



Household determinants of poverty in Savannakhet, Laos: Binary choice model approach

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ABSTRACT

Lao PDR is one of the economically least developed countries in the world. As a member of the GMS region and the ASEAN, Lao PDR stands to benefit from the growth of the GMS region by the East West Economic Corridor that links the Central Region of Lao PDR with Thailand and Vietnam through Savannakhet. This paper uses a detailed household survey data set to identify, sign, and test the significance of the key factors that affect poverty by location and well-being subgroup among the urban, semi-urban and rural populations of Savannakhet. We found that household size, distance from the EWEC, agriculture landholding and working in the agricultural sector are causes of household poverty. Agricultural employment has a particularly large impact in rural areas. Other factors such as age, gender and educational level of the household head evidence no influence in determining poverty. One possible reason could be that infrastructure has been improved only in recent years. Thus, economic opportunities vary widely for any given characteristic of the household head.

Keywords: Lao PDR, Poverty, Binary choice, East West Economic Corridor.

JEL Classification: O13, Q42, Q43

1. Introduction

Although Lao PDR is one of the economically least developed countries in the world -- the United Nations Human Development Index 2010 ranked it 122 out of 169 countries -- it was nonetheless “one of the 10 ‘top movers’ in the world in terms of progress on human development over the past 20 years” (<http://www.ruralpovertyportal.org>). Since the introduction of economic reforms in the mid-1980s, the head-count ratio (or “incidence of poverty”) dropped from 39% of the population in the mid-1990s to 27.6 % in 2010; while the country enjoyed rapid economic growth, with the annual GDP rising from 4.1% in 1999 to 7.9 % in 2010 (International Monetary Fund, 2011). Although still the least developed economy in the Greater Mekong Subregion (GMS), Lao’s social indicators have been significantly improved as the economy has become more fully interconnected with the economies of neighboring countries. Indeed, Laos has set the goal of eliminating poverty by 2015 and graduating from least developed country status by 2020 (IUCN and NERI, 2011).

The reduction of poverty and hunger is a pressing issue in the developing countries, including Lao PDR. Such reductions must be driven by attaining high economic growth through increased investment in productive sectors, industrialization, sustainable management of natural resources with high productivity, infrastructural development, trade promotion, and overall socioeconomic transformation. Poverty reduction is an outcome of coordinating these seven areas through both specific policies and the overall development agenda. The results of the 2007-2008 LECS4 Survey indicated that most of the population of about 6 million live in rural areas and depend upon agriculture and natural resources for survival. In the Seventh Five-Year Plan (2011-2015), the Lao government has targeted

“achievement in imagination; achievement in human resource development; achievement in mechanism, regime, administrative system; achievement in poverty reduction by attracting more sources of funds and promoting special policy, and constructing basic infrastructure in local areas”.

These planning objectives are summarized under the slogan “Boukthalu” (Ministry of Planning and Investment, 2011).

As a member of the GMS region and the ASEAN, Lao PDR stands to benefit from the growth of the GMS region. The East West Economic Corridor (EWEC) links the Central Region of Lao PDR with Thailand and Vietnam through Savannakhet. The 1,450-km long corridor passes through four countries and connects with the main east-west roads, including the Yangon – Dawei road in Myanmar, the Tak – Mukdahan in Thailand, Road 9 in Savannakhet, Laos PDR, and the Quang Tri - Danang City in Vietnam.

It was intended that the EWEC help develop trade toward the north and the south to the major commercial centers of Bangkok and Ho Chi Minh City, thereby bringing practical and long-term benefits to member countries. The corridor should also help cities and small towns along it to strengthen trans-border trade and attract investment. The EWEC should therefore catalyze new economic activities by more effectively using economic

space and establishing trans-national economic areas through which products from participating countries may even integrate global markets in Europe and America. However, most member localities remain underdeveloped, highly populated and geographically remote. Agriculture-based economies have not yet played an important direct role or permitted the strong development of an industrial sector (ADB, 2008).

Nonetheless, the EWEC remains the key gateway to the regional international market in both the ASIAN region and the international market because it will shorten the access time to the sea. For example, the ADB (2008) evaluation study reported that the project was successful and

“highly relevant” to development needs at the regional and national levels. As a regional road, it addressed a strategic need to strengthen links between Laos PDR, Thailand, and Viet Nam. The all-weather road aimed to expand the market for transit and bilateral trade. It also interconnects national transport networks to generate trade and efficiency benefits. It was appropriately designed to support economic centers and to complement poverty reduction (via a rural road component in Laos PDR) (p iii)

The coverage of the present research study will be limited to the single section of the economic corridor that passes through Savannakhet, Laos PDR. Savannakhet Province lies at the centre of Laos at the junction of the East West Economic Corridor (Road no. 9) and the North-South Axis (Road no. 13). The provincial population of 843 thousand represents one-seventh of the national population on 21,774 sq km. The Lao government has given top priority to road infrastructural development to better connect the district, province and national levels. As a result, the road network continues to steadily improve and is much better and extensive than before.

But despite relatively good road infrastructure that integrates it with many socioeconomic centers in Lao PDR and foreign countries, a full one-tenth of the population (84,000 people in 14,286 households) still lives below the poverty line. The poor are concentrated in the eastern part of the province where infrastructures are less developed and access to market more restricted. Although attracting investment into these areas remains a challenge, certain industries, such as the plantation industry, are making inroads (International Union for Conservation of Nature (IUCN) Lao PDR and The National Economic Research Institute (NERI), 2011).

Against this backdrop, the present study seeks to answer three several practical questions for the formulation of poverty-reduction policies. *What are the significant causes of poverty in the households of Savannakhet? Does poverty differ significantly among rural, semi-urban and urban areas or by distance in kilometers from the EWEC? What are the significant determinants of poverty in each of the rural, semi-urban and urban groups of households?* The overall hypothesis is that *excessive distance from the EWEC is a significant cause of poverty that is intensified by socio-demographic and household-head characteristics and the lack of non-agricultural employment.* To answer these questions and test this hypothesis, this paper will use econometric modeling to

identify the significant factors that affect poverty in Savannakhet province as a whole and by urban, semi-urban and rural area within the province.

2. Literature review

Infrastructures have long been recognized as playing a central role in economic development and the amelioration of living standards. The term “infrastructure” covers such multiple subsectors road transport, and rail links, energy, telecommunications, power supplies, water, sanitation, ports and airports and low-income housing (NESDB and The World Bank, 2008). Barrios (2008) has classified the development intervention into four categories as follows: “*economic infrastructure e.g. credit, production support; physical infrastructure e.g. roads, irrigation; capacity building e.g. training, information dissemination; and support services e.g. marketing services, facilitation of access to basic social services*”. Roy (2010) mentioned that any infrastructural improvement has impacts on both the economic and social sectors in general and the poor in particular. What the poor need is an opportunity for a better education, a minimal standard of healthcare services, power supplies, roads, clean water for drinking and sanitation, entry into markets, access to loans and investment capital, etc. Otherwise, closed access to schools leads to poorly educated people, lack of access to healthcare services and clean water leads to poor health, lack of access to world markets leads to heightened costs of production and transportation; time spent on non-productive activities reduces worker efficiency, etc. Thus, greater access to such infrastructure is potentially a powerful tool for improving both poverty reduction and economic development.

Jacoby (1998) estimated the household level benefits from road projects in Nepal. The results showed that poorer households get more benefit from road improvement in the remote areas. Consistent with this finding, Stone and Strutt (2009) used a computable general equilibrium to trace the benefits of the development of economic transport corridors. Their results showed the potential benefits improving land transport and trade facilitation, particularly intra-regional trade within the Greater Mekong Subregion. Additionally, Menon (2006) analyzed the differential quantity of road access of rural villages in Lao PDR. The results show that roads help cut the incidence of poverty because poor people have opportunities to get more income from road improvement which leads to reduced costs for the goods they purchase.

The World Bank (2000) has said that

“Poverty is a multidimensional concept involving the lack of the social, cultural and or economic means necessary to procure a minimum level of nutrition, to participate in the everyday life of society, and to ensure economic and social reproduction”

Parker and Kirkpatrick (2003) have also summarized the characteristics of poor household in developing countries. Their research showed that poor households suffer from both the absence and reliability of public infrastructure services and others services. Five years later (2008), they emphasized that infrastructure improvements might bring significantly positive impacts on the income and welfare of poor

households as distinct from average income. Oraboune (2007) has identified a crucial key of infrastructure development in the case of Lao PDR for both poverty reduction and private sector development for three reasons.

“First, focusing on farm-to-market road construction with proper mechanisms to link rural farmers to the growing demand within the country and in the region is significant for poverty reduction. Second, improvement of logistic infrastructure, particularly factory-to-port transportation, is critical to enhancing business performance, export development and economic growth. And third, widening choices for logistic transportation in the longer term of the infrastructure development strategy of the country will greatly boost growth and assist in the poverty reduction program.”

In 2005, Warr (2005) confirmed the result that in Laos PDR, the development of road infrastructure can effectively reduce rural poverty. Two years later (Warr, 2007), he indicated that the poverty-reduction impacts of road improvement depend critically upon both the type of road and road location.

These results seem to hold true internationally. In Nigeria, Ogun (2010) also concluded that infrastructural development can reduce poverty. In Vietnam, Phat (2012) explained that the poverty rate is high in rural households suffering from poor access to agricultural land and markets for their produce.

3. Methodology

Probit and Logit models are the most widely used members of the family of generalized linear models in the case of binary dependent variables. Such models constitute an appropriate technique to determine the probability of a household remaining poor. This class of models explains the behavior of dichotomous dependent variables that can assume a value of one or zero depending upon the particular specification adopted; they compute the conditional probability of the dependent variable being equal to one (Zampino, 2010), (Sikander & Ahmed, 2008).

The dependent poverty variable can be defined in multiple ways including the income, expenditure and calorie intake methods. In the present research, the dependent variable is a dummy variable with “poor” households living below a 1.25 US dollars per day per person (1) distinguished from “non poor” households living above a 1.25 dollar (0).

Lemieux (2012) introduces binary response models: Probit, Logit and linear probability models following Wooldridge (2002). Consider the models:

$$E(y|x) \equiv (Pr(y = 1|x) = G(x\beta) \tag{1}$$

This is an index model as it constrains the effect of x to go through the index $x\beta$. The function $G(\cdot)$ in the linear probability model is the identity function. An obvious problem is the inconsistent nature of the probability model whereby nothing can prevent $x\beta$ from going below zero or above one. Therefore, Probit and Logit models are popularly employed to define probability models, where $G(\cdot)$ becomes a cumulative distribution function that is standard normal in Probit model.

Let us start with the general model as follows:

$$y^* = x\beta + e \quad (2)$$

Where: y^* : denotes the dependent variable (the latent variable)

x : denotes the characteristics vector of household as binary variable (0 or 1).

β : denotes parameters vector

e : denotes the residuals (errors)

The binary variable (poor or non-poor) expression is defined as follows

$$y^* = \begin{cases} 1 & y^* > 0 \\ 0 & y^* < 0 \end{cases} \quad (3)$$

The dependent variable captures a status of household as being either poor or non-poor that can be interpreted as the utility difference between choosing $y^* = 1$ and 0. The probability that $y^* = 1$ can be derived from the dependent variable and the decision rule. Assuming e is follows a standard normal distribution, so

$$\begin{aligned} Pr(y = 1|x) &= Pr(y^* > 0) = Pr(e > -x\beta) \\ &= 1 - \Phi(-x\beta) = \Phi(x\beta) \end{aligned} \quad (4)$$

“The link function relating the linear predictor $\eta = x\beta$ to the expected value μ is the inverse normal cumulative distribution function, $\Phi^1(\mu) = \eta$ ” (Hahn & Soyer, 2005). Therefore, equation (4) is a Probit model.

The specification of the Logit model assumes that e is a logistic cumulative distribution. Therefore, the Logit model is given by

$$Pr(y = 1|x) = \exp(x\beta) / [1 + \exp(x\beta)] \quad (5)$$

Unlike the Probit, the Logit approach became popular because of the closed form of the function $G(\cdot)$ in the model. Thus, the Logit model assumes a logistic distribution, $\ln(\mu/1-\mu) = \eta$. However, the estimate models are qualitatively similar in the case of Logit and Probit models.

Both the Logit and Probit are estimated by maximum likelihood estimation, which can be solved iteratively by numerical methods. Unlike the case of OLS, β in the binary choice model cannot be interpreted as the effect of x on the dependent variable y . Therefore, the marginal effects are compute to show the change in the probability when a unit change in the independent variables. Additionally, Lemieux (2012) mentioned that marginal effects of Probit and Logit model are more likely similar and close to the linear probability model coefficients.

For selecting an acceptable model, we employ three different criteria of model adequacy: a high likelihood ratio, high McFadden R^2 and high percentage of correct predictions. The likelihood ratio explains a significantly smaller deviance. The

McFadden's R^2 is used to explain the percent of variation. The percentage of correct predictions is used to capture the goodness of fit on the observed data.

Using such Probit and Logit estimations, Rajaram (2009) estimated the likelihood of a female household head being poor. He found that such households to be marginally poorer than male-headed households. In the same year, Baslevent and El-hamidi (2009) determined the factors which affected the retirement preferences of Egyptian government sector employees as between early retirement and post-retirement employment. Using a Bivariate Probit model, they found that those one planned to work after their retirement tended to choose early retirement.

4. Data

The primary data for this study were collected specifically for the present study from households in Savannakhet, Lao PDR in 2011. An open ended questionnaire was designed, converted into closed-form questions, and used for household level interviews of 243 households. We focused on only Kayson Phomvihane district in Savannakhet, the urban district that surrounds the EWEC road as it cuts through the province. Outhoumphone district was also included because it includes the intersection of the EWEC with north-sound road no.13. The target population was thus limited to households who lived along EWEC in both districts. This target population was divided into income sub-groups, as well as rural, semi-urban and urban categories at varying distances in time and kilometers from the EWEC. Data were collected on household characteristics, revenue, consumption expenditures, and expenditures on inputs to production processes

Given the objective of identifying, signing and ranking the significance of the factors affecting poverty in Savannakhet province as a whole and by urban, semi-urban and rural area within the province, we formulated four hypotheses for econometric testing:

Hypothesis 1: *Distance* from the EWEC is a significant cause of poverty in Savannakhet households.

Hypothesis 2: The socio-economic factor *household size* has a negative effect on poverty alleviation.

Hypothesis 3: The *age* and *education level* of the head of the household have a positive relationship with poverty alleviation.

Hypothesis 4: working in the *agriculture sector* has a negative effect on poverty alleviation.

To test these hypotheses we used econometric models of the Logit and Probit classes to explore the conditions of inequality which determine which households are poor (1) vs. not poor (0) with respect to the poverty line, while identifying the characteristics of the poor and non-poor. The dependent and the explanatory variables are described in table 1.

TABLE 1. Description of explanatory variables in the Probit and Logit models

variable	Variable description	Hypothesized effect on poverty
AGE	Age of household head (years)	-
HEAD_EDU	The highest level education of household head	-
FEMALE	Gender of household head (female=1, other=0)	+
DISTANCE	Distance from the EWEC (km)	+
HOUSEHOLD SIZE	Total number of members in household	+
LAND	The household's area of land holdings	-
EM_AGRI	Working in agriculture sector	+
RURAL	Rural=1, other=0	+
URBAN	Urban=1, other=0	-

4.1 Dependent variable

The poverty line is a widely used measure of poverty. Since progress in poverty reduction is highly important, the world target is summarized in Millennium Development Goal (MDG) 1: “to reduce by half the proportion of people living on less than a dollar a day, to reducing poverty”. MDG 1 is more powerful in focusing on global poverty. The World Bank has revised the poverty line upward to \$1.25 at 2005 prices instead of \$1.08 at 1993 prices.

“The new data allow more accurate figures for PPP exchange rates and show how previous PPP exchange rates had led to under-estimation in the cost of living in most low- and middle-income countries” (Sabry, 2009).

In this paper, the position of a given household under or at/above the new poverty line is employed as the binary dependent variable. The regression analysis will explore the conditions of inequality which determine which households living below a 1.25 dollar per day per person are poor (1) and which households living above a 1.25 dollar per day per person are not poor (0).

4.2 Independent variables

The description of most of these variables is fairly self-evident in table 1. Additional explanation is provided from the perspective of broad characteristics by many authors, e.g. Andersson et al. (2005), Sikander et al. (2008), Apata et al. (2010), Zampino (2010), Gounder (2011), and Ennin et al. (2011).

In contrast, the relationship between road access and household welfare seems more complex. The standard assumption is that poor road infrastructure, closed access to

schools, lack of access to healthcare services, lack of access to world markets, etc may lead households to be poor and have weaker income. Geographical areas are thus identified as important determinants of poverty. Many authors use geographical areas as proxies for remoteness to capture the set of households most likely to be vulnerable to poverty. Households or farms located at a greater distance from markets are expected to be poorer than those located nearer input and output markets because high transactions costs reduce net incomes. In addition, rural households suffer from poor and unreliable infrastructure compared with urban areas.

In general, a household's welfare increases if it lies in urban areas and is limited in size. Household size is positively related with the level of poverty, such that households with more members are more likely to be poorer. Age is also the one of the major determinants of poverty. Households whose heads are older and more experienced likely have a significantly lower possibility of remaining poor. Access to education is also hypothesized to reduce poverty, implying that limited access to schools leads to workers to be poorly educated. Opportunity for a better education creates better job skills, lower unemployment, and less poverty. Education is therefore a key indicator of poverty alleviation and income redistribution over the long run.

Other factors like the gender of the household head influence the poverty level. It is well-known that male and females have different employment opportunities. Some authors use the gender variable based on the assumption that female-headed households are generally associated with heightened vulnerability to poverty. However, Apata et al. (2010) summarized that the decision making of female household head could be either positive or negative effect for poverty vulnerability.

Another common assumption is that the households whose primary occupation is agriculture are more likely to be poor. This assumption is consistent with many studies in the literature that show that the majority of households whose primary occupation is agriculture lie in the rural areas. This said, agriculture landholding is a major positive factor in determining consumption capacity in agricultural societies; and thus is negatively correlated with the incidence of poverty. This is because land increases the opportunity to diversification into a variety of enterprises and also increases overall profitability of the farm as well as reduces poverty levels of farm.

5. Results

The data have been analyzed in two ways. Table 2 presents the comparison of the Logit models and the Probit models for Savannakhet as a whole, that is for urban, semi-urban and rural areas combined. The coefficients and their marginal effects are provided for the comparison of the two models. Model adequacy and diagnostic checks are also reported to select between the two models to represent the determinants of poverty. The dependent variable is poverty (1 = poor, 0 = non poor) and the poverty line used to separate the poor from the non poor is 1.25\$ per day per person. This is the poverty line as established by the World Bank in 2005. The Logit and Probit is used to identify household characteristics that are associated with higher risk of becoming poor (Dudek,

2006). Since being a poor household = 1, a positive coefficient of the independent variable indicates an increase in the probability of being poor, while factors that negatively influence the dependent variable are reduce the likelihood of being poor.

TABLE 2: Probit and Logit models of determinants of poverty for overall in Savannakhet

Variable	Model I - Probit model		Model II – Logit model	
	Coefficient	Marginal	Coefficient	Marginal
Constant	-.0401 [.5849]	-.0157 [.2293]	-.1240 [.9561]	-.0305 [.2356]
HOUSEHOLD SIZE	.0992*** [.0598]	.0392*** [.0236]	.1625*** [.0972]	.0400*** [.0239]
EM_AGRI	.4751** [.2072]	.1825** [.0763]	.7957** [.3461]	.1890** [.0775]
DISTANCE	.0384* [.0125]	.0152* [.0049]	.0657* [.0219]	.0162* [.0054]
RURAL	-.8441* [.3274]	-.3219* [.1108]	-1.4139** [.5507]	-.3324** [.1105]
LAND	-.0411* [.0131]	-.0162* [.0051]	-.0705* [.0230]	-.0174* [.0056]
FEMALE	.0052 [.1738]	.0021 [.0686]	.6209 D-04 [.2823]	1530D-04 [.0695]
HEAD_EDU	-.6220D-05 [.0004]	-.2455D-05 [.0001]	-.1574 D-04 [.0007]	-.3880D-05 [.0002]
AGE	-.0107 [.0127]	-.0043 [.0050]	-.0168 [.0206]	-.0041 [.0050]
URBAN	.0848 [.1974]	.0335 [.0780]	.1685 [.3240]	.0416 [.0799]
LR statistic	23.9146		24.2174	
McFadden Pseudo R-squared	.0715		.0724	
Correct prediction	62.55%		61.31%	

Note: *significant at 1%, **significant at 5%, ***significant at 10%. Standard error is in the blanket.

Table 2 shows the estimated model and the marginal effects of each explanatory variable on the probability of being poor. The coefficient of household size is positive and significant at the 10% level for both models, indicating that larger households have a greater probability of being in poverty of 3.92% and 4.00% in the Probit and Logit models, respectively. The welfare of households would be increased if households were limited in size through family planning and other policies. This result echoes similar findings by both Geda et al. (2005) and Achia et al. (2011) in Kenya, Zampino (2010) in Nicaragua, and Ennin et al. (2011) in Ghana. Conversely, Gounder (2011) found that household size bears a negative relation with poverty in Fiji because a larger number of members allowed families to share purchases at lower cost per person for a given standard of living (Gounder, 2011).

With respect to differences between urban and rural households in Savannakhet, the results with are surprising. Not only does urban residence not significantly reduce poverty, living in rural areas bears large negative coefficients (32.19% in the Probit model and 33.24% in the Logit model) that are significant at the 1% and 5% levels, respectively. One possible reason could be that despite superior employment opportunities and infrastructures, the urban areas' highly competitive labour market and population density cause economic inequality and other socio-economic problems. Policies to encourage populations to remain in rural areas might therefore constitute a viable option for reducing inter-household inequalities. Those rural areas are differentiated by geography and the levels to which basic infrastructures have been improved. These results are the opposite of those found by Gounder (2011) in Fiji, Zampino (2010) in Nicaragua, and Achia et al. (2010) in Kenya, who all found that living in rural area increases the probability of being a member of a poor household.

But one must be careful in the interpretation of this result because within the rural sector, working in the agricultural sector is a cause of poverty, with a positive sign and 5% significance level for both models. The impacts in terms of the increased probability of becoming a poor household are large: 18.25% and 18.90% in the Probit and Logit models, respectively. How do we explain these apparently contradictory results between rurality and agricultural work? Although for most Lao households, agriculture is an important sector of employment; working in the agriculture sector may lead to reduced household income. This is because, as the ICUN and NERI (2011) explain, the economic structure of Savannakhet has been changing dramatically in recent years as a result of the EWEC road and other forces. That transformation involves a shrinking role of agriculture and growth in industry and services. Household business is often the major alternative to subsistence agriculture. This suggests that many people in the province are still earning a living in the agriculture sector, but that traditional livelihood patterns are being replaced with new more industrialized modes of production. The expansion of downtown areas to other areas derives both from FDI and Lao government investments that have substantially improved the basic infrastructure in rural areas. This situation may have deepened the income gap between households whose primary occupation is agriculture compared with other occupation.

The distance from the EWEC is also a significant, positive cause of household poverty, as expected, at the 1% level. The impacts of distance from the EWEC in terms of the increased probability of becoming a poor household are 1.52% in the Probit model and 1.62% in the Logit model. This implies that those households located at a greater distance from EWEC road being poorer than those located nearer to the EWEC road.

The other significant variable is agricultural landholding. The coefficient of agriculture landholding is negative and significant at 1% level for both models, indicating that increases in land area decrease the probability of being poor. The impact of agriculture landholding is 1.62% and 1.74% in the Probit and Logit models, respectively. The nature of the agricultural profession requires them to hold pieces of land for them. Rice is the major saleable product of the Lao household: aside from own consumption. Moreover revenue from sale of rice can be used to purchase other goods (Andersson, Engvall, and Kokko, 2006). Conversely, Apata et al. (2010) in Nigeria as well as Ennin et al. (2011) in Ghana found that land ownership increases the probability of remaining poor.

Once the above variables are taken into account in the model the standard socio-demographic variables age, gender and educational level of the household head become non-significant. They should therefore not be used as direct targets of policy interventions to alleviate the vulnerability to poverty. Possible reasons for this non-significance may be that the road transportation system (EWEC road) and other transportation-related activities have been improved in recent years in Savannakhet. Therefore, economic opportunities are widely distributed across all types of household head characteristics. Similarly, Ennin et al. (2011) report that the gender of the household was insignificant in all models for Ghana. In contrast, however, Apata et al. (2010) found in Nigeria that female and under-educated heads of household had an increased probability of remaining poor. Gounder (2011) in Fiji and Achia et al. (2010) in Kenya found that age and low education levels were significantly associated with poverty. Zampino (2010) found the education level is significant cause of poverty in Nicaragua.

Our data suggest that the use of Logit models for modeling the determinants of poverty is quite appropriate. The LR test and Pseudo R^2 are higher than in the Probit model. Tables 3, table 4 and table 5 present the comparison of the Logit models and the Probit models separately by urban, semi-urban and rural area within Savannakhet province. They report the marginal effects of each explanatory variable on the probability of being poor for the areas separately. It is true that households in urban areas are better off than in other areas. Yet Table 3 shows that no household or household-head variables are not statistically significant causes of poverty in urban households for any models. This is not surprising because the urban area offers more economic opportunities to households of all types than those in other areas. Infrastructure and other transportation-related activities have been improved and generalized throughout the city.

TABLE 3: Probit and Logit model of determinants of poverty in urban area

Variable	Model I - Probit model		Model II – Logit model	
	Coefficient	Marginal	Coefficient	Marginal
Constant	.4164 [.6838]	.1641 [.2601]	.6578 [1.1040]	.1633 [.2736]
HOUSEHOLD SIZE	.1149 [.0798]	.0456 [.0316]	.1859 [.1299]	.0461 [.0322]
AGE	-.0173 [.0159]	-.0069 [.0063]	-.0277 [.0255]	-.0069 [.0063]
FEMALE	-.0172 [.2204]	-.0068 [.0874]	-.0223 [.3542]	-.0055 [.0879]
HEAD_EDU	-.0004 [.0006]	-.0002 [.0002]	-.0008 [.0010]	-.0002 [.0003]
DISTANCE	-.0135 [.0357]	-.0054 [.0142]	-.0211 [.0562]	-.0052 [.0139]
LAND	-.0286 [.0336]	-.0113 [.0133]	-.0451 [.0566]	-.0111 [.0141]
EM_AGRI	.1024 [.3176]	.0404 [.1247]	.1631 [.5094]	.0402 [.1247]
LR statistic	4.2944		4.2883	
McFadden Pseudo R-squared	.02224		.02221	
Correct prediction	57.14%		57.14%	

Note: *significant at 1%, **significant at 5%, ***significant at 10%. Standard error is in the blanket.

In the semi-urban area, distance from the EWEC bears a positive coefficient as expected and is significant at the 10% level in Probit model; but in the Logit model it is insignificant (Table 4). The impact of distance from the EWEC with increasing probability of becoming a poor household is 2.15% in Probit model. This finding implies that households located at a greater distance have higher transaction costs, transportation and other costs for selling goods or agriculture products, thereby reducing the net sales price received. The other significant variable is working in the agriculture sector, with a positive coefficient significant at the 5% level for both models, as expected. The impacts with increase probability of becoming a poor household are very large with 28.06% and 28.01% in the Probit and Logit models, respectively. Clearly, one strategic factor to be targeted by poverty-reduction policies is agricultural employment.

TABLE 4: Probit and Logit model of determinants of poverty in semi-urban area

Variable	Model I - Probit model		Model II – Logit model	
	Coefficient	Marginal	Coefficient	Marginal
Constant	-.5218 [1.2725]	-.1975 [.4823]	-.7313 [2.0731]	-.1706 [.4843]
DISTANCE	.0569*** [.0332]	.0215*** [.0125]	.0900 [.0562]	.0210 [.0129]
EM_AGRI	.7623*** [.3999]	.2806*** [.1393]	1.2417*** [.6781]	.2801*** [.1427]
HOUSEHOLD SIZE	.0924 [.1188]	.0350 [.0449]	.1438 [.1951]	.0335 [.0454]
AGE	-.0021 [.0270]	-.0008 [.0102]	-.0045 [.0440]	-.0010 [.0103]
FEMALE	-.1047 [.3548]	-.0396 [.1343]	-.2218 [.5872]	-.0515 [.1366]
HEAD_EDU	.0004 [.0007]	.0001 [.0003]	.0007 [.0012]	.0002 [.0003]
LAND	-.0437 [.0366]	-.0165 [.0138]	-.0712 [.0627]	-.0167 [.0146]
LR statistic	11.5350		11.2753	
McFadden Pseudo R-squared	.1131		.1106	
Correct prediction	64.47%		61.84%	

Note: *significant at 1%, **significant at 5%, ***significant at 10%. Standard error is in the blanket.

Likewise in the rural areas (Table 5), the single significant factor in the determination of household poverty is agriculture, with a positive coefficient, as expected, significant at 5% in the Probit model and 10% in the Logit model. The impact of working in the agriculture sector with increasing probability of becoming a poor household is larger than in others areas: 56.99% in the Probit model and 58.71% in the Logit model. This result confirms by Ennin and et al. (2011) that the majority of the households in the rural area that have agriculture as their primary occupation are expected to be poorer than those with different primary occupations.

TABLE 5: Probit and Logit model of determinants of poverty in rural areas

Variable	Model I - Probit model		Model II – Logit model	
	Coefficient	Marginal	Coefficient	Marginal
Constant	1.7249 [2.3994]	.3795 [.1804]	2.5045 [4.1404]	.5876 [.9799]
EM_AGRI	1.6683** [.7064]	.5699** [.1907]	2.9564*** [1.3003]	.5871*** [.1893]
HOUSEHOLD SIZE	-.1607 [0.2042]	-.0622 [.0794]	-.2904 [.3533]	-.0681 [.0832]
AGE	-.0639 [.0622]	-.0247 [.0239]	-.1017 [.1094]	-.0239 [.0255]
FEMALE	-.5484 [.6830]	-.2104 [.2576]	-1.0713 [1.2104]	-.24764 [.2691]
HEAD_EDU	.0010 [.0016]	.0004 [.0006]	.0016 [.0031]	.0004 [.0007]
DISTANCE	.0458 [.0318]	.0177 [.0122]	.0825 [.0571]	.0193 [.0131]
LAND	.1196 [.0776]	.0463 [.0299]	.2128 [.1329]	.0499 [.0308]
LR statistic	13.6348		13.9293	
McFadden Pseudo R-squared	.3676		.3755	
Correct prediction	85.19%		81.48%	

Note: *significant at 1%, **significant at 5%, ***significant at 10%. Standard error is in the blanket.

6. Discussions and Concluding remarks

The results of this paper have pinpointed the key factors affecting poverty in Savannakhet province as a whole and by urban, semi-urban and rural area within the province. To do so, we have employed econometric models of the Logit and Probit classes to explore the conditions of inequality which determine which households are poor and non-poor by poverty line.

The first policy-oriented question posed by this research was *What are the significant causes of poverty in the households of Savannakhet?* The answers to this question may be summarized as a) large household size, b) rural location, c) lack of non-agricultural

business, d) the lack of land e) agricultural worker status, and f) distance from the EWEC. We may deduce that the welfare of Savannakhet households will increase if households are limited in size. Since household business is often the major alternative to subsistence agriculture, working in the agriculture sector may lead to reduce household income. But increasing land area decreases the probability of being poor. Therefore it is principally those employed as agricultural laborers that must be targeted by poverty relief. Finally, since households located at a greater distance from EWEC road being poorer than those located nearer to the EWEC road, it is essential to extend the network of major branches and small feeder roads to reach as many hinterland villages as possible.

The second question posed by this research was *Does poverty differ significantly among rural, semi-urban and urban areas or by distance in kilometers from the EWEC?* The answer is principally the latter. Although urban areas are better off than semi-urban and rural area, area itself is a non-significant cause of poverty. Urban infrastructure has been improved and urban areas have acquired so many more economic opportunities that distance from the EWEC there is non-significant. Similarly, agricultural productivity and hence the need to market are so low in rural areas that distance from highways is also non-significant. It is only in the semi-urban areas where distance from the highway significantly increases the probability of being poor. Net income for the more market-oriented households there reposes on the net sales prices received after transportation costs, which are a direct function of distance from the road. Thus, semi-urban households located at a greater distance from EWEC road have a higher probability of being poorer.

The third question is, *What are the significant determinants of poverty in each of the rural, semi-urban and urban groups of households?* Working in the agriculture sector significantly increases the probability of being poor in both rural and semi-urban areas. Moreover, working in agriculture displays a larger impact as one increases the probability of being poor in both areas. The other significant factor is distance from the EWEC, which increases the probability of being poor in semi-urban areas. In contrast, no factors are significant determinants of poverty in urban areas.

For Savannakhet as a whole (Table 2) our hypothesis testing has rejected hypothesis 3 regarding the effect of the age and education of the household head. But it could not reject hypotheses 1, 2, and 4 that expect the distance from the EWEC, household size, and working in agriculture sector to have a significant negative effect on poverty alleviation.

By subgroup in urban (Table 3), semi-urban (Table 4) and (Table 5) rural populations in Savannakhet, we must reject hypothesis 1 to the effect that distance from the EWEC is an overriding cause of poverty since the result shows only semi-urban location to be significant. We must also reject hypotheses 2 and 3 that predict household size, household head age and education to affect poverty alleviation. The results show no evidence of those variables as significant causes of poverty. But in the case of hypothesis 4, we cannot reject the supposition that working in the agriculture sector has

a negative effect on poverty alleviation. The results confirm that agriculture employment is indeed a significant cause of poverty in semi-urban and rural areas.

The fact that so few variables are significant in these regressions is good news for policy makers to focus their budgets on a few key factors in their formulation or re-alignment of poverty reduction policies. Table 6, based on the results of Tables 2 through 5, proposes a poverty-alleviation matrix which such policy makers could employ. Factors in green with positive stars summarize policy-operable variables that reduce poverty. Factors in red with negative stars indicate policy-operable variables that increase poverty.

TABLE 6. Poverty reduction policy matrix

	Savannakhet	Urban	Semi-urban	Rural
1. Household size	*** ₋			
2. Agricultural employment	** ₋		*** ₋	** ₋
a. Rural area	*			
b. Land owned	*			
3. Distance from highway	* ₋		*** ₋	
4. Human capital formation				

Four key conclusions derive from this table. First, family planning to reduce the number of family members must remain an important government policy to reduce the poverty and increase the welfare of households.

Second, agriculture growth is crucial for poverty reduction. Raising agricultural productivity per worker and diversifying economic activity from agriculture to other sectors are important strategies for reducing poverty in those households whose primary occupation is agriculture and who are therefore expected to be poorer than households with other occupations. This does not mean that people have to leave the rural areas, but it is important to provide as much access to land as possible to achieve economies of scale and adequate incomes per farm household.

Third, further articulating the road infrastructure in rural areas through the addition of branch and feeder roads must become a key priority in decreasing the causes of poverty. Even though the basic infrastructure in rural areas of Savannakhet has been improved, the majority of households still lack complete and practical access. This severely limits the benefits rural dwellers can derive from the road infrastructure.

Finally, human capital formation will be necessary to ensure the success of the above strategies. Lack of education is a factor strongly associated with poverty. Educating the household head provides non-significant results, and women-headed households tend to be poorer than other households. Therefore, promoting equal opportunity for women in education could therefore constitute one key priority in the war on poverty in Lao PDR.

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