarize the general information and behavior of farmers. The differences were subsequently analyzed by an independent t-test and F-test (One Way ANOVA). The final step was to test the correlation using Chi-Square to identify the correlation.

4. Results

The results of the study were divided into five parts: (1) general information of the study area and farmers, (2) farmers' behavior influencing them to use agricultural machinery for rice harvesting, (3) factors influencing farmers to use agricultural machinery for rice harvesting, (4) differential analysis, and (5) hypothesis testing.

4.1 General information of the study area and farmers
4.1.1 General information of the study area
1. Location and territory

Chiang Rai Province is located in the northernmost part of Thailand. It is 805 kilometers north of Bangkok. The province has a total area of 11,524.904 square kilometers and is about 416 meters above mean sea level.

2. Topography and climate

Chiang Rai's topography is classified as a mountain range in the North Continental Highland with patchy plateaus in Mae Suai District, Wiang Pa Pao District, and Chiang Khong District. As for the climate, Chiang Rai is located at the northern end of the country; thus, only slightly affected by the sea. Most of the terrain is high mountains and forests. Therefore, the temperatures in each season are very different.

3. Administration and population

The regional administration of Chiang Rai is divided into 18 districts, which are further divided into 124 subdistrict and 1,764 villages. Local administrations included a provincial administrative organization, a city municipality, 72 subdistrict municipalities, and 70 subdistrict administrative organizations. It has a total population of 1,295,026 people, with 629,960 males and 665,066 females.

4.1.2 General information of farmers

A general survey of 450 rice farmers in Chiang Rai revealed that the number of male respondents was more than female. The most common age range of respondents was between 50-59 years old. Most respondents were married and had the education level of primary school. The average income from rice farming is 30,001-50,000 baht.

Regarding agricultural production, most farmers had their own land. The physical feature of rice farms is characterized by plain fields. The most common number of workers in a household was two people. Most respondents had over 21 years of experience in rice growing.

4.2 Farmers' behavior influencing them to use agricultural machinery for rice harvesting

This study surveyed the farmers' behavior influencing the use of agricultural machinery and revealed that most farmers needed to use machinery for rice harvesting. Farmers stated that agricultural machinery can save labor costs. The most popular brand is Kubota, and the most popular type is the combine harvester. Farmers in Chiang Rai sought information about rice harvesting machinery from their neighbors and made decisions on their own. However, most farmers did not own agricultural machinery. Therefore, they had to hire the machines from a third party, which incurred more costs.

4.3 Factors influencing farmers to use agricultural machinery for rice harvesting

There are four factors influencing farmers to use agricultural machinery for rice harvesting: machinery efficiency, personal factor, marketing factor, and social and cultural factors. The overall significance level is 4.17, which is a high level. Specifically, the personal factor is the most significant ($\bar{x}$ = 4.22), followed by machinery efficiency, marketing factor, and cultural and social factors ($\bar{x}$ = 4.22, 4.19, and 4.08), respectively (Table 1).

Table 1 *Factors influencing farmers to use agricultural machinery for rice harvesting*

Influencing factors	Level of significance		Interpretation	Rank
	$\bar{x}$	S.D.		
1. Machinery efficiency	4.20	0.650	High	2
2. Personal	4.22	0.698	Highest	1
3. Marketing	4.19	0.621	High	3
4. Social and cultural	4.08	0.806	High	4
Overall average	**4.17**	**0.694**	**High**	

Source: *Calculations in this research*

4.4 Difference analysis

The difference in choosing the types and brands of agricultural machinery was analyzed with the independent t-test and One-way ANOVA techniques using the confidence level of 95%. By analyzing demographic data in comparison with farmers' choice of agricultural machinery, it was found that demographic differences, including gender, age, status, and average income, had significant effects on the types of agricultural machinery, with a significance level of 0.05, T/F-test of 3.652, 35.736, 62.610, and 33.479, and the significance values (2-tailed) of 0.000, 0.000, 0.000, and 0.000, respectively. However, differences in education levels did not have any effect on farmers' choice of agricultural machinery because the significance value (2-tailed) was 0.270, which is higher than 0.05 (Table 2).

Table 2 *Difference analysis for choosing the types of agricultural machinery sorted by demographic data*

Demographic data	Decision (types of agricultural machinery)	
	T/F-test	Sig. (2-tailed)
1. Gender	3.652	0.000
2. Age	35.736	0.000
3. Status	62.610	0.000
4. Education level	1.298	0.270
5. Average income from farming	33.479	0.000

Source: *Calculations in this study*

By analyzing demographic data in comparison with farmers' choice of agricultural machinery brands, it was found that differences in demographic data, including gender, age, status, education levels, and average income have significant effects on farmers' choice of agricultural machinery brands at a significance level of 0.05, with the T/F-test scores of -21.523, 129.501, 91.840, 116.138, and 157.426, and the significant values (2-tailed) of 0.000, 0.000, 0.000, 0.000, and 0.000, respectively (Table 3).

Table 3 *Difference analysis of farmers' choice of agricultural machinery brands sorted by demographic data*

Demographic data	Decision (choice of agricultural machinery brands)	
	T/F-test	Sig. (2-tailed)
1. Gender	-21.523	0.000
2. Age	129.501	0.000
3. Status	91.840	0.000
4. Education levels	116.138	0.000
5. Average income from farming	157.426	0.000

Source: *Calculations in this study*

By analyzing production data in comparison with farmers' choice of agricultural machinery types, it was found that differences in production data, including land ownership, the number of workers in the household, experience or period of farming, and physical features of rice fields had significant effects on farmers' choice of agricultural machinery types with a significance level of 0.05, the T/F-test scores of 3.199, 37.790, 50.299, and 181.237, and the significant values (2-tailed) of 0.002, 0.000, 0.000, and 0.000, respectively (Table 4).

Table 4 *Difference analysis of farmers' choice of agricultural machinery types sorted by production data*

Production data	Decision (Machinery types)	
	T/F-test	Sig. (2-tailed)
1. Land ownership	3.199	0.000
2. The number of workers in the household	37.790	0.000
3. Experience or period of farming	50.299	0.000
4. Physical features of the field	181.237	0.000

Source: *Calculations in this study*

4.5 Correlation test

The correlation between factors influencing farmers to use rice harvesting machinery and the types and brands of rice harvesting machinery was tested by Chi-Square Test at the statistical significance level of 0.05. It was found that demographic factors, machinery efficiency, personal factors, marketing factors, and social and cultural factors had a significant correlation with the types and brands of agricultural machinery in rice harvesting at a significance level of 0.05 (Table 5).

Table 5 *Correlation between factors influencing farmers to use rice harvesting machinery and the types and brands of rice harvesting machinery*

Correlation between factors influencing farmers to use rice harvesting machinery	Types		Brands		Results
	Chi-square	Sig.	Chi-square	Sig.	
1. Demographic data					
Gender	16.58	0.000	264.39	0.000	Related
Age	139.17	0.000	253.27	0.000	Related
Average income	94.53	0.000	242.29	0.000	Related
Education level	19.30	0.013	251.97	0.000	Related

Table 5 (*continued*)

Correlation between factors influencing farmers to use rice harvesting machinery	Types		Brands		Results
	Chi-square	Sig.	Chi-square	Sig.	
2. Machinery efficiency					
Durability	33.36	0.000	304.37	0.000	Related
Operating speed	28.53	0.000	335.88	0.000	Related
Reliability	90.00	0.000	250.31	0.000	Related
Multi-functionality	125.02	0.000	305.49	0.000	Related
Flexibility with various field features	60.86	0.000	291.27	0.000	Related
3. Personal factors					
Having large farming area	26.52	0.001	323.32	0.000	Related
Using machinery reduces workload	32.17	0.000	342.17	0.000	Related
Increased income from using machinery	83.62	0.000	263.44	0.000	Related
Machinery produces higher quality than manual workers	111.47	0.000	256.04	0.000	Related
Having more farming experience	55.00	0.000	287.82	0.000	Related
4. Marketing factors					
Price worth quality	64.04	0.000	326.71	0.000	Related
Low down payment	44.78	0.000	135.01	0.000	Related
Special promotion	110.54	0.000	264.04	0.000	Related
Credibility of manufacturer	27.13	0.000	317.46	0.000	Related

Low interest rate for installments	23.79	0.001	219.00	0.000	Related

Table 5 (*continued*)

Correlation between factors influencing farmers to use rice harvesting machinery	Types		Brands		Results
	Chi-square	Sig.	Chi-square	Sig.	
5. Social and cultural factors					
Recommended by friends or neighbors	83.25	0.000	340.81	0.000	Related
Popular in society	61.26	0.000	387.18	0.000	Related
Easy access to source of fund	78.58	0.000	334.37	0.000	Related
Higher necessity in relying on agricultural machinery	100.59	0.000	320.10	0.000	Related
Increased purchasing value of agricultural machinery	87.38	0.000	291.12	0.000	Related

Source: *Calculations in this study*

5. Discussion

According to the demographic data of the farmers who responded to the survey, most of them were males, aged 50-59, married, had an education level of primary school, and had income from farming ranging from 30,001-50,000 baht. The study revealed that differences in demographic data had a significant effect on farmers' choice of rice harvesting machinery types and brands at a statistical significance level of 0.05. The results of this study are consistent with the research by Tilokavichai and Surmsub (2020) who investigate the factors influencing the purchase decision of augmented reality cards. The abovementioned researchers reported that different levels of income resulted in different purchase decisions. Likewise, Songsraboon (2021) investigates the factors influencing the buying decision of Iris Westgate Condominium Nonthaburi and discovers that differences in demographic data result in different decisions to buy a condominium unit. However, the result of the present study disagrees with that of Yuenthon et al. (2021), who test the hypothesis between demographic characteristics and the need of elderly tourists towards hotel services in Chumporn Province, revealing that people with different marital status, education, and income levels share the same needs.

6. Suggestions

This study offers three significant suggestions for government agencies or any organizations related to the procurement of agricultural machinery for farmers. First of all, they should survey the needs of farmers and take a field study to see the physical features of rice farms to choose the appropriate type and size of the machinery. Secondly, the government should promote education and understanding of agricultural machinery and new technology. Lastly, the government should organize training courses regarding agricultural machinery operation or establish a group for sharing information and knowledge between government agents and farmers.

Acknowledgements

7. References

Belton, B., Win, M., Zhang, X., & Filipski, M. (2021). The rapid rise of agricultural mechanization in Myanmar. Food Policy, 101, 1-14.

Chapromma, J. (2017). Factors Affecting Consumer Choice of 24 Hour Fitness Centers in Bangkok, Thailand (Independent Study for a Master's Degree, unpublished manuscript). Graduate School of Thammasat University, Bangkok.

Chiang Rai Provincial Statistical Office. (2021). Chiang Rai Province Statistics Report. Retrieved from https://drive.google.com/file/d/1OW7ATSFAmT4Nm3G5N4qmEkz3XS353hzc/view

Durczak, K., Ekielski, A., Kozlowski, R., zelazinski, T. & Pilarski, K. (2020). A Computer System Supporting Agricultural Machinery and Farm Tractor Purchase Decisions. Heliyon, 6(10), 5-39.

Mottaleb, K. A., Krupnik, T. J., & Erenstein, O. (2016). Factors Associated with Small-scale Agricultural Machinery Adoption in Bangladesh: Census Findings. Journal of Rural Studies, 46(2016), 155-168.

National Statistical Office of Thailand. (2018). Survey Report of the elderly population in Thailand, *2017*. Retrieved from http://www.nso.go.th/sites/2014en/Survey/social/domographic/OlderPersons/2017/Full%20Report_080618.pdf

Ruaipom, K. & Buarabut. (2015). An Investigation of Behavior and Problems of Fruit Farmers' Agricultural Machinery Operation. Journal of Social Science, 4 (2), 25-32

Songsraboon, R. (2021). The Factor Affected to Buying Decisions of Iris Westgate Condominium Nonthaburi. Journal of Liberal Art of Rajamangala University of Technology Suvarnabhumi, 3(1), 27-36

Tilokavichai, V. & Surmsub, A. (2020). Factors Influencing Purchase Decision Augmented Reality Card. Journal of Accountancy and Management, *12*(2), 135-148

Udomtummakul, P., Supornpraditchai, T., & Khamrod, S. (2020). Demographic factors, psychological factors, social factors, and marketing mix 7Ps affecting customer decision toward fitness center in Bangkok during the outbreak of COVID-19. Panyapiwat Journal, 12(3), 25-38.

Yuenthon, N., Yaemjamuang, B., Berndt, P., Muenpaopong, O., & Chobtong, N. (2021). Hypothesis Testing Between Demography Characteristics and the Need of Elderly Tourists Towards Hotel Services in Chumporn Province. Journal of Innovation and Management, *6*(1), 139-147