

IMPROVING POVERTY TARGET AND ALLEVIATION POLICY USING SPATIAL STATISTICS AND GIS

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ABSTRACT: Poverty is spatially dependent. In rural area, the poor people depend on natural resources for subsistence agriculture. The government announced poverty alleviation policy on the national agenda. However, poor households responded that they did not gain expected benefit from the poverty alleviation programs due to no logical selection strategy for investment or targeting the poor. Poverty mapping is a powerful tool to identify and visualize the pocket of poverty and the affluence as well. The combination of GIS and SA analysis is suitable to identify associated factors of poverty, and indicated the spatial pattern of poverty which is appropriate for address poverty interventions. This paper aims to evaluate the possibility of investigates the potential of spatial statistical analysis and GIS analysis with Basic Minimum Need (BNM) database in Samrongthap district, Surin province. The household survey and BMN database at different time was conducted and analyzed spatial pattern of poverty for this study. The similarity results of pattern and distribution from both data are suggested to use BNM database to analyze spatial distribution of poverty in national scale. In addition, this finding can help the government officer to address the poverty alleviation programs related to their problems and poverty pocket area which is suitable and effective in analysis the changing of poverty distribution base on the database.

INTRODUCTION

Poverty is manifested by lack of income, rights and access to public services and resources. Poverty is spatial dimension. More than two thirds of the poor lived in Northeast of Thailand (NESDB, 2011). Although, Thai government announced the poverty alleviation policy and programs to empower poor people however some poor people in remote area did not gain benefit from these programs (Boontatarakoon, 2006). GIS and its application in tackling poverty with the spatial information, human well-being and poverty indicator analysis for example the poverty maps have evidenced useful for study and identify in poverty and design poverty policy strategies (Sachs, 2005; Akinyemi, 2008). The Thailand poverty map was constructed by employing a small area estimation technique and GIS analysis through collaboration of the National Statistical Office (NSO), NESDB Thailand Development Research Institute (TDRI), and the World Bank which is completed in 2002. It was reported that poverty maps are useful in assisting in the process of Thailand's poverty eradication programs (Healy and Jitsuchon, 2007). Nowadays, poverty maps do not various use in Thailand due to many reasons such as it complicated in process of construction and it provided in some indicators of poverty which is not explained the reason of the poor. In reality, poverty needs to be analyzed in conjunction with other techniques and factors that are related to poverty and spatial information. Given the spatial dependency of poverty, geographical targeting of the poor would help develop and implement poverty alleviation programs more effectively (Benson, 2002). Spatial autocorrelation analysis could be used as one of the methods that could help in targeting poor households or communities in directing limited resources for developing better poverty alleviation strategies (Thongdara et al., 2011). Therefore, the public policy and poverty alleviation measurement should consider composition and relevant information for decision making. This study aims to improve the targeting of poverty using GIS technique to alleviate poverty.

STUDY AREA

The study was located in the northeast region of Thailand which is recorded the highest poverty incidence. Surin province is recorded as one of the top five provinces with the highest poverty incidence in Thailand during 1998 to 2004 (Kaenmanee et al., 2003; NESDB, 2008). The Samrongthap district was the study area with a total area of 277 km² and 10 sub-districts in the Samrongthap district. Major types of land use include paddy cultivation covering 86% of the total cultivated lands in the study area (Figure 1). According to agricultural statistics of Thailand (OAE, 2010), The Northeast region has the highest proportion of agricultural land with 43% of the total of the agricultural land in Thailand.

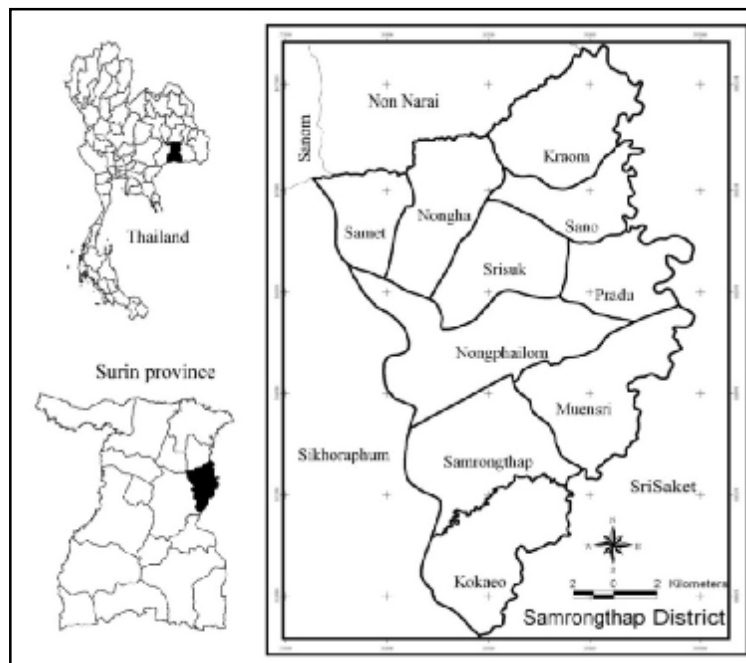


Figure 1: The study area

METHODS

Details of the methodology are described in the following steps:

Data collection

The field survey of social, physical and institutional characteristics that collectively influence the agricultural production, farm income and the livelihood of the households in study area were used in this study using a questionnaire-based survey. Household locations with respect to farm locations were identified by using GPS. Based on the random sampling, 195 household samples were chosen from a total of 9,736 rural households.

Data analysis

Descriptive statistics were used for analysis of the basic features of the household characteristics data in a study area, for example frequency, average, and percentage. Data description refers to the dimension of poverty and the social and economic conditions of respondents. This study used Surin province's poverty line as the threshold level to classify the poor. In this study the Net Farm Income (NFI) was considered as a contributor to rural poverty. The spatial analysis functions in GIS were used to analyze factors that might relate to NFI.

In order to analyze spatial patterns of poverty, this study was adopted spatial autocorrelation (SA) to analysis. This study used Moran's I as the statistical index because Moran's I uses numeric distribution which is more desirable than Geary's C (Cliff and Ord, 1973, 1981). Moran's statistical index identifies whether samples represent a cluster pattern, random pattern, or dispersal pattern. Moran's index evaluates these patterns in two different ways: global Moran's statistics and local Moran's statistics (Anselin, 2005). In the global Moran's index, a spatial pattern of all of the samples is evaluated. In this step, it is possible to identify the presence of any spatial patterns. The local

Moran's index provides further details about how the samples are related to their neighbors. In other words, the local pattern is either clustered or dispersed. This research used ArcView, ArcGIS and GeoDA software to conduct the SA analysis. The spatial weight matrix was defined as a local neighborhood around each household polygon. It is compared with the weighted average in order to support the spatial autocorrelation measurement.

The global Moran's I and the local Moran's I were calculated on the global and local scales using equations 1 and 2 (Wong and Lee, 2005).

$$I = \frac{n \sum \sum w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{W \sum (x_i - \bar{x})^2} \quad (\text{Equation 1})$$

Where x_i is the attribute value of area unit i , \bar{x} is the mean value in the study region, w_{ij} is the spatial weight matrix, W is the sum of all cell values in the spatial weights matrix, and n is the number of area units in the entire study area.

$$I_i = z_i \sum_j w_{ij} z_j \quad (\text{Equation 2})$$

Where z_i and z_j are deviations from the mean for corresponding x where δ is the standard deviation of variable x .

RESULTS & DISCUSSION

Based on the poverty line report by the NESDB, household consumption below 12,648 Baht/person/year was defined as poor in this study. According to survey data concerning household consumption, it was found that more than two-thirds (70%) of total sample were poor. Base on an average size of the families of the poor group was 5.32 while the non-poor group was 4.61. It was found that poor households are composed of large numbers of children and elderly people than non-poor. An average education attainment was 4.82 years. When comparing educational attainment between poor and non-poor groups, 98% of the non-poor group had primary school education or higher while 15% of household heads of poor households were illiterate.

The average farm holding size of poor household was 13.37 rai whereas the average holding size for non-poor was 19.80 rai. More than 70% of the poor group had land holding less than average of the study area. 75% of the total households owned land. Among the poor 96 households (71%) owned land while 51 households (86%) among non-poor owned land. Rice is the major crop in the study area with the major rice varieties of Kao Dok Mali 105 and RD 15. The average rice yield in the study area was about 350 kg/rai (2.19 t/ha) which is below the average rice yield of the country at 427 kg/rai or 2.67 t/ha (OAE, 2007). Almost 60% of poor households had a rice yield below average compared to about 42% for non-poor households. The majority of households in the survey reported that water shortages, pests, disease and the variation of rainfall distribution in the study area affects and damages rice cultivation and yield.

The livestock income is supplementary household income in the study area. 92 households in the surveyed reported earning income from livestock activities with an average of 17,223 Baht/household. There are 60 households of poor household earned income from livestock with an average of 11,543 Baht/household while 32 households of non-poor households earned income from livestock with an average of 27,873 Baht/ household (Table 1).

Table 1: Household characteristics among poor and non poor

HH Characteristics	Non-poor (59 HH)	Poor (136 HH)	Total (195 HH)
Average size of HH. (head)	4.61	5.32	5.11
Average education level (year)	6.07	4.28	4.82
Average farm holding (rai)	19.80 (3.17 ha)	13.37 (2.14 ha)	15.31 (2.45 ha)
Own land (HH)	51 (86.44%)	96 (70.59%)	146 (74.87%)
Average rice yield (Kg/rai)	400.51 (2.50 t/ha)	327.59(2.05 t/ha)	349.65(2.19 t/ha)
Average Income from livestock(Baht/HH)	27,873.28	11,543.50	17,223.42

As stated above, the net farm income was considered as a contributor to rural poverty due to the major source of household incomes was come from NFI. Figure 2 showed the distribution of median NFI by sub-districts and overlay with distribution of households NFI by quintile. Sub-districts located in the east (light shade) had lower NFI than the study area. The figure showed the median NFI in the east sub-districts below than median NFI in study area (22,364 Baht/household/year) such as Muensri, Kokaeo, Samrongthap Pradu and Sano. The bottom quintile group of NFI clustered in Muensri, Samrongthap and Pradu sub-districts as well. Based on the households' survey, the household sample in Muensri and Pradu sub-districts had small farm holding and higher than average rice damage areas from flooding and water shortages than the rest of the sub-districts. These factors could have an effect on the rice production and net farm income also. Compare with figure 3 which is showed the poverty incidence of Samrongthap district from NSO data. These maps showed the distribution of poverty incidence in sub-districts in year 2001, 2004 and 2006 respectively. It was found that the high poverty incidence sub-districts corresponding with distribution of low NFI sub-districts in figure 2 which are located in the east of district.



Figure 2: Median net farm income and household NFI by quintile

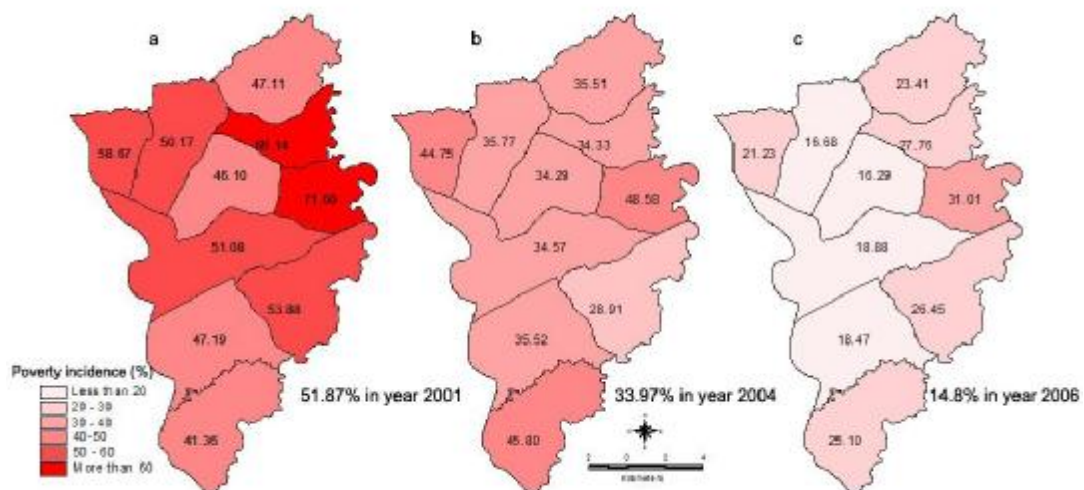


Figure 3: Poverty map of Samrongthap district in year 2001, 2004 and 2006

Base on the result of influencing factor with NFI, it was found that income from livestock, rice yield, total area cultivated, and participating in agricultural training were explained the contribution of NFI in study area. In

addition, GIS can help to identify spatial distribution of poverty and their relationship with other factors. GIS analysis was used to locate unsuitable areas for rice cultivation, farm holding size, flood potential areas, cost and benefit return of investment of rice, area of rice damage and reasons, household that faced with the agricultural problems and constrains (Thongdara, 2011). It can conclude that these corresponding factors can reduce household NFI in the study area.

However, the relationships of location and households' information can help to understand the pattern and distribution of household NFI which is useful for targeting the poor. To understand the relationship among them, this study investigate the spatial relationship of households that have similar NFI and probable tendencies in spatial clustering.

Figure 4 showed clustering tendency in the spatial distribution of household NFI. Black squares represent high NFI households surrounded by high NFI neighbors (high-high), and black circles represent low NFI households surrounded by low NFI neighbors (low-low). On the other hand, white circles and white squares were spatial outliers with low NFI households surrounded by high NFI neighbors (low-high), and high NFI households surrounded by low NFI neighbors (high-low). The 23 low-low NFI households with the household characteristics, environmental and physical problems in the study area may be related to poverty such as water shortages and pest problems and soil suitability.

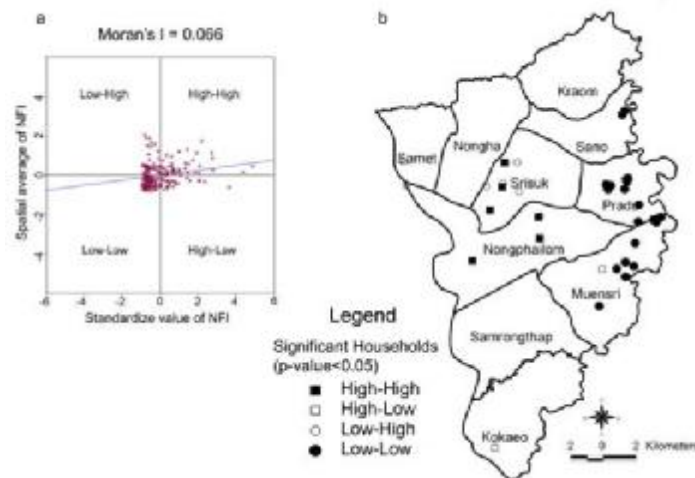


Figure 4: Moran scatter plot and LISA cluster map: **a** Moran scatter plot matrix, **b** LISA cluster map of household NFI ($p < 0.05$)

In order to extend the study, an attempt used national village database (BMN) which is collected households and villages base information frequency in every year over the whole country. Therefore, the village database of BMN which updates quality of life indicators of household level in every year by CDD was analyzed using spatial autocorrelation analysis. The objective of this was to evaluate the possibility of using readily available BMN database for practical usage based on statistical tools identified in the research work. The per capita household income is one of 42 indicators in the economic aspect from basic minimum need of household data which is available and collected over rural community in every year. To compare with the result of this study, the spatial autocorrelation was applied to the per capita income from CDD in the year 2009 and 2010 to 97 rural villages of the study area (Figure 5 and 6).

The Moran's Index for the global spatial autocorrelation analysis shows the clustering pattern of per capita income. Based on local SA, there are 29 and 18 villages out of a total of 97 villages with significant LISA at p -value < 0.05 in year 2009 and 2010 respectively. It shows 17 and 8 villages that have low per capita income are surrounded with low per capita income neighbor villages (low-low relationship) in year 2009 and 2010. The low-low relationship of per capita income villages are clustered and distributed in Pradu, Muensri and Sano in the east sub-districts. These are the same as the distribution pattern of household NFI observed in this study. This result confirms that the sub-districts located in the east of the study area have low income as well as NFI and the poor remains in the east sub-

districts of the study area at the present time. The result of spatial autocorrelation is suitable tool to identify poverty pocket and hotspots for targeting appropriate interventions.

The national strategies and poverty alleviation policies address the problems at the country level providing financial assistance to poor household identified subjectively without targeting specific problems, for example the Village Community Funding program. The contribution of this finding can help the government officer to address the poverty alleviation programs related to their problems and poverty pocket area which is suitable and effective in analysis the changing of poverty distribution base on the database. For example, the cluster of poor that had problems in low rice yield, the action leads to an improvement in the quality of life by providing opportunities to improve their rice yield rather than temporary financial contributions.

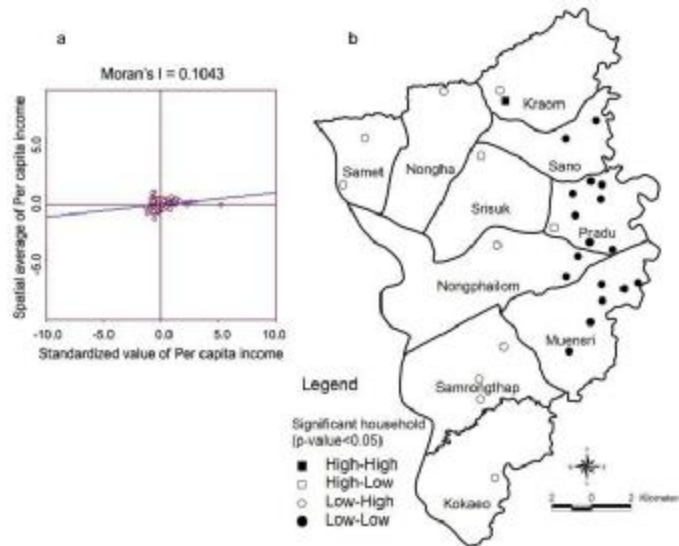


Figure 5: Moran scatter plot and LISA cluster map: **a** Moran scatter plot matrix, **b** LISA cluster map of village per capita income ($p < 0.05$) Year 2009

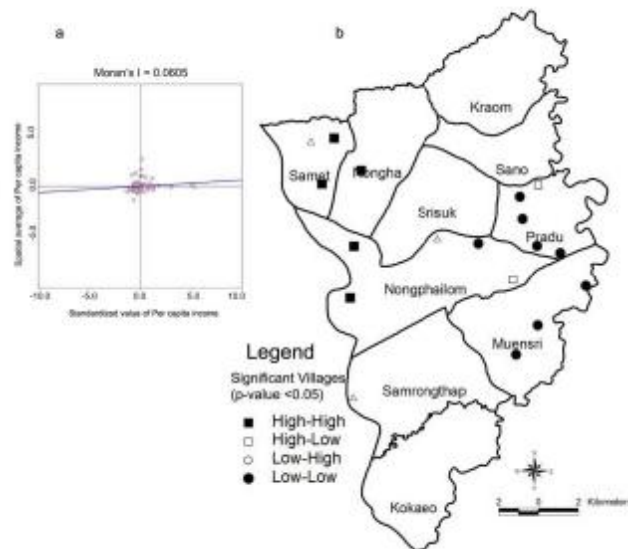


Figure 6: Moran scatter plot and LISA cluster map: **a** Moran scatter plot matrix, **b** LISA cluster map of village per capita income ($p < 0.05$) Year 2010

CONCLUSIONS & RECOMMENDATIONS

Although, poverty incidence had fallen, the income gap still remained when looked at the distribution of income quintiles. The household characteristics from survey data were showed among poor and non-poor households for

example, family size, agricultural production and farm land area. An average of educational attainment, farm holding, rice yield, income, expenditure of poor group was lower than non-poor group except family size. The poor still remains and the poverty alleviation programs may not benefit direct to the poor because of method and process in target selection. In addition, the programs lack of the mechanism and integration of allocate resources among the government ministries. GIS proved to be a tool to identify spatial distribution of poverty and their relationship with other factors. The spatial autocorrelation analysis is suitable tool to identify poverty pocket and hotspots for targeting appropriate interventions as well which can apply in BMN rural village database. The SA analysis provides similar results when compared with the household survey data of the study in GIS and SA analysis. Therefore, it is suggested that SA is suitable for analyze spatial distribution of poverty in national level to improve target poverty intervention objectively.

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