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Factors affecting the adaptation of farmers affected by the urban expansion of Chiang Mai city

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Abstract It has been many affected factors in urban expansion on the agricultural sector in Chiang Mai, Thailand. The research revealed that urban expansion caused to decrease in agricultural areas, while housing projects, shopping malls, buildings, and numbers of non-local labors were increased. Farmers noticed these changes in low-level of adaptation. The five factors found significantly affected the farmers' adaptation. The farmers who gained high education, small agricultural land, in membership group, and received agricultural information from various sources, and agreed that there are changed in agriculture due to urban expansion found to be high level of adaption. Government officers should raise the farmers' awareness of urban expansion that affected on the sustainability of agricultural occupation. They should promote adaptation knowledge and provide production inputs to the farmers. Furthermore, farmer group should be encouraged the farmers to share their knowledge and experiences with others.

Keywords: Urban expansion, Farmer's adaption, Thailand

Introduction

Urban expansion has wide affected on farmers who the land within the areas of expansion due to land use is changed (Naab *et al*., 2013). This leads the farmers to alter their production processes to make them suitable for the changing environment, economy, and society. Various social and economic problems are caused by urban expansion, especially the rising cost of living (Omondi, *et al*., 2017). This usually puts the pressure on the farmers who practice traditional agriculture to change their production patterns to serve the customers' needs (Larson *et al*., 2001; Tripathi and Rani, 2018). In USA, Heimlich and Barnard (1992) reported that decreased in agricultural areas caused the farmers to change production patterns in order to increase yields and

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product value. In Japan, Tsubota (2007) found that the farmers changed from conventional to organic agriculture, while types of crops used to produce are also replaced with the new ones. Urban expansion has made farmers to adapt and continue their agricultural career.

Chiang Mai is one of the main agricultural production areas in Thailand. There are about 1,154,727 rais of agricultural land as (8.37% of total province area). There are 176,639 agricultural households or 22.57% of total household in the province (Chiang Mai Provincial Agricultural Extension Office, 2018). Settlements in Chiang Mai are in clusters resulting from the construction of ring road networks. This makes the city and its vicinities to expand along these main roads (Jongkroy and Thongbai, 2014). Such an expansion has caused to changes the local people's livelihoods. Agricultural areas have been converted to residential areas, streets, shopping centres, and other convenient facilities causing the reduction of agricultural areas (National Statistic Office Thailand, 2017). This is especially true in Muang, Hang Dong, and Mae Rim districts. From a survey by Chiang Mai Provincial Agricultural Extension Office in the production year 2000/01 to 2016/17, it was found that Muang, Hang Dong, and Mae Rim districts lost agricultural land of 57.1%, 51.7%, and 29.9%, respectively (Chiang Mai Provincial Agricultural Extension Office, 2018). The decrease of such areas in the three districts was caused by the use of agricultural areas for other purposes. Some farmers sold their land to investors to construct housing projects and shopping malls while remaining farmers had to adapt and continue their agricultural occupation.

In Thailand, there are several studies on the effects of urban expansion on the agricultural sector (e.g. Suteethorn, 2012; Tsuchiyaa *et al*., 2015; Kamal *et al*., 2016 and Sasima *et al*., 2016). However, only a few researches exploring on the farmers' adaptation to urban expansion, especially in Chiang Mai. The research aspect is necessary to bridge the knowledge gap. Thus, the present study is aimed to explore the farmers' adaptation level, their adaptation methods, and factors affecting their adaptation. Insights gained from research findings could be used by concerned government offices to effectively provide information and support to those farmers who need to adapt to urban expansion to continue their agricultural career.

Materials and methods

Data were collected in the year 2019 from the farmers in Muang, Hang Dong, and Mae Rim districts that have been affected by urban expansion. The mixed methods with exploratory sequential design was applied where qualitative data were firstly collected and used to form a questionnaire to gather

quantitative data (Creswell, 2012). Accordingly, for qualitative study, 19 farmers who experienced in urban expansion effects for at least ten years, and two agricultural extension officers from each district were purposively selected. To collect data, a semi-structured interview and focus group discussion were conducted.

For quantitative study, a sample size of 200 farmers was specified, following Yamane formula (Yamane, 1973), where there are 3,128 farmers living in the three districts. Multi-stage and convenient sampling were then used for sampling population, and locating individual farmers for quantitative study in the three districts. A structured interview with questionnaire was employed to collect data.

Qualitative data were analyzed by means where patterns, themes, core consistency and core meaning were identified. Descriptive statistics were used for quantitative data analysis including frequency, percentage, mean and standard deviation. Multiple regression analysis was also employed. In analyzing factors relating to the level of the farmers' adaptation to urban expansion, a model for multiple regression analysis is specified as follows:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10}$$

where Y = level of the farmers' adaptation based on 19 questions concerning their adaptation with the flowing scales for each question: 1 = least adaptation, 2 = slightly adaptation, 3 = moderately adaptation, 4 = significant adaptation and 5 = highly adaptation, X_1 = gender (1= male, 0 = female), X_2 = age (year), X_3 = education (number of years in education), X_4 = agricultural experience (year), X_5 = agricultural land area (unit: Rai), X_6 = being a member in an agricultural group (1 = member 0 = non-member), X_7 = yearly income (Baht), X_8 = sources of agricultural news they receive (number of sources), X_9 =frequency of contacting with agricultural extension officer (time/year) and X_{10} = attitude level of agricultural change (average score).

Results

From qualitative study, in-depth interview of 19 farmers, was found that 13 out of 19 realized the effect of city expansion. They informed that size of agricultural areas in their district decreased due to land buying (price speculation) as land price rised. Such land would become the housing project, shopping malls. Moreover, 15 out of 19 farmers viewed that number of farmers who lived in urban expansion areas decreased and there were more incoming non-local labors. Positive effect was found in production factors that purchased easily with more varieties to choose. In group discussion, it was found that

some farmers who used to do single crop farming changed to mixed crop farming. They tried to search for knowledge about organic fertilizer to reduce the cost of chemical fertilizer and became more interested in organic farming. In the interview with 6 agricultural extension officers (district level), they knew the problem and effect from urban expansion toward agriculture. They tried to find for supporting to promote the diverse agriculture to increase income and utilize in a limited land efficiently e.g. catfish farming, growing mushroom, vertical frog farming, and growing household vegetables.

Result from quantitative study (collecting data from 200 small-scale farmers working in urban expansion areas in Chiang Mai) revealed that 66% of the sampling farmers were male with average age of 59.54 years old (lowest: 31 years old and highest: 80 years old). Most of them (85.5%) had primary level of education; average experience in agriculture was 35 years. Most of them did their agriculture in irrigation areas. They have agricultural land averaged 9.32 Rais. It was 81.5% of agriculture as main occupation and yearly total income is over 60,001 Baht/year. Most of them received agricultural production news of 44.8% from district agricultural extension office followed by TV (25.2%) and radio (13.9%), respectively. Most farmers contacted with agricultural extension officers around 1-5 times per year, 73.5% belong to agricultural membership.

Urban expansion resulted in changes in many aspects. When studying opinions of farmers toward change in agricultural products, it was found that overall picture the farmers viewed in uncertain level ($\overline{X}$ = 3.33). The urban expansion causing agricultural change, they strongly agreed ($\overline{X}$ = 4.46). They viewed to change in production factors, rising production cost and factors became much available (for selling), prices of production factors were high. Their opinion were in agreeable level ($\overline{X}$ = 3.43). They viewed to change in economy, much needs for local agricultural products, product prices became high and much sell their products. But they disagreed to change in land factor ($\overline{X}$ = 2.10). In the factor of production, they gave the opinion in uncertain level ($\overline{X}$ = 3.32), they were uncertain that agricultural land decreased. They had attempted to increase yields per area and brought more agricultural technology into agricultural sector as shown in Table 1.

The farmer adaptation in urban expansion areas of Chiang Mai, it was found that, they adapted themselves in the level of least adaptation. Regarding each aspect of adaptation of farmers, there existed the following adaptation as in physical aspect, the farmers were least adaptation level of land dividing for sale, reducing growing area, let some areas for others to lease, increasing production per area, and adjust pattern to increase value by using non-dangerous chemical farming. The farmers were slightly adapted to change the

crops according to market demand. The farmers were least adaptation level in economy to change selling methods, joining community enterprise and, contract farming with agricultural business corporation. The slightly adaptation was earning extra income from non-agricultural sector such as being freelance labor.

Table 1. Opinions of farmers toward agricultural changes from effect of urban expansion

Changes	$\overline{X}$	**S.D.**	**meaning**
Productions	3.32	0.377	Uncertain
Production factor	4.46	0.527	Strongly agree
Land factor	2.10	0.574	Disagree
Economic factor	3.43	0.550	Agree
Total	**3.33**	**0.290**	**uncertain**

* remarks: criteria for measuring opinion level: Average mean: 1.00 - 1.80= strongly disagree, 1.81 – 2.60=disagree, 2.61 – 3.40=uncertain, 3.41 – 4.20=agree and 4.21 – 5.00=strongly agree.

They were least adaptation level in society to farmer group to negotiate in cooperation with state officer, building network for sharing product, information, service or cost comparing, negotiating cost of production and yields. The slightly adaptation was grouped to share the production process skill and set organization for mutual benefit in the community as shown in Table 2.

Table 2. Small-scale farmer adaptation in urban expansion areas in Chiang Mai

Aspects	$\overline{X}$	**Level of adaptation**
Physical	1.38	least adaptation
Economic	1.39	least adaptation
Social	1.44	least adaptation
Total	**1.40**	**least adaptation**

Table 3. Average mean and standard deviation of variables used in analysis

Variables	$\overline{X}$	**S.D.**	**VIF.**
1. gender	0.66	0.474	1.071
2. age	59.54	8.320	1.598
3. education	2.37	1.095	1.425
4. agricultural experiences	35.10	15.237	1.556
5. size of agricultural land	9.32	11.414	1.861
6. being membership in agricultural group	0.73	0.442	1.075
7. total income	81,225.00	154,480.876	1.876
8. sources of agricultural information	2.03	1.041	1.166
9. frequency of contacting with agricultural extension officers	2.91	2.677	1.140
10.opinion level toward agricultural changes	3.34	0.297	1.229
11. level of farmer adaptation	1.834	0.675	

Result showed a correlation between each pair of independent variables, no independent variables had correlation value higher than 0.80 due to cause multicollinearity. Variance Inflation Factor (VIF) of each independent variable, that was the least VIF value of 1.071 and the highest was 1.876. VIF of each variable was rather low (close to 1). It can be explained that no problem of multicollinearity that would violate hypothesis controlling multiple regression analysis (Table 3).

The multiple regression was analysed by entering 10 independent variables resulting F value of 9.299 and P-value was 0.00. It showed that at least one independent variable correlated with dependent variable in linear equation. The value of multiple coefficient of determination (R^2) was 0 .328. It explained that there was variation of dependent variable (which the level of farmer adaptation was 32.8%.) Among ten independent variables, five of them correlated with dependent variable at statistically significant of 0.05. They were correlated to education, size of agricultural land, membership of agricultural group, sources of agricultural information and level of opinion toward agricultural changes. The positive correlation of variables were education, membership of agricultural group, sources of agricultural information and level of opinion toward agricultural changes. The negative correlation of variable was the size of agricultural land. Result perceived that the farmers with high level of education, being membership, receiving information from several sources, had high level of opinion towards agricultural changes in urban expansion, and decreased the tendency in agricultural land areas to be adaptive more than farmers with opposite characteristics. The details are shown in Table 4.

Table 4. Multiple regression analysis of factors affecting farmer adaptation from effect of urban expansion

Variables	b	t	P-value
1. gender	-.086	-.976	.331
2. age	-.008	-1.275	.204
3. education	.095	2.154	.033**
4. agricultural experience	.005	1.386	.167
5. size of agricultural land	-.017	-3.582	.000***
6. membership of agricultural group	.201	2.125	.035**
7. total income	6.022E-7	1.686	.093
8. sources of agricultural information	.184	4.415	.000***
9. frequency in contacting with agricultural extension officers	.016	.978	.329
10. level of opinion toward agricultural change	.562	3.746	.000***
Constant value	-.364	-.638	.524
R^2= .328 **SEE = .570**	**F = 9.299**	**Sig. of F = .000**	

* Significance of statistics t < significant level 0.05

Discussion

The qualitative study found that effect from urban expansion caused agricultural land areas to be decreased because plots of land were sold for making housing projects or shopping malls. This is similar to the study of Satterthwaite *et al.* (2010) who found that urban expansion had changed value of agricultural land, causing the selling of land around agricultural areas. Furthermore, some farmers said urban expansion resulted in more income of non-local labours as found in the studies of Redwood (2009) and Kontothanasis (2017). It revealed that when urbanization expanded into agricultural areas, it would cause employment and economic activities. Some farmers affected by urbanization changed production pattern from single crop growing to mix crop farming. According to the studies of Marion *et al.* (2016) and Grothmann and Patt (2003), it was found that farmers adapted themselves by changing production pattern to meet the demand of consumers by changing process, structure and pattern style in production to increase value of yields per land areas.

In quantitative study demonstrated that the most farmers were of small-scale farmers owning small plot of land area, long time experience in agriculture career, not much potential in production due to low education, low production cost and low income. However, in social aspect, they set a group to receive news and information that many communications with relevant officers.

The research finding revealed that most farmers acknowledged the effect of urban expansion into agricultural sector but were not garantee to exist the change in areas where they grew crops. Although, they realized the effect and change in agriculture found to be low level of adaptation. It may be due to they were not much fully concerned with such situation. They were lack of knowledge in agricultural production adaptation as seen from what they should adapt i.e. development of farming areas to be agricultural tourist destination, changing channel for selling e.g. online selling, establishing community enterprise, creating social network for sharing news and information. Moench and Dixit (2004) reported that such adaptation was to reduce vulnerability which Bennett and John (1969) explained its adaptation to achieve individual goal. If such adaptation is successful, farmers would achieve their goals i.e. higher yields as they anticipated and earning high income.

The adaptations to urban expansion of farmers were significantly affected by five variables as follows: the farmer's level of education had positive affected on their adaptation. The farmers who have higher level of education tended to adapt more than farmers who have lower level of education. This may be because those who have high level of education know

how to apply adaptation technology due to their ability to get access to the information of agricultural technology that help to overcome the problem of urban expansion. The size of agricultural area affected negatively toward farmer adaptation. The farmers who have the big land areas and accepted to adapt less than those with small land areas. The farmers who own small land were more flexible to use areas for other activities without high cost of investment. This is similar to the study of Heimlich and Barnard (1992) who found that well adapted farmers were small land that near the urban area and could give high yields per area. The membership of agricultural group had positive effect toward the adaptation tended to adapt more than non-members. It implied that member in a group, received new knowledge in agricultural products and sharing skills with other members. Bennett and John (1969) and Nirathron and Piemyat (2010) explained that social network in style of farmer membership affected their adaptation. The number of agricultural sources had positive affected toward their adaptation. Farmers who received information from several sources could adapt better than those receive knowing news from less sources. Receiving information or news from several sources can make farmers get better knowledge and know more alternative ways for suitable and fast adaptation. The opinion toward agricultural changes affected from urban expansion had positive effect on adaptation. The agree level of opinion had more to change in agricultural sectors from urban expansion than those with "less agree" level of opinion. They realized the changes in several aspects of agricultural production to adapt themselves to continue a survival of agricultural career. This is in accordance with the study of Heimlich and Barnard (1992) Who found that realization of changes from urban expansion resulted to change in agricultural production and can help farmers to adapt in several aspects e.g. changing production pattern and cooperation in trading.

Result revealed that urban expansion caused the changes to agricultural sector in Chiang Mai especially decreased agricultural land. However, the most farmer group were less adaptation. They realised the effect on agricultural career, news and information including budget supporting from relevant officers. Farmer's adaptation is important to sustain agricultural career and green zone of the city. Inwood and Sharp (2012) said that farmer adaptation needed the factors in economy and social interaction.

The factors affecting farmer adaptation depended on the government policy to prevent loss in agricultural sector from urban expansion to conserve farming land and sustain agricultural career. Relevant offices should promote and support farmers about production technology to increase the values of yields suggested to develop farmers' land to be agricultural tourist destination. This should include financial support and budget to the farmers with to get low

interest rate loan. Importantly, farmers should realize the effect toward sustainability in their career, create group to help and share information among each other, including negotiating price of yields and news relating adaptation in production from various sources.

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