SMALLHOLDER FARMERS' ADAPTATION IN AGRICULTURAL PRODUCTION IN EXPANDED URBAN AREAS, CHIANG MAI PROVINCE

SUPANNIKA SUPASUB

DOCTOR OF PHILOSOPHY
IN AGRICULTURAL EXTENSION AND RURAL DEVELOPMENT

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A THESIS SUBMITTED TO CHIANG MAI UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN AGRICULTURAL EXTENSION AND RURAL DEVELOPMENT

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Examination Committee:

..... Chairman
(Prof. Dr. Buncha Somboonsuke)

..... Member
(Asst. Prof. Dr. Juthathip Chalermphol)

..... Member
(Asst. Prof. Dr. Budsara Limnirankul)

..... Member
(Assoc. Prof. Dr. Ruth Sirisunyaluck)

..... Member
(Dr. Sukit Kanjina)

Advisory Committee:

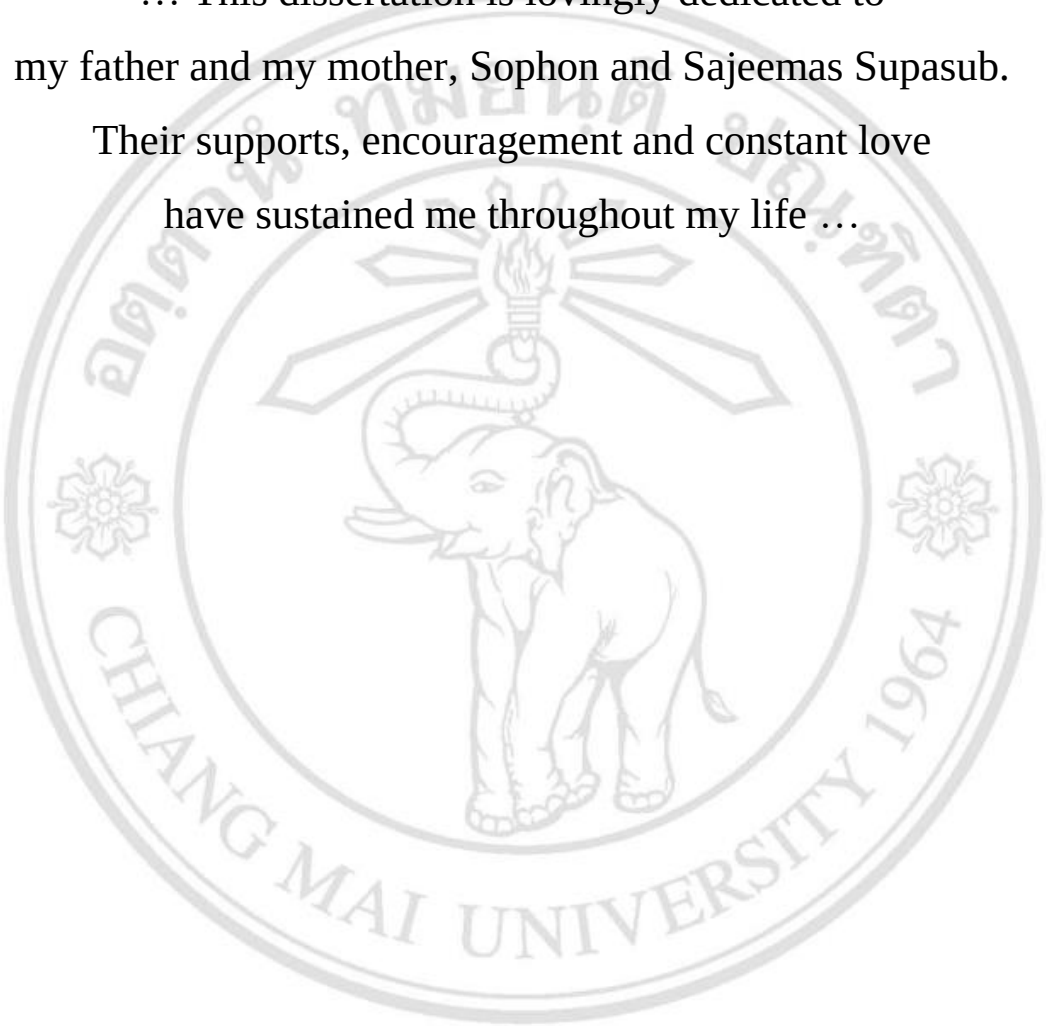
.....Advisor
(Asst. Prof. Dr. Juthathip Chalermphol)

.....Co-advisor
(Asst. Prof. Dr. Budsara Limnirankul)

.....Co-advisor
(Assoc. Prof. Dr. Ruth Sirisunyaluck)

3 April 2020

… This dissertation is lovingly dedicated to
my father and my mother, Sophon and Sajeemas Supasub.
Their supports, encouragement and constant love
have sustained me throughout my life …



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Supannika Supasub

หัวข้อดุษฎีนิพนธ์ การปรับตัวของเกษตรกรรายย่อยในการผลิตทางการเกษตรในเขตพื้นที่ขยายตัวของเมือง จังหวัดเชียงใหม่

ผู้เขียน นางสาว สุพรรณิการ์ ศุภทรัพย์

ปริญญา ปรัชญาดุษฎีบัณฑิต
(ส่งเสริมการเกษตรและพัฒนาชนบท)

คณะกรรมการที่ปรึกษา

ผศ.ดร.จุฑาทิพย์ เฉลิมผล	อาจารย์ที่ปรึกษาหลัก
ผศ.ดร.บุศรา ลิ้มนิรันดร์กุล	อาจารย์ที่ปรึกษาร่วม
รศ.ดร.รุจ ศิริสัญลักษณ์	อาจารย์ที่ปรึกษาร่วม

บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาสภาพการเปลี่ยนแปลงการทำการเกษตร ลักษณะทางเศรษฐกิจและสังคมของเกษตรกรรายย่อย วิเคราะห์การปรับตัวของเกษตรกรรายย่อยในพื้นที่ที่มีการขยายตัวของเมือง และนำเสนอแนวทางการส่งเสริมการเกษตรเพื่อการปรับตัวของเกษตรกรรายย่อยในพื้นที่ที่มีการขยายตัวของเมือง ในจังหวัดเชียงใหม่ ใช้วิธีการวิจัยแบบสำรวจ โดยสัมภาษณ์เพื่อทราบถึงสภาพเบื้องต้นของพื้นที่ทำการศึกษาจากเจ้าหน้าที่สำนักงานเกษตรอำเภอและเกษตรกรที่อยู่ในพื้นที่ขยายตัวของเมืองมากกว่า 10 ปี ใน 3 อำเภอ ได้แก่ อำเภอเมือง อำเภอหางดง และอำเภอแม่ริม ตามด้วยการวิจัยเชิงปริมาณซึ่งเก็บรวบรวมข้อมูลโดยใช้แบบสัมภาษณ์กับเกษตรกรรายย่อยที่ทำการผลิตในเขตพื้นที่ขยายตัวของเมือง จังหวัดเชียงใหม่ จำนวน 200 ราย

ผลจากการศึกษา พบว่า เกษตรกรรายย่อยร้อยละ 66 เป็นเพศชาย เกษตรกรร้อยละ 50.5 มีอายุระหว่าง 56-65 ปี โดยมีอายุเฉลี่ย 59.54 ปี ในด้านการศึกษา เกษตรกรร้อยละ 85.5 มีระดับการศึกษาในชั้นประถมศึกษา เกษตรกรร้อยละ 27 มีประสบการณ์ในการทำการเกษตรอยู่ระหว่าง 41-50 ปี ทางด้านเขตพื้นที่เพาะปลูก พบว่า เกษตรกรร้อยละ 80 ทำการเพาะปลูกอยู่ในเขตพื้นที่ชลประทาน เกษตรกรร้อยละ 63.7 ทำการเพาะปลูกข้าว เกษตรกรรายย่อยร้อยละ 45.5 มีพื้นที่ทำการเกษตรอยู่ระหว่าง 6-15 ไร่ ด้านอาชีพ เกษตรกรรายย่อยร้อยละ 81.5 ประกอบอาชีพเกษตรกรรมเป็นอาชีพหลัก เกษตรกรร้อยละ 38 มีรายได้ในภาคการเกษตรอยู่ระหว่าง 25,001-50,000 บาท/ปี ในส่วนของรายได้นอกภาคการเกษตร พบว่า เกษตรกร ร้อยละ 50 มีรายได้นอกภาคการเกษตรต่ำกว่า 10,000 บาท/ปี ในส่วนของ

รายได้รวมจากทั้งในและนอกภาคการเกษตร พบว่า เกษตรกร ร้อยละ 33.5 มีรายได้รวมอยู่ระหว่าง 25,001-50,000 บาท

ด้านการทำประกันภัยพืชผล พบว่า เกษตรกร ร้อยละ 17.5 ทำประกันภัยพืชผล และเกษตรกร ร้อยละ 73.5 ได้รับเงินช่วยเหลือจากภาครัฐ เกษตรกรร้อยละ 44.8 ได้รับข่าวสารด้านการผลิตทางการเกษตรจากสำนักงานเกษตรอำเภอ โดยเกษตรกรร้อยละ 84 มีความถี่ในการติดต่อกับเจ้าหน้าที่ส่งเสริมการเกษตร 1-5 ครั้ง/ปี โดยเกษตรกรร้อยละ 50.1 ติดต่อกับเจ้าหน้าที่ส่งเสริมผ่านการอบรมความรู้กับเจ้าหน้าที่ ในส่วนของการเข้าร่วมเป็นสมาชิกกลุ่มเกษตรกร พบว่า ร้อยละ 73.5 เข้าร่วมเป็นสมาชิกกลุ่มเกษตรกร

นอกจากนี้เมื่อศึกษาถึงปัจจัยที่มีผลต่อระดับการปรับตัวของเกษตรกร พบว่าปัจจัยที่มีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติมี 6 ปัจจัย ได้แก่ การศึกษา พื้นที่ทำการเกษตร ความถี่ในการติดต่อเจ้าหน้าที่ส่งเสริมการเกษตร รายได้รวม ความคิดเห็นต่อการเปลี่ยนแปลงในพื้นที่ทำการเกษตร และแหล่งข่าวสารด้านการเกษตรที่เกษตรกรได้รับ โดยปัจจัยที่มีความสัมพันธ์เชิงบวกกับระดับการปรับตัวของเกษตรกรรายย่อยด้านการผลิตทางการเกษตรในเขตพื้นที่ขยายตัวของเมือง จังหวัดเชียงใหม่ ได้แก่ การศึกษา ความถี่ในการติดต่อเจ้าหน้าที่ส่งเสริมการเกษตร รายได้รวม ความคิดเห็นต่อการเปลี่ยนแปลงในพื้นที่ทำการเกษตร และแหล่งข่าวสารด้านการเกษตรที่เกษตรกรได้รับ ส่วนตัวแปรที่มีความสัมพันธ์เชิงลบคือ พื้นที่ทำการเกษตร

ในส่วนของแนวทางการส่งเสริมการเกษตรเพื่อการปรับตัวของเกษตรกรรายย่อยในพื้นที่ที่มีการขยายตัวของเมือง ในจังหวัดเชียงใหม่ ควรมีการกำหนดนโยบายที่เกี่ยวข้องกับการควบคุมลักษณะการใช้ประโยชน์ที่ดิน เนื่องจากเมื่อเกิดการขยายตัวของเมืองเข้าสู่พื้นที่ทำการเกษตรมักจะก่อให้เกิดปัญหาการรุกล้ำพื้นที่ทำการเกษตรจากความเป็นเมือง หากภาครัฐสามารถกำหนดและควบคุมว่าพื้นที่ใดควรอนุรักษ์ไว้เพื่อทำการเกษตร รวมถึงออกกฎหมายเพื่อบังคับใช้ และควบคุมการดำเนินงานต่างๆ จะสามารถช่วยให้การผลิตทางการเกษตรในเขตขยายตัวของเมืองเป็นไปอย่างยั่งยืน ในส่วนของหน่วยงานที่เกี่ยวข้องควรทำการเผยแพร่และนำเสนอความรู้ที่เกี่ยวกับการปรับตัวของเกษตรกรในเขตพื้นที่ขยายตัวของเมือง เปิดโอกาสให้เกษตรกรได้สอบถามวิธีการแก้ไขปัญหา และร่วมแสดงความคิดเห็น ประเมินแนวทางที่ได้ทดลองใช้ ส่วนของตัวเกษตรกรเองนั้นควรมีความกระตือรือร้นที่จะปรับตัวและเรียนรู้ทักษะในการผลิตทางการเกษตรท่ามกลางการขยายตัวของเมือง การรวมกลุ่มเกษตรกรจะยิ่งช่วยให้เกิดความเข้มแข็งและสามารถดำเนินการผลิตแบบครบวงจรได้ นอกจากนี้ใน

ส่วนของแบบจำลองการปรับตัวของเกษตรกรรายย่อยในเขตพื้นที่ขยายตัวของเมืองจังหวัดเชียงใหม่ ซึ่งประกอบไปด้วยการนำเอา ปัจจัยทางเศรษฐศาสตร์ ปัจจัยทางกายภาพ ปัจจัยทางสังคม และปัจจัยสนับสนุน มารวมกับแนวทางการปรับตัวด้านการผลิตทางการเกษตรในรูปแบบต่างๆไปปรับใช้เพื่อเป็นแนวทางให้หน่วยงานและผู้เกี่ยวข้องด้านการส่งเสริมการเกษตรปรับใช้ให้เหมาะสมต่อไปได้

Dissertation Title	Smallholder Farmers' Adaptation in Agricultural Production in Expanded Urban Areas, Chiang Mai Province
Author	Ms. Supannika Supasub
Degree	Doctor of Philosophy (Agricultural Extension and Rural Development)
Advisor Committee	Asst. Prof. Dr. Juthathip Chalermphol — Advisor Asst. Prof. Dr. Budsara Limnirankul — Co-advisor Assoc. Prof. Dr. Ruth Sirisunyaluck — Co-advisor

ABSTRACT

This study aimed to examine the smallholder farmer's adaptation to the impact of expanded urban areas in Chiang Mai province. This is a survey research which started by interview 6 government officers and 13 smallholder farmers who have experienced with the impact from expanded urban area in Mueang district, Mae Rim district and Hang Dong district for some general information of the study area. Then used questionnaire to collected quantitative data from 200 smallholders' farmers. The result found that 66% of the farmer were male 50.5% age between 56-65 year. Average age of the farmer was 59.54 year old, 85.5% of the farmer have primary school level. 27% of the farmer have experience in agricultural between 41-50 years and the average experience in agricultural was 35 years. 80% of the farmer were planting in the irrigation zone 63.6% of them were planning rice and 17% were planting vegetables. 45.5% of smallholder farmers have agricultural land area between 6-15 Rai. For the career of smallholder farmers, the data showed that 81.5% of them working as farmer for their full-time career followed by 11% who work as employee and 67.5% of them work as employee for their part time career. Smallholder farmers 38% can made agricultural income between 25,001-50,000 Baht/year.

Moreover, the researcher found that only 17.5% of smallholder farmers have agricultural insurance. Thai government also provide some subsidy for 73.5% of smallholder farmers. 44.8% of smallholder farmers received agricultural information from District Agricultural

Extension Offices. For frequency of contacting with agricultural extension officers found that 84% of stallholder farmers contacted with agricultural extension officers between 1-5 times/year. 50.1% of smallholder farmers communicated with officers by attended to training which arranged by District Agricultural Extension Offices. In case of Membership in agricultural group found that; 73.5% of smallholder farmers were attended to agricultural group.

There were factors affecting farmer adaptation from urban expansion such as education, size of agricultural land, frequency of contacting with agricultural extension officers, total income, opinion level toward agricultural changes and number of agricultural information they receive Variables that had positive correlation were education, frequency of contacting with agricultural extension officers, total income, opinion level toward agricultural changes and number of agricultural information they receive. Variables that had negative correlation were size of agricultural land.

Guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas. The government should be restriction of land use and specified proper amount of agricultural area. Coordinate and control the accordance relevant policies about agricultural production in expanded urban area appropriately. Related organizations need to suggest secondary occupation beside agricultural career for the farmer. Promote safety agricultural production to farmers. Campaign and publicize about how to do agricultural complete production in expanded urban area. The farmer needs to gather agricultural producer's groups who farm in expanded urban area and introduce themselves to the customer to build connection between producers and consumer. Broadcasting agricultural production process to the student who have aware on safety food production in urban area as the way to create the new generation of farmers. Develop agricultural area to be an agritourism destination. Moreover, adjust their agricultural production from traditional to integrated farming and doing agricultural complete production can add more value to their products. Moreover, the researcher has created a model for smallholder farmers' adaptation in agricultural production in expanded urban areas, Chiang Mai province which include economic factors, physical factors, social factors and supporting factors combine with the

idea of smallholder farmers' adaptation from this study can be use as a guideline for related organizations in appropriate agricultural extension.

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1) วิทยานิพนธ์นี้ได้นำเสนอสภาพการเปลี่ยนแปลงด้านการเกษตร ลักษณะทางเศษฐกิจและสังคมบางประการ และการปรับตัวของเกษตรกรที่ทำการผลิตทางการเกษตร ในเขตพื้นที่ขยายตัวของเมือง รวมถึงนำเสนอแนวทางในการส่งเสริมการเกษตรให้แก่เกษตรกรที่อยู่ในเขตพื้นที่ขยายตัวของเมือง

2) ปัจจัยที่มีผลต่อการปรับตัวของเกษตรที่ทำการผลิตในเขตพื้นที่ขยายตัวของเมือง ได้นำเสนอไว้ในวิทยานิพนธ์นี้

STATEMENT OF ORIGINALITY

1. This thesis represented changes in agricultural sector from urban expansion, some of socio-economic characteristics and smallholder farmers' adaptation in agricultural production in expanded urban area including the guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas

2. In order to analyze factors effecting on smallholder farmers' adaptation in expanded urban area are proposed

CHAPTER 1

Introduction

1.1 Historical Background

Urban expansion is the result from rapid development of socio-economic and political development which can defined by the increasing of population density, business area, shelter and industries (Larson et al., 2001; Naab et al., 2013) Especially, when urban expansion into agricultural area will make change on the land use (Naab et al., 2013) and caused decrease of agricultural area for built up the basic structure for urban people. (Elhadary et al., 2013) Lack of appropriated agricultural areas are vulnerable the farmer some of them will jobless because lack of agricultural land area for their production. Urban expansion caused many effects on agricultural sector likes agricultural process, yields, quality and price of agricultural products due to the change of land use. (Naab et al., 2013).

Moreover, urban expansion has effect on agriculture marketing, land use tax that influence the farmer to adapt and make new opportunity from this change. (Larson et al., 2001). On the other hand, urban expansion brings out many opportunities to farmers who farm in urban expansion area. For example, farmers can access more agricultural inputs and changed their role from the producer to seller (Tripathi & Rani, 2018) By the way, agricultural production is one of major role in economic growth because agricultural products will be the food for the city, exchange of the product with another city and agricultural labor can alternate to be industrial labor (Tripathi & Rani, 2018)

This change directly affected on agricultural career and pressure the farmer to adapt and accepted opportunities from the change by adapt their agricultural production process from traditional into value and intensity production (Larson et al., 2001) For example, produced more yield to meet the consumer demand (Tripathi & Rani, 2018). Therefore, farmers in urban and peri-urban area must be adapt for existence by changing agricultural

production process, use more inputs, increase non-agricultural income and attend to training about agricultural production skills to gain their knowledge in agricultural production. (Hussain & Hanisch, 2014) Farmer within expanded urban area will have many patterns for their adaptation and will extremely valuable of smallholder farmers' persistence and their quality of life. (Heimlich & Barnard, 1992)

Thailand has long history with agriculture when urban expansion appeared urban and peri urban agriculture will be more extend and changes role from production to dispersion agricultural product. Agricultural area are convert to build up area, shelter and business area for urban population (Suteethorn, 2012) For example, between 1994-2012 348 square kilometers of Bangkok green area was transform to be residence area which mean Bangkok has lost 42% of its green area (Kamal et al., 2016) Similarly Salaya city, Nakorn Pathom province faced of the same change in land use. (Research Coordination Office of the Sustainable City, 2016)

In addition, the proportion of urban area and built-up area in peri-urban area of Bangkok were enlarge 126% between 2000-2009 meanwhile agricultural area in the same area were decreased 77% between 2000-2009 which have been change to built-up area (Durina et al, 2012). Urban expansion in Thailand also impacted on the change of structure of agricultural labor to be non-agricultural labor (Chankrajang, 2012)

Thailand administration is top-down centralization and low level of decentralization. Every policy is planning by the government sector in Bangkok (McGrath et al, 2014) Thai government has settle the main province in every region of Thailand to decentralization into every part of the country. Chiang Mai is the center of northern part of Thailand (Srikam, 2010; McGrath et al, 2014) Therefore Chiang Mai play a role as twin of Bangkok and being center of government management in the northern of Thailand (McGrath et al, 2014) As above mention initiate more population in Chiang Mai. In 2015 the world bank found that Chiang Mai was one of the most population density in urban area of Thailand with population density of 5,000 person/square kilometer (The world bank, 2015)

Chiang Mai is one of the main agricultural area in Thailand which separated in to 25 districts including total area 13,785,962 rai with 782,290 household and 1,154,727 rai of

agricultural area which is 8.37% of total area. Planting rice, vegetable, crop and horticulture etc. There are 176,639 agricultural household which is 22.57% of total Chiang Mai household (Chiang Mai Provincial Agricultural Extension, 2018) Water source for smallholder farmers in Chiang Mai are irrigation and reservoir for cultivation Chiang Mai urban area is cluster around the city due to the ring road network caused urban area of Chiang Mai expand along with the main road (Jongkroy & Thongbai, 2014) Most of buildup area, dwelling and department store are constructed throughout super highway road or ring road and indicated urban expansion in the area (McGrath et al, 2014) Urban expansion in Chiang Mai has affected on the change of Chiang Mai's people way of life. Many of agricultural area are transform to roads, shelters, department stores and business center these caused decrease of agricultural area. (National Statistic Office Thailand, 2017) Especially in Mueang, Hang Dong and Mae Rim district which are nearby district of Chiang Mai city center. Smallholder farmers in Mueang, Hang Dong and Mae Rim district planted rice, vegetables, fruits and some flowering-plant (Chiang Mai Provincial Agricultural Extension Office, 2018) Agricultural area in Mueang district, Hang Dong district and Mae Rim district were decreased 57.12%, 51.70% and 30% respectively between 2001-2017. (Chiang Mai Provincial Agricultural Extension Office, 2018)

There are 11,721 of agricultural household in Mueang, Hang Dong and Mae Rim district which is 6.63% of Chiang Mai's agricultural household. There are 66,394 rai of agricultural area in Mueang, Hang Dong and Mae Rim district which is 5.75% of Chiang Mai's agricultural total area. (Chiang Mai Provincial Agricultural Extension Office, 2018) From reviews on the reason of agriculture land decreased in Mueang, Hang Dong and Mae Rim district, Chiang Mai Province found that changes of land use is the major cause such as the built-up area but there still some farmers who remain and farm in expended urban area. Suspicion that how urban expansion effected to the farmer who still farm in expanded urban area and how do they adapt to the situation.

From the previous research about urban expansion in Thailand are study on the field of architecture and logistic. For example, the study of distances of agricultural product traveled from their farm to consumer in the center of Bangkok. This study aims to build

up awareness on how important of urban agriculture (Suteethorn, 2012; Tsuchiyaa et al, 2015) Bangkok is the capital city of Thailand everything in Bangkok are developed to be civilization which influence nearby province became urban area. There was a study about the effected of urbanization by using GIS to analyzed behavior of the consumer in peri-urban area where 20 kilometers away from Bangkok city center to understand the potential of the sustainable food production in expanded urban area in Bang Mae Nang subdistrict, Bang Yai district Nonthaburi province (Tsuchiyaa et al, 2015) by study on the changes of agricultural area to real estate using aerial photo graph map for prediction the green area in the future. (Kamal et al., 2016) Mostly of the study about urbanization and agriculture happened in Bangkok and nearby province due to huge changes from agricultural society to urban society (Kamal et al., 2016)

From the review literature, there are none of the study about smallholder farmers' adaptation in agricultural production in expanded urban area and the number of urban growths spread into agricultural area are increase everywhere in the world. Knowing how urbanization effected to the farmer, the change of agricultural area in expanded urban area and the adaptation of farmer in that area might be necessary. The study of smallholder farmers' adaptation in agricultural production in expanded urban area, Chiang Mai province can be an example for this phenomenon. Mixed methods research with exploratory sequential design was applied. This study aims to study changes in agricultural practice; and socio-economy characteristics of smallholder farmers in expanded urban area, to analyze smallholder farmer's adaptation strategies in expanded urban area, and to develop the guideline on agricultural extension for adaptation of smallholder farmers in expanded urban area. Finally, the result of this study can use in agricultural development plan in urban expansion area for related organizations. Smallholder farmers who stay in urban expansion area in another place can use the result for adaptation on their farms.

1.2 Research question

How urban expansion impact on agricultural sector and how do farmers adapt to urban expansion?

1.3 Objectives

1. To study changes in agricultural production and some socio-economy characteristics of smallholder farmers in expanded urban areas in Chiang Mai province
2. To analyze smallholder farmers' adaptation in agricultural production in expanded urban areas in Chiang Mai province
3. To develop the guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas in Chiang Mai province

1.4 Expected Benefits

The result of this study can use will be classify to present as a guideline for everyone who involve in agricultural sector such as farmers, related organization and government; as following details.

Farmers who farms in expanded urban area can use the idea of adaptation in agricultural production in expanded urban area from this study for their own farm which can help them to sustain their agricultural career.

Related organizations will use the suggestion from this study to do extension for the farmer who farm in expanded urban area and they can give the right and proper advices about how to adapt their agricultural production for the farmer.

Government can use the result from this study to release new policy which is helpful for farmers who farm in expanded urban area to adapt on their agricultural production. Government should specify proper operation for related organization and legislation some law which can prevent agricultural land from urban use.

1.5 Conceptual Framework

The study of smallholder farmers' adaptation in agricultural production in expanded urban area, Chiang Mai province has conceptual framework as following figure

Conceptual Framework

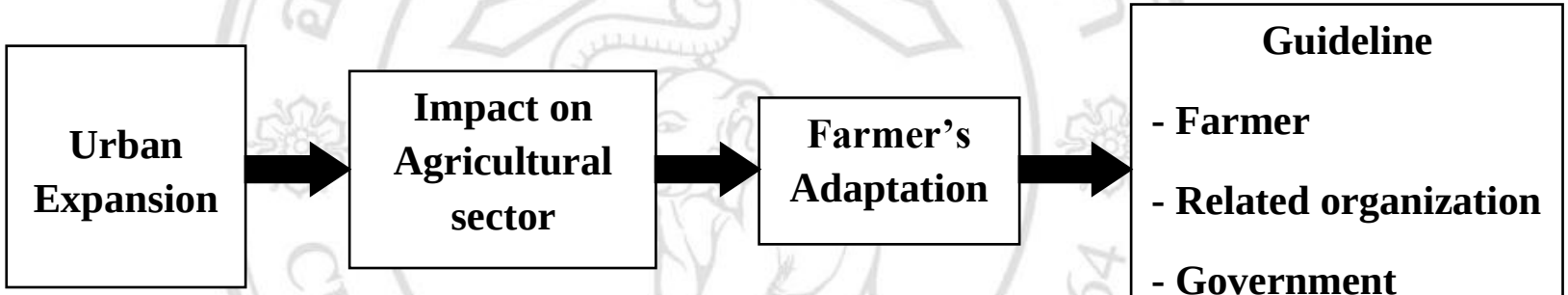


Figure 1.1 Conceptual Framework

1.6 Definition

Smallholder farmer farmers who registered with Chiang Mai Provincial Agricultural Extension Office.

Farmer's Adaptation means the way that farmers changed their agricultural process or some behavior which influences to their agricultural career. This adaptation can divide into 3 types physical, economic and social.

The change means the transformation of agricultural sector from urbanization which can classify into 4 types the change in agricultural production process, the change of agricultural inputs, the change on agricultural land and the change in economy.

Expanded urban area means the area in Mueang district, Hang Dong district and Mae Rim district which have varieties land use in both agricultural and non-agricultural land use. This area should have population density between 491-2,463 people/ square kilometers and still have agricultural area remain.

CHAPTER 2

Literature Review

The study of smallholder farmers' adaptation in agricultural production in expanded urban area, Chiang Mai province the researcher did literature review in related topic such as adaptation theory, definition of adaptation and types of adaptation. Another related topic is expanded urban area and its effect on agricultural sector, urban expansion of Chiang Mai and the study that related to expanded urban area and agricultural sector. This chapter will present the meaning of urban and urban expansion, urban expansion with agricultural sector, urban expansion in Chiang Mai province, meaning and characteristic of adaptation, farmers' adaptation strategies, laws and policies which related to urban expansion and agricultural sector and related research as the following details.

2.1 Urban Area and Urban Expansion

The development of technology and infrastructure have been rising nowadays which made people livelihood are more convenient. The development of land also made change on land use which can be built-up areas. However urban area and urban expansion have specific meaning and characteristic as the following details

2.1.1 Urban Area also known as the area with high population density like a community and most people in this area are not farm including the administrative center of the city. Urban area must be civilization and many roads connect to nearby area. As the physical characteristics mentioned above are made urban area different from rural area The United states of America specify that urban area should has 2,500 people/square kilometers. Municipality in Thailand specify for the area which has 10,000 people and named this area as an urban area (Nurat, 2010; Phunchana, 2010) There are 3 indictors to specify urbanization as follows

- Population density per square kilometers

- Proportion of population in municipal area for instant there will be at least 5 million baht of annual government statement of expenditure with more than 7,000 people/square kilometers which has 1,500 people/square kilometer of population density for subdistrict-municipal

- Land use in urban area will be less for use the land as an agricultural area and will have built up area like shelter, department store and business area (Treewanchai et al., 2014)

2.1.2 Urban Expansion is the result of socio-economic and political development which appear by the number of population and expanding of urban boundary then make change on land use. (Madsen et al., 2010; Zasada, 2011; Naab et al, 2013) Urban expansion caused changes in every aspects of the city that are physical, economy and environment aspect (Naab et al, 2013)

Rapid of world's economic growth, global gross domestic product, industrial labor and services lead to the rise of population in urban area howsoever numbered of population not only increase by economic growth but can raise by natural like birth rate. Apparently, China has very high in economic growth but low birth rate. Rise of Chinese population are from the urbanization. On the other hand, the country in Sub-Saharan which has low economic growth the growth of population is from birth rate. (Satterthwaite et al, 2010)

2.1.3 Urban Expansion and Agricultural sector; rapid urbanization can cause many problems as a domino effect. For example, rapid population density incurs lack of food in urban area. (Omondi et al., 2017) Urban pressure on agricultural sector and the development with efficiency are the main reason for smallholder's farmers adaptation (Zasada, 2011) even though the population can access food but it is might be not clean, low quality, less nutrition and effect to consumer's health (Kontothanasis, 2017) Urban expansion made change on consumer demanding dur to the rise of population and trend of consumption resulting in agricultural changes to meet the consumer needs which can indicate the level of food security of that city. Moreover, urban expansion can raise land price and trading will occur nearby agricultural area. (Satterthwaite et al, 2010) Farmers

who farm in expanded urban area will change their behavior depend on the potential of the adaptation. Due to their planting area will surrounded by urban development influence the farmer to adapt. Finally, farmers will react to urbanization and accept new way of agricultural production which impact from urban expansion (Zasada, 2011; Henke & Vanni, 2017)

Meanwhile, urban expansion also effects on farmers who farmed in urban area. For example, there are many farmers in European countries who farmed in expanded urban area need to created variety of agricultural practices to produced more income likes accepted new types of plants and try to increase the quality of their products then direct sell it. (Busck et al, 2006) Farmers in south-eastern of Pennsylvania, USA have to change their agricultural production from traditional agricultural production to intensity agricultural production by self-operation on the process and add more labors in their farm (Larson et al, 2001) Increasing of population caused the growth of land price which also effect to land tax that hard to reserve their agricultural land. Farmers in south-eastern of Pennsylvania, USA try to adapt by sell low yield land and keep only the higher one. On the other hand, urban expansion also brings hope and opportunities to farmers (Heimlich & Barnard, 1992) It is also said that urban expansion has influences farmers on physical, economy and social side.

- Physical; when urban area expanded into agricultural area it is result more green space in urban area (Urban Development and resilience unit, 2013) which help of sustainable development due to growth of the city expand to agricultural area then impact on development of sustainable agricultural production and result to food security and produce long term sustainable in socio-economic and environment. (Darmawan, 2016) Urban expansion has clearly affect to the change in environment such as changes on land use and infrastructure (Lovell, 2010) By the way, there were some negative effected from urban expansion on biophysical and agricultural resources like the disperse of land use (Gomes et al, 2019) Moreover, farming in peri-urban area will cause competitive in land use and marketing with non-agricultural land use especially on the land price (Zasada, 2011)

- Economy; Urban expansion to agricultural area created many of economic activities (Redwood, 2009; Kontothanasis, 2017) and solve poverty problems (Urban Development and resilience unit, 2013) However, there were some issues with people who live in peri-urban area such as underemployment in some area which happen with people who can find a new job. It is also said that urban expansion has pressure on people who farm in expanded urban area and can only create agricultural income (Le & Dung, 2018)

- Social; Agricultural production in urban area can help woman role more than only a housewife into a producer that produced food for the family (Olivier and Heinecken, 2017) and have more opportunity in grouping of the farmer and society. (Urban Development and resilience unit, 2013)

2.2 Urban expansion in Chiang Mai province

Concentric pattern is the pattern of urban expansion in Chiang Mai which is urban area expanded as ring's shape started from the center of the city. There are very dense in the center of the city and spread along with the road. Roads will separate the area into section. This kind of pattern will produce strong point to the city because every part of the city will be useful and easy for city planning. By the way there are some bad points for this pattern which is traffic because every road lead to center of the city and people need more time on crossing the city

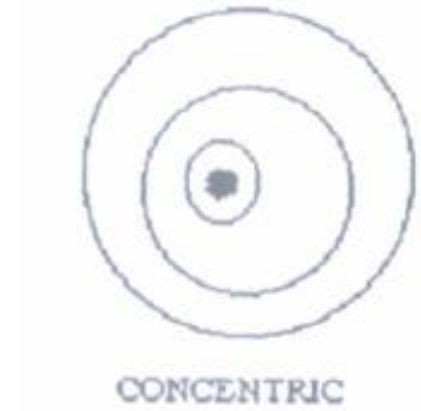


Figure 2.1 Concentric pattern of urbanization

Chiang Mai has known as one of the most important cities with highly develop rate in Thailand. Chiang Mai play a role as the center of cultural and economy with being in the fourth ranked of population aspect and also full with history and cultural in the northern of Thailand (Chiang Mai Municipality, 2014) There were a lot disperse of urban expansion in Chiang Mai especially in agricultural area. Rapid of urban expansion in Chiang Mai without support plan to oppose with made change on urban condition in 3 categories such as urban spatial, urban social and urban political which cause change on land use and inequality of economy and class. (Auttarat, 2014)

Chiang Mai has cluster type of urbanization by enlarged along with department stores and official places on the ring road network. Factors effecting on urbanization of Chiang Mai are good environment factor and factors on the change in land use from agricultural to non-agricultural (Shummadtayar & Ongsavangchai, 2018)

There was no direction with urbanization in Chiang Mai plus no specific rules for land use which caused varieties of urban expansion. But in 2008-2018 found that there was some urban planning for Chiang Mai and grouping shelter's area. Apparently, urban expansion in Chiang Mai province were dispersed from the center of the city and made Meaung district are very urban and extend one's influences to nearby district (Chiang Mai Municipality, 2014; Shummadtayar & Ongsavangchai, 2018) which are Saraphi district, San Sai district, San Kamphaeng district and Mae Rim district due to adjoining area. The population were increased, more traffic, numbered of housing development and department store in this area. Nevertheless, the researcher has compiled the information about urban expansion in 3 districts where the research was conducted as following details.

- Meaung district has high density of urban expansion especially in Mae Hiya sub-district, Suthep sub-district, Pa-Deat sub-district, Fah-Ham sub-district and Pa-Ton sub-district. There are many high buildings in the form of dormitory to support the customer demand. Urban expansion of Chiang Mai is spread into agricultural area along with the ring road which influences to land use.
- Mae Rim district disperse of urban area are along with the road and made change on the land use from agricultural area transform to housing development. For example, in

Rim Nuea sub-district, Rim Tai sub-district and Mueang Kaeo sub-district were found that many housing developments were built-up and has changed on land use from agricultural area to business and service area

- Hang Dong district has a lot of housing development along with Chiang Mai-Hang Dong road and also along with the irrigation canal such as Nong Khwai sub-district, Hang Dong sub-district and San Phak Wan sub-district have more department stores, convenient stores and business establishments.

(Chiang Mai Municipality, 2014; Shummadtayar & Ongsavangchai, 2018)

2.3 Adaptation

2.3.1 Definition of adaptation; the effort to attempted, solve and survive from problems even it is physical problem, demanding or emotional problem and able to live in its environment. Good adaptation's plan will happen when someone adapt and able to live in the environment with pleasure. There is a goal in every of adaptation such as success in their work, survive, step across the threshold or the limit. There are 2 plans in adaptation as following detail. (Nirathron & Piemyat, 2010)

- Primitive Adjustment is the old way of adaptation which has only 2 choices; against or retreat it for adapt. For example, someone will fight against trouble or else retreat that problems.

- Modified Adjustment is an adaptation with appropriate adjustments or in accordance with problems and situations. Solving problems and change of behavior will be apply in this kind of adaptation.

Adaptation can be summoned as coping mechanism or associate with people or material resources to achieve the goal and resolve the problem. (Bennett, 1969)

2.3.2 Adaptation process will be including level of adaptation and appearances of adaptation.

2.3.2.1 Level of adaptation; the level of individual adaptation process can divide into 2 level which are conscious attempt of adaptation and unconscious attempt of adaptation.

- Conscious Attempt of Adaptation can perform in 2 way which are try more to win the obstacle and reach the goal, change the goal if this goal is too hard to reach.

- Unconscious Attempt of Adaptation; when the person faced with problems and cannot solve it, they will find the solution by using mental mechanism or self - defense mechanism.

2.3.2.1 Appearances of Adaptation can divide into 2 appearances

- Complete adaptation; happened when a person face with the problems and can solve the problems b themselves and feel relief after they coped with it.

- Incomplete adaptation; happened when someone face with the problems and cannot solve it but they can decrease stress from that problems and still worried about the problems.

2.4 Farmer's Adaptation strategies is divided into 2 types; vulnerability reduction and long-term development (Moench and Dixit, 2004) which need two level of consideration in farmer's adaptation strategies (Bennett, 1969)

- Fullfilment personal goal; Farmer will reach their goals after adapted like having right amount of production and income.
- Preserve the natural resources; Natural resources is one of the most important things for farmer's livelihood. Farmer who succeed in socio-economics' purpose however create negative impact on the environment may considered as adaptation on one side or one dimension which not the right adaptation or maladaptive.

The most important issue for farmer's adaptation strategies is they should maintain proper balance of socio-economy benefit and environment preservation to remain the sustainable in their livelihood (Bennett, 1969) Adaptation behaviors are option which farmer will

deciding on alternative but some of them will not have much option in practically. Thus, opportunity costs will be involved in the farmer decision like decide to use resources, determine on their agricultural production process. Therefore water, land, labor and investment in agricultural production can counted as opportunity costs (Bennett, 1969; Nirathron and Piemyat, 2010) There are four condition that influence the farmers' adaptation strategies as the following.

- Farmers are able to use limited natural environment such as water resource or land efficiently
- Farmers are able to decrease their production cost and increase their income
- Farmers interaction with their society and other farmers to exchange their knowledge or compare their production cost with each other
- Government has policies to support and ministration the farmer in every step of their production process (Bennett, 1969)

According to Chiotti whom presented four factors effecting on farmer's adaptation strategies

- Atmosphere like soil, rainfall and weather
- Social such as personal characteristic, economic and marketing conditions
- Economy such as cost, benefit, income and expense
- Contribution from government and related agencies (Chiotti et al, 1997; Suta et al, 2014)

Socio-economy characteristic is one of the most affect factors on farmer's adaptation strategies Those socioeconomic characteristics are include education level, household income, experience in agricultural field and frequency of contact with government agricultural extension officer (Uddin et al, 2014). As a result, it can be concluded that farmers' adaptation strategies consist of four main factors which are physical and environmental factor, economy factor, social factor and government policy which support their adaptation strategies. Of the existing study about the persistence of agricultural land and adjustment from rural to urban in issue of inheritance and adaptation of their farm

found that farmers need economy factor, local culture, land ownership, social interaction and natural resource to help in farmer's adaptation (Inwood & Sharp, 2012)

Farmer's adaptation can be express as transform agricultural production to meet the consumer demand by changing the process and the structure of their agricultural production then farmers will gain potential and benefit. (Marion et al, 2016; Grothmann and Patt 2003) Adaptation in science field always related to capability and capacity of adaptation which involves coping and enduring in uncertainty situation. (Marion et al, 2016) There are two types of farmer's adaptation as following;

1. Enthusiastic Adaptation is an adjust which happen promptly divide into 3 forms

- *Unforeseen adaptation* is the adaptation that farmers have plan to coping with the situation by using details from the environment to make the decision.
- *Flexible adaptive with plan and option;* for example, farmers always plan to protect detriment in agricultural process. This kind of adaptation include predictable and resolve scheme.
- *Pressure adaptation* happen when the farmer has a plan to manage their adjustment and using period to cope with the changes.

2. Responsive Adaptation Farmers will adapt after the changes; divide into 3 forms;

- *Slowly adaptation* is a gradually adaptive by observe the external changes then anticipate the proper situation
- *Arrange the problem then making the decision;* Farmers will sort the difficulty and choose a suitable way to adapt.
- *Resolve the problem making a new plan;* search for appropriately way to adaptive by fix the rules or making new plan after discover the change.

There are some concepts in farm adaptation as the following

- Adaptation strategies and decision making for the whole farm. This is a long-term of adaptation to succeed in agricultural production depends on resources and farm structure
- Adaptation with tactics divide into two form

- Adaptation for agricultural season and the farm. Farmers will consider on agricultural seasons, production techniques and estimate the cultivation to find decent way for adaptation within the change of environment
- Daily adaptation; Farmers will monitor present situation. Process in agricultural production can cancel, transform and fix along with the situation.

- Subsequent Adaptation; Farmers will use critical and tactical planning before making the decisions for adapt (Marion et al, 2016)

2.5 Agricultural policies in various countries

In the United State of America most of farmers satisfied with differential assessment laws which include preferential assessment, deferred taxation and restrictive agreement (Keene, 1977; Larson et al, 2001). Preferential assessment makes tax allowance on their farmland base on farm use value instead of land market value then deferred taxation is an add on policy for pay some tax on their conversion and the restrictive agreement can produced time for farmers to planting on their farm before convert the land to non-agricultural land (Keene, 1977). Moreover, agricultural security areas, agricultural zoning and right-to farm are the policies that farmers in expanded urban areas can take advantages (Larson et al, 2001).

Western countries such as France, Italy and Algeria law about peri-urban farmland protection always use to prevent agricultural land (Perrin et al, 2016). By the way land fragmentation in many countries of Europe is the result from more population density and lack in land use management. In northern Europe the government must focus on land use planning which control of agricultural land fragmentation and population density at the same time (Oueslati et al, 2014) this policy also uses in Japan (Sioen et al, 2018). In Japan the government made a city planning to control the land price and land use, the city must be zoning and separate in two sections urbanization promotion area (UPA) and urbanization control area (UCA) and made the line between these two areas (Tsubota, 2007). Farmers in UPA can convert their land to non-farm use without asking for the

permission from Agricultural land law. By the way the farmers in UPA have to pay tax as the residential land (Tsubota, 2007; Sioen et al, 2018).

Land use planning is playing a major role when study about the way to mitigate the effect of urban expansion to agricultural area for example in Vietnam, China, Ghana and Malaysia the government concerned about urban growth and protecting agricultural area. (Siciliano, 2012; Elhadary et al, 2013; Naab et al, 2013; Pham et al, 2014)

In Thailand there are some policies about urban expansion and agricultural sector. Thai government try to produced more opportunity for the farmer to have their own agricultural land and improve farmer's income by support the entire of sustainability agricultural area started from set more condition about the allocated agricultural area to the poverty farmers. Preventive measure on the high quality of agricultural area and extend opportunity to access limited of their agricultural land. Constraint form Parliament act of agricultural land preservation and land management system. And protect the proper area to create agricultural production-based area and give support for the farmers to farm related with quality of soil, quantity of water resource and the demand of consumer. Moreover, Thai government also try to help the farmer to create non-agricultural income, produce more knowledge and let the farmers access to information technology and knowledge management system in agricultural knowledge. Improve and update agricultural law such as agricultural chemical legislation, co-operation law, agricultural land reform, food law and related law about agricultural production standard (The Twelfth National Economic and Social Development Plan, 2017)

Moreover, Ministry of Agriculture and Cooperative collaborated with Department of Agricultural Extension were announced some policies for spreading agricultural knowledges and agricultural information service for farmers in a role of education center to increase efficiency of agricultural production. There were many services from the education center for farmers such as soil analysis and household accounting. This education center will include petition and solve problems service for the farmer and use the area around the center to be an example farm which can give information for the farmer this will conform with the way to plant in expanded urban area (Ministry of

Agriculture and Cooperative, 2018). Comprised with agricultural production and management for produced agricultural products through the supply chain to increase efficiency of the production, decrease production cost, improve product quality, add value and connect the market with products. Moreover, allow farmer to produce their agricultural products along with potential of the area by using zoning method to specify the proper area for each product (Department of Agricultural Extension, 2017)

2.6 Related research

The study about planting under urban pressure when it comes to decrease of agricultural area and changes in land use. The data of decrease agricultural land and changes in land use of 2010 were used to predict the result in 2025. This study aimed to develop cognitive orientation in the decline of agricultural land and changes of land use in peri-urban context. In additional to understand how state of social, economy, environment and planning influence to framer's intention in changes land use and how spatial characteristic effect to this phenomenon (Gomes et al, 2019)

A study of farmer's decision to investment in agricultural production which effected from specific green area in Southern Ontario by interview with 21 farmers whose farm were in peri-urban area. The result found that there were three sources that influence to farmer's decision; Farmers' mental map, decode from the interview. Ontario's Greenbelt can be the first step in land use planning to prevention agricultural area. The efficiency way to preserve agricultural area should include another role from supply chain who can help the farmer to access to the market and provide agricultural technique, information to farmer (Akimowicz, 2016)

A survey about the character of farming in peri-urban area in Italy by compare spatial analysis from 7 different areas and evaluate the change in farm's structure at micro level from 6th of agriculture's census in Italy. The result found that six types that focus on the market were confront with pressure and opportunity from urban influence. Responsive farm is increase which cause social diversity and economy service for the number of urban populations. Risk management became to one of business strategies which lead the

farmer to the market these can improve flexibility of metropolitan area and normal area that can connect the urban with the rural (Henke & Vanni, 2017)

A study about multifunctional of agricultural in expanded urban area in Trau Quy province, Hanoi, Vietnam. The researcher collected questionnaire from 60 farmers who have non-agricultural activities along with agricultural activities. The result found that the different level that farmer maintain on their own farm resulting them being multifunctional such as income distribution, new occupations, land conservation, food security, food safety and social interaction. The more proper condition to development agricultural area will create more functions of agricultural in expanded area (Le & Dung, 2018)

The study of geography of farmer's adaptation in peri-urban started from conceptualized a model and geo-modeling of four suburban farms in the United States through interviews with agricultural households. Focused on placement peri-urban farmers as one of the conditions for industrial development and farmers marketing. In this study framework will focus on the food system which will be an important goal in food development in the study area (Clark & Munroe, 2013)

There is a study about farmer's adaptation in urbanization in United States of America. This study divided the type of adaptation by sort of farm and used spatial analysis to analyzed the data. It's resulted that urbanization is one of the most important influencers with agricultural area. Mostly farm in urban area has small scale and has ability to produce more yield per acer. Large number of farmers are switch their role from producer into seller and use intensity agricultural production. Farmers in urban area has more stable of finances than farmers who farm in rural area. (Heimlich & Barnard, 1992)

Urban expansion effect on both problems and opportunity on agricultural sector such as farmers can access good quality of inputs, government agencies will take control on land tax and land use which pressure on framers to adapt for making changes. (Heimlich & Barnard, 1992) In this study, researcher divide into 3 types of farm; recreational, adaptive and traditional. Farm appearances are depending on farm resources. The result of this study is as following. Adaptive farms are the farm that has intensity agricultural

production with high yield of production and trading cooperation. Traditional farms are increase the cost on agricultural production with pressure on farmers in case of working hard but get the same paid. Recreational farms are the biggest type of farmers in America which use non-agricultural income to maintain their farm. (Heimlich & Barnard, 1992)

The study of farmers adaptation from rural to urban and the remain of agricultural area in United states of America case study of succession and adaptation. This study aims to know how the farm succession analyzing by heir. Face-to-face interview is the main research instrument from 51 agricultural households using snowball sampling. Voice recorder will record the interview then analyzed the data by an expert simultaneously with qualitative research analysis program. This research focused on the analyzed in socio-economic characteristics of the household and it is result that the heir of agricultural work can be divide into 2 types; First, no heir which is the group that has low growth rate with their agricultural business but still has motivation to adapt. Second type is descendant which can be separate into 3 form; extend their farm, increase yield of their agricultural product and develop to be entrepreneur. (Inwood & Sharp, 2012)

In south eastern of Pennsylvania, United states of America; Larson was study about effected from urbanization on agricultural sector. This study focused on how the urbanization effected on agricultural sector (Larson et al, 2001) Mail survey is the main research instrument collect data from 300 farmers and use multinomial logit models to test the change of land use, questions for this study are as the following

1. Does farmers change to be high-value enterprise?
2. Does farmers use their planting area for non-agricultural activities to respond consumer need?
3. Farmers sell their land for non-agricultural use and get the reasonable price?
4. Any public policy that preserve agricultural area to contain planting area in the city?

The main focused of this study are change in agricultural production, selling agricultural land for non-agricultural activities, Any farmers want to buy more land to produce more yield and meet the consumer needs, Projects and activities that can preserve planting area (Larson et al, 2001) Question about the farm type, change in land use and develop to an

entrepreneur, policy about land use and farm labor. Indicators which can prove that urbanization has affected on agricultural sector are the change of agricultural production from traditional to intensity and high quality. The result of this study is mostly of farmers in south east of Pennsylvania operate traditional agricultural production and adapt to the urbanization as the following

1. Manage every process in farm by themselves
2. Set up their own retail shop
3. Land-extensive cash cropping
4. Direct livestock sales
5. Supplemental employment
6. Separate their land into single lot for planting
7. Engage in non-traditional enterprise such as set up farm tour, direct sale (selling the product at their farm will get more income
8. non-farm income
9. Trading their land to increase planting area and speculate the land price

Growth of population density and policy that help in preserve agricultural land influence farmers adaptation. More population made change in land use from agricultural use to other then the government set the policy that can preserve agricultural area and remain the green area in the city. Another policy that assist farmers to cope with the change on agricultural production is an agricultural security areas project which can produce more yield and extend agricultural area. (Larson et al, 2001)

The study of effect from agricultural activities on urbanization case study of India. The objectives of this study aim to know about the role of agricultural sector in urbanization process in India. From related theory linked effect of agricultural process to urbanization with the type of its economy (close/open economy). Some theory mentioned that agricultural process can have positive effect on urbanization in close economy but give negative effect on urbanization in open economy. (Tripathi S. And Rani C., 2018) Population of the city states as control variable in this study. Yield of agricultural product and growth in gross domestic product are independent variables to indicated agricultural activities by used Matsuyama's theoretical framework and panel data model. The result

of this study found that when agricultural activities are increase the level of urbanization will decrease or in other words agricultural activities can decrease depends on the number of urbanization evident from decline of agricultural area. On the other hand, cost of agricultural production has positive effect on urbanization. Number of agricultural productions can further when government subsidize on the cost of fertilization. Higher yield of agricultural production will provide food for the city. Migrated from rural to urban is one of the most important reason with level of urbanization (Tripathi S. And Rani C., 2018)

The study on dynamic of agricultural development and farmer's adaptation behavior in megacity of Hyderabad, India both qualitative and quantitative data collected from 120 farmers by semi-structure interview for qualitative data. Quantitative data scale the change of cost and inputs. Propulsion of the farmer change can define by qualitative data. Factors affecting to farmer's adaptation are pressure on population, increase of land price, agricultural use on land, renting rate, migration, lower of agricultural income and the knowledge of urban agriculture. Farmers adapt by sharing family labor, change sort of their product, intensity agricultural production. By the way urbanization also pressure on environment such as dropped of agricultural land, increase of the land price, decline labors and inputs cost higher (Hussain & Hanisch, 2014)

Agricultural area in Japan has divide into 3 zones such as agricultural land use area, urbanization promotion area: (UPA) and the rest. Since 1990, farmers in urbanization area of Japan are adapted to organics agricultural process, changed type of plant such as decided to produced vegetable instead of rice, direct sale, sending agricultural products to the department store or school to provide food for the student, search for non-agricultural income and development agricultural area to agritourism destination (Tsubota, 2007) Most farmers who farmed in urban area are expert in planting in limited area and focused on direct sale their product to nearby customers and try to produced high quality of agricultural product. (Sioen et al, 2018)

Agricultural area in Hanoi, Vietnam has influential from urbanization by changed the land use from agricultural area to industrial place, shelter but still remain some area for using

as agricultural area. Farmers in Vietnam try to gain more non- agricultural income and developed their agricultural area to agritourism destination (Pham et al, 2014) Urbanization immediate to the form of agricultural area evidenced in agricultural area where it is close to urban area will have small area and also produced rice, corn, vegetables and flowers. Pham was study by used the satellite images to classify land use in Hanoi by divide the area into built-up area, agricultural area, water resources and vacated area to analyzed relation between the change in agricultural sector, land use and the growth of urbanization. (Pham et al, 2014)

Agricultural area in the north of China also effected from urbanization since 1980. There were extend irrigation area and try to find the best way to managed their farm to reached highest efficiency of their own farm (Han et al, 2018) There were more of agricultural enterprises to meet consumers need in urban area (Siciliano, 2012) Urban expansion can provide opportunity to farmers and decreased the lack of agricultural labor. The government invested in agricultural extension for farmers to produced more yield and value in the process. (Jiang et al, 2013) From this details can summarized that urbanization created innovation and technology which efficiency and increase more yeild (Deng et al, 2015)

Farmers in Seberang Perai, Malaysia have 2 way of adaptation strategies to urbanization which are negative adaptation strategies such as abolish agricultural area to sell their land for built-up area and positive adaptation strategies by change their process from traditional to value production and change from planting rice to short growth duration due to it has short cultivation time and has better price. Moreover, most farmers in Seberang Perai, Malaysia also try to created non-agricultural income (Elhadary et al, 2013)

Urbanization impacted on agricultural land use in urban area of developed countries in case study of Tamale, Ghana aimed to study about impacted on agricultural land use from rapid urbanization. This study applied mixed method research to collected the data. Questionnaire was the research instrument in quantitative data collection with farmers who farmed in peri-urban area of Tamale, steps are as follows;

- 300 questionnaires are conducted by simple random sampling
- Qualitative data collected by visual observations on daily agricultural land use
- institutional surveys
- key informant interviews

This study found that rapid urbanization caused trading and requirement on business land use. Due to urban expansion heir of the farmer will change from use the land for agricultural to be built-up area, infrastructure because it produced more benefits this effected to decline number of farmers and agricultural labor. However, urbanization has negative pressure on farmers who has poverty problem. Government has to create a policy which preserved agricultural land to maintain farmer career. (Naab et al, 2013)

Many countries in Africa such as Kenya, Ethiopia, Rwanda, Malave and Mozambique have many changes on land use dur to the impacted from urbanization. Distanced farm still relies on themselves. Farmers has more skill and knowledge to adapt their farm into entrepreneur in the farm that closed to the city. Information from the conference of the international counselor of agricultural research which including 25 agricultural developers who expert in both development of physical and social. Agricultural in urbanization can divide into 3 categories, as following

1. Produced to support their life or they named it subsistence. Farmers produced agricultural product for family consumption farmers will use less inputs due to they didn't expect to sell their product. Mostly of farmers in this category are women in poor family and have limited land area.
2. Produced for commercial they always use high quality for inputs. Farmers in this category will have skills and knowledge on their cultivation. Product will be participated in food chain. They will access more opportunities in trading. Farmers can access to source of investment funds for renting or buying planting land and they will be created non-agricultural income.
3. Transitional category, Farmers will abandon their agricultural area. Mostly of the farmer in this category cam make income from agricultural. To decline agricultural career in their goal and change to do another career instead of farmer

by using agricultural income to help them reach their goals then collect more income from other career.

(Masters et al, 2013)

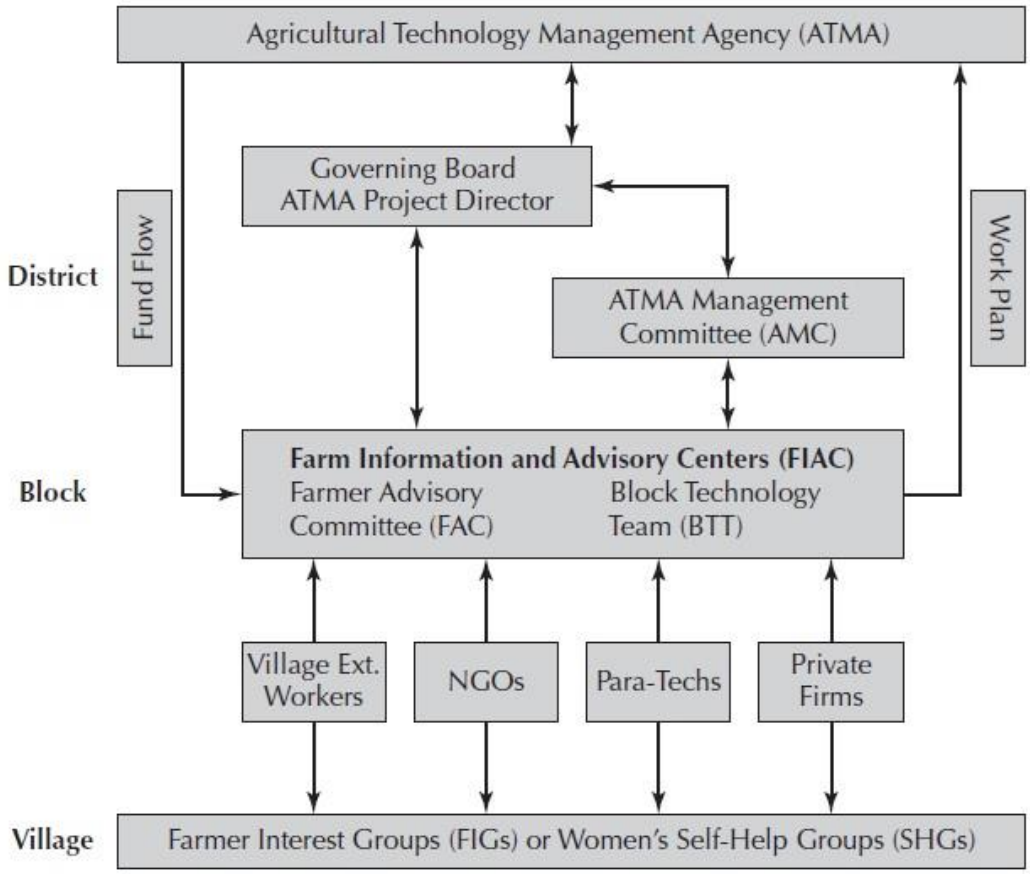
In European, there were many studies about adaptation in agricultural sector within urbanization in Poland, Netherland and Spain. This study needs fundamental of empirical research to analyzed impact from increased of population density and expanded of urban area on agricultural sector. The Bayesian averaged model was conducted in this study. There were 3 types in the impact of urbanization on agricultural sector such as the change in agricultural land influence to decreased agricultural yield and less inputs of food which effect on food security in long term. Agricultural development will dropped farmers quality of life who farmed in rural area and the drop away of agricultural area give negative result on agricultural structure. (Oueslati et al, 2014)

However, urban expansion created more opportunity to extend client base for farmers because there are more people in urban area. Farmers can access high quality inputs for their agricultural products such as there were many vegetable farms and vineyards establish in urban area which mean that farmers have adapt and appliance from urbanization. Urban expansion also impacts on inputs price and cost of production. (Oueslati et al, 2014) There was a study about interaction between urbanization and agricultural sector by development a theory model for analyzed agricultural sector and supporting sectors. Then test this model from the impact of increased population, explain the result from the development of the area and further of population density (Oueslati et al, 2014) There were small farms with high yield happened around urban area, farmer's cost of living was rising and they choose to produced vegetable instead of livestock. A study about the process of urban expansion and the change of landscape in Europe found that farmers who planted vegetables can produced more income in urban area. Urbanization can help farmers on hiring more labors to work in their planting area then development all of agricultural activities. (Antrop, 2004)

2.7 Guideline to improve agricultural extension system for developing country

Agricultural extension is the important way for communicate, exchange, educate etc. between farmers and agricultural extension officers to get efficient and effective agricultural production. In this study, researcher demand to present the guideline to improve agricultural extension system for expanded urban area by compile the information from literature review and data collection. Suitable way of agricultural extension system for developing country need to reach two keys goals; national food security, improving income in smallholder farmers and eliminate poverty problems. If the country needs to success these goals must have to improve and develop the agricultural extension system. (Swanson & Rajalahti, 2010)

Process to develop agricultural extension system for developing country should consider about how to use the natural resources in the proper way and sustainable in long term and spread new innovation and new technology by educated the farmer to make more income and plant many types of agricultural production. As well as encouraging the integration of farmers to exchange the knowledge about agricultural production process and problems in their production process. Moreover, the government should be changing the operation of agricultural extension system by decentralized which can transfer administration and responsibility from government agencies to local government officials. This kind of agricultural extension operations began in the 1980s. Decentralization of administrative means reforming the existing basic management structure to local government. Also known as transfer power to the local office for participate in decisions and approvals of various operations according to local needs (The World Bank, 2000; Swanson & Rajalahti, 2010) and bottom-up to know what are the needs of the farmer and give farmers an opportunity to participation in improving of agricultural extension system (Swanson & Rajalahti, 2010) there is an example of decentralized agricultural extension system.



Ref: Swanson & Rajalahti, 2010

Figure 2.2 Example of decentralized agricultural extension system

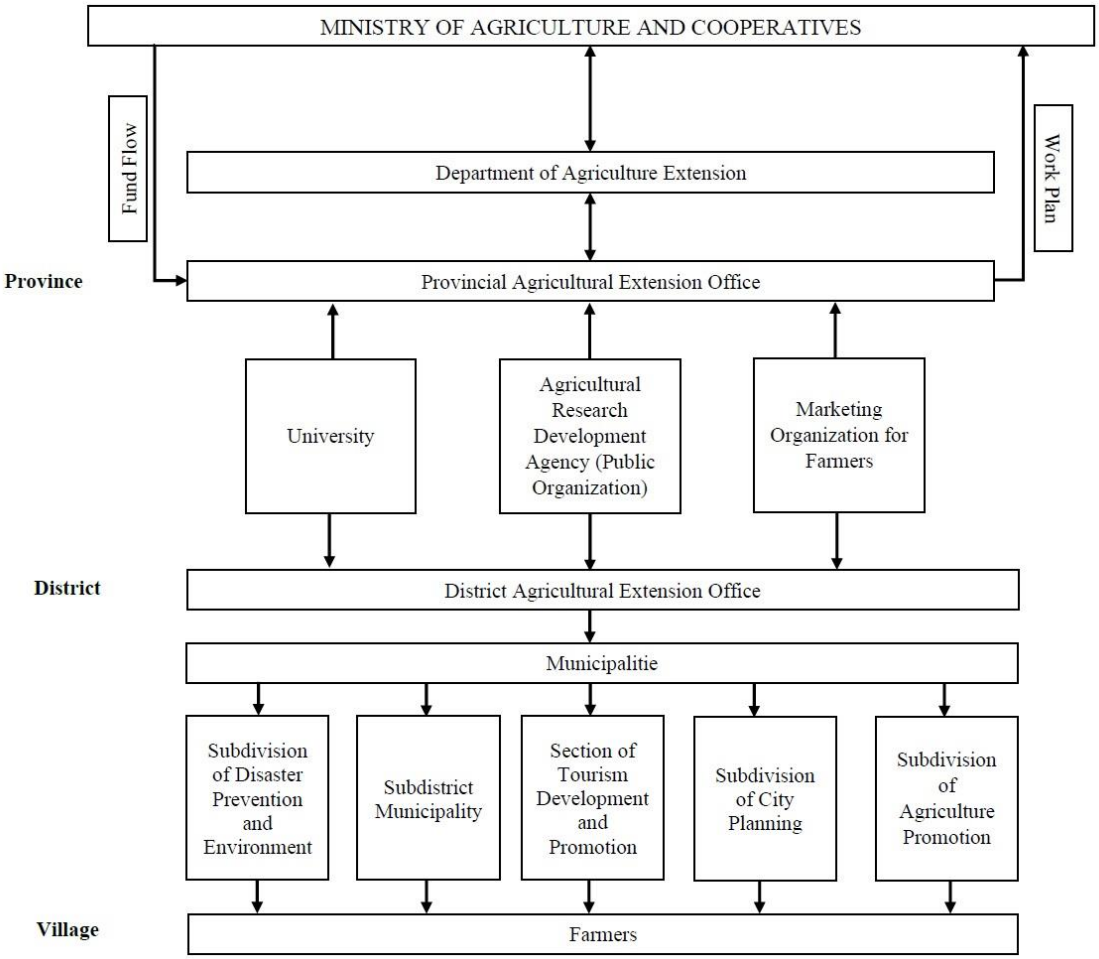


Figure 2.3 Suggestion procedure for decentralized agricultural extension and bottom-up

CHAPTER 3

Research Methodology

From literature reviews and compile of theory about farmer's adaptation on agricultural production in expanded urban area, Chiang Mai province. In this chapter researcher will present designed of research methodology, research site, target population and sampling. Research instruments were created along with analysis statistics. Cronbach's alpha and index of item-objective congruence (IOC) were applied to checked content validity of the instrument, as following detail;

3.1 Research design

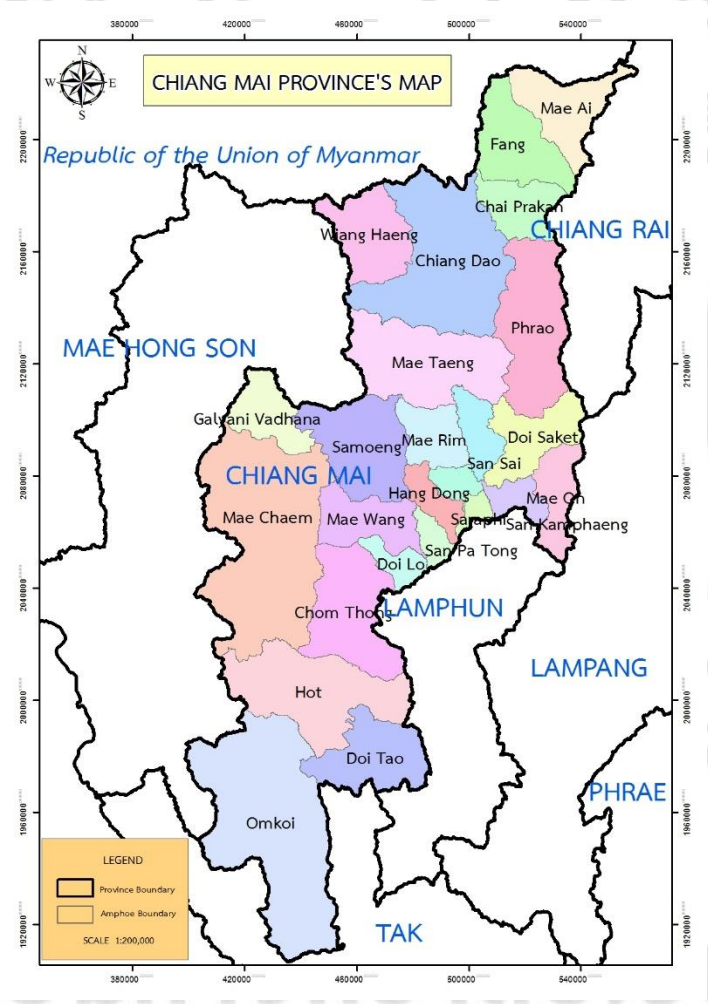
The study of smallholder's farmer adaptation in agricultural production in expanded urban area, Chiang Mai province applied survey research. Started by collected general information in the study area then develop questionnaire and used as the research instrument to collected quantitative data.

3.2 Research site

Chiang Mai province has known as one of an important area for agricultural production in Thailand has 25 districts of administrative divisions. Six districts are defined as urban expansion area of Chiang Mai province; Mueang district, Saraphi district, Mae Rim district, Hang Dong district, San Sai district and San Kamphaeng district. Total agricultural area in Chiang Mai are 1,154,727 rais (8.37% of total land area) planted rice, vegetables, crops and horticulture etc. There are 176,639 agricultural household (22.57% of total household) (Chiang Mai Provincial Agricultural Extension Office, 2018). Irrigation and reservoir are the main water resource for agricultural production in Chiang Mai.

3.3 Target Population

Target population of this study were the farmers who has experience from the effected of urban expansion in 6 district of Chiang Mai province that are Meaung district, Mae Rim district, Hang Dong district, Saraphi district and San Kampheang district which have 33,540 of agricultural household.



Ref: Information for Chiang Mai, 2015

Figure 3.1 Map of Chiang Mai province

This study conducted in expanded urban area in 3 districts of Chiang Mai province; Mae Rim district, Mueang district and Hang Dong district. Agricultural information of these area is as following.

- Mueang district is located in the center of the province and surrounded by Mae Rim district, Hang Dong district, San Sai district, Saraphi district and San Kamphaeng district
- Mae Rim district is located 8 kilometers from center of the city
- Hand Dong district is located 15 kilometers from center of the city

Table 3.1 Agricultural information of the study area

Districts	Household	Agricultural household	Total area (Rais)	Agricultural area (Rais)
Mueang district	163,618	985	109,467	4,404
Mae Rim	40,770	6,796	286,840	35,350
Hang Dong	45,743	3,940	169,716	26,640

3.4 Sampling

The researcher used multi-stage sampling for this study which include 4 steps as the following.

Step 1 Random the sample district

This study started from meeting with agricultural extension officers from 6 District Agricultural Extension Offices in the district that nearby Mueang district there are Meaung district, Mae Rim district, Hang Dong district, San Sai district, San Kamphaeng district and Saraphi district then found that there were some effects on agricultural area from urban expansion as following;

1. Urban area expanded into agricultural area which caused the changed-on land use from agricultural use to non-agricultural use such as built-up area, infrastructure and department store.

2. The number of farmers in the area has decreased due to urban expansion into agricultural area and increased demand on service labors. Some farmers changed their career from farmers to another career such as employee, open their own shop and employee for the company.

3. The number of agricultural land decreases because rising of land price many farmers sell their agricultural land to the investors.

Then interviewed more about how do the farmer adapt to urbanization in Mueang district there are Meaung district, Mae Rim district, Hang Dong district, San Sai district, San Kamphaeng district and Saraphi district to selected the study area. Found that farmers in Mae Rim district and Hang Dong district have adapt to produced more safety agricultural products, concern about the quality of agricultural production inputs and try to improve their agricultural products standard to meet the consumer need. Some farmers changed from produced rice to produced vegetables because vegetable need less time to grow and easy to sell after harvest. There are some different adapted in San Sai district and San Kamphaeng district most farmers choose to sell their agricultural land instead of changes their agricultural process or changes the plant. The remain farmers in San Sai district and San Kamphaeng district have to plan their agricultural crop and management their farm to be ready for the natural disaster and economic disaster.

The study area of this study should have 3 districts; Mueang district, Mae Rim district and Hang Dong district due to there are more kind of adaptation in these areas than in San Sai district and San Kamphaeng district and this study has limited time and financial then San Sai district and San Kamphaeng district will not include in the study area.

Sample in this study are the farmers who planted in expanded urban area of Chiang Mai province from 3 district; Mueang district, Mae Rim district and Hang Dong district which are planting rice, vegetables, crops etc. There are 11,721 of agricultural household in Mueang, Hang Dong and Mae Rim district which is 6.63% of Chiang Mai's agricultural household. There are 66,394 rai of agricultural area in Mueang, Hang Dong and Mae Rim district which is 5.75% of Chiang Mai's agricultural total area. (Chiang Mai Provincial Agricultural Extension Office, 2018)

Step 2 Selected sub-district from Mueang district, Mae Rim district and Hang Dong district by using these conditions

- Population density between 491-2,463 people/ square kilometers (Reference from sub-district population density map)

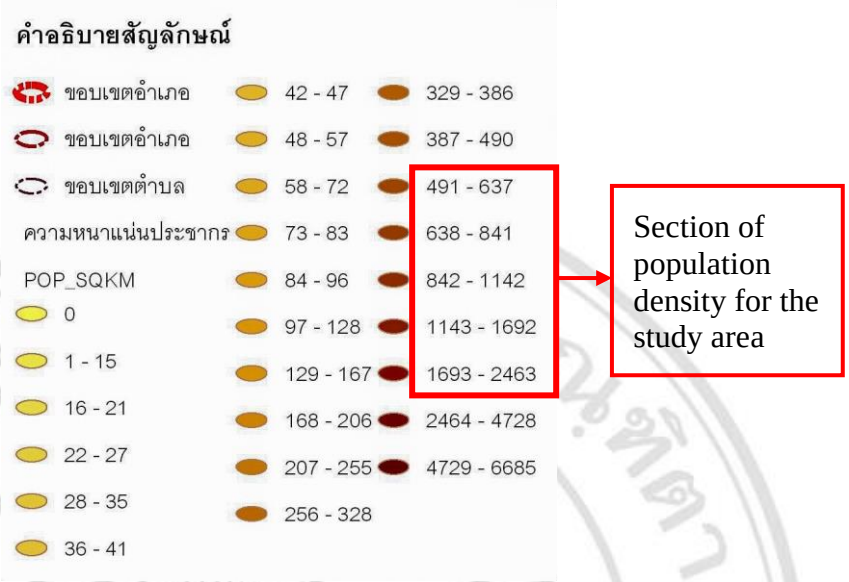


Figure 3.2 definition of symbols in population density map

From literature review urban area is the area which has population density 2,500 people/square kilometers and this study aims to explored only in expanded urban area which mean this research did not applied in the area that's has population density more than 2,500 people/square kilometers described as the diagram

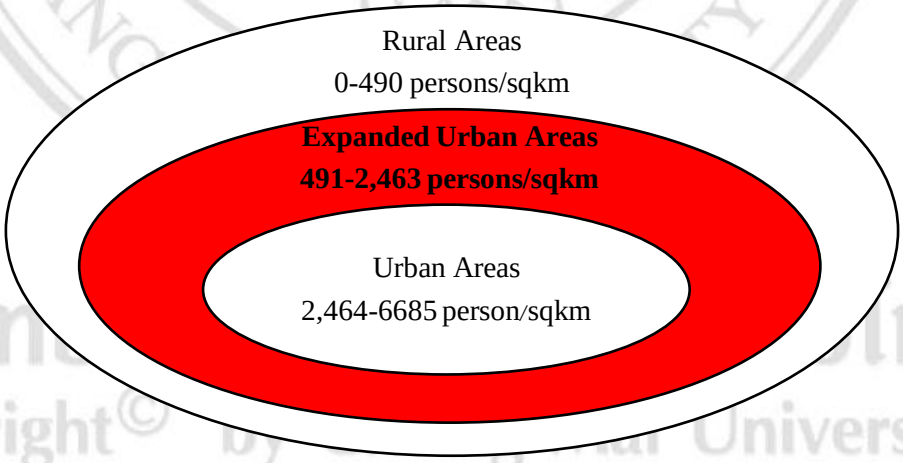
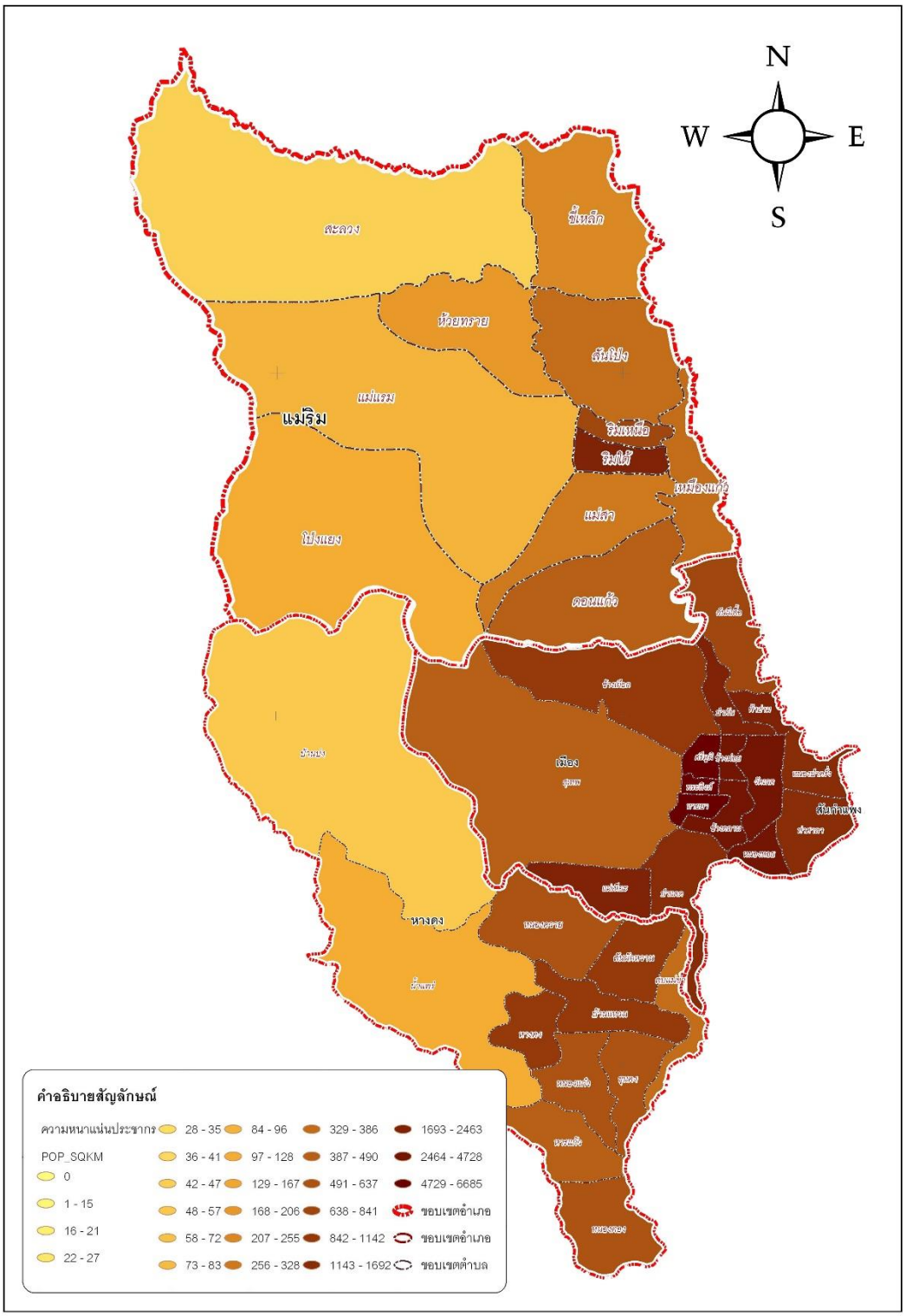


Figure 3.3 Study area (Red)

- Agricultural area (Reference from sub-district population density map)

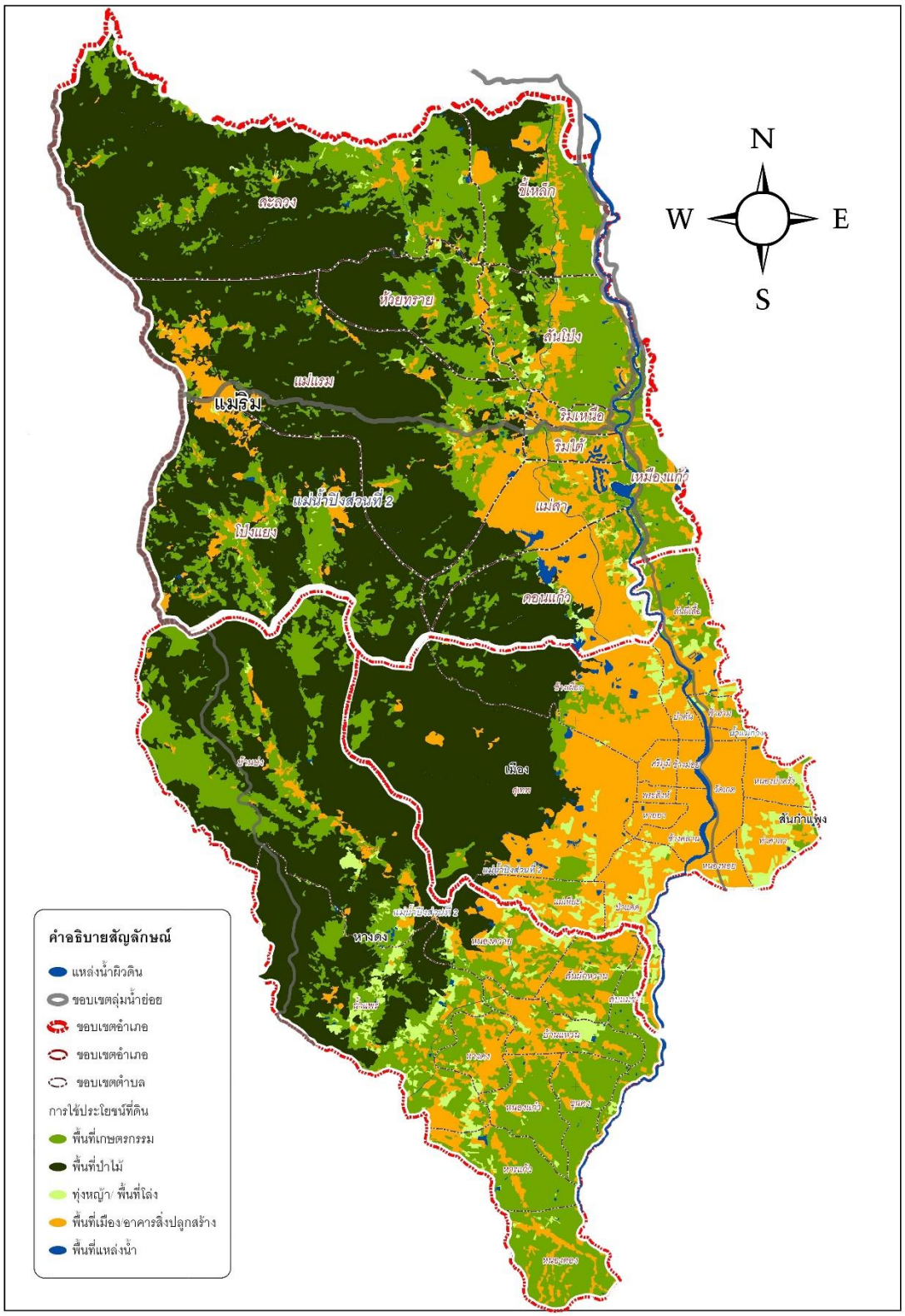
Figure 3.4 definition of the symbol in land use map

Then overlapped population density map and land use map to specify study area



Ref: Information for Chiang Mai, 2015

Figure 3.5 Map of population density/square kilometers in study area



Ref: Information for Chiang Mai, 2015

Figure 3.6 Map of land use in study area

After the overlapped the map of population density and land use area. Researcher can clarify the details of study area as the table 3

Table 3.2 Sample selected by multi-stage sampling

Details	Mueang District	Hang Dong District	Mae Rim District
Sub-districts in expanded urban area	3 Sub-districts	4 Sub-districts	5 Sub-districts
Agricultural households (households)	Su Thep 172 Pa-daet 168 San Phisuea 218 **558 households**	San Phak Wan 233 Hang Dong 122 Nong Khwai 115 Khun Khong 517 **987 households**	Rim Nuea 214 Rim Tai 184 San Pong 824 Mae Sa 137 Don Kaeo 224 **1,583 households**
Total	**3,128 farmers**		

Determine sample size by Yamane formula Yamane (1967)

$$n = \frac{N}{1 + Ne^2}$$

Where :

n = sample size required

N = number of farmers in the population (3,128 farmers)

e = allowable error (0.07)

Substitute numbers in formula:

$$n = \frac{3{,}128}{1 + 3{,}128\ (0.07)^2}$$

n = 191.582 farmers

n = 192 farmers

After calculated the sample size by substituting the numbers into the Yamane formula, the numbers of sample are 191.582 farmers and increase it to 200 households from 3,128 households.

Step 3 numbered of agricultural household in each sub-district from the sampling first step as proportional allocation and stratified sampling

$$n1 = \frac{n\ N1}{N}$$

Where:

n1 = sample size required every district of the study area

n = sample size required

N1 = number of farmers in every district of the study area

N = number of farmers in the population (3,128 farmers)

Sample of farmers who planted in expanded urban area, Chiang Mai province from sub-district are as the following table

Table 3.3 sample from districts

Mueang District			**Hang Dong District**			**Mae Rim District**		
Sub-disrict	**Population (household)**	**Sample (household)**	**Sub-disrict**	**Population (household)**	**Sample (household)**	**Sub-disrict**	**Population (household)**	**Sample (household)**
Su Thep	172	11	San Phak Wan	233	15	Rim Nuea	214	13
Pa-daet	168	11	Hang Dong	122	8	Rim Tai	184	12
San Phisuea	218	14	Nong Khwai	115	7	San Pong	824	52
			Khun Khong	517	34	Mae Sa	137	9
						Rim Nuea	224	14
Total	**558**	**36**	**Total**	**987**	**64**	**Total**	**1,583**	**100**

In order to obtain reliable of data, researcher has increased sample size to 200 farmers.

Step 4 use simple random sampling to random the sample from sub-district for interview general information of the study area. Researcher need 13 farmers and 6 government officers from District Agricultural Extension Offices, details as following

1. Sample from framers were selected by non-probability sampling. Non-probability sampling was the technique for select qualitative sample of this study. It is a sampling technique in which the researcher selects samples based on the subjective judgment of the researcher rather than random selection. In non-probability sampling, not all members of the population have a chance of participating in the study unlike probability sampling, where each member of the population has a known chance of being selected. Non-probability sampling is most useful for exploratory studies and used in studies where it is not possible to draw random probability sampling due to time or cost considerations. Types of non-probability sampling for this study is purposive sampling to selected 13 farmers who experienced urban expansion effects for at least ten years.

2. Sample from agricultural extension officers were selected by 1 Chief of District Agricultural Extension Office and 1 government officer in District Agricultural Extension Office from 3 districts total were 6 government officers from 3 District Agricultural Extension Offices.

3.5 Research Instruments

This study applied both qualitative and quantitative research instrument to collected data; detail as following

3.5.1 Research instrument to compile general information of the study area

There were questions to specify the study area, gather agricultural production data and the information about urbanization. The data will collect and analysis to design the questionnaires for quantitative research (Appendix A). The information of the question as following;

1. Interview with government officers from of District Agricultural Extension for general information in the study area to select the area and schedule time for data collection.
2. Interview with government officers from of District Agricultural Extension about impact of expanded urban area on agricultural sector in study area. Researcher was defined the answer and group it into category such as influenced of expanded urban area on agricultural sector, adaptation strategies of farmers and obstacles on their adapted.
3. Set a group for farmers with government officers and let them discussed about the situation and changes from impact of urban expansion.

3.5.2 Quantitative instrument; Questionnaires were compiled from literature review and qualitative data from semi-structure review, group discussion and observation. Then choose main issues about farmers adaptation in agricultural production in expanded urban area to design questionnaire for quantitative data collection and support qualitative data (Appendix B) This questionnaire has 5 parts as flowing details;

Part 1 Closed-ended questions about socio-economic characteristics of farmers such as gender, age, education level, experienced in planting, agricultural area, type of their plants, land tenure, main/part-time career, acknowledgement the news about agricultural, membership and training.

Part 2 Closed-ended questions about how urban expansion appeared in farmer's area, urban composition from farmers opinion, places that defined to be in urban area within 5 kilometers from their agricultural area, roads and basic public utility in agricultural area.

Part 3 Closed-ended questions about the change from impacted of urban in farmer's living area such as landed, infrastructure, population, way of life, economy and environment.

Part 4 Closed-ended questions about changes on agricultural sector from urban expansion by calculated their agreement on the massage. There were 5 level of opinion as following;

1 = Strongly Disagree 2 = Disagree
3 = Undecided 4 = Agree
5 = Strongly Agree

Part 5 Divided into 2 sections; First section closed-ended questions about farmer's adaptation to the change on agricultural sector by urban expansion. Farmer need to respond on adaptation strategies and if they did adapt how was the result. Second section open-ended questions about how sustainable on their adaptation, problems and obstacles while farmers try to adapted and suggestion on how to adapt efficiently.

3.6 Data collection

3.6.2 Interview data collected from 13 farmers and 2 government officers from District Agricultural Extension Offices in Meaung district, Mae Rim district, Hang Dong district.

3.6.2 Quantitative data; collected by face-to-face interview with questionnaire from 200 farmers in Meaung district, Mae Rim district, Hang Dong district.

3.7 Quality testing of research instruments

Researcher used reliability and validity to tested the quality of the research instrument of this study.

3.7.1 Reliability testing of research instrument

The researcher tested questionnaire which thesis professors were agreed with 20 farmers who planting in expanded urban area in Saraphi district, Chiang Mai province. Then used to result from part 3 the change from impacted of urban in farmer's living area such as landed, infrastructure, population, way of life, economy and environment, part 4 changes on agricultural sector from urban expansion by calculated their agreement on the massage and part 5 farmer's

adaptation to the change on agricultural sector by urban expansion to calculated reliability of the questionnaire via SPSS. The result found that part 3,4,5 of the questionnaire has Cronbach's alpha as the following

Part 3 Cronbach's alpha = 0.765

Part 4 Cronbach's alpha = 0.546

Part 5 Cronbach's alpha = 0.657

3.7.2 Content Validity

Researcher has reviewed and studied on theory and related research about famer's adaptation strategies in expanded urban area and compiled with the suggestion from agricultural government officers in the study area to designed the questionnaire. By the way, this questionnaire needs a test for measured the quality of it. And this questionnaire already test reliability from the previous topic in this topic the researcher will test validity of the questionnaire. The most important validity is the content validity; the extent to which the instrument measures what to be measured. The expert judgment is the practical approach to estimating the content validity. At least 3 experts should be asked to judge each item whether it really measure the expected attribute. In this study researcher used the item objective congruence (IOC) Index is used as the basis for screening the item quality. In each item, the experts are asked to determine the content validity score:

The score = 1, if the expert is sure that this item really measured the attribute.

The score = –1, if the expert is sure that this item does not measure the attribute.

The score = 0, if the expert is not sure that the item does measure or does not measure the expected attribute.

Then put the score from experts into this formula to measure congruence of content validity.

$$IOC = \frac{\sum R}{N}$$

Where: IOC = The IOC index mean of expert scores

$\sum R$ = Total measure point from experts

N = Number of experts

3 Experts were measured congruence of content validity for this study. The qualified items should have the IOC equal to or greater than 0.50 the result shows in appendix C

3.8 Data Analysis and Statistics

This study divides into 2 parts such as interview data and quantitative study then the data analysis of this study will be separate into 2 parts; details as following

3.8.1 Interviewed data; were analyzed by means of content analysis, where patterns, themes, core consistency and core meaning were identified.

3.8.2 Quantitative data analysis; Statistic Package for the Social Sciences (SPSS) was used for analysis the data which divide into 2 categories

1. Socio-economic characteristics of the farmer will be analyzing by Descriptive Statistics such as Percentage, Frequency, Mean, Minimum, Standard Deviation and Weight Mean Score

Weight Mean Score will calculate from opinion of the farmer measure by Linkert's Scale detail as following

Weight Mean Score	1.00 - 1.80	Strongly Disagree
Weight Mean Score	1.81 – 2.60	Disagree
Weight Mean Score	2.61 – 3.40	Undecided
Weight Mean Score	3.41 – 4.20	Agree
Weight Mean Score	4.21 – 5.00	Strongly Agree

2. Analyzing factors affecting farmer adaptation, the researchers employed multiple regression analysis to find the correlation between dependent and several independent variables in order to find how much each independent

variable correlated with dependent variable. This study used 10 independent variables consisting of: gender, age, education level, agricultural experience, size of agricultural land, membership in agricultural group, total income, sources of agricultural information they received, frequency of contacting with agricultural extension officers, and opinion toward agricultural changes. A model for multiple regression analysis is specified as follows:

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

Table 3.4 Details of independent variables which are used in multiple regression

Independent variables	**Symbol**	**Item**	**Variable measurement**	**Unit**
1. Gender	X_1	Part 1 item 1	Gender (1= male, 0 = female)	Nominal Scales
2. Age	X_2	Part 1 item 1	Age (year)	Ratio Scales
3. Education level	X_3	Part 1 item 2	Education (number of years in education)	Nominal Scales
4. Agricultural experience	X_4	Part 1 item 3	Agricultural experience (year)	Ratio Scales
5. Size of agricultural land	X_5	Part 1 item 5	Agricultural land area (Rai)	Ratio Scales
6. Membership in agricultural group	X_6	Part 1 item 13	Being a member in an agricultural group (1 = member 0 = non-member)	Nominal Scales
7. Total income	X_7	Part 1 item 9	Total income	Ratio Scales
8. Sources of agricultural information they received	X_8	Part 1 item 10	Sources of agricultural news (number of sources)	Interval Scales

Table 3.4 (Continued)

Independent variables	Symbol	Item	Variable measurement	Unit
9. Frequency of contacting with agricultural extension officers	X_9	Part 1 item 11	Frequency of contacting with agricultural extension officer (times/year)	Ratio Scales
10. Opinion toward agricultural changes	X_{10}	Part 4 item 1-4	Opinion level of agricultural change (average score)	Interval Scales

The dependent variable (Y) was level of farmer adaptation which was resulted from urban expansion in Chiang Mai. Level of the farmers' adaptation based on 19 questions concerning their adaptation with the following scales for each question:

0 = no adaptation 1 = least adaptation 2 = slightly adaptation
3 = moderate adaptation 4 = significant adaptation 5 = highly significant

Multiple regression analysis by entering 10 independent variables into the equation and calculated using Enter method.

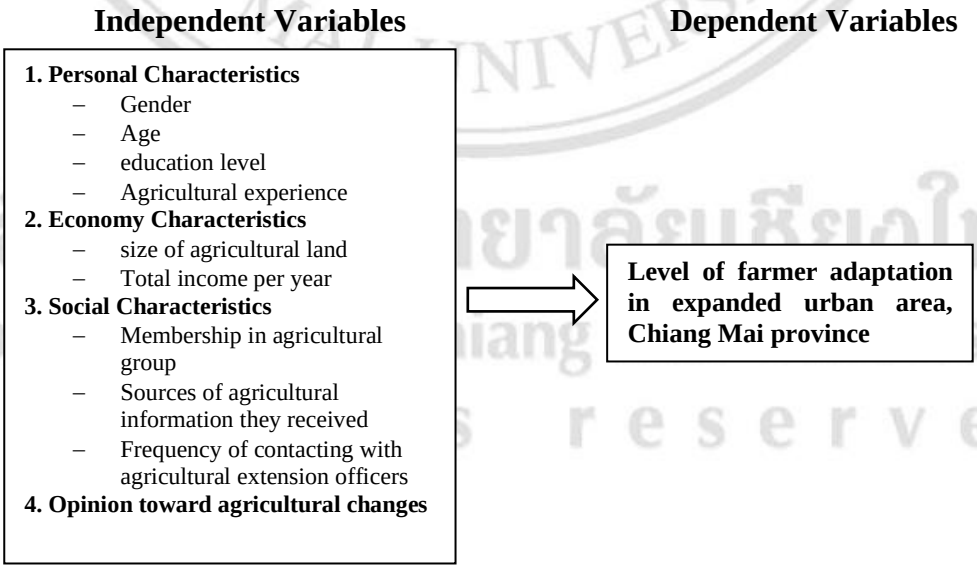


Figure 3.7 Independent Variables and Dependent Variables for Multiple regression

CHAPTER 4

Result

This study collected data by conducted face-to-face interview from 13 farmers and 6 government officers in the study area. Then compiled information from the interview with literature review to designed an instrument for quantitative data collection. Quantitative data was collected from questionnaires interview with 200 farmers in the study area.

4.1 General information of the study area

4.1.1 Agricultural production in the study areas

Mueang district; Most farmers in Su Thep sub district have produced their agricultural products by integrate farming system. Vegetables likes basil, sweet basil, peppermint, cucumber and yard long bean are produced by farmers in this area. Moreover, farmers in Su Thep sub district planted mango and lime in every season. Farmers in Pa-Deat sub district are produced longan, rice and vegetable and mostly use integrate farming systems in their farm. Farmers will sell their products in the market nearby their planting area.

Hang Dong district; Rice and longan are the main agricultural products in Khun Khong sub district. Farmers in Khun Khong sub district always faced with water shortages every dry season but they can cope with this by using ground water instead of natural water. Farmers in Hang Dong and San Phak Wan sub district produced rice and longan more than vegetables due to there not many vegetable markets in Hang Dong sub district.

Mae Rim district; Farmers planted rice and using integrate farming system in Don Kaeo sub district and try to produced agricultural products with non-chemical process. Reservior are the main water resources in Don Kaeo sub district. Irrigation water is the main water resource in Mae sa sub district, rice is the main agricultural products. Some farmers produced vegetables likes chinese kale, celery, tomato and Chinese parsley. Farmers will sell their vegetable products in local market and sell rice to rice-mill where is located in nearby district.

Apparently, small farmers who planting in expanded urban area in Chiang Mai province were try to produced their products by adapted from traditional farming to integrated farming system. And try to use less chemical in their production process to satisfy the needs of consumer.

4.1.2 Awareness about urban expansion

Agricultural extension officers in the study area were perceived with problems and impact from urban expansion on agricultural sector. Similar problem is decline on agricultural area. This problem happened because of rising of population in the study area people demanded to use the land for non-agricultural use then land price is increasing most farmers choose to sell their land to the investor. Agricultural land will change to built-up area, shelter, department store and infrastructure of urban area including most farmers are very old and agricultural income was not their main income.

Most of farmers have perception about urban expansion such as roads, built-up area, shelters and department store etc. Here is some definition of urban from farmer's aspect. Urban is the place which has convenient life style and facilities such as department store, convenient store, housing development and higher of population density also has many tourists visit in the city. The number of people who moved into the study area were from people who moved to live in the area and people who moved to work in the area. As we can see farmers in the study area were able to hire more agricultural labors because of the demand for agricultural labors were increased. The labors will come to work in the farm for the farmers and most of these labors were outlander such as Tai-Yai. By the way there still have some labors who are Thai from another province name Sukhothai came into the area for harvest rice. Moreover, farmers in the study area were aware that agricultural tourism will become famous trend so they start to asked for some advice and suggestion from District Agricultural Extension Office.

4.1.3 Impact from urban expansion on agricultural sector

The result from in-dept interview with 6 agricultural extension officers found that urban expansion could impact on agricultural sector in many aspects. For example, agricultural land decreased due to there were more convenient things appeared in the area which

caused the rising of land price then farmers choose to sell their land instead of keep it. There was some argument issue between farmers and people who live in housing development which located near to agricultural area. Most farmers agreed that urban expansion made changed on cost of agricultural production. There will be easier for the farmer to access agricultural inputs and can choose the right inputs for their farm. These inputs will help farmers produce their product to satisfy the needs of their consumer.

Land price in expanded urban area are rising which give an opportunity to farmers to sell their agricultural area to the investor and transform the land into non-agricultural use this caused decline number of farmers in the area. In addition to have more people move into the area will increase the demand for housing development which caused the problem about water way to flow into the farm were blocked by the road of housing development. Some farmers open their own grocery store due to many people move into the area and they need more groceries things this idea can help farmer created non-agricultural income. From the changed in agricultural sector which effected by urban expansion influences on farmers and agricultural sector. The main effect which appeared in every area is decline number of farmers in expanded urban area.

Some farmers forced to cancel their agricultural land tenancy agreement from the landlord due to the landlord wanted to sell their land for non-agricultural use such as built-up area, housing development and department store. Most of farmers in this area are renting land for produced their agricultural products when the landlord needs the land for another propose farmers should change the way to created their income from non-agricultural activities. When agricultural area was decreased this will affect to decline the number of farmers in the area because they do not have land to planting. There were many farmers who quit agricultural career and being an employee instead. Urban expansion also effected on an environment too. The biggest issue that appeared in every area were solid wastes.

4.1.4 Adaptation to the changes in agricultural sector

Overall, District Agricultural Extension Office have been promoted variety of agricultural practices for the farmer to remain agricultural area and implement every part of their

agricultural area. As following details; In case of decreased of agricultural land area District Agricultural Extension Office suggested the farmer to adapt their agricultural production process. For example, changes types of planting system, home-grown vegetable and animal husbandry to produce more income.

District Agricultural Extension Office have been promoted non-chemical agricultural production to help farmers reduced cost of pesticide and get high quality product which good for consumers and farmers health. Organic production and non-chemical agricultural process will be a good way to promoted to the farmer who produced in expanded urban area. Because when farmers use less chemicals in the production process the production cost will drop and the price of organic products is higher than chemicals product.

In addition, District Agricultural Extension Office try to help the farmer improve the standard of their agricultural products by arrange training program for food safety production. Create more opportunity for the farmer to access to the market and created some policies to help farmers plan their cultivation during the year and manage the risk from impact of urban expansion, natural disasters and economy. The government officer wanted farmers to plan the proper cultivation crops.

The changes in agricultural sector from urban expansion and effect from urban expansion to the farmer have been pressure on the farmer who planting in this area which push the farmer adapt to this situation as the following details. Due to the convenient in the way of communication and transportation which help farmer to established more farmer's groups and community enterprises to help each other in agricultural production process, marketing and exchange the production knowledge. Some farmers change their type of agricultural product from produced rice to integrated farming system especially on vegetables because vegetables have short growing season and can sell right after harvest without any processing which is appropriate for planting in expanded urban area.

Farmers still try to study about organic fertilizer due to chemicals fertilizer need more cost and danger to the health of producers and consumers. Non-chemical production gets more attention from the farmers because the consumer interest in the trend about food

safety. Evidence, indicates that urban expansion made change and effect on both agricultural sector and farmers in many aspects. Farmers need time, skills and money to help them adapt in urban expanded area. They required more training about how to produced quality production in limited area and they request for more market to sell their products. There will be better if Agricultural Extension Office can provide cheap inputs of agricultural production for farmers. Agricultural Extension Office need to keep agricultural area and try not to lose it to feed the city and consumer can easy to get fresh products.

Table 4.1 Summary impact from urban expansion on agricultural sector and farmer's adaptation to the impact

Positive Impact	**Negative Impact**	**Farmer's Adaptation**
1. Increased number of populations	1. decreased of agricultural land area	1. produce more variety of agricultural practices
2. the demand of agricultural products are rising	2. decline number of farmers	2. change their type of agricultural product
3. more external labor	3. rising of land price	3. animal husbandry for less area
4. easy access agricultural inputs	4. argument issue between farmers and people who live in housing development	4. produce safety food to meet consumer demand
5. easy access to the market	5. changed on cost of agricultural production	5. change to organic production
6. more housing developments and roads	6. caused the problem about water way to flow into the farm were blocked by the road of housing development	6. government organization give an opportunity for the farmer to sell their product
7. create non-agricultural income	7. Some farmers forced to cancel their agricultural land tenancy agreement from the landlord	7. plan the proper cultivation crops

Table 4.1 (Continued)

Positive Impact	Negative Impact	Farmer's Adaptation
8. more tourists coming to the area	8. more effects on environment likes solid wastes	8. establish farmer's group 9. changes from monoculture to integrated farming system 10. some farmer use non-chemical agricultural production

4.2 Quantitative result

Quantitative research was collected by questionnaire with the sample of 200 smallholder farmers in expanded urban area the result divide into 5 parts as the following.

<u>Part 1</u> Personal data and some socio-economic of stallholder farmers

1. Personal, Economy and Social data of stallholder farmers

From the study about personal, economy and social data with the sample of 200 smallholder farmers. There were the data about gender, age, education level, agricultural experience, cultivated area, type of agricultural production, agricultural area, land ownership the analysis data appear on table 4.2- 4.4 as the following.

Table 4.2 Personal data of smallholder farmers n = 200

Personal data	**amount (person)**	**Percantage**
Gender		
Male	132	66
Female	68	34
Age (year old)		
<-35	3	1.5
36-45	9	4.5
46-55	43	21.5
56-65	101	50.5
66-75	41	20.5
> 76	3	1.5
($\bar{X}$ = 59.54, Max = 80, Min = 31, S.D. = 0.886)		
Education level		
Lower than primary school	1	0.5
Primary school	171	85.5
Secondary school	9	4.5
High school	5	2.5
Diploma	6	3.0
Bachelor degree	6	3.0
Higher than Bachelor degree	2	1.0

Table 4.2 (Continued) n = 200

Personal data	amount (person)	Percentage
Agricultural experience (year)		
< - 10 year	22	11.0
11-20 year	28	14.0
21-30 year	34	17.0
31-40 year	38	19.0
41-50 year	54	27.0
> 51 year	24	12.0
($\overline{X}$ = 35.1, Max = 60, Min = 1, S.D. = 15.237)		
Cultivated area		
Irrigation area	160	80.0
Non-irrigation area	40	20.0
Type of agricultural production (Multiple response)		
Rice	172	63.7
Home-grown vegetables	46	17.0
Crops	18	6.7
Horticulture	30	11.1
Flowering plant	4	1.5

From the analysis of personal data of smallholder farmers who planting in expanded urban area, Chiang Mai province.

Table 4.2 shows; 66% of the farmer were male 50.5% age between 56-65 year old followed by 21.5% age between 46-55 year old. Average age of the farmer was 59.54 year old lowest age was 31 highest age was 80 year old. For the education level found that 85.5% of the farmer have primary school level followed by 4.5% of the farmer have secondary school level. 27% of the farmer have experience in agricultural between 41-50 years follow by 19% of the farmer have experience in agricultural between 31-40 years and the average experience in agricultural was 35 years. 80% of the farmer were planting in the irrigation zone 63.6% of them were planning rice and 17% were planting vegetables.

Apparently, most of the farmer were elderly with lower than standard education level and spend long time with doing agricultural practices. Smallholder farmers who planting in expanded urban area were producing rice as their main agricultural product then vegetables, horticulture, crops and flowering in order.

Table 4.3 Economy characteristics of smallholder farmers who farm in expanded urban area, Chiang Mai province n=200

Economy characteristics	amount (person)	Percentage
Agricultural land area (Rai)		
< - 5	82	41.0
6 - 10	59	29.5
11 - 15	32	16.0
16 - 20	12	6.0
> 21	15	7.5
($\bar{X}$ = 9.32, Max = 120.00, Min = 0.1, S.D. = 11.414)		
Land ownership (owned; Rai)		
< - 5	179	89.5
6 - 10	14	7.0
11 - 15	3	1.5
16 - 20	2	1.0
> 21	2	1.0
($\bar{X}$ = 1.170, Max = 120.00, Min = 0.1, S.D. = 0.594)		
Land ownership (renting; Rai)		
< - 5	110	55.0
6 - 10	43	21.5
11 - 15	22	11.0
16 - 20	11	5.5
> 21	11	5.5
($\bar{X}$ = 1.832, Max = 70.00, Min = 0.1, S.D. = 1.172)		

Table 4.3 (Continued) n = 200

Economy characteristics	amount (person)	Percentage
Full time career		
Farmer	163	81.5
work as employee	22	11.0
government officer	2	1.0
Own business	7	3.5
Other (trade etc.)	6	3.0
Part time career		
No part time career	65	32.5
Farmer	37	18.5
work as employee	82	41.0
Own business	11	5.5
Other (trade etc.)	5	2.5
Agricultural income (Baht/year)		
<-10,000	28	14.0
10,001-25,000	58	29.0
25,001-50,000	76	38.0
50,001-75,000	16	8.0
75,001-100,000	11	5.5
> 100,00	11	5.5
($\bar{X}$ = 43,620 Baht/year, Max = 500,000 Baht/year, Min = 4,000.00 Baht/year, S.D. = 56,976.682 Baht/year)		
Non-Agricultural income (Baht/year)		
< -10,000	100	50.0
10,001-25,000	45	22.5
25,001-50,000	29	14.5
50,001-75,000	8	4.0
75,001-100,000	4	2.0
> 100,00	14	7.0
($\bar{X}$ = 37,855 Baht/year, Max = 1,200,000 Baht/year, Min = 0.00 Baht/year, S.D. = 119,170.896 Baht/year)		

Table 4.3 (Continued) n = 200

Economy characteristics	amount (person)	Percentage
Total income (Baht/year)		
< -10,000	7	3.5
10,001-25,000	41	20.5
25,001-50,000	67	33.5
50,001-75,000	40	20.0
75,001-100,000	14	7.0
> 100,001	31	15.5
($\bar{X}$ = 81,225 Baht/year, Max = 1,700,000 Baht/year, Min = 4,000 Baht/year, S.D. = 154,480.876 Baht/year)		
Crop insurance		
No crop insurance	164	82.5
Crop insurance	36	17.5
- 1-5 years	- 21	- 10.5
- 6-10 years	- 15	- 7.5
Government subsidy		
No government subsidy	53	26.5
Government subsidy	147	73.5
- 1-5 years	- 101	- 50.5
- 6-10 years	- 46	- 23.0

From the analysis data of the smallholder farmers economy characteristics who farm in expanded urban area, Chiang Mai province details in table 4.3 found that;

45.5% of smallholder farmers have agricultural land area between 6-15 Rai followed by 41% of smallholder farmers have agricultural land area less than 5 Rai and 89.5% of them owned agricultural land area less than 5 Rai. For the career of smallholder farmers, the data showed that 81.5% of them working as farmer for their full-time career followed by 11% who work as employee and 67.5% of them work as employee for their part time career. Smallholder farmers 38% can made agricultural income between 25,001-50,000 Baht/year followed by 29% of them can made agricultural income between 10,001-

25,000 Baht/year. An average agricultural income of smallholder farmers who planting in expanded urban area in Chiang Mai province was 43,370 Baht/year. Smallholder farmers 50% can created non-agricultural income less than 10,000 Baht/year; an average non-agricultural income was 37,855 Baht/year. For their total income including agricultural and non-agricultural income found that 33.5% of smallholder farmers 25,001-50,000 Baht/year; an average total income of them was 81,225 Baht/year. Moreover, the researcher found that only 17.5% of smallholder farmers have agricultural insurance; 10.5% of them had agricultural insurance for 1-5 years and 7.5% of them had had agricultural insurance for 6-10 years. Thai government also provide some subsidy for 73.5% of smallholder farmers; 50.5% of them were subsidized for 1-5 years and 23% of them were subsidized for 6-10 years.

The result from table 4.3 indicated that most of farmers were small farmer which have low in both of agricultural and non-agricultural income per annual. Most of them have no agricultural insurance but more than half of them got subsidy from the government.

Table 4.4 Social characteristics of smallholder famers who planting in expanded urban area, Chiang Mai province n = 200

Social characteristics	amount (person)	Percentage
Sources of agricultural information (Multiple response)		
Newspaper	13	6.5
Radio	58	29.0
Television	105	52.5
Social network (Line, Facebook)	17	8.5
District Agricultural Extension Offices	198	99.5
Other (Staffs from rice research center, Seed seller and Fertilizer shop etc.)	26	13.0
Frequency of contacting with agricultural extension officers (times/year)		
none	12	6.0
contact 1-5 times/year	168	84.0
contact 6-10 times/year	15	7.5
Contact more than 10 times/year	5	2.5
The way to communicate with officers (Multiple response)		
Meet officers at the office	57	28.5
Telephone	25	12.5
Application Line	6	3.0
Application Facebook	1	0.5
Officers visiting at the farm	92	46.0
Officers come for training	185	92.5
Other (Meet government officers at the co-operation)	3	1.5
Membership in agricultural group		
Not attend to agricultural group	53	26.5
attend to agricultural group	147	73.5

Table 4.4 (continued) n = 200

Social characteristics	amount (person)	Percentage
Awareness in urbanization		
never	180	90.0
aware	20	10.0
awareness about adaptation in agricultural production		
never	180	90.0
aware	20	10.0

From the analysis data of social characteristics of smallholder farmers who planting in expanded urban area, Chiang Mai province details in table 4.4 found that;

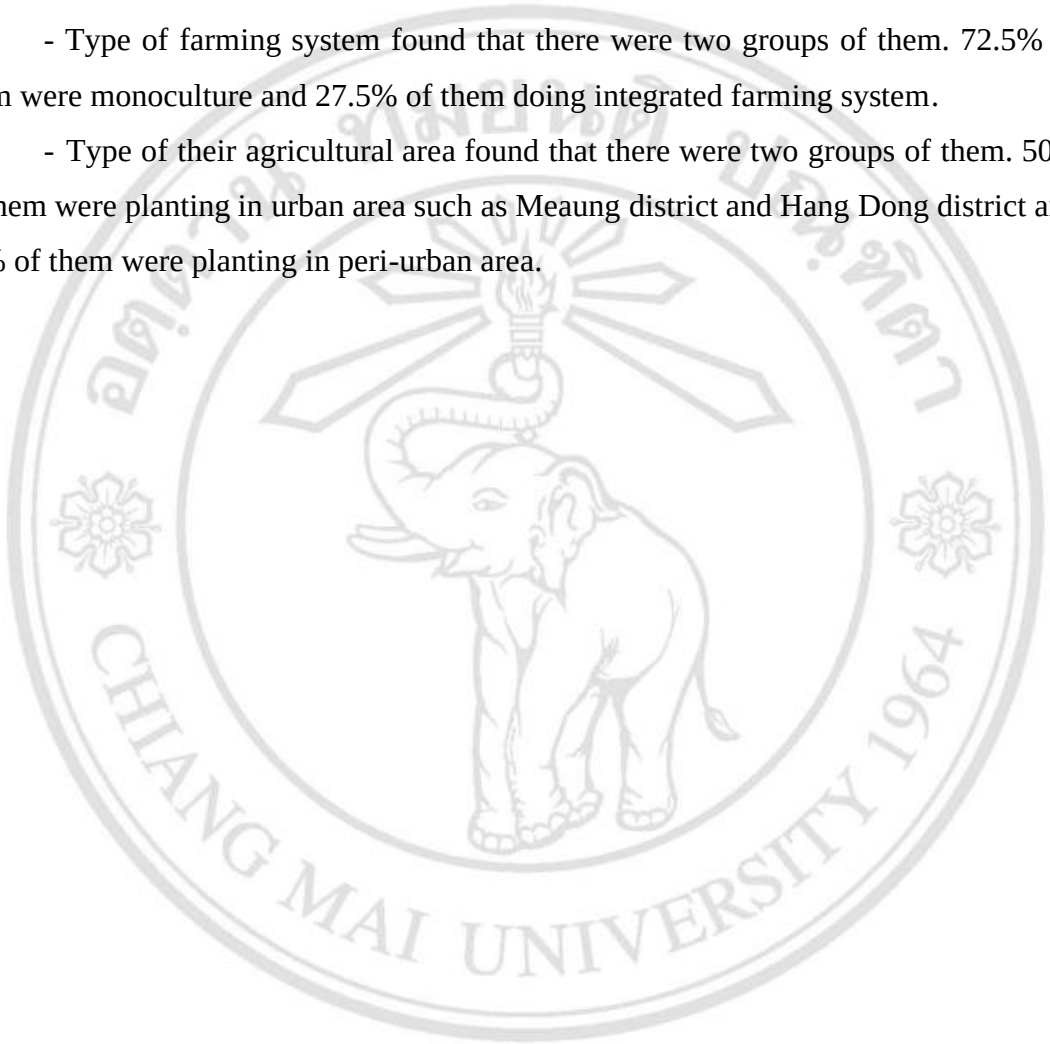
99.5% of smallholder farmers received agricultural information from District Agricultural Extension Offices followed by 52.5% of smallholder farmers received agricultural information from television and 29.0% of smallholder farmers received agricultural information from radio. For frequency of contacting with agricultural extension officers found that 84% of stallholder farmers contacted with agricultural extension officers between 1-5 times/year followed by 7.5% of stallholder farmers contacted with agricultural extension officers between 6-10 times/year. In the way that smallholder farmers communicated with officers found that; 92.5% of smallholder farmers communicated with officers by attended to training which arranged by District Agricultural Extension Offices followed by 46.0% of smallholder farmers communicated with officers when the officers visited their own farm. In case of Membership in agricultural group found that; 73.5% of smallholder farmers were attended to agricultural group but 90% of smallholder farmers never aware about urbanization and adaptation in agricultural production in expanded urban area.

The result from table 4.4 indicated that District Agricultural Extension Offices was the main sources of agricultural information for smallholder farmers. Smallholder farmers who farm in expanded urban area attend to agricultural group to exchange the way they produced their products, asking for more production information but suspected that most of them never aware about urbanization and adaptation in agricultural production in expanded urban area.

From the study of socio-economic characteristics of smallholder's farmer and changes in agricultural production in expanded urban area in Chiang Mai province. The researcher can divide characteristics of smallholder's farmers in the study area as following details;

- Type of farming system found that there were two groups of them. 72.5% of them were monoculture and 27.5% of them doing integrated farming system.

- Type of their agricultural area found that there were two groups of them. 50% of them were planting in urban area such as Meaung district and Hang Dong district and 50% of them were planting in peri-urban area.



<u>Part 2</u> Smallholder farmer's perception in urbanization

The study of cognition of smallholder farmers about urbanization, urbanization components and indicator of urbanization in a 5 kilometers radius from agricultural land areas. The result of data analysis appears in table 4.5 - 4.7

Table 4.5 Urbanization components from smallholder farmers point of view n=200

Urbanization components (Multiple response)	amount (person)	Percentage
Temple	150	75.0
Market	144	72.0
School	142	71.0
Department store	117	58.5
Convenient store (7-eleven, Mini Big C etc.)	115	57.5
Housing development	100	50.0
Police station	91	46
Subdistrict Health Promotion Hospital	69	34.5
Nightclub	66	33.0
Condominium	37	18.5
Factory	31	15.5

The study of cognition of smallholder farmers about urbanization components from 200 smallholder farmers point of view found that; 75.0% of them answered that temple is an urbanization component, 72.0% of them answered that market is an urbanization component, 71.0% of them answered that school is an urbanization component, 58.5% of them answered that department store is an urbanization component, 57.5% of them answered that convenient store is an urbanization component and 50.0% of them answered that housing development is an urbanization component. There were only 15.5% of them answered that factory is an urbanization component.

Which is indicated that smallholder farmer understanding that urbanization has many components that can see it apparently and familiar to the farmers such as temple, market, school department store, convenient store and housing development but there was less factory in the study area.

Table 4.6 Urbanization components in agricultural land areas of smallholder farmers

n=200

Urbanization components in agricultural land areas of smallholder farmers (Multiple response)	**amount (person)**	**Percentage**
None	131	34.5
Housing development	87	43.5
Temple	78	39.0
School	46	23.1
Market	40	20.0
Convenient store (7-eleven, Mini Big C)	40	20.0
Nightclub	26	13.0
Subdistrict Health Promotion Hospital	17	8.5
Police station	13	6.5
Department store	13	6.5
Factory	10	5.0
Condominium	6	3.0

From the study about urbanization components in agricultural land areas of smallholder farmers the result showed that 43.5% of them answered that there was a housing development in their agricultural land areas, 39.0% of them answered that there was a temple in their agricultural land areas, 23.1% of them answered that there was a school in their agricultural land areas, 20.0% of them answered that there were market and convenient store in their agricultural land areas. However, there were 34.5% of smallholder farmers answered that there were no urbanization components in their agricultural land areas.

Apparently, smallholder farmers have point of view that urbanization component should be included temple the most followed by market, school, department store and housing development in order. On the other hand, from the real appearance of urbanization indicator in their agricultural land areas included housing development the most followed by temple, school, market and convenient store.

Table 4.7 Public utility in agricultural land area n=200

Issues	amount (person)	Percentage
Access of concrete road and drain in agricultural land area		
No access	18	9.0
access	182	91.0
Public utilities in agricultural land area (Multiple response)		
Electricity	101	50.5
Water supply	54	27.0
Telephone network	49	24.5
Internet	19	9.5

From the analysis of public utility in smallholder farmer's agricultural land area details in table 4.7 found that;

91% of smallholder farmers answered that there were concrete road and drain in access into their agricultural land area. For public utilities in agricultural land area found that; 50.5% of smallholder farmers has electricity in their agricultural land area, 27.0% of smallholder farmers has water supply in their agricultural land area, 24.5% of smallholder farmers has telephone network in their agricultural land area and 9.5% of smallholder farmers has internet in their agricultural land area.

Possibly conclude that there were public utilities in agricultural land area which included electricity, concrete road and drain the most.

Part 3 Effect of urban expansion

Analysis result of the study about smallholder farmers opinion on the change from the effect of urban expansion in smallholder farmers living area are shows in table 4.8

Table 4.8 smallholder farmers opinion on the change from the effect of urban expansion in smallholder farmers living area n=200

Aspects	Level of change				$\bar{X}$ (S.D.)	Meaning
	None	High	Medium	Low		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
1.Land					**2.713 (1.179)**	**Low level of change**
- Size of agricultural land area	86 (43.0)	88 (44.0)	21 (10.5)	5 (2.5)	2.555 (1.413)	Medium
- Agricultural land area has change to non-agricultural use	84 (42.0)	88 (44.0)	18 (9.0)	10 (5.0)	2.550 (1.406)	Medium
- Rising of land price	17 (8.5)	166 (83.0)	16 (8.0)	1 (0.5)	3.655 (0.865)	High
- Trading land for speculate	39 (19.5)	136 (68.0)	19 (9.5)	6 (3.0)	3.260 (1.195)	High
- Trading land for invest in agricultural or list it as agricultural land for rent	147 (73.5)	22 (11.0)	12 (6.0)	19 (9.5)	1.545 (1.016)	Low

Table 4.8 (Continued) n=200

Aspects	Level of change: None amount (person) (%)	High amount (person) (%)	Medium amount (person) (%)	Low amount (person) (%)	$\bar{X}$ (S.D.)	Meaning
2. Infrastructures					**2.295 (1.218)**	**Low level of change**
- Accessible by road to the land	59 (29.5)	73 (36.5)	58 (29.0)	10 (5.0)	2.725 (1.235)	Medium
- Installation of electrical systems	70 (35.0)	71 (35.5)	52 (26.0)	7 (3.5)	2.620 (1.286)	Medium
- Installation of water supply	85 (42.5)	66 (33.0)	40 (20.0)	9 (4.5)	2.435 (1.328)	Low
- Housing development built-up	83 (41.5)	79 (39.5)	22 (11.0)	16 (8.0)	2.485 (1.370)	Low
- Number of department stores that occurred in the area	127 (63.5)	26 (13.0)	31 (15.5)	16 (8.0)	1.780 (1.126)	Low
- The expansion of irrigation zone	151 (75.5)	9 (4.5)	25 (12.5)	15 (7.5)	1.520 (0.976)	Low
- Number of retail shops and convenient store that occurred in the area	63 (31.5)	58 (29.0)	48 (24.0)	31 (15.5)	2.505 (1.211)	Low

Table 4.8 (Continued) n=200

Aspects	Level of change: None amount (person) (%)	High amount (person) (%)	Medium amount (person) (%)	Low amount (person) (%)	$\bar{X}$ (S.D.)	Meaning
3. Population					**2.932 (0.9636)**	**Medium level of change**
- Number of the immigrants	17 (8.5)	113 (56.5)	53 (26.5)	17 (8.5)	3.310 (0.947)	High
- Number of migrant labors	12 (6.0)	143 (71.5)	38 (19.0)	7 (3.5)	3.560 (0.824)	High
- Number of tourists that come to travel in the area	103 (51.5)	30 (15.0)	28 (14.0)	39 (19.5)	1.925 (1.120)	Low
4. Livelihoods					**2.922 (0.806)**	**Medium level of change**
- Various of occupations	20 (10.0)	86 (43.0)	71 (35.5)	23 (11.5)	3.115 (0.967)	Medium
- Convenience way of life such as the way of communication, how to travel in the area etc.	0 (0)	170 (85)	27 (13.5)	3 (1.5)	3.835 (0.410)	High
- Exposure to new cultures	109 (54.5)	21 (10.5)	30 (15.0)	40 (20.0)	1.815 (1.042)	Low

Table 4.8 (Continued) n=200

Aspects	Level of change				$\bar{X}$ (S.D.)	Meaning
	None	High	Medium	Low		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
5. Economy					**2.915 (0.988)**	**Medium level of change**
- Various of products and service in the area	4 (2.0)	144 (72.0)	48 (24.0)	4 (2.0)	3.660 (0.621)	High
- People in area have to spend their money	3 (1.5)	176 (88.0)	18 (9.0)	3 (1.5)	3.835 (0.508)	High
- More labors were employed for service	14 (7.0)	132 (66.0)	38 (19.0)	16 (8.0)	3.440 (2.440)	High
- People in the area are earning money from many ways	8 (4.0)	56 (28.0)	113 (56.5)	23 (11.5)	3.085 (0.741)	Medium
- Non-agricultural income have been created	5 (2.5)	83 (41.5)	85 (42.5)	27 (13.5)	3.230 (0.774)	Medium
- There are operating of agricultural business companies in the area	157 (78.5)	5 (2.5)	14 (7.0)	24 (12.0)	1.335 (0.717)	Low
- The establishment of community enterprises	116 (58.0)	29 (14.5)	22 (11.0)	33 (16.5)	1.820 (1.115)	Low

Table 4.8 (Continued) n=200

Aspects	Level of change: None amount (person) (%)	High amount (person) (%)	Medium amount (person) (%)	Low amount (person) (%)	$\bar{X}$ (S.D.)	Meaning
6. Environmental					**3.058 (1.000)**	**Medium level of change**
- Solid Wastes	19 (9.5)	133 (66.5)	44 (22.0)	4 (2.0)	3.455 (0.928)	High
- Noise pollution	60 (30.0)	58 (29.0)	41 (20.5)	41 (20.5)	2.485 (1.198)	Low
- Air pollution	6 (3.0)	184 (92.0)	7 (3.5)	3 (1.5)	3.845 (0.585)	High
- Water pollution	81 (40.5)	59 (29.5)	40 (20.0)	20 (10.0)	2.385 (1.282)	Low
- Soil pollution	60 (30.0)	56 (28.0)	71 (35.5)	13 (6.5)	2.615 (1.184)	Medium
- Rainfall in the area	6 (3.0)	150 (75.0)	19 (9.5)	25 (12.5)	3.565 (0.824)	High
Total mean and standard deviation of all aspects					**2.805 (1.026)**	**Medium level of change**

From the analysis of smallholder farmers opinion on the change from the effect of urban expansion in smallholder farmers living area during the past 10 years the data showed in table 4.8 found that;

Overall of the farmers agreed that the urban expansion into agricultural area made change to their living area at medium level ($\overline{X}$= 2.805) when considered to the change in other aspects the result can divided as following details; The farmer has opinion at low level of change in land aspect ($\overline{X}$= 2.713) low level of change in infrastructures aspect ($\overline{X}$= 2.295) medium level of change in population aspect ($\overline{X}$= 2.932) medium level of change in livelihood aspect ($\overline{X}$= 2.922) medium level of change in economy aspect ($\overline{X}$= 2.915) and medium level of change in environmental aspect ($\overline{X}$= 3.058)

According to the result from table 4.7 there were changes on many aspects by urban expansion. For example, Land aspect; there were high level of change on rising of land price and trading land for speculate while there was medium level of change on size of agricultural land area and agricultural land area has change to non-agricultural use then there was low level of change on trading land for invest in agricultural or list it as agricultural land for rent. Infrastructures aspect; there were medium level of change on accessible by road to the land and installation of electrical systems while there was low level of change on installation of water supply, housing development built-up, the expansion of irrigation zone, number of department stores retail shops and convenient store that occurred in the area. Population aspect; there were high level of change on number of the immigrants and migrant labors who came to work in the area but there was low level of change in number of tourists that come to travel in the area. Livelihoods aspect; there was high level of change on convenience way of life such as the way of communication, how to travel in the area etc. There was medium level of change on various of occupations and low level of change in exposure to new cultures. Economy aspect; there were high level of change on various of products and service in the area, people in area have to spend their money and more labors were employed for service. Medium level of change on people in the area are earning money from many ways and non-agricultural income have been created. Low level of change on the operation of agricultural business companies in the area and establishment of community enterprises. Environmental aspect; there were high level of change on solid wastes, air pollution and rainfall in the area. Medium level of change on soil pollution and low level of change on water pollution and noise pollution.

<u>Part 4</u> Smallholder farmers opinion toward agricultural changes by effect of urban expansion

The study of smallholder farmers opinion toward agricultural changes by effect of urban expansion will by answers in opinion level of the farmers which can divided into 5 level;

1 = strongly disagree

2 = disagree

3 = uncertain

4 = agree

5 = strongly agree

Which can divide the change into 4 aspects; 1. Production 2. Agricultural inputs 3. Land factor 4. Economic factor the analysis result shows in table 4.9

Table 4.9 Smallholder farmers opinion toward agricultural changes by effect of urban expansion n=200

Aspects	Opinion level					$\bar{X}$ (S.D.)	Meaning
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
1. Production						**3.320 (0.970)**	**uncertain**
- Decreased of agricultural area in your community	66 (33.0)	85 (42.5)	1 (0.5)	46 (23.0)	2 (1.0)	3.835 (1.150)	Agree
- Farmers try to produced more yields per area	27 (13.5)	102 (51.0)	17 (8.5)	53 (26.5)	1 (0.5)	3.505 (1.041)	Agree
- Separate their land into single lots	2 (1.0)	43 (21.5)	22 (11.0)	126 (63.0)	7 (3.5)	2.535 (0.901)	Disagree

Table 4.9 (continued) n=200

Aspects	Opinion level					$\bar{X}$ (S.D.)	Meaning
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
- Production cost is increase	104 (52.0)	88 (44.0)	1 (0.5)	5 (2.5)	2 (1.0)	4.435 (0.726)	Strongly agree
- Use new technology in their agricultural process	77 (38.5)	110 (55.0)	0 (0)	13 (6.5)	0 (0)	4.255 (0.763)	Strongly agree
- Changes in agricultural production from traditional to more organic production	16 (8.0)	65 (32.5)	16 (8.0)	97 (48.5)	6 (3.0)	2.940 (1.119)	Uncertain
- There was some pressure on farmers to adapt on their agricultural production	33 (16.5)	83 (41.5)	12 (6.0)	70 (35.0)	2 (1.0)	3.375 (1.153)	Uncertain

Table 4.9 (continued) n=200

Aspects	Opinion level					$\bar{X}$ (S.D.)	Meaning
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
- Farmers has pressure to adapt and produce to reach the need of consumers	2 (1.0)	80 (40.0)	15 (7.5)	80 (40.0)	2 (1.0)	3.180 (1.087)	Uncertain
- More agricultural labors are employed	17 (8.5)	117 (58.5)	8 (4.0)	55 (27.5)	3 (1.5)	3.450 (1.030)	Agree
- More agricultural product and agricultural business	36 (18.0)	97 (48.5)	17 (8.5)	47 (23.5)	3 (1.5)	3.580 (1.081)	Agree
- Some infrastructure such as road block the water way	4 (2.0)	25 (12.5)	27 (13.5)	138 (69.0)	6 (3.0)	2.415 (0.822)	Disagree
- strictly control of land use and land tax from government organization	2 (1.0)	23 (11.5)	23 (11.5)	144 (72.0)	8 (4.0)	2.335 (0.771)	Disagree

Table 4.9 (continued) n=200

Aspects	Opinion level: Strongly agree amount (person) (%)	Agree amount (person) (%)	Uncertain amount (person) (%)	Disagree amount (person) (%)	Strongly disagree amount (person) (%)	$\bar{X}$ (S.D.)	Meaning
2. Agricultural inputs						**4.461 (0.605)**	**Strongly agree**
- Price of agricultural inputs are rising	108 (54.0)	80 (40.0)	5 (2.5)	7 (3.5)	0 (0)	4.445 (0.713)	Strongly agree
- Farmers can access more agricultural inputs	95 (47.5)	102 (51.0)	2 (1.0)	1 (0.5)	0 0	4.455 (0.547)	Strongly agree
- There were more facilities which helpful for agricultural production	102 (51.0)	94 (47.0)	3 (1.5)	1 (0.5)	0 (0)	4.485 (0.557)	Strongly agree
3. Land factor						**2.100 (0.722)**	**Disagree**
- Their land lease was canceled	1 (0.5)	15 (7.5)	29 (14.5)	124 (62.0)	31 (15.5)	2.155 (0.790)	Disagree
- Farmers need to sell some of their land	1 (0.5)	20 (10.0)	8 (4.0)	149 (74.5)	22 (11.0)	2.145 (0.759)	Disagree
- Farmers sell their whole land	1 (0.5)	9 (4.5)	5 (2.5)	159 (79.5)	26 (13.0)	2.000 (0.617)	Disagree

Table 4.9 (continued) n=200

Aspects	Opinion level: Strongly agree amount (person) (%)	Agree amount (person) (%)	Uncertain amount (person) (%)	Disagree amount (person) (%)	Strongly disagree amount (person) (%)	$\bar{X}$ (S.D.)	Meaning
4. Economic factor						**3.433 (0.870)**	**Agree**
- More demand on agricultural product from your community	40 (20.0)	94 (47.0)	50 (25.0)	15 (7.5)	1 (0.5)	3.785 (0.867)	Agree
- Product price is increase	7 (3.5)	38 (19.0)	57 (28.5)	50 (25.0)	48 (24.0)	2.530 (1.151)	Disagree
- More marketing opportunities	34 (17.0)	78 (39.0)	57 (28.5)	30 (15.0)	1 (0.5)	3.570 (0.959)	Disagree
- You can sell more products	7 (3.5)	28 (14.0)	85 (42.5)	65 (32.5)	15 (7.5)	2.735 (0.915)	Uncertain
- The community can sell more products	3 (1.5)	45 (22.5)	97 (48.5)	52 (26.0)	3 (1.5)	2.965 (0.778)	Uncertain

Table 4.9 (continued) n=200

Aspects	Opinion level					$\bar{X}$ (S.D.)	Meaning
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
- Consumer need to consume safety agricultural products	78 (39.0)	103 (51.5)	5 (2.5)	14 (7.0)	0 (0)	4.225 (0.804)	Agree
- Consumer need to buy more healthy products	78 (39.0)	103 (51.5)	5 (2.5)	14 (7.0)	0 (0)	4.225 (0.804)	Agree

From the data analysis of smallholder farmers opinion toward agricultural changes by effect of urban expansion the data showed in table 4.9 found that;

Overall farmers have uncertain level ($\bar{X}$= 3.330) toward agricultural changes by effect of urban expansion then consider in many aspects found that; Farmers have uncertain level on production aspect ($\bar{X}$ = 3.320) however farmers have strongly agree level on agricultural inputs aspect ($\bar{X}$= 4.461) but they have disagree level in the change of Land factor ($\bar{X}$= 2.100) and they have agree level in economic factor ($\bar{X}$= 3.433)

Apparently, Farmers still have uncertain on the change toward agricultural by effect of urban expansion in some issues as the following details;

1. Production aspect; farmers were strongly agreed with increased of production cost and helpful technology for their production, farmers were agreed with the decline of agricultural land and they try to produce more yield per area. More agricultural products and more agricultural business companies. A lot of agricultural labors were employed. However, farmers were uncertain that there was pressured influence them to adapt on their agricultural production process to meet the need of the consumers or change their

traditional agricultural production to organics agricultural production. Moreover, farmers were agreed to separate their land into single lots.

2. Agricultural inputs aspect; farmers were strongly agreed with price of agricultural inputs are rising. By the way farmers can access more agricultural inputs and there were more facilities which helpful for agricultural production.

3. Land aspect; Farmers were disagreed that their land lease was canceled they do not need to sell some of their land or sell their whole land.

4. Economy aspect; Farmers were agreed that there was more demand on agricultural product from your community. However, farmers were disagreed that agricultural product price is increasing and get more marketing opportunities. Furthermore, farmers were uncertain that they and their community can sell more products.

<u>Part 5</u> Smallholder's farmer adaptation level on the impact of urban expansion in expanded urban area.

From the study of smallholder's farmer adaptation level on the impact of urban expansion in expanded urban area researcher was collected data about level of adaptation and adaptation procedure from farmers which can divide into 3 aspects; Physical aspects, Economy aspects and Social aspects. The result shows in table 4.10

Table 4.10 Smallholder's farmer adaptation level on the impact of urban expansion in expanded urban area, Chiang Mai province. n=200

Aspects	Level of adaptation						$\bar{X}$ (S.D.)	Meaning
	No adaptation	Highly adapt 80-100%	Significant adapt 60-79%	Moderately adapt 40-59%	Slightly adapt 20-39%	Least adapt 1-19%		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
<u>1. Physical</u>							**0.553 (1.101)**	**No adapt**
- Separate their land for sell	185 (92.5)	0 (0)	2 (1.0)	3 (1.5)	5 (2.5)	5 (2.5)	0.160 (0.629)	No adapt
- Reduced agricultural land area	174 (87.0)	2 (1.0)	10 (5.0)	9 (4.5)	2 (1.0)	3 (1.5)	0.420 (1.157)	No adapt
- Increased agricultural land area	181 (90.5)	0 (0)	3 (1.5)	10 (5.0)	2 (1.0)	4 (2.0)	0.250 (0.831)	No adapt
- Increased higher yield per area	127 (63.5)	6 (3.0)	16 (8.0)	36 (18.0)	8 (4.0)	7 (3.5)	1.125 (1.610)	Least adapt
- separate agricultural land for rental	198 (99.0)	0 (0)	1 (0.5)	1 (0.5)	0 (0)	0 (0)	0.035 (0.352)	No adapt

Table 4.10 (continued) n=200

Aspects	Level of adaptation						$\bar{X}$ (S.D.)	Meaning
	No adaptation	Highly adapt 80-100%	Significant adapt 60-79%	Moderately adapt 40-59%	Slightly adapt 20-39%	Least adapt 1-19%		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
- changing crops according to market demand	138 69.0	26 13.0	16 8.0	13 6.5	4 2.0	3 1.5	1.220 (1.933)	Least adapt
- Improve their agricultural land to be an agritourism destination	188 94.0	0 0	5 2.5	2 1.0	0 0	5 2.5	0.155 (0.702)	No adapt
- increase production value by using non-chemical farming	131 65.5	8 4.0	12 6.0	34 17.0	8 4.0	7 3.5	1.065 (1.601)	Least adapt
2. Economy							**0.560 (1.035)**	**No adapt**
- Changing selling methods such as online etc.	169 84.5	11 5.5	5 2.5	5 2.5	2 1.0	8 4.0	0.510 (1.352)	No adapt
- Joining community enterprises	160 80.0	16 8.0	6 3.0	8 4.0	0 0	10 5.0	0.690 (1.557)	No adapt
- Create non-agricultural income	74 37.0	4 2.0	26 13.0	44 22.0	38 19.0	14 7.0	1.730 (1.552)	Slightly adapt

Table 4.10 (Continued) n=200

Aspects	Level of adaptation						$\bar{X}$ (S.D.)	Meaning
	No adaptation	Highly adapt 80-100%	Significant adapt 60-79%	Moderately adapt 40-59%	Slightly adapt 20-39%	Least adapt 1-19%		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
- Joining contact farming	197 98.5	1 0.5	0 0	0 0	0 0	2 1.0	0.035 (0.366)	No adapt
- Agricultural business corporation.	198 99.0	1 0.5	0 0	0 0	0 0	2 1.0	0.030 (0.366)	No adapt
3. Social							**0.602 (1.168)**	**No adapt**
- Assemble farmer's group to exchange agricultural production skills	98 49.0	34 17.0	24 12.0	20 10.0	8 4.0	16 8.0	1.790 (2.031)	Slightly adapt
- Assemble farmer's group to be a mediator between farmers and government officers	181 90.5	10 5.0	4 2.0	3 1.5	2 1.0	0 0	0.395 (1.263)	No adapt
- Building social network to exchange products and services or compare agricultural production cost	189 94.5	5 2.5	2 1.0	0 0	1 0.5	3 1.5	0.190 (0.887)	No adapt
- Assemble farmer's group for bargain the price of agricultural production inputs	194 97.0	1 0.5	0 0	2 1.0	0 0	3 1.5	0.070 (0.475)	No adapt

Table 4.10 (continued) n=200

Aspects	Level of adaptation						$\bar{X}$ (S.D.)	Meaning
	No adaptation	Highly adapt 80-100%	Significant adapt 60-79%	Moderately adapt 40-59%	Slightly adapt 20-39%	Least adapt 1-19%		
	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)	amount (person) (%)		
- Establish organization for community common interests	146 73.0	30 15.0	12 6.0	7 3.5	2 1.0	3 1.5	1.130 (1.955)	**Least adapt**
- Others adaptation	198 99.0	0 0	2 1.0	0 0	0 0	0 0	0.040 (0.398)	**No adaptation**
Total mean and standard deviation of all aspects							**0.571 (1.101)**	**No adaptation**

From the analysis data of smallholder's farmers adaptation on the impact of urban expansion in expanded urban area as in table 4.10 found that;

Most of smallholder's farmers have no adaptation level ($\bar{X}$= 0.571) when consider in aspects found that most of them have no adaptation level on physical aspect ($\bar{X}$= 0.553) economy aspect ($\bar{X}$= 0.560) and social aspect ($\bar{X}$= 0.602)

Apparently, most farmer who planting in expanded urban area still have no adaptation on their agricultural production as the following information

1. Physical aspect; farmers were adapted 1-19% on increased agricultural land area, changing crops according to market demand and increase production value by using non-chemical farming. Signally, farmers have no adaptation level by separate their land for sell, reduced agricultural land area, increased higher yield per area, separate agricultural land for rental and improve their agricultural land to be an agritourism destination.
2. Economy aspect; Farmers were adapted 20-39% on create non-agricultural income but they were not adapted on changing selling methods such as online etc., joining community enterprises, joining contact farming and joining agricultural business corporation.

3. Social aspect; Farmers were adapted 20-39% on assemble farmer's group to exchange agricultural production skills. Farmers 1-19% were adapted by establish organization for community common interests but they still have no adaptation on assemble farmer's group to be a mediator between farmers and government officers, building social network to exchange products and services or compare agricultural production cost and assemble farmer's group for bargain the price of agricultural production inputs.

From the compile of smallholder's farmers adaptation, the result showed that most of them have no adaptation level on their agricultural production on the impact of urban expansion in expanded urban area. However, there still have some farmers who adapt in many procedures which can analysis the data as in table 17

Table 4.11 The result of smallholder's farmers adaptation

Aspects	Result of adaptation			$\bar{X}$ (S.D.)	Meaning	n
	Improve amount (person) (%)	Same amount (person) (%)	Drop off amount (person) (%)			
1. Physical				**2.660 (0.396)**	**Improve**	
- Separate their land for sell	14 (7.0)	1 (0.5)	0 (0)	2.933 (0.258)	Improve	15
- Reduced agricultural land area	22 (11.0)	2 (1.0)	2 (1.0)	2.769 (0.587)	Improve	26
- Increased agricultural land area	10 (5.0)	9 (4.5)	1 (0.5)	2.450 (0.604)	Improve	20
- Increased higher yield per area	58 (29.0)	12 (6.0)	3 (1.5)	2.753 (0.521)	Improve	73
- Separate agricultural land for rental	2 (1.0)	0 (0)	0 (0)	3.000 (0.000)	Improve	2
- Changing crops according to market demand	60 (30.0)	0 (0)	2 (1.0)	2.350 (0.356)	Improve	62
- Increase production value by using non-chemical farming	68 (34.0)	0 (0)	2 (1.0)	2.942 (0.335)	Improve	70
- Improve their agricultural land to be an agritourism destination	2 (1.0)	9 (4.5)	1 (0.5)	2.083 (0.514)	Improve	12

Table 4.11 (Continued)

Aspects	Result of adaptation: Improve amount (person) (%)	Same amount (person) (%)	Drop off amount (person) (%)	$\bar{X}$ (S.D.)	Meaning	n
2. Economy				**2.928 (0.182)**	**Improve**	
- Changing selling methods such as online etc.	28 (14.0)	2 (1.0)	1 (0.5)	2.871 (0.427)	Improved	31
- Joining community enterprises	31 (15.5)	7 (3.5)	1 (0.5)	2.769 (0.484)	Improve	39
- Create non-agricultural income	176 (37.0)	0 (0)	0 (0)	3.000 (0.000)	Improve	126
- Agricultural business corporation.	2 (1.0)	0 (0)	0 (0)	3.000 (0.000)	Improve	2
- Joining contact farming	3 (1.5)	0 (0)	0 (0)	3.000 (0.000)	Improve	3
3. Social				**2.816 (0.252)**	**Improve**	
- Assemble farmer's group to exchange agricultural production, skills	93 (46.5)	7 (3.5)	1 (0.5)	2.910 (0.319)	Improve	101
- Assemble farmer's group to be a mediator between farmers and government officers	16 (8.0)	4 (2.0)	0 (0)	2.800 (0.410)	Improve	20
- Building social network to exchange products and services or compare agricultural production cost	11 (5.5)	0 (0)	0 (0)	3.000 (0.000)	Improve	11
- Assemble farmer's group for bargain the price of agricultural production inputs	2 (1.0)	5 (2.5)	0 (0)	2.285 (0.487)	Same	7

Table 4.11 (Continued)

Aspects	Result of adaptation			$\bar{X}$ (S.D.)	Meaning	n
	Improve amount (person) (%)	Same amount (person) (%)	Drop off amount (person) (%)			
- Establish organization for community common interests	48 (24.0)	5 (2.5)	0 (0)	2.905 (0.295)	Improve	53
- Others adaptation	2 (1.0)	0 (0)	0 (0)	3.000 (0.000)	Improve	2

Farmers who adapt on their agricultural production in expanded urban area found that the result were improved as following details smallholder's farmers were improved after adapt on physical aspect ($\bar{X}$= 2.660) smallholder's farmers were improved after adapt on economy aspect ($\bar{X}$= 2.928) and smallholder's farmers were improved after adapt on social aspect ($\bar{X}$= 2.816).

From the data analysis of smallholder farmer's adaptation in agricultural production in expanded urban area found that there were some farmers who adapted and get the result from their adaptation which can divide into 3 level;

1.00 – 1.66 Drop off
1.67 – 2.33 Same
2.34 – 3.00 Improve

1. Physical aspect

Number of farmers who adapted (Person)	Procedure of adaptation	Result
73	- Increased higher yield per area	Improve
70	- Increase production value by using non-chemical farming	Improve
62	- Changing crops according to market demand	Improve
26	- Reduced agricultural land area	Improve
20	- Increased agricultural land area	Improve
15	- Separate their land for sell	Improve
12	- Improve their agricultural land to be an agritourism destination	Improve
2	- Separate agricultural land for rental	Improve

2. Economy aspect

Number of farmers who adapted (Person)	Procedure of adaptation	Result
126	- Create non-agricultural income	Improve
39	- Joining community enterprises	Improve
31	- Changing selling methods such as online etc.	Improve
3	- Joining contact farming	Improve
2	- Agricultural business corporation.	Improve

3. Social aspect

Number of farmers who adapted (Person)	Procedure of adaptation	Result
101	- Assemble farmer's group to exchange agricultural production skills	Improve
53	- Establish organization for community common interests	Improve
20	- Assemble farmer's group to be a mediator between farmers and government officers	Improve
11	- Building social network to exchange products and services or compare agricultural production cost	Improve
7	- Assemble farmer's group for bargain the price of agricultural production inputs	Same
2	- Others adaptation	Improve

4.3 Factors affecting the level of farmer adaptation in agricultural production in expanded urban area, Chiang Mai province.

Analyzing factors affecting farmer adaptation, the researchers employed multiple regression analysis to find the correlation between dependent and several independent variables in order to find how much each independent variable correlated with dependent variable. The researcher selected 189 farmers who were adapted to calculated. This study used 10 independent variables consisting of: gender, age, education level, agricultural experience, size of agricultural land, membership in agricultural group, total income, sources of agricultural information they received, frequency of contacting with agricultural extension officers, and opinion toward agricultural changes.

The dependent variable (Y) was level of farmer adaptation which was resulted from urban expansion in Chiang Mai. Level of the farmers' adaptation based on 19 questions concerning their adaptation with the following scales for each question:

0 = no adaptation 1 = least adaptation 2 = slightly adaptation
3 = moderate adaptation 4 = significant adaptation 5 = highly significant

Primary of data analysis found that 66.0% of the farmer were male and have average age at 59.54 year old graduated from elementary education. 9.32 rai was the average of their agricultural area and the farmer have experienced on agricultural for 35 years. The average of their total income was 81,225 baht/annual there were two sources of agricultural information for the farmer and the farmer contact with agricultural officers 3 times/year on average. The farmer has medium level of the opinion on the change in their living area and they have no adapt level for their adaptation.

Table 4.12 Average mean and standard deviation of variables used in analysis

Variables	$\bar{X}$	S.D.
1. gender	0.677	0.468
2. age	59.158	8.278
3. education	2.391	1.122
4. agricultural experience	34.497	15.356
5. size of agricultural land	9.422	11.677
6. frequency of contacting with agricultural extension officers	2.968	2.734
7. membership in agricultural group	0.751	0.433
8. total income	84,055.555	158,363.239
9. opinion level toward agricultural changes	3.354	0.299
10. number of agricultural information they receive	2.074	1.044
11. level of farmer adaptation	0.614	0.464

When studying the correlation between each pair of independent variables, no independent variables had a correlation value higher than 0.80 which could cause Multicollinearity that infringe hypothesis of multiple regression details show in table 19. When checking the value of VIF (Variance Inflation Factor) of each independent variable, the variable that had the least VIF value was 1.071 and the highest was 1.876. As value of VIF of each variable was rather low (near 1) it was safe to say that no problem of Multicollinearity happening that would violate hypothesis controlling multiple regression analysis technique. The researcher was specified symbol for all variables as the following details;

The dependent variable (Y) = level of the farmers' adaptation based on 19 questions concerning their adaptation with the flowing scales for each question:

0 = no adaptation 1 = least adaptation 2 = slightly adaptation

3 = moderate adaptation 4 = significant adaptation 5 = highly significant

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 (Rai)

X_6 = frequency of contacting with agricultural extension officer (times/year)

X_7 = being a member in an agricultural group (1 = member 0 = non-member)

X_8 = annual income (Baht)

X_9 = opinion level of agricultural change (average score)

X_{10} = sources of agricultural news (number of sources)

Table 4.13 Correlation between dependent and several independent variables for multiple regression

Variables	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
Y	1.000	-.026	-.009	.286***	.051	-.069	.312***	.177***	.104	.455***	.425***
X_1		1.000	-.042	.201***	-.112***	.113	.042	.048	.082	.061	.038
X_2			1.000	-.374***	.535	-.192***	-.031	.033	-.162***	.018	-.072
X_3				1.000	-.251	.205	.241***	.026	.215***	.278***	.211***
X_4					1.000	-.139***	-.005	-.040	-.206***	.127***	-.044
X_5						1.000	.063	.083	.667***	.116	.145*
X_6							1.000	.155***	.088	.120	.236***
X_7								1.000	.090	.123*	.053
X_8									1.000	.127**	.112
X_9										1.000	.260***
X_{10}											1.000

Notation * < 0.05
** < 0.01
***< 0.001

From the multiple regression analysis, by entering 10 independent variables into the equation and calculated using Enter method, the result was that F = 13.304; Sig = .000 meaning there was at least 1 independent variable that correlated with dependent variable in linear equation. When considering value of Multiple coefficient of determination, R2, value of R2 was .428 meaning that all independent variables can explain the variation of dependent variable (level of farmer adaptation as 42.8%.) Among 10 independent variables, 6 of them correlated with dependent variables at statistically significant of 0.05 or lower. They were 1. Education 2. Size of agricultural land 3. Frequency in contacting with agricultural extension officers 4. Total income 5. Level of opinion toward agricultural changes 6. Sources of agricultural information they receive. Variables that had positive correlation were education, frequency in contacting with agricultural extension officers, total income, level of opinion toward agricultural changes, sources of agricultural information they receive. Variables that had negative correlation were size of agricultural land. A model for multiple regression analysis is specified as follows:

$$
\begin{aligned}
Y = {} & -1.548 - .071X_1 + .000X_2 + .060X_3^{**} + .002X_4 \\
& (-4.250)\ (-1.233)\ \ (.034)\ \ (2.129)\ \ (.786) \\
& -.013X_5 + .027X_6^{**} + .116X_7 + 6.089E\text{-}7X_8^{***} \\
& (-4.132)^{***}\ \ (2.611)\ \ (1.849)\ \ (2.668) \\
& +.486X_9^{***} + .133X_{10}^{***} \\
& (4.998)\ \ (4.914)
\end{aligned}
$$

* Significance of statistics t < significant level 0.05

Table 4.14 Multiple regression analysis of factors affecting farmer's adaptation from urban expansion

Variables	Standardize Beta	t	Sig
1. gender	-.072	-1.233	.219
2. age	.002	.034	.973
3. education	.145	2.129	.035**
4. agricultural experience	.055	.786	.433
5. size of agricultural land	-.320	-4.132	.000***
6. frequency of contacting with agricultural extension officers	.158	2.611	.010**
7. membership in agricultural group	.108	1.849	.066
8. total income	.207	2.668	.008**
9. opinion level toward agricultural changes	.313	4.998	.000***
10. number of agricultural information they receive	.299	4.914	.000***
R2= .428 SEE = .361 F = 13.304 Sig. of F = .000			

* Significance of statistics t < significant level 0.05

From the analysis of multiple regression in table 4.13 can conclude that there are 6 independent variables which have statistical significance correlate with dependent variable (level of farmer's adaptation in expanded urban area, Chiang Mai province). According to the previous details it can prove that there are factors affecting farmer adaptation from urban expansion; 1. Education 2. Size of agricultural land 3. Frequency in contacting with agricultural extension officers 4. Total income 5. Level of opinion toward agricultural changes 6. Sources of agricultural information they receive. Variables that had positive correlation were education, frequency in contacting with agricultural extension officers, total income, level of opinion toward agricultural changes, sources of agricultural information they receive. Variables that had negative correlation were size of agricultural land. This result can perceived that the farmers, with high education, having high yearly income, receiving information from several sources, contacting relevant officers frequently, had level of opinion in "agree" level that there existed agricultural changes resulted from urban expansion and decreasing tendency in agricultural land areas, they tended to be adaptive more than farmers with opposite characteristics.

4.4 Difficulties and obstacles in smallholder's farmers adaptation

There were some difficulty and obstacles for the farmers who adapted in expanded urban area which caused the way of adaptation. Difficulty and obstacles in this situation can divide into 8 aspects as the following details;

- Agricultural area also one of difficulty that farmers have faced. For example, some farmers sell their land to use in another purpose instead of planting such as housing development. This can define as Primitive Adjustment which mean farmers need to fight or back up with the change (Bennett, 1969) As seen by There were many of farmers who stopped their agricultural career which caused decline number of agricultural areas.

– Increased of agricultural production cost even when urban expansion can give more opportunities to farmers to access more agricultural inputs. However, this also raised the price of agricultural inputs because of there were more demand from the farmer but there was unstable price of agricultural products which made farmers cannot estimate proper cost and benefit. As from the data collection found that most farmers in the study area are small farmers and have low income that make their adaptation proceed gradually because sometimes, they need money for their adaptation. This can define as reaction adaptation mean farmers experienced with the changes and then they try to cope with the change (Marion et al, 2016)

- No heir on agricultural career, most farmers are very old and agricultural career need patient and strong body to run it which mean elderly people cannot do all agricultural production process by their own and their child will not heir on agricultural career because others career can make more income and need less energy to work than working in the farm.

- Migrant labors; due to higher number of migrant labors come into their agricultural area which help the farmer to hire more agricultural labors however this effected to the price for hiring migrant labors will be rise and increase their agricultural production cost.

4.5 Recommendation for farmer's adaptation

Sustainable adaptation in agricultural career for farmers who farmed in expanded urban area need to be gradually process. Times and moneys are the main factors for farmer's adaptation in agricultural production in expanded urban area, details as following.

- Economy aspects; farmers gave the opinion that cost of agricultural production is the most important factor in their agricultural production. If farmers can adapt and control their agricultural production cost by produced their own pesticide and reduce chemical use in their production will help the farmer have sustainable in their adaptation. Moreover, revenue-expense account plays a major role in agricultural career because when farmers know their monthly revenue-expense account they will manage their own money and avoid agricultural debt. Varieties of agricultural products that they've produced and create non-agricultural income will help the farmer to increase their income.

- Agricultural knowledges aspect; Seeking for new information which helpful for agricultural career will help the farmer to have more ability on their adaptation. For example, attend to some training which arrange by District Agricultural Extension Offices, exchange information about their agricultural production process with the agricultural learning center and pay attention on the market demand and economic situation.

- Agricultural production aspect; farmers have been adapted in many ways of agricultural production. For example, produced non-chemicals vegetables to serve the need of customers whom concern on food safety. Some of them start to do integrated farming system to use every part of their agricultural area or changed their agricultural types from planting rice to planting vegetables because it is taking shorter cultivation time for planting vegetables than rice and farmers can sell their vegetables product right after the harvest. Furthermore, the farmer should be concern about quality of their products and manage their own production planning to predict their income and the amount the yield of their agricultural products.

- Social aspect; They suggested that District Agricultural Extension Offices should support them to establish varieties of the farmer groups which can help them exchange

the information about their agricultural production and help each other to find better way in their production process. Farmers commercial groups also a great way to help the farmers to add more value and develop for branding their products.

4.6 Guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas in Chiang Mai province

From the data analysis of this study composed with review literature about the related agricultural policies from The Twelfth National Economic and Social Development Plan of Thailand we can suggest some helpful guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas shows in figure 4.1

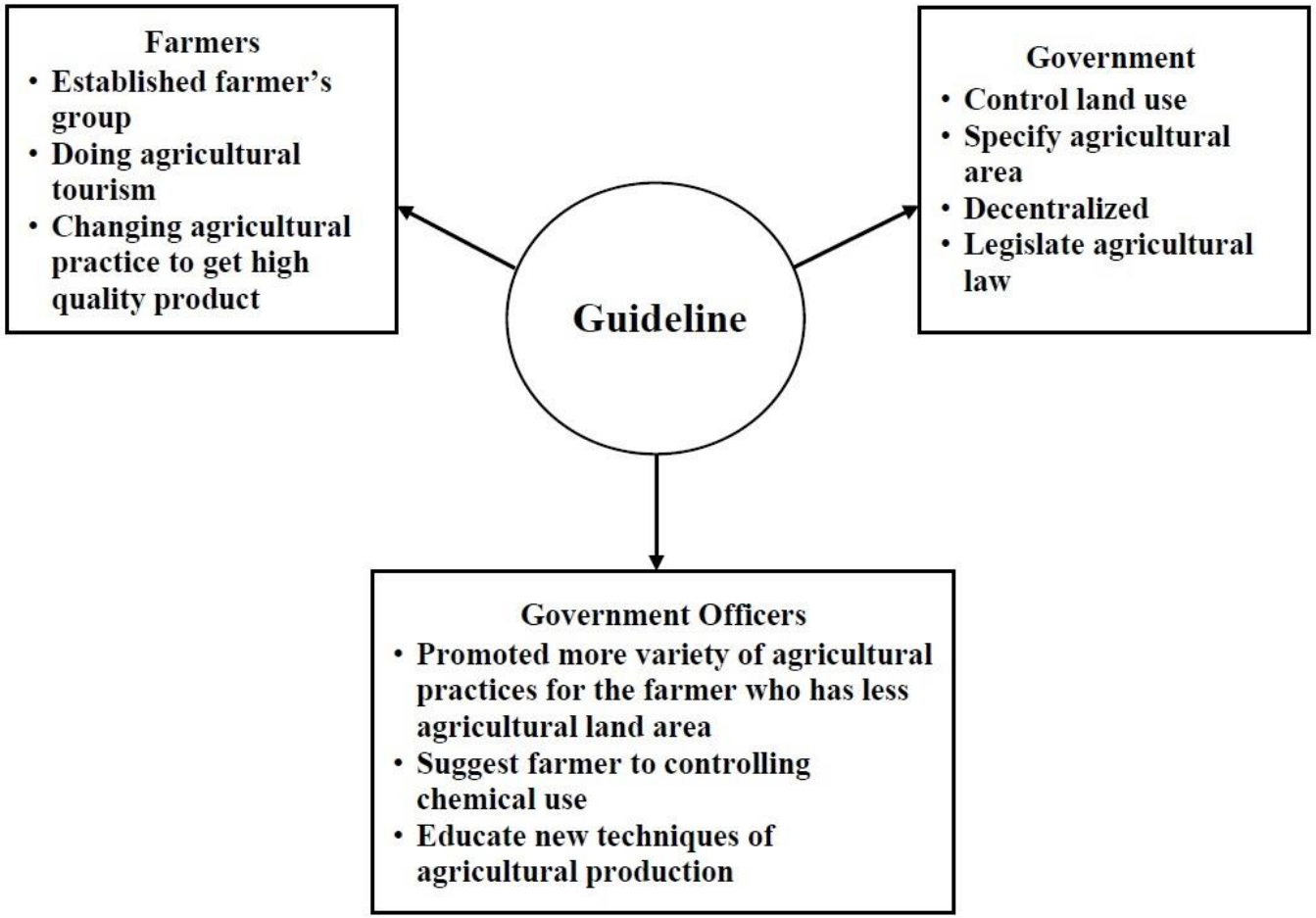


Figure 4.1 Guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas

From figure 4.1 its showed guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas. Apparently, the planning should be plan in every level such as country level, related organization from both government and private and the most important level is the farmer themselves. The guideline that have been suggested were derived from the review literature about farmer's adaptation to urbanization in many different countries composed with qualitative and quantitative data from the study area then append it with agricultural policies from The Twelfth National Economic and Social Development Plan of Thailand.

To make this guideline proceed efficiency people who involve in the development of farmer's adaptation in expanded urban area should be decentralized the working process and start to work from bottom up. First step, they must be asking for the need of the farmers then bring all the need to connect with the state agencies and related organization from both government and private to understand duty of every party then make it as a country policy which is proper with the area and situation.

Researcher has an idea for the guideline for the farmer to adaptation in expanded urban areas as the following details;

- Gather agricultural producer's groups who farm in expanded urban area and introduce themselves to the customer to build connection between producers and consumer and set up network of agricultural producers in expanded urban area. This kind of group also appear in The United States of America in the form of an organization named "The Lexicon of Sustainability" it performs by grouping with the farmers who farmed in urban area to give awareness to the consumer about where their food came from and how it is produced. This idea is conforming with the guideline to development for Thailand agricultural sector in The Twelfth National Economic and Social Development Plan (2017) said that the government should promote the farmer to establish entrepreneurs to meet the efficiency production and reduce production process. The farmer should be access to proper agricultural technology which helpful for their agricultural production. Moreover, market mechanism can protect the farmer from product's price risk.

- Develop agricultural area to be an agritourism destination. Farmers and consumer get closer when urban expansion to agricultural area indicated by farmers can direct sell their products to the consumer because customer can come and pick the product from farming area. If the farmer can develop their agricultural area to be an agritourism destination they will have more income when the customer come to visit their farm. In Japan, farmers can direct sell their products to the customer or deliver their products to the department store and they also develop their agricultural area to be an agritourism destination (Busck *et al*., 2006; Tsubota, 2007)
- Adjust their agricultural production from traditional to integrated farming and add more value to their products. If the farmer product only one crop they will not make income during the year. Each plant has different type, different time for planting and harvesting then farmers should produce varieties of plants in their agricultural area and they can sell many products during the year. In the United States of America, Agricultural land in urban area has smaller size where can produce more products and higher yield than farm in the rural area. Most farmers who farmed in urban expansion area have significant amount of their agricultural products (Heimlich & Barnard, 1992) Which is match to a policy from The Twelfth National Economic and Social Development Plan (2017) determine that the government should promote sustainable agricultural production to the farmer by change from single crop to sustainable agricultural. For example, nature farming, integrate farming, organic farming and agroforestry.
- Doing agricultural complete production. Farmers should have more opportunity to create more income and develop their agricultural production skill by learning to agricultural complete production. Agricultural complete production mean farmers will plant, harvest, process and sell it by their own in every process. This complete production will guarantee that the farmer will have market for their products. Farmers who farmed in urban are of Pennsylvania, the United States of America adapted by establish a retail store and trade cooperation to access the

market (Larson et al, 2001). Moreover, there were some farmers who can develop their production skills to became an entrepreneur (Inwood & Sharp, 2012).

Guidelines for related organizations which can help farmer to adaptation in agricultural production in expanded urban areas with efficiency and reach their goals of adaptation are in the following details;

- Suggest secondary occupation beside agricultural career for the farmer. Single crop production cannot make farmers meet sustainable in their career then the related organization such as Provincial and District Agricultural Extension Offices must promote variety of agricultural practice and product in order to increase more income and make use of the land through the limit for instance catfish farming, mushroom cultivation and vertical frog farming. Changing their agricultural practice to add more value and gain more income and meet the need of consumers. This guideline will be match with The Twelfth National Economic and Social Development Plan (2017) define that government organization should be support farmer to conform their agricultural production process with ability of land area, water resource and market demand and encourage the farmer to access to good price and high quality of agricultural inputs.
- Promote safety agricultural production to farmers. Nowadays, consumer have more concern about their health if the related organization from both government and private can suggest farmers to increase non-chemical agricultural products will help them gain more income from niche market. The organization need to follow The Twelfth National Economic and Social Development Plan (2017) that they should allow farmers to produce more products that good for health. It can be arranged as a training program which host by government organization and subsidy the farmer who produce organics food that can help to decrease their production cost and get the right products for market demand.
- Campaign and publicize about how to do agricultural complete production in expanded urban area. Each farmer has different ability, skills and knowledge for adaptation if the related organizations can arrange a training about how to do

agricultural complete production in expanded urban area will be help famers to have efficiency in their adaptation. Give more knowledge to improve standard of agricultural production also good for the farmer. The Twelfth National Economic and Social Development Plan (2017) defined that related organization should develop the system to certified the production standard and check on agricultural product quality along with improve standard of agricultural food safety to certain the customer. Expand the concept of agriculture accord to the principles of sufficiency economy to support the learning process and drive towards sustainable agriculture. As well as promoting financial management skills in order for the farmer to be able to effectively manage income, capital and debt.

- Setting an organization which can provide agricultural production knowledge such as Provincial and District Agricultural Extension Offices and university by provide learning aid which can give information of agricultural production in expanded urban area to be an example for the farmer in good agricultural practice. Including obtain market for the farmer to bring their products on the shelf which can guarantee that they will absolutely sell their product.

Guidelines for the government to help farmer to adaptation in agricultural production in expanded urban areas with efficiency and reach their goals of adaptation. Nation policy for agricultural sector will lead and control the operation of related organizations with the farmer. Details are as the following;

- Restriction of land use and specified proper amount of agricultural area. This is the most important issue which is related to the impact of urban expansion into agricultural area. Because if the government is strict on land use in every area it will help to remain and protect agricultural area from decreasing. Agricultural security areas and agricultural zoning are the policy to protect the loss of agricultural area from urbanization and control the land use in the United states of America (Larson et al, 2001). In England there is green belt project that can protect green area from the influences of urban expansion by specified the area that not allow to build-up the building and applied in many of European countries (Zasada, 2011). The Twelfth National Economic and Social Development Plan

(2017) decided that Thailand should have a strong policy to preserve agricultural area and give more opportunities for the farmer to use their agricultural land. Land bank also one of a good protocol to spread land ownership to the farmer and poor to have their own land.

- Coordinate and control the accordance relevant policies about agricultural production in expanded urban area appropriately. Thai government should be specifying an organization to take responsibility on the operation of every relevant policies about agricultural production in expanded urban area. In case if there are issues in the operational people who involve in this operation will take action to solve the problem and people will know where to go if they have something to complain about the operation.
- Legislate rules to control the operation between the relevant institutes and farmer's network to reduce the conflict during the operational for every parties who participate. Start by propose Act of preservation on agricultural area to manage the proper use of agricultural area. Maintaining suitable are for agriculture to be an agricultural production base including determine the appropriate use of agricultural land. Modernize related law for agricultural sector such as Chemical laws, Cooperative law, Land reform law, Food law and the related law which for the standard of agricultural product (The Twelfth National Economic and Social Development Plan, 2017)

From the result of this study, researcher can summary scenario of the study shows in figure 4.2

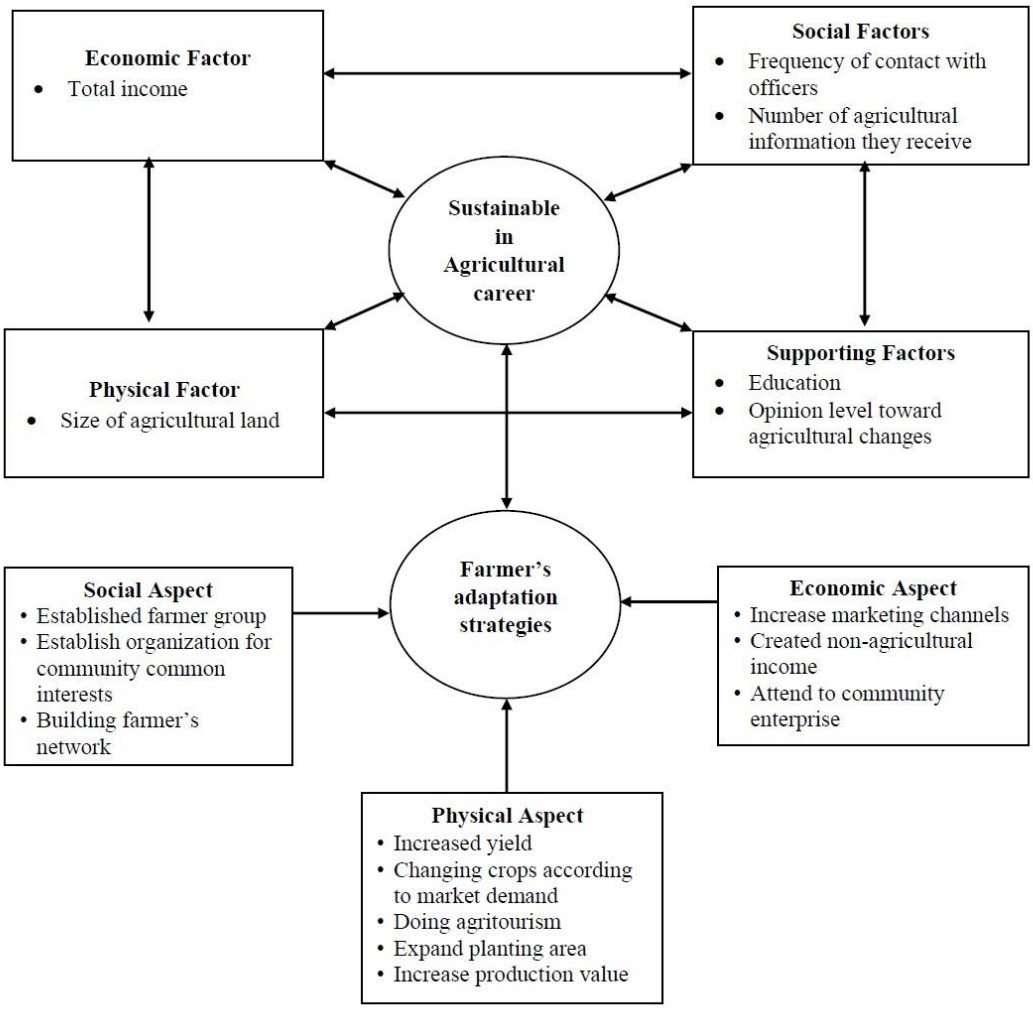


Figure 4.2 Model for smallholder farmers' adaptation in agricultural production in expanded urban areas, Chiang Mai province from the study

CHAPTER 5

Conclusion

The study of smallholder farmers' adaptation in agricultural production in expanded urban area, Chiang Mai province applied mixed method research, exploratory design. Started by collected qualitative data to explored the research topic then develop the research instrument and used the research instrument to collected quantitative data for examine the qualitative result by collect quantitative data from the sampling. There were 3 objectives for this research as the following;

1. To study changes in agricultural production and some socio-economy characteristics of smallholder farmers in expanded urban areas in Chiang Mai province
2. To analyze smallholder farmers' adaptation in agricultural production in expanded urban areas in Chiang Mai province
3. To develop the guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas in Chiang Mai province

From the study of personal and socio-economy characteristics of smallholder farmers in adaptation of agricultural production in expanded urban areas, Chiang Mai province. There were 200 farmers of samplings collected data about gender, age, education level, agricultural experience, cultivation area, type of agricultural production and land ownership. The result found that 66% of the farmer were male 50.5% age between 56-65 year old followed by 21.5% age between 46-55 year old. Average age of the farmer was 59.54 year old lowest age was 31 highest age was 80 year old. For the education level found that 85.5% of the farmer have primary school level followed by 4.5% of the farmer have secondary school level. 27% of the farmer have experience in agricultural between 41-50 years follow by 19% of the farmer have experience in agricultural between 31-40 years and the average experience in agricultural was 35 years. 80% of the farmer were

planting in the irrigation zone 63.6% of them were planning rice and 17% were planting vegetables.

Apparently, most of the farmer were elderly with lower than standard education level and spend long time with doing agricultural practices. Smallholder farmers who planting in expanded urban area were producing rice as their main agricultural product then vegetables, horticulture, crops and flowering in order. Most farmers applied integrated farming for their production process because they want to make use of the land through the limit. Additional data from the sampling said that agricultural career needs strong body, patient and high energy to manage in their farm that not persuade young people to work in the farm because they can make more income from another career.

From the analysis data of the smallholder farmers economy characteristics who farm in expanded urban area, Chiang Mai province found that 45.5% of smallholder farmers have agricultural land area between 6-15 Rai followed by 41% of smallholder farmers have agricultural land area less than 5 Rai and 89.5% of them owned agricultural land area less than 5 Rai. For the career of smallholder farmers, the data showed that 81.5% of them working as farmer for their full-time career followed by 11% who work as employee and 67.5% of them work as employee for their part time career. Smallholder farmers 38% can made agricultural income between 25,001-50,000 Baht/year followed by 29% of them can made agricultural income between 10,001-25,000 Baht/year. An average agricultural income of smallholder farmers who planting in expanded urban area in Chiang Mai province was 43,370 Baht/year. Smallholder farmers 50% can created non-agricultural income less than 10,000 Baht/year; an average non-agricultural income was 37,855 Baht/year. For their total income including agricultural and non-agricultural income found that 33.5% of smallholder farmers 25,001-50,000 Baht/year; an average total income of them was 81,225 Baht/year.

Moreover, the researcher found that only 17.5% of smallholder farmers have agricultural insurance; 10.5% of them had agricultural insurance for 1-5 years and 7.5% of them had had agricultural insurance for 6-10 years. Thai government also provide some subsidy for 73.5% of smallholder farmers; 50.5% of them were subsidized for 1-5 years and 23% of them were subsidized for 6-10 years. This result indicated that most of farmers were small

farmer which have low in both of agricultural and non-agricultural income per annual. Most of them have no agricultural insurance but more than half of them got subsidy from the government.

From the analysis data of social characteristics of smallholder farmers who planting in expanded urban area, Chiang Mai province found that 44.8% of smallholder farmers received agricultural information from District Agricultural Extension Offices followed by 25.2% of smallholder farmers received agricultural information from television and 13.9% of smallholder farmers received agricultural information from radio. For frequency of contacting with agricultural extension officers found that 84% of stallholder farmers contacted with agricultural extension officers between 1-5 times/year followed by 7.5% of stallholder farmers contacted with agricultural extension officers between 6-10 times/year. In the way that smallholder farmers communicated with officers found that; 50.1% of smallholder farmers communicated with officers by attended to training which arranged by District Agricultural Extension Offices followed by 24.9% of smallholder farmers communicated with officers when the officers visited their own farm.

In case of Membership in agricultural group found that; 73.5% of smallholder farmers were attended to agricultural group but 90% of smallholder farmers never attended to the training about urbanization and adaptation in agricultural production in expanded urban area. This result indicated that District Agricultural Extension Offices was the main sources of agricultural information for smallholder farmers. Stallholder farmers who farm in expanded urban area attend to agricultural group to exchange the way they produced their products, asking for more production information but suspected that most of them never attended to the training about urbanization and adaptation in agricultural production in expanded urban area.

The study of cognition of smallholder farmers about urbanization components from 200 smallholder farmers point of view found that; 14.1% of them answered that temple is an urbanization component, 13.6% of them answered that market is an urbanization component, 13.4% of them answered that school is an urbanization component, 11% of them answered that department store is an urbanization component, 10.8% of them answered that convenient store is an urbanization component and 9.4% of them answered

that housing development is an urbanization component. There were only 2.9% of them answered that factory is an urbanization component. From examine of urban structure which including school, temple, hospital and market are all the cultural and social infrastructure sector. Which is indicated that smallholder farmer understanding that urbanization has many components that can see it apparently and familiar to the farmers such as temple, market, school department store, convenient store and housing development but there was less factory in the study area.

From the study about urbanization components in a 5 kilometers radius from agricultural land areas of smallholder farmers the result showed that 17.2% of them answered that there was a housing development in a 5 kilometers radius from agricultural land areas, 15.4% of them answered that there was a temple in a 5 kilometers radius from agricultural land areas, 9.1% of them answered that there was a school in a 5 kilometers radius from agricultural land areas, 7.9% of them answered that there were market and convenient store in a 5 kilometers radius from agricultural land areas. However, there were 25.8% of smallholder farmers answered that there were no urbanization components in a 5 kilometers radius from their agricultural land areas.

Apparently, smallholder farmers have point of view that urbanization component should be included temple the most followed by market, school, department store and housing development in order. On the other hand, from the real appearance of urbanization indicator in a 5 kilometers radius from their agricultural land areas included housing development the most followed by temple, school, market and convenient store.

The analysis of public utility in smallholder farmer's agricultural land area found that 91% of smallholder farmers answered that there were concrete road and drain in access into their agricultural land area. For public utilities in agricultural land area found that; 45.3% of smallholder farmers has electricity in their agricultural land area, 24.2% of smallholder farmers has water supply in their agricultural land area, 22.0% of smallholder farmers has telephone network in their agricultural land area and 8.5% of smallholder farmers has internet in their agricultural land area. Possibly conclude that there were public utilities in agricultural land area which included electricity, concrete road and drain the most.

In the study about smallholder farmers opinion on the change from the effect of urban expansion in smallholder farmers living area during the past 10 years found that Overall of the farmers agreed that the urban expansion into agricultural area made change to their living area at medium level when considered to the change in other aspects the result can divided into 6 aspects;

1. The farmer has opinion at low level of change in land aspect; there were high level of change on rising of land price and trading land for speculate while there was medium level of change on size of agricultural land area and agricultural land area has change to non-agricultural use then there was low level of change on trading land for invest in agricultural or list it as agricultural land for rent.

2. The farmer has opinion at low level of change in infrastructures aspect; there were medium level of change on accessible by road to the land and installation of electrical systems while there was low level of change on installation of water supply, housing development built-up, the expansion of irrigation zone, number of department stores retail shops and convenient store that occurred in the area.

3. The farmer has opinion at medium level of change in population aspect; there were high level of change on number of the immigrants and migrant labors who came to work in the area but there was low level of change in number of tourists that come to travel in the area.

4. The farmer has opinion at medium level of change in livelihoods aspect; there was high level of change on convenience way of life such as the way of communication, how to travel in the area etc. There was medium level of change on various of occupations and low level of change in exposure to new cultures.

5. The farmer has opinion at medium level of change in economy aspect; there were high level of change on various of products and service in the area, people in area have to spend their money and more labors were employed for service. Medium level of change on people in the area are earning money from many ways and non-agricultural income have been created. Low level of change on the operation of agricultural business companies in the area and establishment of community enterprises.

6. The farmer has opinion at medium level of change in environmental aspect; there were high level of change on solid wastes, air pollution and rainfall in the area. Medium level of change on soil pollution and low level of change on water pollution and noise pollution.

From the study of smallholder farmers opinion toward agricultural changes by effect of urban expansion found that overall farmers have uncertain level toward agricultural changes by effect of urban expansion then consider in 4 aspects;

Apparently, Farmers still have uncertain on the change toward agricultural by effect of urban expansion in some issues as the following details;

1. Farmers have uncertain level on production aspect; farmers were strongly agreed with increased of production cost and helpful technology for their production, farmers were agreed with the decline of agricultural land and they try to produce more yield per area. More agricultural products and more agricultural business companies. A lot of agricultural labors were employed. However, farmers were uncertain that there was pressured influence them to adapt on their agricultural production process to meet the need of the consumers or change their traditional agricultural production to organics agricultural production. Moreover, farmers were agreed to separate their land into single lots.

2. Farmers have strongly agreed level on agricultural inputs aspect; farmers were strongly agreed with price of agricultural inputs are rising. By the way farmers can access more agricultural inputs and there were more facilities which helpful for agricultural production.

3. Farmers have disagreed level in the change of land factor aspect; Farmers were disagreed that their land lease was canceled they do not need to sell some of their land or sell their whole land.

4. Farmers have agreed level in economic factor aspect; Farmers were agreed that there was more demand on agricultural product from your community. However, farmers were disagreed that agricultural product price is increasing and get more marketing opportunities. Furthermore, farmers were uncertain that they and their community can sell more products.

The study of smallholder's farmers adaptation on the impact of urban expansion in expanded urban area found that; Most of smallholder's farmers have no adaptation level when consider in aspects found that;

1. Farmers have no adaptation level on physical aspect; farmers were adapted 1-19% on increased agricultural land area, changing crops according to market demand and increase production value by using non-chemical farming. Signally, farmers have no adaptation level by separate their land for sell, reduced agricultural land area, increased higher yield per area, separate agricultural land for rental and improve their agricultural land to be an agritourism destination.

2. Farmers have no adaptation level on economy aspect; Farmers were adapted 20-39% on create non-agricultural income but they were not adapted on changing selling methods such as online etc., joining community enterprises, joining contact farming and joining agricultural business corporation.

3. Farmers have no adaptation level on social aspect; Farmers were adapted 20-39% on assemble farmer's group to exchange agricultural production skills. Farmers 1-19% were adapted by establish organization for community common interests but they still have no adaptation on assemble farmer's group to be a mediator between farmers and government officers, building social network to exchange products and services or compare agricultural production cost and assemble farmer's group for bargain the price of agricultural production inputs.

Analyzing factors affecting farmer adaptation.

The researchers employed multiple regression analysis to find the correlation between dependent and several independent variables in order to find how much each independent variable correlated with dependent variable. This study used 10 independent variables consisting of: gender, age, education level, agricultural experience, size of agricultural land, membership in agricultural group, total income, sources of agricultural information they received, frequency of contacting with agricultural extension officers, and opinion toward agricultural changes.

The result found that there were factors affecting farmer adaptation from urban expansion 1. Education 2. Size of agricultural land 3. Frequency in contacting with agricultural extension officers 4. Total income 5. Level of opinion toward agricultural changes 6. Sources of agricultural information they receive. Variables that had positive correlation were education, frequency in contacting with agricultural extension officers, total income, level of opinion toward agricultural changes, sources of agricultural information they receive. Variables that had negative correlation were size of agricultural land. This result can perceive that the farmers, with high education, frequency in contacting with agricultural extension officers, having high total income, had level of opinion in "agree" level that there existed agricultural changes resulted from urban expansion, receiving information from several sources, and decreasing tendency in agricultural land areas, they tended to be adaptive more than farmers with opposite characteristics.

Guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas in Chiang Mai province

Guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas. Apparently, the planning should be plan in every level such as country level, related organization from both government and private and the most important level is the farmer themselves. To make this guideline proceed efficiency people who involve in the development of farmer's adaptation in expanded urban area should be decentralized the working process and start to work from bottom up. First step, they must be asking for the need of the farmers then bring all the need to connect with the state agencies and related organization from both government and private to understand duty of every party then make it as a country policy which is proper with the area and situation.

1. The farmer need to gather agricultural producer's groups who farm in expanded urban area and introduce themselves to the customer to build connection between producers and consumer. Broadcasting agricultural production process to the student who have aware on safety food production in urban area as the way to create the new generation of farmers. Develop agricultural area to be an agritourism destination. Moreover, adjust their agricultural production from traditional to integrated farming and doing agricultural complete production can add more value to their products.

2. Related organizations from government and private sectors need to suggest secondary occupation beside agricultural career for the farmer. Promote safety agricultural production to farmers. Campaign and publicize about how to do agricultural complete production in expanded urban area. Setting an organization which can provide agricultural production knowledge.

3. The government is the biggest sector which is involve in the guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas. Restriction of land use and specified proper amount of agricultural area. Coordinate and control the accordance relevant policies about agricultural production in expanded urban area appropriately. Legislate rules to control the operation between the relevant institutes and farmer's network to reduce the conflict during the operational for every parties who participate.

CHAPTER 6

Discussion

The study of smallholder farmers' adaptation in agricultural production in expanded urban area, Chiang Mai province has both result for qualitative research and quantitative research. In this chapter will discuss the result of this study with related research in various aspects.

Discussion general information of study area

From content analysis of this study showed that government officers and farmers are both aware on urban expansion and impact of its. Urban expansion caused on decreased number of agricultural land area and number of farmers. This issue happened in many countries such as the United states of America (Heimlich and Barnard, 1992) European countries (Antrop, 2004; Oueslati et al., 2014) Vietnam (Pham et al., 2014) and India (Hussain and Hanisch, 2014) found that sizes of farm in urban area always smaller than farm in the rural area but can produced higher yield. For the farmer's adaptation occurred in positive way like doing organic agricultural production and changed type of agricultural products responded to the consumer demand.

Identically with the study of Sioen et al. (2018) found that Japanese farmers who farmed in urban area try to direct sell their product to the customer and some have changing their agricultural products from rice to vegetables or fruits and created non-agricultural income. Accordance to Jiang et al. (2013) found that the urbanization in China give non-agricultural opportunities for the farmer such as gain more income from non-agricultural career and reduced the lack of agricultural labors. Redwood (2009) and Kontothanasis (2017) all agreed that when urban expansion into agricultural area created more works and more activities for particle economics. The farmer who farmed in expanded urban area in Chiang Mai province also try to develop their agricultural land to be an

agritourism. Busck et al. (2006) and Tsubota (2007) discovered that the farmer can doing agritourism when the urban expanded into their agricultural land.

There is an interested point about farmers' adaptation strategies in expanded urban area of Chiang Mai which is formed many of farmer's group for exchange agricultural information, knowledge of production, difficulties and obstacles in agricultural production process. Deng et al. (2015) reported that Chinese farmers gathered many groups to exchange agricultural information which initiated innovations and technologies that facilitate efficiently agricultural production and increase production yield. Moreover, female farmers can increase their role to produced more income to their household by attended to community enterprises this appeared in the study from Olivier and Heinecken (2017) and Urban Development and resilience unit (2013) found that the urbanization in Cape Town helped on women role instead of raising their kids and being a housewife to became a producer of their own food for the family and have opportunity to attend in social group of urban farmer in the city.

The positive way of adaptation like stopped their career on agricultural and sell the land for built-up area were not much appeared in Chiang Mai (Elhadary et al., 2013) because farmers sell some of their land but still have the remain of their agricultural area. From the result can assumed that farmers who plant in urban expansion area of Chiang Mai province use modified adjustment to survive (Bennett, 1969). This adaptation type can help the farmer to preserve their agricultural career and still can created income for their households. The trend of consumer demand such as non-chemical vegetables give benefit to the farmer to find the market for their products but if they need a sustainable in agricultural career, they should produce higher quality and produced more products to meet the market demand.

Discussion quantitative result

In the quantitative study, from analysis on fundamental characteristics of farmers, it was found that most farmers were small-scale farmers owning small plots of land, having long time experience in agriculture careers and having not much potential in production due to their low education, low production cost because of their low yearly income. However,

in social roles, they grouped themselves, received news and information, had lots of contact with relevant officers.

This study also revealed that most farmers acknowledged the effect of urban expansion on the agricultural sector but were not sure whether there existed change in the areas where they grew their crops. Although they realized the effect and change in agriculture, it was found that they have low level of adaptation. This may be because they were not fully awakened to such situation. They also lacked knowledge in agricultural production adaptation as can be seen from what they should have adapted to but not yet done in relation to development of farming areas to be agricultural tourist destinations, changing channels for selling such as online selling, grouping themselves to become community enterprise, or creating agricultural group to become negotiator when contacting governmental officers, building social network for sharing news and information, grouping in order to negotiating price. Moench and Dixit (2004) said that such adaptation was to reduce vulnerability reduction which Bennett (1969) called adaptation for achieving individual goals. If such adaptation is successful, farmers would achieve their goals such as higher yields as they anticipated, and earning higher income appropriately.

From analysis of factors affecting adaptation of farmers to urban expansion, it was found that factors that (statistically significant) affected them were the following 6 variables as following.

1. Education of the farmer had positive effect toward farmer adaptation. This mean, 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. Similar to the study of Chaplin (2004) found that education level influences the need of changes in farm management. Zasada (2011) proved that more education about how to farm in urban expansion area can increased agricultural area in urban fringe.

2. Size of areas for agriculture affected negatively toward farmer adaptation. This means that, farmers who own much more land areas would adapt less than those with less land areas. This is because farmers who own small land plot were more flexible or could use their areas to do other activities easier, without high cost of investment. This is according to the study of (Heimlich and Barnard,1992) which found that farmers who adapted well were those with small land plots near urban areas and could give higher yields per area. Same with the study of Gomes et al. (2019) declined of agricultural area under pressure of urban expansion helped farmers to adapt on their agricultural production. Stinger et al. (2020) found that size of agricultural land affected farmer's adaptation.

3. Frequency of contact with agricultural extension officers affects positively farmer adaptation. Those who contacted the officers several times could adapt well compared to those with less contact. This is because the relevant officers are important figures who drive for development of agriculture, so if farmers get in touch with them regularly, they would receive relevant knowledge, approach and new suggestions for adaptation to practice more in reality.

4. Yearly income was affected positively toward the adaptation. This means that, farmers who had high yearly income could adapt themselves better than those with low yearly income. This was because production adaptation involved budget. Urban expansion made production costs become higher, causing farmers to spend more. The result was in parallel with the research of Larson et al., (2001) which found that farmers in urban expansion areas usually found a way to earn extra income so that they could bring extra money to invest in improving production patterns. Pham et al., (2014) found that farmers working in urban expanding areas in Vietnam needed to find extra income from the non-agricultural sector to earn money to invest in changing production patterns. Furthermore, Uddin et al., (2014) found that economic characteristics of farmers affected adaptation especially total household income.

5. Opinion toward agricultural changes affected by urban expansion had a positive effect on their adaptation. That is, those who have "agree" level of opinion more in aspect that there exist changes in agricultural sectors from urban expansion would be able to

adapt better than those with “less agree” level of opinion. When they realized changes in several aspects in agricultural production, this would help them be energetic to find a way to adapt themselves to continue survival of agricultural career. This is in accordance with the study of Heimlich and Barnard (1992) which found that realization of changes from urban expansion resulted in changes in agricultural production and can help farmers adapt themselves in several aspects such as changing production pattern and cooperation in trading.

6. Number of agricultural information sources they receive had a positive effect toward their adaptation. Farmers who received information from several sources could adapt better than those receiving news from fewer sources. Receiving information or news from several source can make farmers get better knowledge and see more alternative ways for suitable and faster adaptation. Similar to the study of Akimowicz (2016) Found that the more agricultural information that farmers can access the more they can adapt

Guideline on agricultural extension for adaptation of smallholder farmers in expanded urban areas in Chiang Mai province

1. The guideline for the farmer

- Gather agricultural producer’s groups who farm in expanded urban area and introduce themselves to the customer to build connection between producers and consumer and set up network of agricultural producers in expanded urban area. This kind of group also appear in The United States of America in the form of an organization named “The Lexicon of Sustainability” it performs by grouping with the farmers who farmed in urban area to give awareness to the consumer about where their food came from and how it is produced. This idea is conforming with the guideline to development for Thailand agricultural sector in The Twelfth National Economic and Social Development Plan (2017) said that the government should promote the farmer to establish entrepreneurs to meet the efficiency production and reduce production process. The farmer should be access to proper agricultural technology which helpful for their agricultural production. Moreover, market mechanism can protect the farmer from product’s price risk.

- Broadcasting agricultural production process to the student who have aware on safety food production in urban area as the way to create the new generation of farmers. The Twelfth National Economic and Social Development Plan (2017) said that Thailand should create more farmers by generate new farmers from the policy of "Back home graduated" and arrange module that emphasize on agricultural practical section to build knowledge and skills farmer who can improve the standard of agricultural production, process, marketing and farm management
- Develop agricultural area to be an agritourism destination. Farmers and consumer get closer when urban expansion to agricultural area indicated by farmers can direct sell their products to the consumer because customer can come and pick the product from farming area. If the farmer can develop their agricultural area to be an agritourism destination they will have more income when the customer come to visit their farm. In Japan, farmers can direct sell their products to the customer or deliver their products to the department store and they also develop their agricultural area to be an agritourism destination (Busck *et al*., 2006; Tsubota, 2007)
- Adjust their agricultural production from traditional to integrated farming and add more value to their products. If the farmer product only one crop they will not make income during the year. Each plant has different type, different time for planting and harvesting then farmers should produce varieties of plants in their agricultural area and they can sell many products during the year. In the United States of America, Agricultural land in urban area has smaller size where can produce more products and higher yield than farm in the rural area. Most farmers who farmed in urban expansion area have significant amount of their agricultural products (Heimlich & Barnard, 1992) Which is match to a policy from The Twelfth National Economic and Social Development Plan (2017) determine that the government should promote sustainable agricultural production to the farmer by change from single crop to sustainable agricultural. For example, nature farming, integrate farming, organic farming and agroforestry.

- Doing agricultural complete production. Farmers should have more opportunity to create more income and develop their agricultural production skill by learning to agricultural complete production. Agricultural complete production mean farmers will plant, harvest, process and sell it by their own in every process. This complete production will guarantee that the farmer will have market for their products. Farmers who farmed in urban are of Pennsylvania, the United States of America adapted by establish a retail store and trade cooperation to access the market (Larson et al, 2001). Moreover, there were some farmers who can develop their production skills to became an entrepreneur (Inwood & Sharp, 2012).

2. Guidelines for related organizations

- Suggest secondary occupation beside agricultural career for the farmer. Single crop production cannot make farmers meet sustainable in their career then the related organization such as Provincial and District Agricultural Extension Offices must promote variety of agricultural practice and product in order to increase more income and make use of the land through the limit for instance catfish farming, mushroom cultivation and vertical frog farming. Changing their agricultural practice to add more value and gain more income and meet the need of consumers. This guideline will be match with The Twelfth National Economic and Social Development Plan (2017) define that government organization should be support farmer to conform their agricultural production process with ability of land area, water resource and market demand and encourage the farmer to access to good price and high quality of agricultural inputs.
- Promote safety agricultural production to farmers. Nowadays, consumer have more concern about their health if the related organization from both government and private can suggest farmers to increase non-chemical agricultural products will help them gain more income from niche market. The organization need to follow The Twelfth National Economic and Social Development Plan (2017) that they should allow farmers to produce more products that good for health. It can be arranged as a training program which host by government organization and

subsidy the farmer who produce organics food that can help to decrease their production cost and get the right products for market demand.

- Campaign and publicize about how to do agricultural complete production in expanded urban area. Each farmer has different ability, skills and knowledge for adaptation if the related organizations can arrange a training about how to do agricultural complete production in expanded urban area will be help famers to have efficiency in their adaptation. Give more knowledge to improve standard of agricultural production also good for the farmer. The Twelfth National Economic and Social Development Plan (2017) defined that related organization should develop the system to certified the production standard and check on agricultural product quality along with improve standard of agricultural food safety to certain the customer. Expand the concept of agriculture accord to the principles of sufficiency economy to support the learning process and drive towards sustainable agriculture. As well as promoting financial management skills in order for the farmer to be able to effectively manage income, capital and debt.
- Setting an organization which can provide agricultural production knowledge such as Provincial and District Agricultural Extension Offices and university by provide learning aid which can give information of agricultural production in expanded urban area to be an example for the farmer in good agricultural practice. Including obtain market for the farmer to bring their products on the shelf which can guarantee that they will absolutely sell their product.

3. Guidelines for the government

- Restriction of land use and specified proper amount of agricultural area. This is the most important issue which is related to the impact of urban expansion into agricultural area. Because if the government is strict on land use in every area it will help to remain and protect agricultural area from decreasing. Agricultural security areas and agricultural zoning are the policy to protect the lost of agricultural area from urbanization and control the land use in the United states of America (Larson et al, 2001). In England there is green belt project that can protect

green area from the influences of urban expansion by specified the area that not allow to build-up the building and applied in many of European countries (Zasada, 2011). The Twelfth National Economic and Social Development Plan (2017) decided that Thailand should have a strong policy to preserve agricultural area and give more opportunities for the farmer to use their agricultural land. Land bank also one of a good protocol to spread land ownership to the farmer and poor to have their own land.

- Coordinate and control the accordance relevant policies about agricultural production in expanded urban area appropriately. Thai government should be specifying an organization to take responsibility on the operation of every relevant policies about agricultural production in expanded urban area. In case if there are issues in the operational people who involve in this operation will take action to solve the problem and people will know where to go if they have something to complain about the operation.
- Legislate rules to control the operation between the relevant institutes and farmer's network to reduce the conflict during the operational for every parties who participate. Start by propose Act of preservation on agricultural area to manage the proper use of agricultural area. Maintaining suitable are for agriculture to be an agricultural production base including determine the appropriate use of agricultural land. Modernize related law for agricultural sector such as Chemical laws, Cooperative law, Land reform law, Food law and the related law which for the standard of agricultural product (The Twelfth National Economic and Social Development Plan, 2017).

REFERENCES

Akimowicz, M. Cummings, H. Landman, K. 2016. Green lights in the Greenbelt? A qualitative analysis of farm investment decision-making in peri-urban Southern Ontario. *Land Use Policy 55 (2016) 24–36.*

Antrop, M. 2004. Landscape change and the urbanization process in Europe. *Landscape and Urban Planning,* 67, 9–26.

Auttarat, S. 2014. The study of impacts to local developments due to the expiration of comprehensive plans in the Northern Region. *Journal of Architectural/Planning Research and Studies, 11 (2), 83–98.*

Bennett, W. J. 1969. *The Northern Plainsmen: Adaptive strategy and agrarian life*. Chicago: Aldine.

Busck, A. G. Kristensen, S. P. Præstholm, S. Reenberg, A. & Primdahl, J. 2006. Land system changes in the context of urbanisation: Examples from the peri-urban area of Greater Copenhagen. *Geografisk Tidsskrift, Danish Journal of Geography 106(2): 21-34.*

Chankrajang, Th. 2012. The Effects of Rural Land Right Security on Labour Structural Transformation and Urbanization Evidence from Thailand. WIDER Working Paper Series 041, *World Institute for Development Economic Research (UNU-WIDER).*

Chaplin, H., Davidova, S., Gorton, M., 2004. Agricultural adjustment and the diversification of farm households and corporate farms in Central Europe. J.Rur. Stud. 20, 61–77.

Chiang Mai Municipality. 2014. Chiang Mai Sustainable Urban Transport Project. *Incorporation with the Office of Transport and Policy Planning, Global Environment Facility and The World Bank.*

Chiang Mai Provincial Agricultural Extension Office. (2018). Agricultural information of Chiang Mai production year 2016/17. [in Thai]

Chiangmai Provincial Agricultural Extension Office. 2001. Agricultural information of Chiang Mai production year 2000/01. [in Thai]

Clark, J. K., & Munroe, D. K. 2013. The relational geography of peri-urban farmer adaptation. *Journal of Rural and Community Development,8*(3), 15-28.

Darmawan, L. C. 2016. Analysis of urban agriculture sustainability in Metropolitan Jakarta (case study: urban agriculture in Duri Kosambi). *Procedia - Social and Behavioral Sciences. vol. 227 p.95 – 100. Published by Elsevier.*

Deng, X., Huanga, J., Rozelleb, S., Zhang J. & Li, Z. 2015. Impact of urbanization on cultivated land changes in China. *Land Use Policy*, 45, 1–7.

Department of Agricultural Extension. 2017. Strategic Plan 2017-2021. Retrieved from https://www.doae.go.th/upload/files/2560-2564.pdf

Durina. Nagasawa, R. and Patanakano, B. 2012. Urbanization and its Influences on the Suburban Landscape Changes in Bangkok Metropolitan Region, Thailand. *The Japanese Agricultural System Society*. (J. JASS), 29(2) : 29 〜 39, 2013

Elhadary, Y. A. E., Samat, N. & Obeng-Odoom, F. 2013. Development at the Peri-Urban Area and Its Impact on Agricultural Activities: An Example from the Seberang Perai Region, Penang State, Malaysia. *Agroecology and Sustainable Food Systems*, 37:834–856.

Gomes, Ed. Abrantes, P. Banos, A. Rocha, J. Buxton, M. 2019. Farming under urban pressure: Farmers' land use and land cover change intentions. *Applied Geography 102 (2019) 58–70.*

Grothmann, T. & Patt, A. 2003. Adaptive capacity and human cognition. In: Meeting of the Global Environmental Change Research Community, Montreal, Canada, pp 1–19.

Han, S., Tang, Q., Xu, D. & Yang, Z. 2018. Impacts of urbanization and agricultural development on observed changes in surface air temperature over mainland China from 1961 to 2006. *Theoretical and Applied Climatology*. Springer-Verlag GmbH Austria, part of Springer Nature.

Heimlich E. Ralph & Barnard H. Charles. (1992). Agricultural adaptation to urbanization: Farm types in northeast metropolitan areas. *Journal of Agricultural and Resource Economics. Northeastern Agricultural and Resource Economics Association*, 21(1), April.

Henke, R. & Vanni Fr. 2017. Peri-urban agriculture: an analysis of farm typologies in Italy. *NEW MEDIT* N. 3/2017.

Hussain, Z. and Hanisch, M. 2014. Dynamics of peri-urban agricultural development and farmers' adaptive behaviour in the emerging megacity of Hyderabad, India. *Journal of Environmental Planning and Management. Vol. 5, No.4 ,495 –515.* ISSN: 1360-0559.

Information for Chiang Mai. 2015. District's Land use map. Publication. Chiang Mai governor office. Chiang Mai Provincial Hall.

Information for Chiang Mai. 2015. District's population density map. Publication. Chiang Mai governor office. Chiang Mai Provincial Hall.

Inwood M. Shoshanah & Sharp S. Jeff. 2012. Farm persistence and adaptation at the rural-urban interface: Succession and farm adjustment. *Journal of Rural Studies*. 28, 1, 107-117.

Jiang, L., Deng, X. & Seto, K. C. 2013. The impact of urban expansion on agricultural land use intensity in China. *Land Use Policy*, 35, 33– 39.

Jongkroy, P. & Thongbai, C. 2014. Patterns of the Spatial Distribution of Urbanized Areas in Thailand. *Kasetsart J. (Soc. Sci), 35, 30 – 44.*

Kamal N., Imran M. and Tripati K.N. 2016. Greening the Urban Environment Using Geospatial Techniques, A Case Study of Bangkok, Thailand. *International Conference - Green Urbanism. GU. Published by Elsevier.*

Kontothanasis G. 2017. Social practices of urban agriculture in the metropolitan region of Thessaloniki. *Procedia Environmental Sciences, 38, 666 – 673.*

Larson, J. M., Findeis, J. L. & Smith, S. M. (2001). Agricultural Adaptation to Urbanization in Southeastern Pennsylvania. *Agricultural and Resource Economics Review. 30/1 (April), 32-43.*

Le, Phuong Ng. & Dung, Mau Ng. 2018. Multifunctionality of Peri-Urban Agriculture: A Case Study in Trau Quy Commune, Hanoi City. *International journal of Rural Development, Environment and Health Research (IJREH).* Vol-2, Issue-4, Jul-Aug, 2018.

Lovell, S.T. 2010. Multifunctional Urban Agriculture for Sustainable Land Use Planning in the United States. *Sustainability, 2, pp.2499-2522.*

Madsen, F. M. Kristensen, S. B. P. Fertner, Ch. Busck, A. G. & Jørgensen, G. 2010. Urbanisation of rural areas: A case study from Jutland, Denmark. *Geografisk Tidsskrift- Danish Journal of Geography 110(1):47-63.*

Marion, R. Alban, Th. and Jacques E. Bergez. 2016. Processes of adaptation in farm decision-making models. A review. Review article. Agron. Sustain. Dev. (2016) 36: 64. DOI 10.1007/s13593-016-0402-x.

Masters, W. A., Djurfeldt, A. A., Haan, C. D., Hazell, P., Jayne, T., Jirström, M. & Reardon, T. 2013. Urbanization and farm size in Asia and Africa: Implications for food security and agricultural research. *Global Food Security,* 2:156–165.

McGrath, B. Corte, M.B. & Sangawongse,S. (2014). *Rapid Cities Prototyping Urban Growth. New Constellations New Ecologies.*

Ministry of Agriculture and Cooperative. 2018. Conceptual project. Retrieved from https://www.moac.go.th/dwl-files-401291791023

Moench, M. & Dixit, A. 2004. *Adaptive Capacity and Livelihoods Resilience. The Institute for Social and Environmental Transition*. International, Boulder, Colorado, U.S.A. and the Institute for Social and Environmental Transition, Nepal.

Naab, F. Z. Dinye, R. D. & Kasanga, R. K. (2013). Urbanization and its impact on agricultural lands in growing cities in developing countries: A case study of Tamale in Ghana. *Modern Social Science Journal, 2, 256-287.*

National Statistic Office Thailand. 2017. Chiang Mai's Provincial Statistic Report: Population and Housing Census. Chiang Mai Statistic Office. Chiang Mai Government Center. (in Thai)

Nirathron, N. and Piemyat, S. 2010. Adaptive Strategies of Farmers Affected by Free Trade Agreement. *Human Resources Institute, Thammasat University.* National Research Council of Thailand.

Nurat, Ch. 2010. Urban structure in Samut Prakan Province Adjacent Periphery Area of Bangkok Metropolitan. *Thesis. Degree of Master of Urban Planning and Development Program. Faculty of Architecture and Planning.* Thammasat University.

Olivier D.W. and Heinecken L. 2017. Beyond food security: women's experiences of urban agriculture in Cape Town. *Springer Science and Business Media Dordrecht.*

Omondi S.O., Kosura W.O. & Jirström M. 2017. The role of urban-based agriculture on food security: Kenyan case studies. Geographical Research. *Institute of Australian Geographers. May, 55, 2, 231–241.*

Oueslati, W., Salanié, J. & Wu, J. 2014. Urbanization and agricultural structural adjustments: Some lessons from European cities. Working paper, *GATE Groupe d'Analyse et de Théorie Économique Lyon-St Étienne,* 42.

Perrin C., Clement C., Melot R. & Nougaredes B. 2016. Farmland preservation issues in the urban fringe: a review in developed countries. *10th Annual conference of the international academic association for planning law and property rights.* Bern, Switzerland, 17-19 February 2016.

Pham, V. C., Thi-Thanh-Hiên Pham, Thi Huyen Ai Tong, Thi Thuy Hang Nguyen & Ngoc Hai Pham. 2014. The conversion of agricultural land in the peri-urban areas of Hanoi (Vietnam): Patterns in space and time. *Journal of Land Use Science*, Taylor & Francis. Mortimer House, 37-41 Mortimer Street London W1T 3JH, UK.

Phunchana, Ch. 2010. The Impact of Urban Sprawl on the Residents' Mobility in Pathum Thani Province. *Thesis. Degree of Master of Urban Planning and Development Program. Faculty of Architecture and Planning.* Thammasat University.

Redwood M. 2009. *Agriculture in Urban Planning: Generating Livelihoods and Food Security*. International Development Research Centre. London.

Research Coordination Office of the Sustainable City. 2016. Study of Approach for Enhancing Urban Development to Sustainable City with Participation: A case study for Salaya City, Nakhonpathom. *ศูนย์วิจัยและฝึกอบรมด้านนิเวศวิทยาอุตสาหกรรม. คณะสิ่งแวดล้อมและทรัพยากรศาสตร์. มหาวิทยาลัยมหิดล.* Retrieve from http://www.en.mahidol.ac.th/EI/sustainableCity/salaya/index.html.

Satterthwaite D., McGranahan G. & Tacoli C. 2010. Urbanization and its implications for food and farming. *Philosophical transactions of the royal society B*, 365, 2809–2820.

Shummadtayar, Um. & Ongsavangchai, N. 2018. Urbanization and urban context variants of old districts in Chiang Mai. *Journal of Environmental Design. Vol.5 No.1 (January - June 2018).*

Siciliano, G. 2012. Urbanization strategies, rural development and land use changes in China: A multiple-level integrated assessment. *Land Use Policy*, 29, 165– 178.

Sioen, G. B. Terada, T. Sekiyama, M & Yokohari, M. 2018. Resilience with mixed agricultural and urban land uses in Tokyo, Japan. *Sustainability, 10, 435.*

Srikam W. 2010. Urbanization and Urbanism in Thailand. Faculty of Arts. Sipakorn University. *A collection of online open-access materials about urban studies. Urban Research.* Retrieved from http://www.cujucr.com/downloads/pdf_4_2006/Wichai%20Srikam.pdf

Stringer, L.C. Fraserb, E.D.G. Harrisc, D. Lyona, C. Pereirad, L. Warda, C.F.M. Simeltone, E. 2020. Adaptation and development pathways for different types of farmers. Environmental Science and Policy 104 (2020), 174–189

Suteethorn, K. 2012. The Impacts of Food miles on The Pattern of Footprint of Bangkok's Food supply. *NAJUA: Architecture, Design and Built Environment.* Journal of Faculty of Architecture, Silpakorn University [in Thai]

Swanson, B. E. and Rajalahti, R. 2010. Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming and Evaluating Extension Systems. *Agriculture and Rural Development Discussion Paper 45*. The International Bank for Reconstruction and Development/The World Bank 1818 H Street, NW, Washington, DC 20433.

The Twelfth National Economic and Social Development Plan (2017-2021). 2017. Office of the National Economic and Social Development Board Office of the Prime Minister. Bangkok, Thailand

The World Bank. 2000. Decentralizing Agricultural Extension: Lessons and Good Practice. Work in progress for public discussion. *Agricultural Knowledge & Information Systems (AKIS).*

The World Bank. 2015. Urbanization in Thailand is dominated by the Bangkok urban area. *News. Feature Story*. Retrieved from http://www.worldbank.org/en/news/feature/2015/01/26/urbanization-in-thailand-is-dominated-by-the-bangkok-urban-area

Treewanchai, S. Saelim, P. and Sungkasem K. 2014. “Urbanization situation in the southern of Thailand and Song Kla province. Public policy for the future development of the city. [In Thai]

Tripathi, S. & Rani, C. 2018. The impact of agricultural activities on urbanization: Evidence and implications for India. *Journal International Journal of Urban Sciences*, 22, 1, 123-144.

Tsubota, K. 2007. Urban Agriculture in Asia: Lessons from Japanese Experience. *FFTC Annual Report 2006*.

Tsuchiya, K. Harab, Y. and Thaitakoo, D. 2015. Linking food and land systems for sustainable peri-urban agriculturein Bangkok Metropolitan Region. *Landscape and Urban Planning. Vol.143 p.192–204.*

Uddin, M.N. Bokelmann, W. and Entsminger, J.S. 2014. Factors Affecting Farmers’ Adaptation Strategies to Environmental Degradation and Climate Change Effects: A Farm Level Study in Bangladesh. *Climate 2014, 2(4), 223-241.*

Urban Development & resilience unit. 2013. Urban agriculture: Findings from four city case studies. *The World Bank.* 1818 H Street, NW Washington, DC 20433 USA.

Yamane, Taro. 1967. Statistics, an Introductory Analysis. 2nd Ed., *New York: Harper and Row.*

Zasada, Ingo. 2011. Multifunctional peri-urban agriculture—A review of societal demands and the provision of goods and services by farming. *Elsevier. Land Use Policy 28 (2011) 639– 648.*

APPENDICES

APPENDIX A

Questions for general information of the study area

- What is urban mean in your opinion?
- What is agricultural practice in your farm?
- How urban expansion impact on your agricultural career?
- What are pros and cons of urban expansion from your opinion?
- How do you adapt to the impact of urban expansion?
- Is the government organizations know about the change from urbanization?
- How do the government organization manage on the change?
- How can the government organization can help the farmer to adapt in agricultural production in expanded urban area?

APPENDIX B

Questionnaires for quantitative data collection

[ ] Hand Dong [ ] Meaung [ ] Mae Rim

Explanation Please mark ✓ into [ ] and fill in the blank

Part 1 Socio-economic characteristics of farmers

1. Gender [ ] 1. Male [ ] 2. Female Age.....year

2. Level of education

[ ] 1. Lower than primary school [ ] 2. Primary school [ ] 3. Secondary school

[ ] 4. High school [ ] 5. Diploma [ ] 6. Bachelor degree

[ ] 7. Higher than Bachelor degree

3. Agricultural experience.....year

4. Cultivated area [ ] 1. Irrigation area [ ] 2. Non-irrigation area

5. Agricultural area.....Rai..... ngan; Separate into	Planting area (Rai)
5.1. Rice field area species.....	Area .....Rai..... ngan
5.2. Vegetables.....	Area .....Rai..... ngan
5.3. Crops.....	Area .....Rai..... ngan
5.4. Horticulture.....	Area .....Rai..... ngan
5.5. Flowering plant.....	Area .....Rai..... ngan

6. Land ownership (Only agricultural area)

[ ] 1. Owner Area .....Rai..... ngan [ ] 2. Renting Area .....Rai..... ngan

7. Full time career

[ ] 1. Farmer [ ] 2. work as employee [ ] 3. government officer

[ ] 4. Own business [ ] 5. Private company employee

8. Part time career

[ ] 1. Farmer [ ] 2. work as employee [ ] 3. government officer

[ ] 4. Own business [ ] 5. Private company employee

9. Income

[ ] 1. Agricultural income.....Baht/year

[ ] 2. Non-agricultural income..... Baht/year

10. Sources of agricultural information (Multiple response)

[ ] 1. Newspaper [ ] 2. Radio [ ] 3. Television

[ ] 4. Social network (Line, Facebook) [ ] 5. Others.....

11. Frequency of contacting with agricultural extension officers.....times/year

12. The way to communicate with officers (Multiple response)

[ ] 1. Meet officers at the office [ ] 2. Telephone [ ] 3. Application Line

[ ] 4. Application Facebook [ ] 5. Officers visiting at the farm

[ ] 6. Officers come for training [ ] 7. Others……

13. Membership in agricultural group

[ ] 1. Attend [ ] 2. Not attend

14. Crop insurance

[ ] 1. No Crop insurance [ ] 2. Has Crop insurance for.....year

15. Government subsidy

[ ] 1. No subsidy [ ] 2. Subsidized for.....year

17. Attend to training about urbanization

[ ] 1. Never

[ ] 2. Attended Named .....

18. Attend to training about adaptation in agricultural production

[ ] 1. Never

[ ] 2. Attended Named .....

<u>Part 2</u> How urban expansion appeared in farmer's area

1. Urbanization components from smallholder farmers point of view (Multiple response)

[ ] 1. School
[ ] 2. Temple
[ ] 3. Subdistrict Health Promotion Hospital
[ ] 4. Police station
[ ] 5. Market
[ ] 6. Department store
[ ] 7. Housing development
[ ] 8. Condominium
[ ] 9. Night club
[ ] 10. Factory
[ ] 11. Convenient store (7-eleven, Mini Big C etc.)

2. Urbanization components in a 5 kilometers radius from agricultural land areas of smallholder farmers (Multiple response)

[ ] 1. School
[ ] 2. Temple
[ ] 3. Subdistrict Health Promotion Hospital
[ ] 4. Police station
[ ] 5. Market
[ ] 6. Department store
[ ] 7. Housing development
[ ] 8. Condominium
[ ] 9. Night club
[ ] 10. Factory
[ ] 11. Convenient store (7-eleven, Mini Big C etc.)

3. Access of concrete road and drain in agricultural land area

[ ] 1. No access [ ] 2. access

4. Public utilities in agricultural land area (Multiple response)

[ ] 1. Electricity [ ] 2. Water supply [ ] 3. Telephone network

[ ] 4. Internet

<u>Part 3</u> Smallholder farmers opinion on the change from the effect of urban expansion in smallholder farmers living area

Aspects	None	Level of change		
		High	Medium	Low
<u>1.Land</u> - Size of agricultural land area				
- Agricultural land area has change to non-agricultural use				
- Rising of land price				
- Trading land for speculate				
- Trading land for invest in agricultural or list it as agricultural land for rent				
<u>2. Infrastructures</u> - Accessible by road to the land				
- Installation of electrical systems				
- Installation of water supply				
- Housing development built-up				
- Number of department stores that occurred in the area				
- The expansion of irrigation zone				
- Number of retail shops and convenient store that occurred in the area				
<u>3. Population</u> - Number of the immigrants				

Aspects	None	Level of change		
		High	Medium	Low
- Number of migrant labors				
- Number of tourists that come to travel in the area				
4. Livelihoods - Various of occupations				
- Convenience way of life such as the way of communication, how to travel in the area etc.				
- Exposure to new cultures				
5. Economy - Various of products and service in the area				
- People in area have to spend their money				
- More labors were employed for service				
- People in the area are earning money from many ways				
- Non-agricultural income have been created				
- There are operating of agricultural business companies in the area				
- The establishment of community enterprises				
6. Environmental - Solid Wastes				
- Noise pollution				
- Air pollution				
- Water pollution				
- Soil pollution				
- Rainfall in the area				

<u>Part 4</u> Smallholder farmers opinion toward agricultural changes by effect of urban expansion

Aspects	Opinion level				
	5 strongly agree	**4 agree**	**3 uncertain**	**2 disagree**	**1 strongly disagree**
<u>1. Production</u> - Decreased of agricultural area in your community					
- Farmers try to produced more yields per area					
- Separate their land into single lots					
- Production cost is increase					
- Use new technology in their agricultural process					
- Changes in agricultural production from traditional to more organic production					
- There was some pressure on farmers to adapt on their agricultural production					
- Farmers has pressure to adapt and produce to reach the need of consumers					
- More agricultural labors are employed					
- More agricultural product and agricultural business					
- Some infrastructure such as road block the water way					
- strictly control of land use and land tax from government organization					

Aspects	Opinion level				
	5 strongly agree	**4 agree**	**3 uncertain**	**2 disagree**	**1 strongly disagree**
2. Agricultural inputs - Price of agricultural inputs are rising					
- Farmers can access more agricultural inputs					
- There were more facilities which helpful for agricultural production					
3. Land factor - Their land lease was canceled					
- Farmers need to sell some of their land					
- Farmers sell their whole land					
4. Economic factor - More demand on agricultural product from your community					
- Product price is increase					
- More marketing opportunities					
- You can sell more products					
- The community can sell more products					
- Consumer need to consume safety agricultural products					
- Consumer need to buy more healthy products					

<u>Part 5</u> Smallholder's farmer adaptation on the impact of urban expansion in expanded urban area.

Adaptation	No adaptation	Adaptation level					Result		
		Highly adapt 80-100%	Significant adapt 60-79%	Moderately adapt 40-59%	Slightly adapt 20-39%	Least adapt 1-19%	Improve	same	Drop off
<u>1. Physical</u> - Separate their land for sell									
- Reduced agricultural land area									
- Increased agricultural land area									
- Increased higher yield per area									
- separate agricultural land for rental									
- changing crops according to market demand									
- increase production value by using non-chemical farming									
- Improve their agricultural land to be an agritourism destination									

Adaptation	No adaptation	Adaptation level					Result		
		Highly adapt 80-100%	Significant adapt 60-79%	Moderately adapt 40-59%	Slightly adapt 20-39%	Least adapt 1-19%	Improve	same	Drop off
2. Economy - Changing selling methods such as online etc.									
- Joining community enterprises									
- Create non-agricultural income									
- Joining contact farming									
- Agricultural business corporation.									
3. Social - Assemble farmer's group to exchange agricultural production skills									
- Assemble farmer's group to be a mediator between farmers and government officers									

Adaptation	No adaptation	Adaptation level					Result		
		Highly adapt 80-100%	Significant adapt 60-79%	Moderately adapt 40-59%	Slightly adapt 20-39%	Least adapt 1-19%	Improve	same	Drop off
- Building social network to exchange products and services or compare agricultural production cost									
- Assemble farmer's group for bargain the price of agricultural production inputs									
- Establish organization for community common interests									
- Others adaptation……..									

Difficulties and obstacles in your adaptation

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Suggestion for your efficiency adaptation

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<u>Thanks for the participation</u>

APPENDIX C

The IOC index mean of expert scores

Item No.	Expert 1			Expert 2			Expert 3			Total $\sum R$	IOC = $\frac{\sum R}{N}$
	1	0	-1	1	0	-1	1	0	-1		
1	√			√			√			3	1
2	√			√			√			3	1
3		√		√			√			2	0.67
4		√		√			√			2	0.67
5	√			√			√			3	1
6	√			√			√			3	1
7	√			√			√			3	1
8	√			√			√			3	1
9	√			√			√			3	1
10		√		√			√			2	0.67
11		√		√			√			2	0.67
12			√	√			√			2	0.67
13	√			√				√		2	0.67
14	√			√				√		2	0.67
15	√			√			√			3	1
16		√		√			√			2	0.67
17	√			√			√			3	1
18	√			√			√			3	1
19		√		√			√			2	0.67
20		√		√			√			2	0.67

Item No.	Expert 1			Expert 2			Expert 3			Total $\sum R$	IOC = $\frac{\sum R}{N}$
	1	0	-1	1	0	-1	1	0	-1		
21	√			√				√		2	0.67
22	√			√			√			3	1
23		√		√			√			2	0.67
24		√		√			√			2	0.67
25	√			√			√			3	1
26	√			√			√			3	1
27	√			√			√			3	1
28	√			√			√			3	1
29		√		√			√			2	0.67
30	√			√			√			3	1
31	√			√			√			3	1
32	√			√			√			3	1
33	√			√			√			3	1
34	√			√			√			3	1
35	√			√			√			3	1
36	√			√			√			3	1
37	√			√			√			3	1

CURRICULUM VITAE

Author's Name Ms. Supannika Supasub

Date of Birth November 17, 1988

Place of Birth Mukdahan, Province Thailand

Education

2020 PhD in Agricultural extension and rural development Chiang Mai University (Survey research)

2010 Master Degree in Agricultural Extension, Chiang Mai University GPA 3.69 (Quantitative research)

2006 Bachelor's Degree in Agricultural Extension, Minor in Agricultural Management, Chiang Mai University

Publications

Journal of Agricultural Research and Extension, Smallholder Farmers' Adaptation to The Impact of Expanded Urban Areas in Chiang Mai Province, Year 37, Volume 1, January-April 2020 (Full Paper)

International Journal of Agricultural Technology, Factors affecting the adaptation of farmers affected by the urban expansion of Chiang Mai city