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

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Key words: Urban poverty, high resolution satellite imagery, visual interpretation, spatial correlation, urban poverty area.

SUMMARY

Identification of the slum using high resolution satellite imagery and environmental data set has been widely used in many countries to estimate, detect and identify urban poverty areas. By using visualization approach on high resolution remote sensing images the identification of poverty area can be investigated earlier before any site visit work being conducted. Due to the increasing cost of life expenses at urban area in Malaysia presently, the investigation of urban poverty in dense areas becomes much essential, especially in showing the relationship and impact of rapid development towards poor people at urbanized area. In this study, justification of 'poor people' is referred to the people who acquire gross household income lower than poverty line income declared by the government. Therefore, in delineating urban poor, several physical criteria like the layout and characteristic of squatter and type of housing in Malaysia has been identified. Other contribution factor like location of industrial estate, commercial area and public transport network are also important in intersecting and downsizing the scale of the urban poverty area which indirectly refle http://www1.treasury.gov.my/data/le/index.htmlct on the needs of the poor. This paper discusses an ongoing study in determining the urban poverty area of large township of Penang Island by using visual interpretation and correlation study on high resolution satellite images in order to generate a most recent urban poverty map for future development. The accuracy of the identified location shown from the findings will be verified through checking on the statistical and census data of the study area.

A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

1/13

FIG Congress 2014
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Kuala Lumpur, Malaysia 16 – 21 June 2014

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1. INTRODUCTION

Urban poverty can be described as more than a collection of characteristics which has a dynamic condition of vulnerability or susceptibility to risks (Rogers 2006a). The rapid urbanization and development occurred in Malaysia cities over the last three decades revealed remarkable changes which would degrade some peoples' life in urban poverty (Nair, 2009). For some people nowadays, they interpret poverty much more complex than the lack of money where a multitude of factors could contribute the pathway into poverty'. According to Zulkarnain (2013), 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.

Like other country in the world, the approaches of measuring poverty cases in Malaysia are based on Poverty Line Income (PLI). Basically poverty can be measured either by using a conventional approaches of absolute or relative PLI. In the absolute approach, poverty is measured by taking a poverty line income and estimating the number of households or individuals below this line while in the relative approach, poverty is measured by taking the average income of the bottom 40 percent of households and estimating the number of households or individuals below this poverty line (EPU 2013).

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 were also considered.

2. STUDIES BACKGROUND

2.1 Poverty Eradication Program in Malaysia

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

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 or known as 'Skim Projek Perumahan Rakyat Termiskin (PPRT)' 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.

However in the year 1997 to 1998, the unexpected Asia financial crisis had occurred and it has fluctuated the economy of Malaysia which indirectly also had given a bad impact to the poverty groups. The situation only improve after year 2002 through a quick recovery program implemented in 1998 the economic growth of our country has well sustained until now. The recent contribution from the government to combat poverty could be seen through various project like '1Azam program'in year 2010, 'Bantuan Rakyat 1 Malaysia (BR1M)' in year 2012, 'e-Kasih' program, 'Kedai Rakyat 1 Malaysia', 'Klinik 1 Malaysia', 'Bantuan Kepada Nelayan' and many more are part of the initiative in helping the poor as well as low and medium income community for better life. In line with our mission to move forward to reach the Vision 2020 and to become a 'High Income Developed Country', Malaysia government has set a milestone to try to totally eradicate poverty by year 2015.

In several cases of poverty which relates to poor people who lives at squatter area in Klang Valley a decades ago, the squatter settlement has been demolished while the resident has been moved to a new settlement under government housing project known as 'Project Perumahan Rakyat' (PPR) (Jabatan Perumahan Negara, 2013). Normally it consist of flat houses that is rented or sold to eligible person with a low price. This continuous project is part of Government Transformation Program (GTP) and it has been offered in stages at selected areas and ones who want to purchase the PPR housing unit need to apply for the house with the condition of their household income is less than RM2500.00 per month. On the other hand for medium income groups' applicants with their household ranges from RM2500.00 to RM7500.00, they can apply a housing unit under PR1MA projects that offered throughout the country (Economic Report 2013/2014, 2014). However the number of housing is limited to the cost and size of area to be developed thus may rigid the chances of many eligible people to own the house.

2.2 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

A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution   3/13
Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
Kuala Lumpur, Malaysia 16 – 21 June 2014

additional data (such as census records) that exists for these small areas in order to obtain estimates.

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.

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:-

    i)   it could identify different classes of building types (eg. housing, industrial, commercial and infrastructure,

    ii)   classes for impervious surfaces (road and rail infrastructure, parking lots, etc.), and

    iii)   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.

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.

3. AIMS 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:-

i.   To identify and classify the urban spatial types as well as urban poverty characteristic needed in the study.

ii.   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.

iii.   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.

A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution   4/13
Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
Kuala Lumpur, Malaysia 16 – 21 June 2014

4. SCOPE AND LIMITATION OF STUDY

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).

5. STUDY AREA

In this research, a study area has been chosen to be conducted at Penang Island in Malaysia. (Fig. 1). The area was formerly known as a trading ports for tea, spices (clove and nutmeg from local plantations), china, pepper from Acheh and textiles from India since early 1980-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.

6. RESEARCH METHODOLOGY

In general, spatial correlation study used in this research also known as correlation research is one of a common type of scientific research method. It is a scientific study in which researcher investigates associations between the chosen variables. Normally the aim of correlation research is to determine whether one or more variables can predict other variables. It also allows us to find out what variables may be related or correlated even though there is no causal relationship. 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

A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution Satellite Imagery, (6843)   5/13
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
Kuala Lumpur, Malaysia 16 – 21 June 2014

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):

Table 1. Characteristic of Housing Types in Malaysia
(source: modified from Sahriman et al, 2013)

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.	Condo-minium	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.

4.1 Identification of Urban Poor Criteria

4.1.1 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 categorizes as a slum. In the sustainable development concept and understanding, the slum or squatter can be considered as poverty area (Henninger and Snel 2002). 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:

   i)   Dense housing area along the sea edge (Fig.1),
   ii)   Dense housing area along the river's edge (Fig.2),
   iii)   Dense housing area located at city centre (Fig.3), and
   iv)   Dense housing area located in within a well-planned settlement (Fig.4).

A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

6/13

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
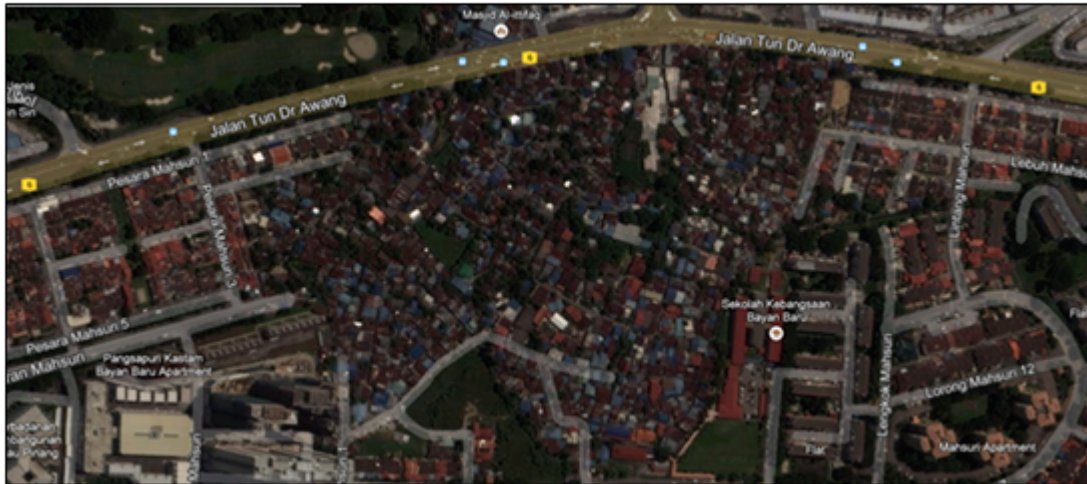Kuala Lumpur, Malaysia 16 – 21 June 2014

Fig. 1 Example of squatter area along the sea edge

Fig. 2 Example of squatter area along the river's edge.

Fig. 3 Example of squatter area situated in city centre.

Fig. 4 Example of dense housing area located in within a well-planned settlement

4.1.2 Low cost houses location
Instead of squatter, the other criteria should be added in determining 'urban poor' location is by identifying of low cost houses. Types of low cost houses normally small in size with the built up area less than 1000ft^2. 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. As the time goes by, the surrounding area of these low cost houses were developed, thus forming a new atmosphere of the urban poor in the positive and negative ways. Even though their gross household incomes may increase a little bit, however the tremendous increases on current expenses for goods, miscellaneous bills and food will make these peoples' loss their purchasing power. In the other cases, some of the low cost houses which was built on the short term lease hold land also give disadvantages to the poor to own their properties. Therefore, the element of low cost houses also should to be included in urban poor criteria besides of squatter.
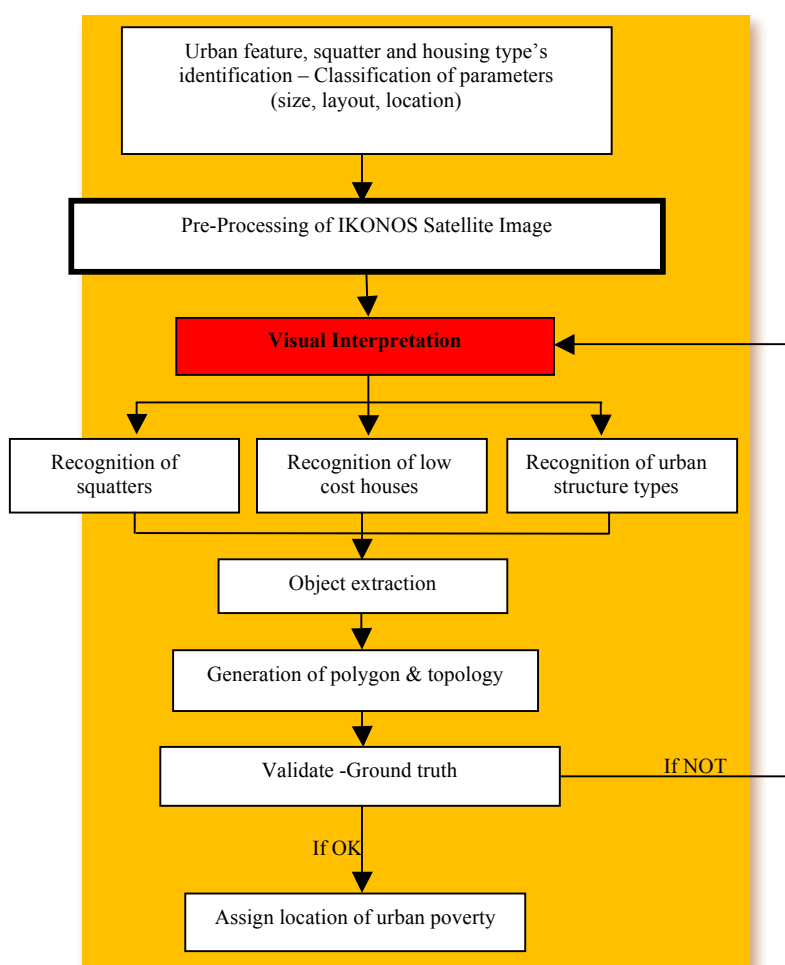
4.3 Visual Interpretation Method on High Resolution Satellite Images

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 Sahriman 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).

Target may be defined in terms of the way they reflect or emit radiation. This radiation is measured and recorded by a sensor and ultimately is depicted as an image product such as an aerial photo or a satellite image. Recognizing targets is one way to make an interpretation and

A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution   8/13
Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
Kuala Lumpur, Malaysia 16 – 21 June 2014

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. 5 Flowchart of Research Methodology Process

The above figure (Fig. 5) shown the methodology used in producing an urban poverty map for the studies. 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

A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

9/13

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
Kuala Lumpur, Malaysia 16 – 21 June 2014

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.

7. Expected Result

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.

8. Concluding Remarks

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

A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution   10/13
Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
Kuala Lumpur, Malaysia 16 – 21 June 2014

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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A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

11/13

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
Kuala Lumpur, Malaysia 16 – 21 June 2014

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A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

12/13

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
Kuala Lumpur, Malaysia 16 – 21 June 2014

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A Concept of Urban Poverty Area Identification Using Spatial Correlation Studies on High Resolution Satellite Imagery, (6843)
Nazirah Md. Tarmizi, Noorita Shahriman, Ismail Maarof and Abd Manan Samad (Malaysia)

13/13

FIG Congress 2014
Engaging the Challenges - Enhancing the Relevance
Kuala Lumpur, Malaysia 16 – 21 June 2014