




A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution Satellite Imagery

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Presentation Outline

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- Studies background
- Aim & Objectives
- Scope and Limitation of Study
- Study Area
- Methodology
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FIG

Introduction

Urban Poverty



- a collection of characteristics which has a dynamic condition of vulnerability or susceptibility to risks

After 3 decade of rapid urbanization and development

- poverty much more complex than the lack of money where a multitude of factors could contribute the pathway into poverty
- the term poverty can also be referred to different adverse social and psychological repercussions namely **domestic violence, crime, perceived inadequacy** of social investments and social expansion of human capital, **unfair** service delivery, and **feeble political** participation thus make the definition of poverty is ultimately country specific



FIG

Introduction (con'td)



Measuring Poverty cases

- based on *relative Poverty Line Income (PLI)* or *absolute conventional* approaches

According to Malaysian Economical Planning Units (EPU), 2013

- **absolute approach**
by taking a poverty line income and estimating the number of households or individuals below this line
- **relative approach,**
by taking the average income of the bottom 40 percent of households and estimating the number of households or individuals below this poverty line



FIG

Introduction (Con'td)



In other words, those families who obtained their household **income below than average PLI** assign to a certain region of an area can be considered as poor.

Determination of PLI in Malaysia was first introduced in the year 1977 which was calculated based on the *Household Expenditure Survey* (HES) collected in the year 1973.

The **recent information** used to determine PLI mainly refer to the minimum requirements of a household for *food, clothing* and *footwear* while other non-food items such as *rent, fuel* and *power or energy* were also considered.



FIG

Studies Background



Poverty Eradication Program in Malaysia

Many programs have been set up by the government as an instrument to eradicate the number of poverty incidences.

- i. For instance, the **Poverty Eradication Program** itself has been one of the focus under the New Economic Plan (NEP) introduced in the year 1970-s.
- ii. The consequences of the introduction of NEP from year 1971 until 1990 has proven could **reduce a large numbers** of poverty at rural area as well as reducing income disparities between ethnic groups in Malaysia.
- iii. Subsequently in the following year, the government has introduced a new strategy in **empowering poverty eradication program** which has been mentioned in the National Development Policy (NDP) as to replace the previous successful NEP's program that just ended.






Studies Background

In this new policy plan, one of the government objective was to deprive the hard-core poverty groups either from the rural or urban area.

To achieve this objective, effort has been made to provide *incentive* for hard-core poverty groups in term of housing, social, economy and *provision* to basic amenities through a special development program like Hard-core Poverty Housing Project Scheme by the local people.

In term of monetary, the government has also offered a *micro credit finance* under Amanah Ikhtiar Malaysia (AIM) Fund program as to help the hard-core poverty groups to list themselves out of poverty regardless of their race, gender and political affiliation.





Method Used in Poverty Mapping

The most popular technique used in determining poverty is by using Small Area Estimation Method. This is a [statistical](#) techniques involving the [estimation of parameters](#) for small [sub-populations](#), generally used when the sub-population of interest is included in a larger [survey](#). The term "small area" in this context generally refers to a small geographical area such as a county. If a survey has been carried out for the population as a whole (for example, a nation or state-wide survey), the [sample size](#) within any particular small area may be too small to generate accurate estimates from the data. To deal with this problem, it may be possible to use additional data (such as [census](#) records) that exists for these small areas in order to obtain estimates.



FIG **Method Used in Poverty Mapping** 

In the process of producing a poverty map, the choice of *methods and data sources* for poverty mapping should be determined in accordance to the purpose for which the resulting map will be used, which often dictates the appropriate level of precision and resolution (Henninger and Snel 2002).

Basically, there are *five elements or constraint* that need to be considered in producing poverty mapping methodology including the purpose or objective of the project, poverty philosophy of practitioner or institution, availability of the data, analytical capacity and the cost (Benjamin, 2003).

While in Tara et al (2007), they states that the *limitation of the poverty mapping* is often due to the quality of census and household survey data because the data are time sensitive.



FIG **Method Used in Poverty Mapping** 

The use of remote sensing and GIS in classifying the concept of *Urban Structure Types* (UST) has proven to be very important in urban spatial research (Banzhaf and Hofer, 2008) whereby they has characterized the UST components as follows:-it could identify different classes of building types (eg. housing, industrial, commercial and infrastructure, classes for impervious surfaces (road and rail infrastructure, parking lots, etc.), and classes of open spaces (woodland, parks, field, etc.)

Moreover they conclude that the composition among any of those three classes also can be used to form UST. Meanwhile, urban vegetation pattern analyzed using vegetation index analysis (NDVI) also important to quantify socio-environmental values and to relate it with socio-spatial differentiation.



FIG **Method Used in Poverty Mapping**

On the other hand, the spatial heterogeneity of poverty using selected high resolution remote sensing based on spatial indicators such as roof coverage densities and a lack of proper road network characterized by the irregular layout of settlements has been introduced and proposed by Sliuzas and Kuffer (2008) in their studies. Based on these indicators, they found that the heterogeneity of several deprived neighborhoods can be identified and the different types of poverty areas also could be delineated.



FIG **Aim and Objectives**

The aims of the study is to investigate the possible method of acquiring urban poverty area from high resolution remote sensing satellite imagery which relates to census and statistical data. In specific, this study is conducted in order to fulfil these following objectives:-

- To identify and classify the urban spatial types as well as urban poverty characteristic needed in the study.
- To perform visual interpretation and data extraction in determining urban poverty area based on identified criteria on high resolution satellite imagery in order to locate the urban poverty area.
- To verify the identified urban poverty area using existing statistical data from Malaysia census and thus to suggest urban poverty location based on spatial correlation between the urban and poor elements of the study area.



FIG



Scope and Limitations

In line with the objective to assist and ensure the success of anti-poverty programs in Malaysia as a whole, the overview of the location and size of the area of poverty should be highlighted.

In this study, the relationship between the type and residential location relative to the spatial characteristics of the city will be made to give a clear picture of the location of the urban poor in detail.

As the image data used are of high resolution, then the chosen criteria will be analyzed using visualization and image interpretation method according to the characteristics described by Ahris (1991) and Banzhaf and Hofer (2008).









FIG



Study Area

In this research, a study area has been chosen to be conducted at Penang Island in Malaysia. The area was formerly known as a **trading ports** for tea, spices (clove and nutmeg from local plantations), china, pepper from Aceh and textiles from India since early 1880-s. Later on, the regional trade grew to include tin and rubber. From uninhabited island, many of the settlement has been build up by traders from inside and outside the country who working and lives there has bring a lot of prosperity which indirectly change the geographical and socio-economic landscape of the island. Now, the most remarkable location of Penang Island is on its historical site, scenic seashores, commercial centre and also industrial area has attract many local and foreign people to come either to work or just for vacation.

However, the increasing numbers of people working in Penang Island and the lack of affordable house to purchase by low and medium income group might be a reason why some people choose to lives in squatter many years. Penang is one of the three main city in Malaysia who has a huge number of squatters at their urban area. This issue has been reported in Utusan Malaysia newspaper dated 10 December 2013 which stated the number of squatter in Penang Island alone was 2875 houses.









FIG



Methodology

In order to suites the socioeconomic data, various correlation and regression method could be applied (Rogers 2006b) and the best correlations will be exploited to produce a spatially detailed map of any selected index of poverty area required.

The correlation and regression that have been applied will be used to determine the relationship of the study between the map and the socioeconomic problem.

In this paper, a study has been made with an attempt to investigate and identified the urban poverty area by using visual interpretation method and spatial correlation study on high resolution IKONOS satellite imagery. Since the spatial resolution provided by IKONOS satellite imagery can reach up to 1 m x 1m for a pixel size or better, the recognition of object at the desired area can be made more accurately.

Besides that, the characteristic of urban poor which categorized in poverty will be accessed based on squatter and housing types visualize from acquired satellite images. Generally housing units can be classified into the following main types (Table 1):








FIG



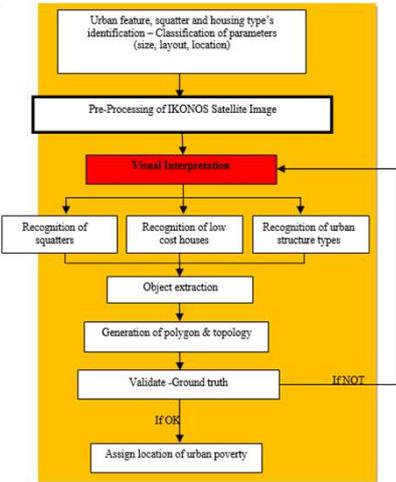
Methodology

This methodology started with the **identification** of general urban spatial features, squatter area and the characteristic of housing types in Malaysia.

Then the **selection of study area** was made and a high resolution satellite image for the chosen area was required from Agency of Remote Sensing Malaysia. At the first stage, studies was carried out by doing **visual interpretation** against selected high resolution satellite images to identify all of the composed parameters. After that, all the recognized elements will be digitized to form spatial features of polygon layers for the designated criteria.

At the second stage, a **checking or validation** process will be performed as to intersect spatial layer of urban and poor properties with the census data. An analysis will be conducted to verify the out coming result. Finally if the finding agree with the census and statistical data, then the mapping of urban property area will be proceed.

However if the results are contradict, the process of characterizes and visual interpretation on urban poor and urban spatial types properties must be **repeated** to rebuild the spatial correlation study



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graph TD
    A[Urban feature, squatter and housing type's identification - Classification of parameters (size, layout, location)] --> B[Pre-Processing of IKONOS Satellite Image]
    B --> C[Visual Interpretation]
    C --> D1[Recognition of squatters]
    C --> D2[Recognition of low cost houses]
    C --> D3[Recognition of urban structure types]
    D1 --> E[Object extraction]
    D2 --> E
    D3 --> E
    E --> F[Generation of polygon & topology]
    F --> G[Validate - Ground truth]
    G -- IF NOT --> C
    G -- IF OK --> H[Assign location of urban poverty]
    
```








FIG



No.	Types	Characteristic
i.	Detached	A separate house, which does not share a common wall with another house.
ii.	Semi-detached	Two separate houses, which share a common wall and have separate entrances.
iii.	Terrace/link	Houses built in rows of three or more units of which each has a common wall or walls adjoining to the next house.
iv.	Cluster	A separate house which shares a wall with the next house and joins back to back with another house.
v.	Apartment	A multi-story building which consists of separate housing units. Facilities provided by the developer/management are superior compared to that of a flat like 'surau', playground, lift, security services and surrounded by fence.
vi.	Condominium	A multi-story building which is considered as an exclusive and luxurious property. Facilities and services provided by the developer/management are much better compared to the apartment. Among the facilities are special parking lots for each owner, swimming pool, gymnasium, laundry, lift, fenced area and strict security system services.
vii.	Improvised/temporary hut	This category is meant for temporary shelter and unfit for living. They are usually built of discarded materials such as plywood, zinc, or others.

Table 1: Characteristics of Housing Types In Malaysia



FIG



Identification of Urban Poor Criteria

Squatter location

A proper house should provide a sufficient living area and not too overcrowded and has good building structure, has ownership and well-connected to public facilities.

If the condition is vice versa the area could be categorized as a slum. In the sustainable development concept and understanding, the slum or squatter can be considered as poverty area (Henninger and Snel 2002).

Low cost houses location

Types of low cost houses normally small in size with the built up area less than 1000ft².

This type of houses was designed in the form of terrace house or flats unit usually comes with two bedroom per unit a few decades ago nearby the city center as to provide accommodation to a small family who obtained low monthly income.



FIG



The characteristics that can be taken into consideration in **identifying urban poverty** area can be referred to Ahris (1991) who has classified the squatter area as follows:



Fig.1: Dense housing area along the sea edge



Fig.2: Dense housing area along the river's edge



Fig.3: Dense housing area located at city centre



Fig.4: Dense housing area located in within a well-planned settlement



FIG

Visual interpretation method on high resolution satellite images



In Chandra and Ghosh (2007) and Sulaiman et al (2012), they both agree that the most significance types of spectral classification are including *Supervised* and *Unsupervised classification*. However Sahrman et al (2013), were suggesting the two appropriate methods in identifying the poverty area using remote remote sensing which inclusive of 'spectral classification' and 'visual interpretation'.

Spectral classification is known as the process of sorting pixels into a **finite number of individual classes** or to categories of data based on their data file values while visual interpretation method is used to analyse the various targets in an images where those targets maybe environmental or artificial features that consists of points, lines, or areas (Bohari et. al. 2011).

Recognizing targets is one way to make an interpretation and information extraction. Observing the differences between targets and their backgrounds involves comparing different targets based on any, or all, of seven visual elements or characteristics including of **tone, shape, size, pattern, texture, shadow and association** (site) (Keith, 2006).

Prior to this study, a preliminary work of using IKONOS satellite imagery to determine poverty area has been done successfully based on the guided characteristic of squatter mentioned earlier, in Klang, Selangor. Based on the preliminary observation to the Google Earth satellite image, it was found that the study area has a potential reason to be studied due to some squatter characteristic which almost similar to what has been described in Ahris (1991).

The application of visual interpretation method on high resolution satellite image of the study area discover several location of the squatter or slum which is disoriented and built in within a well-planned housing area on the image.



FIG



Expected Results

Since the research is still in the on-going process, only the expected outcome will be discussed here. At the end of the study, it is expected the outcomes are as follows:

- i. **To show the Spatial Correlation Criteria of Urban Poverty Area on High Resolution Satellite Imagery**
Result from the study will show the spatial correlation criteria that suitable to determine the poverty area based on the three elements which are the spatial poor, housing types (low cost houses) and urban spatial features as mentioned previously in the methodology. This is to relate that by doing a visual interpretation of satellite imagery, the poverty area can also be detected and identified using a certain characteristic that has been proven.
- ii. **To produce an Analysis of Urban Poverty Distribution**
Based on the urban poverty area that will be assigned once the visual interpretation completed, the accuracy of urban poverty distribution will be discussed. This is important as it would reflect the future development should be carry out in order to eradicate the poverty. Analysis also will be made in comparison to the conventional poverty mapping approaches especially to see the different in urban poverty distribution area.
- iii. **To produce a Thematic Poverty Map of the Urban Area based on Visual Interpretation Method and Statistical Data**
A thematic poverty map will be produced based on the visual interpretation method of the spatial features combined with census statistical data acquire from Department of Statistic, Malaysia. This map will includes several layers of information such as location of poverty area, water bodies, residential, industrial, inland communication network and vegetation. The use of the thematic poverty map is to ease the audience like community leader, town planner, academician and private sector to study the information shown on the map.









FIG



Discussion and Conclusion

This paper has reviewed and discussed on poverty issues in Malaysia. Due to the increasing size of urban area and its modernization, surrounding peoples who obtained low household income are *exposed to urban poverty*.

The detection and studies on the urban poverty area using 'Visual Interpretation' and 'Spatial Correlation Study' on high resolution satellite imagery may help to *highlight the importance* of this issue which need to be solved before year 2020.

From the expected result, future development also can be *planned specifically* to reduce the number of poverty without any leakage to non-related groups. Furthermore, the application of Remote Sensing and high resolution satellite imagery has never been used intensively in this kind of study previously in Malaysia.

As conclusion, even though poverty is a complex issue and needs to be addressed on a *multitude of levels* and *with engagement* from a multitude of partners, contribution from local research also need to be acknowledged in understanding of the dynamic relationships between poverty, social capital, infrastructure and sustainable development in a holistic ways.









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Acknowledgement

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Thank you for your attention!

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