Vulnerability to poverty of rural farm households in Thailand

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Abstract—This research intends to estimate vulnerability to poverty, specify vulnerable groups and identify strategies that households use to address the exposure to risk of rural farm households in Northeastern and Northern Thailand. This study was conducted in four provinces of Thailand in the Northeastern region (Kalasin and Buri Ram provinces) and the Northern region (Chiangmai and Nan provinces). Data on a total of 1,400 households was collected in the year 2014. The research methodology applied was the feasible generalized least square (FGLS) method, which was employed to determine how log consumption impacts the welfare status of households.

The result on vulnerability to poverty analysis was reached by the feasible generalized least square (FGLS) method. Upon subjecting the data to analysis, the first stage of the OLS revealed that 48% of the variation in log consumption (a measure of well-being) can be explained by the following factors: household size square, family member education, household head education, non-farm occupation of the household head, disabled persons, unemployed family members, non-farm full-time employees, own livestock, monetary assets, tangible asset value, total borrowing, expenditure on risks, risk severity, unemployment, theft of producer goods, crop loss via insects, working disability by accident to the household head, and theft of crops.

The estimates show that about 53.57% of households were vulnerable to poverty. The comparison of observed poverty status based on the vulnerability index shows that 75% of farm households are poor, whereas another 25% are non-poor. The classification of poverty status based on observed poverty status and the vulnerability index can be classified into four groups. Firstly, poor households with high vulnerability to poverty account for 9.64%. Secondly,

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households that are currently not poor but have a high vulnerability to being poor in the future account for 43.93%. Thirdly, poor households that have a low vulnerability to poverty account for 19.14%. Finally, non-poor with low vulnerability to poverty account for 27.29%.

Policy recommendations for the factors influencing poverty are as follows: 1) theft of agricultural commodities; farmers should install lighting, keep watch at night, use technology networks like video cameras or smart phones to catch thieves; 2) a solution to the disabled family member problem is suggested by the government creating social worker jobs, education in specific skills and employment education and planning for a smart city for the disabled; 3) for crop loss caused by insect and plant disease issues it is suggested that farmers reduce pesticide use, employ crop rotation and practice organic farming; 4) unemployment problems can be solved by increasing the specific skills of labor consistent with factory demand and government consideration of a migrant policy; 5) providing rural education by using innovative tools and methods to the challenges posed by home-school distance; beyond formal education, the study suggests education in specific skills and employable education.

Keywords: Vulnerability to poverty, poverty, risk management, feasible generalized least square, farm household

Introduction

Over the last four decades, Thailand has made remarkable progress in social and economic development, moving from a low-income country to an upper-income country in less than a generation. Thailand's economy grew at an average annual rate of 7.5 percent in the boom years of 1986 to 1996 and 5 percent following the Asian crisis during 1999 to 2005. Historically, economic growth has been the key driver of poverty reduction in Thailand**.** However, GDP grew by less than 2 percent a year in 2014 and 2015. Looking ahead, the World Bank forecasts the growth rate of Thailand will be 2.9 to 3.3 percent for 2016-2018 (World Bank, 2016).

Poverty has declined substantially over the last 30 years from 67% in 1986 to 7.1% in 2015 during periods of high growth and rising agri-

cultural prices (World Bank, 2018). However, poverty and inequality continue to pose significant challenges, with vulnerability as a result of faltering economic growth, falling agricultural prices and ongoing droughts. Poverty in Thailand is primarily a rural phenomenon. As of 2014, over 80 percent of the country's 7.1 million poor lived in rural areas. Moreover, an additional 6.7 million were living within 20 percent above the national poverty line and remained vulnerable to falling back into poverty (World Bank, 2018). Although inequality has declined over the past 30 years, wealth distribution in Thailand remains unequal compared with many countries in East Asia. Significant and growing disparities in household income and consumption can be seen across and within the regions of Thailand, with pockets of poverty remaining in the Northeast, North and Deep South (World Bank, 2016).

In Thailand, the poverty line has been utilized for assessing and monitoring the poverty situation. Thailand's poverty line was 2,575 Baht per person per month in 2013; 2,647 baht in 2014; and 2,644 Baht in 2015.The average poverty line from 2006 to 2015 indicates that northern and northeastern region had the lowest poverty line (Table 1).

Table 1. Poverty Line (Expenditure) by Region and Province: 2006 – 2015 (baht/person/month)

Region and Province	2015	Average 2006-2015 (10 years)
Whole Kingdom	2,644	2,334
Bangkok	3,132	2,841
Central Region	2,827	2,539
Northern Region	2,377	2,087
Northeastern Region	2,355	2,042
Southern Region	2,724	2,400

Source: Data, 2006-2015. Data from the Household Socio-Economic Survey, National Statistical Office. Processing by the Development Indicators database and social NESDB, Office of The National Economic and Social Development Board.

By all estimates and available definitions, the poverty of households in the Northern and Northeastern region of Thailand is strikingly widespread and pervasive. It is more a rural phenomenon in Thailand with almost 90% of poor people in rural areas. Furthermore, this extreme poverty is aggravated by the high level of vulnerability and the large variance in levels of essential food consumption. Households experience poverty differently and there are different aspects of poverty like deprivation, powerlessness, vulnerability, seasonality etc.

Poverty is one of the chronic social problems of Thailand and both the former and current government set different strategies to eradicate it. Various interventions have been undertaken to strengthen the grassroots economy, as well as to reduce the incidence of poverty. However, it is difficult to solve these problems due to the complexity of the economy and society and especially the vulnerability of the household itself. There is widespread poverty in Thailand and many households suffer spells of chronic and transient poverty. Also, the ability of households to cross a given income threshold or poverty line is very limited.

Poverty is dynamic. In solving the poverty of Thailand, policy makers need to understand poverty from a multidimensional view and solve the poverty problem directly by target groups. This will not only help people who are in the poverty group but will include people who are expecting to fall into poverty in the near future or who are in the vulnerability group. Therefore, this research focuses on identifying the vulnerability to poverty group in northern and northeastern Thailand.

Literature review/research gap

Poor rural households are vulnerable. Their livelihood systems are often so fragile and finely balanced that a small misfortune can destabilize the households for many years. Crises and shocks which either require immediate outlays of cash or which diminish already low and irregular incomes, or both, have long-term effects on livelihood strategies and welfare (World Bank and DFID, 1999). Chambers and Conway (1992) were among the first to give a scholarly definition of livelihood. In this research context, livelihood is, therefore, defined as:

> The capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustain-

> able when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Chambers and Conway, 1992: 7-8).

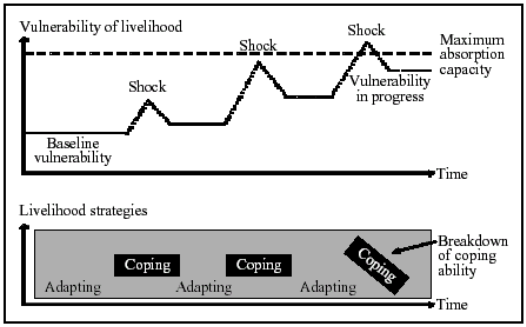
The sustainable livelihood framework can be used as an analytical tool to identify and assess internal and external factors to the household that affect its socio-economic survival.

Livelihood strategies will differ with regard to whether people have to deal with gradual changes or sudden shocks and crises. Adaptive livelihood strategies seek to mitigate risks through livelihood adjustment (e.g. family planning or accessing insurance) or change and diversification of income creating activities. This type of strategy is quite deliberate and adjusts the livelihood to long-term changes and challenges (i.e. socio-economic trends). Coping strategies (e.g. migration, sale of livestock or reduction of consumption expenditure) seek to minimize the impact of livelihood shocks and are a short-term response to sudden or periodic shocks (Carney et al. 1999, Korf, 2002). Coping strategies, although providing some protection in the short run, limit the poor's long-term prospects of escaping poverty (Kanbur and Squire, 2001). Holzmann and Jorgenson (2000) differentiate adaptive livelihood strategies further into risk reduction and risk mitigating strategies. While the so called risk reduction strategies aim at reducing the probability of a shock occurring, the risk mitigating strategies look at reducing the impact of a shock on the livelihood.

Figure 1 illustrates how the exposure to shocks and crises affects the vulnerability of livelihoods and how households adapt to and cope with these externally imposed conditions. The concept of vulnerability and the related adaptive and coping strategies can be used to assess which shocks, crises and which institutional changes in the socio-economic framework influence the livelihoods of the exposed population and in what way. Starting from baseline vulnerability, short-term shocks (e.g. natural disasters, death of an animal) suddenly upset the precarious equilibrium and increase the current vulnerability level. People adopt strategies in response to the livelihood crisis. The immediate response relates to coping strategies. The system recovers and, eventually, households employ new adapting strategies to develop a new portfolio of livelihood activities. The revision and expansion of adapting strategies

can include the adaptation of existing informal local mutual-aid agreements and/or the development and adoption of formal or semi-formal micro insurance schemes for certain risks. Figure 1 shows that the livelihood concept is dynamic in that it attempts to understand change and complex cause-and-effect relationships (Murray, 2001).

Figure 1. Effects of shocks on the vulnerability of livelihoods



Source: Adapted from Korf (2002: 3)

Research method

The purpose is to identify vulnerability, risks and risk management strategies of households in the northern and northeastern region of Thailand. Vulnerability is an important aspect of the household experience of poverty. The fieldwork for the research was conducted between April and December 2014.

Questionnaires were distributed to the research area. After getting all of the distributed questionnaires back, the process of checking, encoding and analyzing data was initiated. The statistical treatment of data was through the use of both descriptive and inferential statistics, such as the frequency, percentage, mean and standard deviation to describe household characteristics. Finally, the quantitative method applies the econometrics model. Feasible generalized least square methodology was employed to find the vulnerability measurement in this study.

By assuming that consumption is log-normally distributed, estimates can be used to form an estimate of the probability that a house-

hold with characteristics X_h will be poor or the household's vulnerability to poverty level.

$$\hat{V}h = \hat{\mathrm{P}}\ (\ln c_h < \mathrm{h}\ c | X_h) = \phi\left[\frac{\mathrm{h}\ \mathrm{c} - X_h \hat{\beta}}{\sqrt{X_h \hat{\theta}}}\right]$$

Data sources were obtained from questionnaires of 1,400 households. The research area was in the northeastern region of Thailand, in Kalasin and Buri Ram provinces, and in the northern region, in Chiangmai and Nan provinces. The method (feasible generalized least square-FGLS) was employed to determine how log consumption impacted the welfare status of households in the research area. It was recognized that one of the basic assumptions of ordinary least square (OLS) is that the error term must have a mean zero and constant variance and that once this constant variance assumption is violated, there is bound to be heteroscedasticity. The relaxation of the constant variance assumption (Chaudhuri, 2000) is a method of determining how the variance of the error term (i.e., now a measure of log consumption) impacts overall well-being (proxies by expenditure on food and non-food items) (Oluwatayo, 2004).

An advantage of the estimation strategy used in this research – using a FGLS approach to estimate the variance of the idiosyncratic component of household consumption – is that it yields a consistent estimate of the true variance of consumption even when consumption is measured with error unless the measurement error varies systematically with some household characteristic(s). It may in fact be the case that measurement error correlates with some observable characteristic of the household. For instance, rural households derive a larger share of their food consumption from their own production than urban households evaluated at imputed (not reported or observed) prices. If this is the case, it is possible to obtain unbiased estimators of consumption variance by estimating separate models for rural and urban areas. Concern about systematic measurement error is another reason for estimating separate models at as disaggregated a level as possible (Emil D Tesliuc, and Kathy Lindert, 2002).

Findings, conclusions

Vulnerability to poverty in rural farm households in the Northern and Northeastern regions of Thailand

The results of the model for the log consumption equation and variance of the log consumption (OLS) are shown in Table 2 below. Upon subjecting the data to analysis, the first stage of the OLS reveals that 48% of the variation in log consumption (a measure of well-being) can be explained by the following factors: household size square**:** family members of below primary education: family members with primary education: family members with secondary education: family members with vocational education: family members with bachelor level: education of the household head: below primary education level of education of the household head: literacy of the household head who cannot read or write: non-farm occupation of the household head: disabled persons: number of unemployed family members: non-farm full-time employees - adult: the belonging of livestock: monetary assets: tangible asset value: total borrowing in last 12 months: expenditure on last five year risk: severity of risk: unemployment in 2014: theft of producer goods in 2014: theft of producer goods during 2010-2013: crop loss due to insect and plant disease in 2014; working disability by accident to household head during 2010-2013: theft of crops during 2010-2013. The rest, 52%, can be attributed to the disturbance term.

The low R^2 value is not uncommon and is due to the measurement error (from unobserved and omitted variables) associated with the use of cross-sectional data in consumption studies. However, this measurement error indirectly accounts for the importance of the disturbance term, a variable that captures idiosyncratic factors (which include risk associated with income) (Oluwatayo, 2004). All the variables included in the analysis have some influence on household well-being. For example, education of family members, non-farm occupation of the household head, disabled persons, number of unemployed, animals owned and unemployment in 2014, have a negative influence on the consumption expenditure of households in the study area.

Generally, most of the model's coefficients (log consumption and variance of log consumption) come up with expected signs. In all samples, household size square, education of the household head:

below primary education level of the household head, literacy of the household head, non-farm full-time employees, monetary assets, other asset value, total borrowing in the last twelve months, expenditure on the last five year risks, severity of risk, theft of producer goods in 2014, theft of producer goods during 2010-2013, crop loss due to insect and plant disease in 2014, working disability of the household head because of accident during 2010-2013, theft of crops during 2010-2013, are positively significant in explaining welfare in the research area.

For instance, a strong relationship is apparent between log consumption and the theft of crops during 2010-2013, whereby a household which has theft of crops has a positive effect on log consumption. An increase in the theft of crops leads to an increase in log consumption of 1.178 Baht. In recent years, theft from farms has become a more common occurrence. Access to high value agricultural equipment, crops (paddy, fruit, vegetable) and cattle that can easily be turned into cash has sparked new interest from thieves. In particular, crop theft is increasing and leading to thousands of Baht in uninsured losses by unsuspecting farmers. In several cases the thefts occur months before discovery of the loss and recovery is almost impossible. For instance, in the research area of Kalasin, the surging rice prices caused the widespread paddy theft of premium quality fragrant rice from a farmer's granary. Therefore, households with a high number of thefts have higher consumption expenditure than households without thefts.

This example is the same as the relationship between log consumption and the working disability of a household head by accident and crop loss through insect and plant disease. In the uncertain case of the household head who faces an accident and is then disabled, he or she cannot work. As a result, the household income is affected directly. An increase in the number of working disabilities of household heads through accident leads to an increase in log consumption of 0.890 Baht. Their family members must pay for the hospital and other health costs to cure their household head. The next important risk to hit households is crop loss through insect and plant disease. An increase in crop loss via insect and plant disease leads to an increase in log consumption of 0.867 Baht. In the area of study, farmers lose their high-value crops particularly rice, maize, vegetables and fruit to insects, pests and diseases every year. The damage and production loss

leads to monetary loss. In spite of increasing pesticide use, the losses in all major crops still increase in relative term. Farmers take the risk of toxic contamination. Therefore, their consumption expenditure is also higher because of the higher pesticide cost, spending to compensate yield loss and spending for taking care of their health.

On the other hand, unemployment in 2014 also had a strong relationship with log consumption but in a negative sense. An increase in unemployment led to a decrease in log consumption of 0.61 Baht. Households, which encounter high unemployment, have less consumption than households that do not encounter unemployment. In the research area, households are hit by unemployment risk. Households, which expect that their family members may be laid off from factories in the future have low present consumption, secure their incomes and plan to save for the future.

In the same direction, households that have disabled family members have a strong relationship with log consumption in the opposite direction. An increase in the inability of a person leads to a decrease in log consumption of 0.435 Baht. Vulnerability is most often associated with poverty but it can also arise when people are isolated, insecure and defenseless in the face of risk, shock or stress. In the case of disabled people in local areas, all of them stay alone while their family members go to work on the farm. They eat less and must help themselves in all daily activities. Disabled people do not work and cannot earn their own income. They are a potentially vulnerable group.

Table 2. Model for estimating vulnerability to poverty by OLS

Variable	Total OLS Log(ctn)	P>|t|	Var(ctn)	P>|t|
Household size square	0.013	0.000	0.001	0.816
	(0.002)		(0.005)	
Family members: below primary education	-0.370	0.000	0.086	0.315
	(0.032)		(0.086)	

Variable	Total OLS Log(ctn)	P>|t|	Var(ctn)	P>|t|
Family members: primary education	-0.293	0.000	0.072	0.352
	(0.029)		(0.078)	
Family members: secondary education	-0.411	0.000	0.009	0.912
	(0.032)		(0.085)	
Family members: vocational education	-0.322	0.000	-0.205	0.117
	(0.049)		(0.131)	
Family members: bachelor education	-0.281	0.000	0.133	0.234
	(0.042)		(0.112)	
Education of household head: below primary	0.447	0.000	0.235	0.159
education	(0.063)		(0.167)	
Education of household head (level)	0.068	0.032	0.337	0.000
	(0.031)		(0.083)	
Literacy of household head: cannot read or	0.320	0.000	1.424	0.000
write	(0.088)		(0.234)	
Non-farm occupation of household head	-0.088	0.000	-0.070	0.210
	(0.021)		(0.056)	
Disabled person	-0.435	0.028	-0.436	0.406
	(0.198)		(0.525)	
Unemployed family member	-0.164	0.000	0.074	0.336
	(0.029)		(0.077)	

Variable	Total OLS Log(ctn)	P>|t|	Var(ctn)	P>|t|
Non-farm full-time employees (adult)	0.128	0.000	0.106	0.006
	(0.014)		(0.038)	
Own livestock (1=have, 0=no)	-0.120	0.014	0.508	0.000
	(0.049)		(0.130)	
Monetary assets	0.000	0.000	0.000	0.883
	(0.000)		(0.000)	
Tangible asset value	0.000	0.002	0.000	0.215
	(0.000)		(0.000)	
Total borrowing in last 12 months	0.000	0.002	0.000	0.410
	(0.000)		(0.000)	
Expenditure on last five years risks	0.000	0.002	0.000	0.589
	(0.000)		(0.000)	
Severity of risk	0.236	0.000	-0.034	0.767
	(0.043)		(0.114)	
Unemployment, 2014	-0.610	0.008	0.800	0.193
	(0.231)		(0.615)	
Theft of producer goods, 2014	0.687	0.000	-0.380	0.426
	(0.180)		(0.477)	
Theft of producer goods, 2010-2013	0.487	0.003	-0.305	0.487
	(0.165)		(0.439)	
Crop loss (insect, plant disease), 2014	0.867	0.000	0.002	0.997
	(0.174)		(0.463)	

Variable	Total OLS Log(ctn)	P>|t|	Var(ctn)	P>|t|
Working disability (accident) of household head, 2010-2013	0.890	0.000	-0.313	0.588
	(0.217)		(0.577)	
Theft of crops, 2010-2013	1.178	0.000	-1.085	0.061
	(0.218)		(0.578)	
Constant	13.432	0.000	-3.061	0.000
	(0.151)		(0.402)	
Observation	1,400		1,400	
R-squared	0.480		0.072	
Prob (F)	0.000		0.000	

Source: Own calculation.

Note: Log (ctn) = Log of consumption.
Var (ctn) = Variance of consumption.
Standard errors are in parenthesis.

The results of the regression model by FGLS are demonstrated in Table 3, which presents the determinants of vulnerability to poverty by FGLS and variance of consumption. The signs of the coefficients found that the education of the household head below primary school, the theft of producer goods in 2014 and crop loss from insect and plant disease in 2014, have a positive impact on log consumption but a negative impact on variance of consumption.

Household size square has a negative impact on log consumption, as well as on variance of consumption. For families with a large number of family members, the consumption expenditure is also high. When households have high expenditure, it causes them to have less money left for other consumption items. If the households are attacked by natural risks, like drought or flood, it will result in crop loss, which makes it probably difficult to achieve smooth consumption.

Family members' education below primary education, primary education, secondary education and vocational education; education

level of the household head; illiteracy of the household head; non-farm occupation of the household head; a disabled person; non-farm full-time employees (adult); monetary assets; tangible asset value; total borrowing in the last twelve months; expenditure on the last five year risks; severity of risk; unemployment in 2014; theft of producer goods during 2010-2013; working disability by accident of the household head during 2010-2013; and theft of crops during 2010-2013, all have a tendency to increase log consumption and also to increase consumption variance. For example, if households have more monetary assets, they will have more ability to consume and have sufficient assets to smooth their consumption during difficult times. Therefore, households may either sell the assets or rent them out. Moreover, the accident incidence of household heads as a kind of risk that hits households leads them to spend more to manage risks, which affects household consumption and its variance.

Table 3. Model for estimation of vulnerability to poverty by FGLS

Variable	Total OLS log (ctn)	P>|t|	Var (ctn)	P>|t|
Household size square	-0.034	0.000	-0.019	0.000
	(0.005)		(0.001)	
Family members: below primary education	0.575	0.000	0.329	0.000
	(0.078)		(0.016)	
Family members: primary education	0.845	0.000	0.416	0.000
	(0.067)		(0.014)	
Family members: secondary education	0.258	0.001	0.221	0.000
	(0.080)		(0.017)	
Family members: vocational education	0.109	0.389	0.147	0.000
	(0.126)		(0.026)	

Variable	Total OLS log (ctn)	P>|t|	Var (ctn)	P>|t|
Family members: bachelor education	-0.024	0.826	0.081	0.000
	(0.108)		(0.023)	
Education of household head: below primary	0.009	0.956	-0.107	0.001
education	(0.161)		(0.034)	
Education of household head (level)	0.993	0.000	0.357	0.000
	(0.076)		(0.016)	
Literacy of household head: cannot read or write	1.914	0.000	0.662	0.000
	(0.222)		(0.046)	
Non-farm occupation of household head	0.350	0.000	0.152	0.000
	(0.053)		(0.011)	
Disabled person	1.461	0.004	0.639	0.000
	(0.505)		(0.106)	
Number of unemployed	-0.075	0.313	0.003	0.830
	(0.075)		(0.016)	
Non-farm full-time employees (adult)	0.074	0.048	0.001	0.942
	(0.037)		(0.008)	
Own livestock (1=have, 0=no)	-0.015	0.904	0.025	0.333
	(0.125)		(0.026)	
Monetary assets	0.000	0.601	0.000	0.000
	(0.000)		(0.000)	
Tangible asset value	0.000	0.282	0.000	0.594
	(0.000)		(0.000)	

Variable	Total OLS log (ctn)	P>|t|	Var (ctn)	P>|t|
Total borrowing in last 12 months	0.000	0.605	0.000	0.023
	(0.000)		(0.000)	
Expenditure on last five year risks	0.000	0.028	0.000	0.008
	(0.000)		(0.000)	
Severity of risk	2.980	0.000	1.090	0.000
	(0.076)		(0.016)	
Unemployment, 2014	0.675	0.256	0.412	0.001
	(0.594)		(0.124)	
Theft of producer goods, 2014	0.090	0.845	-0.138	0.152
	(0.461)		(0.097)	
Theft of producer goods, 2010-2013	0.453	0.286	0.070	0.434
	(0.425)		(0.089)	
Crop loss (insect, plant disease), 2014	0.437	0.329	-0.062	0.512
	(0.448)		(0.094)	
Working disability (accident) of household head, 2010-2013	0.737	0.188	0.077	0.511
	(0.559)		(0.117)	
Theft of crops, 2010-2013	1.280	0.022	0.192	0.102
	(0.560)		(0.117)	
Constant	No constant		No constant	
Observation	1,400		1,400	
R-squared			0.993	
Prob (F)	0.000		0.000	

Source: Own calculation.
Note: Log (ctn) = Log of consumption.
Var (ctn) = Variance of consumption.
Standard errors are in parenthesis.

Relationship between vulnerability to poverty and observed consumption

The relationship between vulnerability and poverty is demonstrated in Figure 2. Figure 2 illustrates this relationship for the whole research area, while the remaining graphs focus on the extremely poor, the very poor, the poor and the non-poor. Each figure uses marginal box plots to illustrate the density of the two distributions (consumption and vulnerability) for the sample being considered.

All of the figures have a horizontal line at the 0.5 vulnerability level, separating those who are more likely to be poor – the vulnerable to be found in the upper part of the graph – from those less likely to be poor –the non-vulnerable to be found in the lower part of the graph.

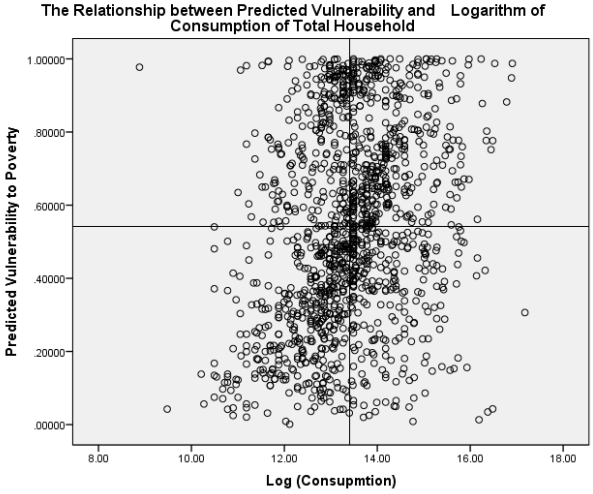
The graphs have vertical lines at the level of extreme and total poverty lines (the left-hand line) and at the extreme poverty line (the upper right-hand graph). These lines separate the extremely poor from the moderately poor and the non-poor.

Figure 2 illustrates the positive relationship between vulnerability and (the logarithm of) consumption. The relationship between vulnerability and current consumption is positive, which is different from what is expected. The expected direction of vulnerability and current consumption is positive because a household which has high current consumption indicates low vulnerability. This is because the household has a high power of purchasing.

However, the results of the study are consistent with the real situation of household livelihoods. It means that the more the consumption the more the vulnerability because the source of money spending on consumption comes from loans. In the background, farm households are vulnerable. Farm occupation has a high risk from unexpected weather, production price and other factors, while the returns are quite low. Farming is costly with the continuing increase of input factors. This is not consistent with the theory of high risk and high return. Although farm households have a high risk from this variation, they must continue with their farm working and find some part time job

or secondary occupation to seek money in order to support family consumption. A lot of farm households change their main occupation from farm working to do other kinds of job such as hired construction worker, trading and so on. Moreover, there are a great number of farm households that are in debt. More consumption means more vulnerability. Households must save a part of their income for debt repayment, so less is left for consumption. Some households repay debt and borrow again because income does not match or balance expenditure. In other words, this may be because vulnerable households have limited income for spending. With a large household size and a small number of employees in a household, money received must be shared among all family member for consumption. Hence, the increase in consumption causes an increase in vulnerability to poverty.

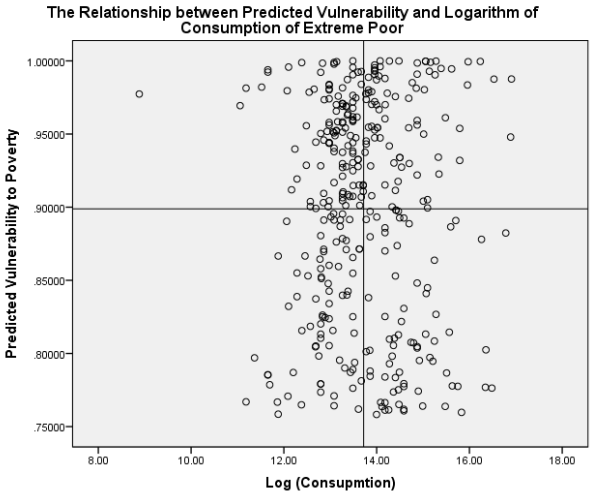
Figure 2. The relationship between predicted vulnerability and the logarithm of consumption of the total household



Source: Own calculation.
Note: Mean of log consumption is at 13.40366.
Mean of predicted vulnerability to poverty is at 0.54166.

Figure 3 demonstrates the relationship between predicted vulnerability and the logarithm of consumption for the extremely poor. The graph zooms in on the "extremely poor" part of the previous graph. As expected, almost all of the extremely poor are among the highly vulnerable. The mean of predicted vulnerability to poverty of the extremely poor household is at 0.89882. The marginal box plot of the graph indicates that almost all households have a vulnerability index in excess of 0.76, with 25.06%. The rate of exit from the extreme poverty pool is extremely low. This means that the majority of the extremely poor in 2014 were also poor in 2015. This segment of the population should be supported through social programs that increase their human capital and their other assets.

Figure 3. The relationship between predicted vulnerability and the logarithm of consumption of the extreme poor



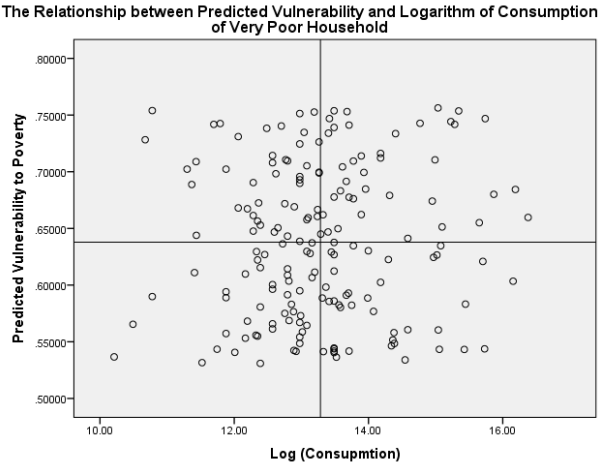
Source: Own calculation.
Note: The mean of predicted vulnerability to poverty of the extremely poor household is at 0.89882.

Figure 4 shows the relationship between predicted vulnerability and the logarithm of consumption of very poor households. The graph

presents the joint distribution of vulnerability and current consumption among the very poor group. From the marginal box plot, it can be seen that very poor households have a vulnerability index in excess of 0.33 but less than 0.75. The mean of predicted vulnerability to poverty of very poor households is at 0.63782. This means that currently poor households will still be poor in the next period.

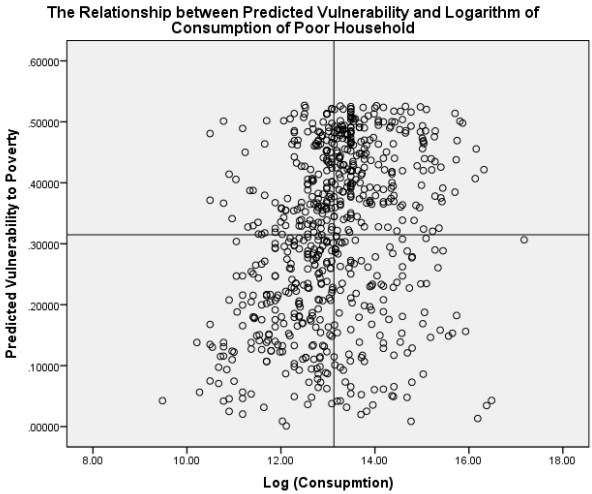
Figure 5 presents the relationship between predicted vulnerability and the logarithm of consumption of poor households. The graph presents the joint distribution of vulnerability and current consumption among poor households. From the marginal box plot, it can be seen that poor households have a vulnerability index in excess of 0.33 but below 0.528. These poor households have a 14.29% vulnerability to be poorer in the future.

Figure 4. The relationship between predicted vulnerability and the logarithm of consumption of very poor households



Source: Own calculation.
Note:The mean of predicted vulnerability to poverty of very poor households is at 0.63782.

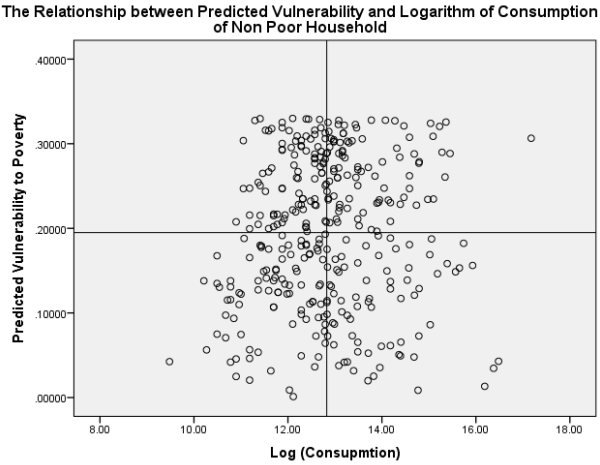
Figure 5. The relationship between predicted vulnerability and the logarithm of consumption of poor households



Source: Own calculation.
Note: The mean of predicted vulnerability to poverty of very poor households is at 0.37468.

Figure 6 presents the relationship between predicted vulnerability and the logarithm of consumption of the non-poor. The graph presents the joint distribution of vulnerability and current consumption for the non-poor. 25% of the non-poor are not vulnerable and those who are vulnerable have consumption levels close to the poverty line. Another part of non-poor groups accounts for 75%, that are not poor at present but who are at risk of falling into the poor group in the next period.

Figure 6. The relationship between predicted vulnerability and the logarithm of consumption of the non-poor



Source: Own calculation.
Note: The mean of predicted vulnerability to poverty of non-poor households is at 0.19497.

Discussion of the vulnerability to poverty group

The concept Thailand uses to calculate the poverty group is most frequently the poverty line as the cut-off for households that stay below the poverty line and are poor and households that stay above the poverty line and are not poor.

Therefore, poverty line measurement in Thailand is based on the concept of physical subsistence and is called the "absolute" approach. People are defined as poor if they do not have sufficient income to satisfy their basic needs. The poverty line defines the minimum basic needs of people and is the threshold income below which one is considered to be poor (NSO, 1999).

Thailand's poverty line in the year 2014 was at 2,647 Baht per capita per month (Table 4). The rural headcount ratio in terms of expected household consumption was less than the poverty line at 28.79%.

Table 4 Poverty Line (Expenditure) by Region (Unit: baht per capita per month)

Poverty line	2014	2015
Country poverty line in 2015	2,647	2,644
Northeastern poverty line in 2015	2,387	2,355
Northern poverty line in 2015	2,355	2,377
Bangkok	3,133	3,132
Central Region	2,832	2,827
Southern Region	2,735	2,724

Source: National Statistics of Thailand, 2017.

When comparing using the regional poverty line of the northeastern region of Thailand, which was at 2,387 Baht per capita per month, the percentage of expected consumption of households lower than the poverty line was 28.86%.

The poverty line of the northern region of Thailand in 2014 equalled 2,355 Baht per month per capita (Table 5).

Table 5. Comparison of expected consumption and the poverty line

Expected consumption	Freq.	%
Country poverty line in 2014 (2,647 Baht per capita per month)		
Expected consumption less than poverty line	403	28.79
Expected consumption more than poverty line	997	71.21
Total	1,400	100.00
Northeastern poverty line in 2014 (2,387 Baht per capita per month)	Freq.	%
Expected consumption less than poverty line	202	28.86
Expected consumption more than poverty line	498	58.29
Total northeastern province	700	87.14

Northern poverty line in 2014 (2,355 Baht per capita per month)	Freq.	%
Expected consumption less than poverty line	139	19.86
Expected consumption more than poverty line	561	80.14
Total northern province	700	100.00

Source: Own calculation.

Poverty and vulnerability in Thailand arise as a result of transient rather than chronic conditions. The main causes of poverty are the lack of land ownership, lack of capital, education and skills, debt, irregular employment, large families, aging and sickness and uncontrollable outside forces (Taneerananon, 2005). This could be the result of chronic conditions (e.g. low level of assets and endowments) or a transient situation (e.g. a temporary setback due to shocks). In terms of vulnerability, the main causes are low expected consumption and high variance of consumption. In order to provide policy advice, the literature (e.g. Bidani and Richter, 2001) should be followed: the pool of vulnerable households divided into two mutually-exclusive groups namely (1) those who are vulnerable due to the high volatility of their consumption or the HV vulnerable, and (2) those who are vulnerable due to their expected low mean consumption or the LM vulnerable (Alayande, 2004).

The result of this study shows two groups of vulnerable households, which are, high and low vulnerable households. The estimates show that about 53.57% of households are vulnerable to poverty (Table 6).

Table 6. Vulnerability to poverty households

Vulnerability households	Freq.	%
High vulnerability ≥ 0.5	750	53.57
Low vulnerability < 0.5	650	46.43
Total	1,400	100

Source: Own calculation.

The comparison of observed poverty status based on the vulnerability index shows that 75% of farm households are poor, whereas another 25% are non-poor (Table 7).

Table 8 shows the classification of poverty status based on observed poverty status and the vulnerability index. Poverty status can be classified into four groups. The first severe group is the poor household with high vulnerability to poverty. This group can be counted at only 9.64%. The second group is the household that is currently not poor but has high vulnerability to being poor in the future, accounting for 43.93%. The third group is the poor household that has low vulnerability to poverty, accounting for 19.14%. The last group is the safe group that is not poor and has low vulnerability to poverty. This group has 27.29%.

Table 7. Comparison of observed poverty status based on vulnerability index

Poverty status	Frequency	Percentage
Poor	1,050	75
Non-Poor	350	25
Total	1,400	100

Source: Own calculation.
Note: Poor = Chronic poor + frequently poor + infrequently poor.
Chronic poor = Chronic poor.
Transient poor = Frequently poor + infrequently poor.

Table 8. Classification of poverty status based on observed poverty status and vulnerability index

Poverty status	Frequency	Percentage
1.Poor and high vulnerability	135	9.64
2.Not poor but high vulnerability	615	43.93
3.Poor but low vulnerability	268	19.14
4.Not poor and low vulnerability	382	27.29
Total	1,400	100.00

Source: Own calculation.

Note: Poor is a household that has consumption below the poverty line. A high vulnerability household is a household that has a 50% probability to be below the poverty line. A low vulnerability household is a household that has a vulnerability index less than 0.5.

The comparison of vulnerability to poverty and household characteristics classified by non-vulnerable and vulnerable households in frequency and percentage of population results are discussed. A vulnerability profile by selected household characteristics is displayed in Table 9. When concentrating on the non-vulnerable group, the northeastern region contains a higher percentage (59.69%) than the northern region. When comparing between non-vulnerable and vulnerable groups, it is indicated that northern households are vulnerable with 62.57%. In the analysis of the province, it is indicated that Chiangmai, Nan and Kalasin province have a high percentage of vulnerable households, while Burriram province has a high percentage of non-vulnerable households.

Table 9. Comparison of non-vulnerable and vulnerable households classified by region and district

	Non-vulnerable			Vulnerable			Total
	Freq.	% (Col)	% (Row)	Freq.	% (Col.)	% (Row)	(Row)
Region							
Northeast	388	59.69	55.43	312	41.60	44.57	700
North	262	40.31	37.43	438	58.40	62.57	700
Total	650	100.00	46.43	750	100.00	53.57	1,400
District							
Burriram	231	35.54	66.00	119	15.9	34.00	350
Kalasin	157	24.15	44.86	193	25.7	55.14	350
Nan	140	21.54	40.00	210	28.0	60.00	350
Chiang Mai	122	18.77	34.86	228	30.4	65.14	350
Total	650	100.00	46.43	750	100.00	53.57	1,400

Source: Own calculation.

Table 10 is a comparison of vulnerability to poverty and household characteristics classified by non-vulnerable and vulnerable households. The calculation in the percentage in the columns and rows gives another view of the comparison. In the overall number of households, non-vulnerable households account for 46.43%, the remaining vulnerable households account for 53.57%. The average household size in the research area is between 4 and 6 people. The comparison of vulnerability to poverty and household size illustrates the interesting result that a larger household size has the tendency to have a lower number of vulnerable groups. For instance, a household size of between 1-3 people has high vulnerable households, amounting to 71.89%. Household sizes between 4-6 people have lower vulnerable households with 42.95%. Household sizes of between 7-9 people have a lower percentage of vulnerable households with 32.99%. It is the opposite direction for household sizes of more than 10 people, which contain the highest percentage of vulnerable households. This clearly indicates that the larger the household size the lower the vulnerability to poverty. The reason behind this may be because the larger household size has a larger social network. Working family members who work in other areas send money back to support the family. The network ties are very strong. Family members have a very close relationship and frequently interact. In a great number of northeastern families members work abroad and are married to foreigners. Therefore, the ability to support other family members is high. In Thai culture, parents invest in their children's education. After their children complete their education, they support their parents. The advantage of a large family is the sharing of the cost of living in a household. Not everyone needs to buy all home appliances. So, not everyone needs to purchase everything. This results in the economy of scale. Therefore, they have savings. Savings are the engine for consumption smoothing as well. Another reason may be because larger numbers of family members indicate a greater number of people participating in the labor force, which means the opportunity for acquiring income is also high. Most of the households in the research area do farm work, which requires a labor supply to help their own household farm to save farm investment costs. In farm work, family members join together to work on the farm and also share the crop production. Rice and other crops produced for their own household consumption and the rest of

production are sold. So, labor supplies are known to be the primary engines for consumption smoothing of households. Lastly, the life of rural farm households is simple. Many households spend less on food because they plant crops and feed animals. Some households collect vegetables from their own fields so it is not necessary to spend a lot by cash. That is why their consumption expenditure is not high.

However, poverty incidence as well as vulnerability to poverty worsens as one moves from medium size to bigger family size households. The vulnerability to poverty increases sharply to 66.67% with the largest family size. An overcrowded household size of more than ten people affects the poverty incidence. Farms in the study area are mostly small size and do not need a great amount of labor participation. Some family members are distinguished by unemployment. Farm profit is not enough to support household expenditure of the largest family size. Larger numbers of family members, above ten people, cause a decline in household savings. Hence, in this case labor supplies and saving are not representative of smooth consumption at all.

When comparing the vulnerability to poverty with the gender of the household head, it can be said that household heads are generally male. There is no difference between vulnerability groups classified by male and female household heads. Concerning the relationship of vulnerability to poverty and the age of the household head, age plays an important role in separating households, which nearly all fall into the vulnerable and non-vulnerable groups. The highest risk of vulnerability to poverty is with household heads below 30 years old. Cross-tabulation results show that young household heads aged less than 30 years old have a pretty high percentage of households falling into the vulnerable group because their household head may have little experience in organizing household income. These households represent 52% of the vulnerable group.

An increase in the age of the household head is found to decrease vulnerability to poverty. Older household heads aged 31-50 years old are active in the labor force, have a high possibility of earning a lot of money and have high experience of livelihood. As a result the middle-aged family boss frees families from vulnerability to poverty. On the other hand, household heads aged between 51 and 60 and 61 and 70 years old are mostly in the vulnerable group and account for 51.14% and 61.80%, respectively. It is recognized that Thailand is becoming

an aging society. Cross-tabulation results indicate that 22.36% of household heads are retired beyond 60 years old. The vulnerability to poverty declines for household heads aged above 70 years old. This may be because the household head at this age may have a certain amount of savings. They have a lot of lessons from the past about how to improve their own income and expenditure flow. They can handle household consumption well and have strategies to handle risks. Although the elderly have fewer opportunities to seek income they are non-vulnerable because they have the other family members to support them.

The last point is the relationship of vulnerability to poverty and the education of household heads. The results demonstrate that household heads with an educational background below primary school are safe in the non-vulnerable group, while household heads who have a primary and secondary education have the risk of falling into the vulnerable group and account for 60% and 55.52%, respectively. The results are very interesting and suggest that higher education can lead households far from the opportunity of falling from the vulnerability into the poverty group. Cross-tabulation results identify that 90.16% of household heads who have a bachelor's education stay in the non-vulnerable group.

Table 10. Comparison of vulnerability to poverty and household characteristics classified by non-vulnerable and vulnerable households

	Non-vulnerable			Vulnerable			Total
	Freq.	% (Col)	% (Row)	Freq.	% (Col)	% (Row)	(Row)
Household size							
1-3 persons	149	22.92	28.11	381	50.8	71.89	530
4-6 persons	429	66.00	57.05	323	43.1	42.95	752
7-9 persons	65	10.00	67.01	32	4.3	32.99	97
> 10 persons	7	1.08	33.33	14	1.9	66.67	21
Total	650	100.00	46.43	750	100.0	53.57	1,400
Gender of household head							
Male	500	76.92	46.82	568	75.7	53.18	1,068
Female	150	23.08	45.18	182	24.3	54.82	332
Total	650	100.00	46.43	750	100.0	53.57	1,400
Age of household head							
< 30 years	12	1.85	48.00	13	1.7	52.00	25
31-40 years	84	12.92	53.16	74	9.9	46.84	158
41-50 years	229	35.23	50.22	227	30.3	49.78	456
51-60 years	192	29.54	42.86	256	34.1	57.14	448
61-70 years	89	13.69	38.20	144	19.2	61.80	233
> 70 years	44	6.77	55.00	36	4.8	45.00	80
Total	650	100.00	46.43	750	100.0	53.57	1,400
Education of household head							
1.Below primary school	80	12.31	56.74	61	8.10	43.26	141
2.Primary school	326	50.15	40.00	489	65.20	60.00	815
3.Secondary school	145	22.31	44.48	181	24.10	55.52	326

4.Vocational school	44	6.77	77.19	13	1.70	22.81	57
5.Bachelors degree and above	55	8.46	90.16	6	0.80	9.84	61
Total	650	100.00	46.43	750	100.00	53.57	1,400

Source: Own calculation.

The number of last year's risk hit households classified by vulnerability proposes that 61.49% of non-vulnerability households did not encounter any risk. On the contrary, vulnerable households faced with one to two risks involved about 57.48% and 63.21%, respectively (Table 11).

Table 11. Number of last year's risk classified by vulnerability household

Number of risks hit household	Non vulnerable	Percent (Row)	Vulnerable	Percent (Row)	Total
No risk	182	61.49	114	38.51	296
One risk	270	42.52	365	57.48	635
Two risks	117	36.79	201	63.21	318
Three risks	81	53.64	70	46.36	151
Total	650		750		1,400

Source: Own calculation.

Theoretical and practical implications

There are some factors which the models suggest have an effect on poverty. The policy implication suggests the main factors, for example, theft of agricultural commodities, working disability of household heads and disabled family members, crop loss through insect and plant disease, unemployment and education.

Firstly, the statistical results show that theft of agricultural commod-

ities matters. Crop theft has long been a problem for farmers. They have a lot of challenging risks already and theft makes it more difficult for them. People generally think that crop theft does not do much harm but if it happens many times, it certainly has an impact. Theft is not stealing only crops but also valuable farm equipment, tools, generators and welding equipment. Farmers should not neglect this problem. They should manage an area of grass land since the wilderness surrounding the farm will be the hiding place of thieves. Farmers should install lighting, keep watch at night, use technology networks like video cameras or smart phones to catch thieves. Farm dogs can help to watch the farm. To sum up, the best way to prevent theft is taking stock of possessions, have locking storage, placing bright lights or motion sensor lighting around the outside of the farm and securing gates with chains and locks. In addition, farmers should discuss with the community the organization of mutual help.

Secondly, in the model, working disabilities of household heads and disabled family members have an influence on poverty. There is no easy solution for this policy implication. Thailand is a poor country. The government does not have enough budget to support all groups of people. Cash donations to non-profit organizations who are offering assistance to disabled people are important. However, a lot of disabled people are not assisted by these organizations and need family support. The disable people need the financial aid for survivors and on long-term recovery efforts. The recommended policy is that government should help workers rendered unemployed due to disability by creating social worker jobs. For example, some in wheelchairs can operate telephones. Governments can give incentives for private companies to participate in hiring disabled people through tax discounts. In addition, special education programs to help them to do basic activities by themselves can reduce pressure on the family. Moreover, the smart city is an idea to help them have access to the city. Accessibility apps can make life easier for people with disabilities. Governments can help them by planning smart city projects, providing public places where disability is welcome: a wheelchair ramp, an automatic front door, a wide bathroom stall with a grab bar, Braille text, low-flicker lighting, glare-free floors, scent-free soap, etc.

Thirdly, the next important variable in the statistical model is crop loss caused by insect and plant disease affecting major *crops* grown

in the research area. Pests are any kind of *insect*, plant, disease or weed that hurts the farmer's profits. Almost all farmers spray to mitigate *crop damage* caused by pests. The use of toxic *pesticides* to manage pest problems has become common. Nonetheless, pesticides are not only harmful and poisonous to humans but also to the environment. Farmers are dependent on costly insecticide use. The insects build resistance to the insecticide then the farmers spray more and more, which results in poor health. Health costs increase household expenditure. This study recommends that farmers should reduce insecticide use and find alternative ways such as planting crops that resist disease. Some crops can naturally withstand pest damage and grow well. Another way is to rotate crop planting. Some farmers grow different crops and wait for a few years before growing the same crop on the same field. The next suggestion is to have organic farms. Currently, organic farms are popular in Thailand. Some organic farmers tend to spray less *pesticide* on their fields than other farmers. It is the best *way to protect crops using a natural method.* For instance, farmers keep pests away from field. Some farmers grow plants that naturally keep the pest out, surrounding their main crops. Another way is to use a natural enemy or insects that eat the pests but do not hurt the crop. Some farmers burn diseased crops in order to stop the pest spreading to healthy crops. The next suggestion is using plastic bags to wrap mango to protect the mango skin, or to bump against the branches and also to protect disease and insect. In addition, many farm households face risks from the unplanned production system. In some seasons farm households are promoted to produce the same kind of crop. After the harvest season there are is plenty of production leading the price to decline and farm households are competing with each other to sell the production. Therefore, farmers can think differently to speculate and forecast the tendency of production quantities and price at the beginning of the cropping season.

Fourthly, unemployment plays an important role in household poverty. Unemployment is categorized in human and social risks. The result indicates that rural unemployment occurs significantly among the young generation, especially in the northeast region since the education system has not adjusted to be consistent with the labor market. Rural employment requires skilled labor rather than formally educated labor. The local factory owner will inevitably hire the under skilled

employee. To solve this problem, the factory owner and local government should join together to arrange training programs in specific skills that are consistent with factory demand. Another problem relating to the unemployment issue is the uncompetitive local labor to migrant labor. In reality, there are already a number of legal and illegal migrants working in the agricultural sector. Their wages are generally lower than those of Thai workers. Hence, Thai laborers who are the hired labor on farms are unemployed. This problem is beyond the capacity of local government to solve alone. The national government should reconsider labor market policies to protect workers, issue job creation policies and migrants workers' policies.

Finally, the statistical results imply that education has a significant effect on poverty. Many poor households suffer from increasing school enrolment and transportation cost. A long distance-to-school effects school attendance and there is inefficient teacher distribution in rural areas. The discussion is over providing access to education in rural areas. It is challenging for the education system development to use innovative tools and methods to the problems posed by home-school distance. In addition, the provision of school transportation has become an option. Local government can help to improve transportation networks. Beyond formal education, the research result indicates that education in specific skills and employment education are important. A number of children drop out at the end of primary and secondary school to help support their families because families cannot afford education fees and they are supposed to take care of their families. Therefore, the provision of skills based education like basic courses similar to crafts, carpentry, welding, electrical maintenance, engine repair, robot controlling amd computer software learning is being demanded by the factory.

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