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and Socio Spatial Inequalities 2015**

*Bridging Socio-Spatial Inequalities through Inclusive Development*

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Bayview Beach Resort, Penang, Malaysia

Editors

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## Table of Contents

No	Title and Authors	Pages
<b><i>Culture and Society</i></b>		
1	Malaysia Towards Zero Poverty by 2020 <i>Yasin Elhadary and Narimah Samat</i>	1-8
2	Sustainable Wellbeing Indicators for Malaysia: An Alternative to Current Malaysia Wellbeing Indicators <i>Aisyah Abu Bakar, Mariana Mohamed Osman, Syahriah Bachok and Mansor Ibrahim</i>	9-16
3	Urban Inequality: A Case of Public Housing Estates in Niger State, Niger <i>Sule Abass Iyanda and Mohammad Abdul Mohit</i>	17-23
4	Sustainable Urban Public Transportation System in Malaysia: A Comparison of Bus Services in Kuantan and Penang <i>Zakiah Ponrahono, Mariana Mohamed Osman, Syahriah Bachok and Mansor Ibrahim</i>	24-30
5	An Assessment of Local Residents' Perception on the Socio-Economic Impact of Iskandar Malaysia <i>Noor Suzilawati Rabe, Mariana Mohamed Osman and Syahriah Bachok</i>	31-37
6	The Life of Seaweed Farmers in Selakan Island, Semporna, Sabah <i>Nurul Auni Jamal and Ahmad Tarmizi Abdul Rahman</i>	38-44
7	Quintuple Helix Model and Urban Development: A Survey of Strategic Cooperation Between University and Industry <i>Nurhazliyah Hanafi, Jalaluddin Abdul Malek and Hamzah Jusoh</i>	45-52
8	Socio-Spatial Inequality of Privatisation Approach to Service Delivery of Electricity in Nigeria <i>Olamide Eniola Victor, Norsiah binti Abd. Aziz and Abdul Razak bin Jaffar</i>	53-59
9	Spatial Inequalities in Sarawak: The Role of Sarawak Corridor of Renewable Energy (Score) <i>Daniel Ugih anak Echoh, Norizan Md Nor and Tarmiji Masron</i>	61-67
10	Social Accessibility of 1Malaysia People's Store Among Low Income Group in Urban Penang, Malaysia <i>Hafizah Rosli, Narimah Samat and Suriati Ghazali</i>	68-73
11	Gender, Space and Entrepreneurship: A Case Study of Felda Women Entrepreneurs in Johor, Malaysia <i>Nor Hafizah Selamat, Farah Syazwani Hayrol Aziz, 'Adzam Anuar, Zaireeni Azmi and Noraida Endut</i>	74-81
<b><i>Economic Growth and Development</i></b>		
12	Economic Inequality in Malaysia: The Enemy Within <i>Shafinah Begum Abd. Rahim</i>	82-89
13	The Question of Bumiputera Participation in Urban Retail Sector: Towards Urban Livability <i>Siti Umira Sulaiman, Shaharuddin Idrus and Abdul Samad Hadi</i>	90-96

14	Local Economic Development- Assessment of Local Attitudes Towards Conservation and Tourism around Royal Belum-Temenggor Forest Complex, Perak, Malaysia <i>Khairul Hisyam Kamarudin, Ibrahim Ngah and Khamarrul Azahari Razak</i>	97-104
15	Income Inequality in the Northern States of Malaysia: An Analysis of Income Quintile <i>Saidatulakmal Mohd, Abdelhak Senadjki, Abdul Fatah Che Hamat and Zakaria Bahari</i>	105-112
16	Relationship Between Poverty And Inequality: A Case Study Of Bumiputera Household In The Northern States Of Malaysia <i>Zakaria Bahari, Saidatulakmal Mohd and Abdul Fatah Che Hamat</i>	113-120
17	Female Poverty in the Northern States of Malaysia <i>Nur Azirah Zahida Mohamad Azhar, Saidatulakmal Mohd, Zakaria Bahari and Abdul Fatah Che Hamat</i>	121-127
18	Patterns of Income Distribution in the Northern States of Malaysia: A Life Cycle Approach <i>Nurul Syifaa Mohd Shakil, Saidatulakmal Mohd, Zakaria Bahari and Abdul Fatah Che Hamat</i>	128-134
 <b><i>Physical Environment and Development</i></b>		
19	Gis in Studying Slope Failure in Penang: Challenges and Potential <i>Nuriah binti Abd Majid and Wan Mohd Muhiyuddin Wan Ibrahim</i>	135-142
20	An Estimation of Sediment Yield using Usle and Rating Curve in Barat Daya Pulau Pinang, Malaysia <i>Sumayyah Aimi Mohd Najib and Zullyadini A. Rahaman</i>	143-150
21	Analysis of Cost-Effectiveness of Agricultural Yield From Vegetable Farming <i>Mohamad Adam Omar, Mohamad Nazuhan Omar and Zullyadini A. Rahaman</i>	151-157
22	Driving Forces in Modelling the Dynamics Urban Spatial Growth for the George Town Conurbation (Gtc) <i>Mohd Amirul Mahamud and Narimah Samat</i>	158-164
23	Infrastructure Accessibility in Nigerian Campuses: Evidence for Policy and Practice <i>Abubakar Ahmed, Mastura Adam and Norafida A. Ghafar</i>	165-172
24	Identifying Shrines Area using Radarsat: Lembah Bujang, Kedah, Malaysia <i>Norzailawati Mohd Noor, Shairatul Akma Roslan, Zuraini Md Ali and Alias Abdullah</i>	173-180
25	Energy Efficient Lighting for Better Environment <i>Noor Aziah Mohd Ariffin and Maikano, Ahmad Abdullah</i>	181-187
26	Treemap Algorithm for Dynamic Stormwater Infiltration Movement into Soil Surface <i>Siti Nurbaidzuri Reli, Izham Mohamad Yusoff, Habibah Lateh and Uznir Ujang</i>	188-193
27	The Influence of Surface Run-Off to 3d Slope Stability Analysis for Rainfall Induced Landslide <i>Noraidah Keling, Izham Mohamad Yusoff, Habibah Lateh and Uznir Ujang</i>	194-201

28	A Comparative Study of Spatial Variation Between the States of Peninsular Malaysia in Terms of Water Supply Characteristics and Consumer's Perception <i>Phang Wai Leng and Chan Ngai Weng</i>	202-209
29	Spatial Inequalities in Malaysia's Non-Revenue Water Rates: Issues, Challenges and Management Strategies <i>Chee Hui, Lai and Ngai Weng, Chan</i>	210-215
30	Predicting Seberang Perai Housing Land Pattern in 2017 <i>Rosmiyati Hasni and Narimah Samat</i>	216-223
31	Development Pressure and Nutrient Concentrations of Sungai Petani Catchment, Kedah <i>Wan Ruslan Ismail, Mohamad Khusairy Mohamad Zahir and Rozana Willy</i>	224-230
32	Application of Spatial Analysis in Assessing the Effect of Coastal Land Reclamation and Development on Seagrass <i>Halophila Ovalis</i> and <i>Halophila Becarrii</i> Distributions in Penang Waters <i>Anisah Lee Abdullah and Anastacia Amanda Anscelly</i>	231-236
33	Urban Park and Educational Benefits of Ecosystem: Case Study of Taman Perbandaran Pulau Pinang <i>Nur Ashiqin Hamzan and Asyirah Abdul Rahim</i>	237-242

## **Preface**

Despite significant advance in development across the globe, progress has been uneven. It has been very rapid in East Asia Latin America and some parts of Middle East, but slow in South Asia and sub-Sahara Africa. Wealth per capita is often used to measure development and categorize countries into low, lower middle, upper middle and upper income countries. Thus, variations in development and subsequent wealth generation have led to widening of gaps between rich and poor countries. This phenomenon has exacerbated inequality among regions and nations.

Socio-spatial inequality can be described as unequal distribution and concentration of resources and services such as medical, welfare and education depending on area or location. It can be caused by culture, religion, race, or remoteness of the areas. This situation can be identified by spatial analysis, where spatial dimension is used to describe patterns of inequality. Furthermore, spatial variation may be compared between different geographical areas in relation to social, culture and environment. This phenomenon may become persistent and self-perpetuating, causing serious economic and social problems. It is pertinent, therefore, to detect issues of inequalities between different areas, or between ethnics groups and find strategies and policies to reduce these inequalities. Thus, making distribution of resources and services more even.

Inequality across the region has motivated the School of Humanities to organize The International Conference on Socio Spatial Inequalities on 19 – 20<sup>th</sup> August 2016 at the Bayview Beach Resort, Penang, Malaysia. The theme of the conference are Bridging Socio-Spatial Inequalities through Inclusive Development.

The aim of the conference was to create a platform for academic discourse, information dissemination and networking amongst academics, health practitioners, academicians, and those who have similar interests so that they can present their research findings on the subject matter related to issues, strategies and policies in development and socio-spatial inequalities. Three sub Themes of the conference are i) Economic Growth and Development; ii) Culture and Society; and iii) Physical Environment Development.

There were a total of four parallel sessions with 64 papers presented during the conference. The topics of the paper presentation at the conference cut across many dimensions: poverty and inequality, planning and urban living, ecosystem and sustainable environment, and youth and crime. Most importantly, through the presentations and discussions participants have gathered new knowledge and discovered latest updates and development on the issues related to socio-spatial inequalities. From all the papers presented at the conference 33 are chosen to be included in this proceedings. All papers were subject to a double-blind peer review process to ensure that good quality papers are presented in this proceedings.

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Proceedings of ‘The International Conference on Socio Spatial Inequalities’

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## **MALAYSIA TOWARDS ZERO POVERTY BY 2020**

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**ABSTRACT:** Since 1970, Malaysia have been adopted various policies to reduce poverty and address the socio-spatial inequality. These policies managed to reduce poverty rate from 52.4% in 1970 to 1.7 % in 2012. However, inequalities and disparity among regions and ethnic groups have not been properly addressed. Policies that worked well nationally might not be suitable to be used in addressing poverty at local level. Thus, this paper aims to critically look at the strengths and weaknesses of such policies particularly in eliminating poverty. The paper is based heavily on the review of the recent literature and the data gathered from Economic Planning Unit-EPU and the Department of Statistics, Malaysia. Empirical experiences have shown that Malaysia has managed to reduce poverty beyond the declaration of MDG; halving poverty by 2015. However several issues need to be addressed as the country aim to be a developed nation with zero poverty as indicated in its vision 2020. Although the slogan "growth with equity" was used, spatial disparities were found among region such as between Sabah and Penang. Penang State, which has experienced steady economic growth, has implemented top-up model of eliminating poverty where families earned less than poverty income line received top-up income from the state government since 2013, claimed to have zero poverty rate. However, the sustainability of this approach is questionable. In addition to that, the sign of incidence of poverty between rural and urban and among ethnic minorities is quite clear. This inequality with external factors (illegal migration and global economy) poses some challenges for achieving the vision 2020. By evaluating the policies and analyzing regional disparities the paper will enrich the literature on poverty and help the planners to formulate sound poverty eradication polices.

*Keywords:* Poverty, policy, Inequalities, MDG, Malaysia

## **INTRODUCTION**

Malaysia is one of the developing countries located in the East South Asia and consists of fourteen states. The total population in 2013 is 29.715 million, which comprised of, the Malay (62.4%), Chinese (22%), Indian (6.6%) and others (8%). The country is diverse in ethnicity, language, culture and religion which have generated obstacles to achieve economic development with quality and equity at the beginning of its independence. Economically, especially at independence in 1957, the country relied heavily on tin and rubber and, to less extent, timber (Samat et al., 2012). During that period, huge proportion of the population were classified as poor (Samat et al., 2014) and overall poverty rate was 49.3% in the year 1970 (EPU, 2013). The government had recognized the challenges and worked hard to overcome poverty and socio-economic disparities.

After independence, several policies and programs were introduced and implemented to foster economic development and at the same time reduce overall poverty. Among the policies introduced were Pre-New Economic policy (PNEP) 1960 – 1970, New economic policy (NEP)1971 -1990, National development policy (NDP) 1991-2000, National vision policy (NVP) 2001–2010 and National transformation policy (NTP) 2011-2020, which aimed to continue nurture economic growth and eliminate overall poverty in the country. Available literature have shown that, these policies and its related programmes had succeeded in promoting economic growth and thus reduce the incidence of poverty very sharply (Elhadary and Samat, 2012). Malaysia has succeeded in reducing poverty rate from 49.3% in 1970 to 12.4 % in 1992 and 6.0% in 2002 to 1.7% in 2012 (EPU, 2013; Mohamed and Xavier 2015). The determination to eradicate poverty is in line with the Millennium Development Goals (MDGs), where Malaysia together with other 188 countries has signed the Millennium Declaration Agreement (MDA) where halving poverty in 2015 is one of its eight goals. Available literature indicated that Malaysia has achieved the goal even before the date mentioned in the agreement (UNDP, 2005). The incidents of poverty in Malaysia had significantly declined from 12.4

% in 1992 and it reached 3.8% in 2009 (Abdul Hakim et al., 2010; Muhamed and Haron, 2011), with hard-core poverty nearly eradicated, declining to 0.7% in 2009 (EPU, 2013). The UNDP (2014) indicated that despite an increase in population by nearly three times since 1970, there are fewer people living in poverty than there were more than four decades ago. Despite this outstanding success in eradicating poverty, still there are some gaps need to be filled if Malaysia is targeting zero poverty and be one of the developed nation in 2020. These limitations of achieving zero poverty are highlighted by several authors. According to Mohamed and Xavier (2015), although the incidence of poverty was significantly reduced in Malaysia, pockets of poverty exist with high incidence among specific ethnic groups and localities. In the same line Nair (2010) indicated that rural, urban and stubborn poverty are still critical issues to grapple with and urgent problems need to be resolved. Based on EPU (2013), poverty in urban area in 1970 and 1992 was 21.3% and 4.7% respectively and 2.3% in 2002 and 1.0% in 2012. While in rural area, poverty rate was 58.7%, 21.2%, 13.5%, and 3.4% in the stated years. The main aim of this paper, therefore, is to uncover the secret behind the sharp reduction of poverty in Malaysia. Not only tracing the story of success, the paper also highlighted the challenges and constraints in addressing poverty. The paper would contribute to the on-going debate on poverty and provide road map towards formulating sound policies that may lead to eradicate poverty and assist Malaysia to be a developed nation by 2020.

## **DEVELOPMENT POLICIES IN MALAYSIA**

Since its independence five major plans have been introduced by Malaysian government to ensure economic growth and thus eradicating poverty. These policies include PNEP 1960 – 1970, NEP 1971 -1990, NDP 1991-2000, NVP 2001–2010 and NTP 2011-2020. The following are some details about these policies. The PNEP adopted immediately after independence to develop the economy of the country. This plan focuses on (i) eradicating absolute poverty irrespective of race by raising income levels and increasing job opportunities, and (ii) restructuring society to remove the identification of race with economic functions (UNDP, 2005). The NEP that ended in 1990 succeeded to reduce the overall poverty incidence in Peninsular Malaysia from 49.3% in 1970 to 17.1% in 1990 (Mohamed and Xavier, 2015). While the poverty among the *Bumiputera* has also decreased to 20.8% in 1990 from 65% in 1970. The NEP is followed by NDP for the period 1991-2000. The NDP is basically a pro-Malay policy, or what is called by Torii (1997) “ethnicity oriented policy”. In this era several programmes to eradicate poverty were implemented. These include the development of local commercial and industrial community, involvement of private sector and development of human resources. Accordingly, poverty incidence continues to decrease from 15% in 1990 to only 6% in the year 2002, and *Bumiputera* poverty stood at 9% for the said year. The NDP is followed by the NVP introduced in 2001.

Generally, NVP aimed at establishing a united, progressive and prosperous Malaysia, where the citizen lives in harmony and engages in full and fair partnership. Moreover, it focuses on minorities group like in Sabah and Sarawak, which still records the highest poverty rates among all the states in Malaysia. This phase ended with continues drop in the incidence poverty to 3.8% in 2009 for Malaysia and 5.3% for *Bumiputera* (Samat et al., 2014; EPU, 2013). The NVP is followed by the NTP (2011-2020). The NTP emphasizes mainly on human development and maintains the people-centric focus through the NEM. In this phase Malaysia set an ambitious goal to be one of the high-income economic countries that is encompassed both inclusive and sustainable. True to its inclusive concept, NEM aims to ensure poverty eradication and a more equitable distribution across ethnic communities and regions. Inclusiveness programmes will seek to enhance the income levels of low-income households from RM 1,440 (USD 480) per month in 2009 to RM 2,300 (USD 770) in 2015. This is alongside with commitment of being a developed nation by 2020 with zero-poverty in that year (EPU, 2013). Since the poverty incidence is considered very small, the government has embarked on addressing the low-income group, which include the bottom 40% and socio-economic inequality between people and places. This policy is still going on but in 2012, poverty rate was at 1.7% for the nation and 2.2% for *Bumiputera* (EPU, 2013).

## **POVERTY ERADICATION: ACHIEVEMENTS**

The adoption of the above mentioned policies and programmes implemented have led to massive economic growth and sharp reduction in poverty. Moreover, the country has witnessed rapid economic growth during the last five decades. Statistical data has shown that between 1971 and 2000, real GDP per capita grew at an impressive 4.2 per cent per annum, on average, as a result of effective public policy which played a direct and key role in alleviating poverty over the same period (UNDP, 2005). According to Mohamed and Xavier (2015), the success at eradicating poverty has been due as much to the steady economic growth as it is due to the wise policies and plans implemented. Furthermore, this economic growth has benefited all Malaysian despite its race and religion. Subsequently, UNDP (2014) agreed that the policy benefited only Bumiputeras, or only rich Bumiputeras at the expense of poor Bumiputeras and the non-Bumiputeras is factually and empirically incorrect. Below are some figures collected from various sources (EPU, 2015, HDI, 2014) reflecting the positive impact of economic growth on the eradication of poverty in Malaysia.

- Overall poverty incidence declined from 49.3% (1970) to 1.7% (2012). Poverty in urban and rural areas decreased from 21.3 % and 58.7% (1970) to 1.0 and 4.3 (2012) respectively.
- The incidence of hardcore poverty also showed a decrease from 6.9 % in year 1970 to 0.2 per cent in year 2012. The hardcore poverty for urban and rural areas showed decreases from 2.4 % and 9.3 (1970) to 0.1 and 0.6 (2012) respectively.
- The incidence of poverty for *Bumiputera* decreased from 64.8% in year 1970 to 2.2 per cent in year 2012. The incidence of poverty for Chinese also dropped from 26% (1970) to 0.3 per cent (2012). Meanwhile for Indians, it decreased from 39.2% (1970) to 1.8 per cent (2012).
- Some states like Melaka, Penang, Selangor and Putrajaya are on the way to approaching zero poverty status.
- MDG target in 1990 (16.5%) of poor people to be halved in the year 2015. This has been achieved 2000 (8.5%) even before the mentioned date.
- Malaysia is moving ahead in Human Development Index as it ranked number 62 in 2014 with overall value increase from 0.577 in 1980 to 0.770 (nearly approaching one).
- The mean monthly household income for Malaysians increased from RM264 (1970) to RM4,025 in 2009 and later to RM5,000 in 2012 with an increase of 7.2 per cent per annually.
- 72.8% of Malaysian population owned houses, 24.0% rented while 3.2 live in quarters in 2012.
- Perception of individual wellbeing in 2013 as indicated in HDI (2014) is 91% for education quality, 87% for health care quality, 75% for standard of living and 83% for job satisfaction.
- The Gini coefficient for both Bumiputera and Chinese continued to improve from 0.440 and 0.425 (2009) to 0.421 and 0.422 (2012) respectively.

The impressive record of poverty reduction in Malaysia is paralleled with massive improvements in basic amenities. By 2013, 95% of overall population served with clean and treated water, while a household with piped water inside reached 93.7%; public water stand pipe 0.2% and other 6.1 % in 2012. Accessible to electricity in general is 99.8 %, and only 0.2% have no electricity. Electricity coverage in rural areas increased from 93% in 2010 to 98% in 2013. During the period 1970-2010, primary education enrolment rate increased from 87% in 1970 to 99% in 2010. Life expectancy rates for both females and males increased to 75 years and 70.2 years, respectively. Literacy rate was as high as 94% in 2010 (Mohamed and Xavier 2015). The EPU in 2015 reported that the road length increased from 137,000 km in 2010 to 230,000 km in 2015. Although these figures reflected the unprecedented development in accessing services, some states still is less developed compared to other. For example in Sabah and Sarawak only 77% of its population had accessed to electricity. The challenges and constraints for not achieving equal access to services and location disparities are discussed in the following section.

## **CHALLENGES AND CONSTRAINTS**

Despite the unprecedented success in reducing the incidence of poverty, pockets of poverty exist among some specific ethnic groups and between localities. Malaysia has to work hard to address such issues in order to reach zero poverty and be one of the developed nation in 2020. The following section highlighted some socio-economic and regional disparities that are in urgent need to be embarked upon.

### **Income Inequality among Ethnic and Social Classes**

The incidence of poverty among ethnic groups reflected a sign of inequality. Although the incidence of poverty among *Bumiputeras* has decreased from a high of 65% since 1970 to 2.2% in 2012, it is still higher compared to only 0.3% for the Chinese and 1.8% for the Indians (Mohamed and Xavier, 2015). The incidence of poverty for *Bumiputera* was 64.8% (1970), 17.5% (1992), 9.0% (2002) and 2.2% (2012) while it was only 26.0%, 3.2%, 1.0% and 0.3% among the Chinese during the same period (EPU, 2013). The incidence of poverty among the Indian was also lower than *Bumiputera* where poverty rate was 39.2% (1970), 4.5% (1992), 2.7% (2002) and 1.8% (2012) (Samat et al., 2012). This implies that despite the positive discrimination (the act of giving advantage to those groups in society that are often treated unfairly because of their race, sex, etc.) made still the incidence of poverty is a little bit higher among *Bumiputera* than Chinese and Indian. This is due to the *Bumiputera* population who are living in rural areas and depend basically on traditional farming and rice cultivation. The inequality between ethnic groups is also found particularly between Indians and the rest of the ethnic groups. The result of Gini coefficient has shown that there is a decreased of inequality between Malay and Chinese compared to Indian. According to the EPU (2015) the Gini result for the Indians had increased from 0.424 (2009) to 0.443 (2012) which reflected income inequality among the Indian community. Even for Malay and Chinese, the measure in the stated year is above four, indicated there is some sign of inequality. This is not only existed between ethnic groups, but also among the three major social classes in Malaysia. The income share of the top 20 % of households fell from a peak of 55.7 % in 1970 to 48.6% in 2012. Over the corresponding years, the income share of the middle (bottom) 40 % households was 32.8 % and 36.6 % while the lower of the social ladder (bottom 40%) is increased from 11% in 1970 to 14.8% in 2012 (EPU, 2015). This indicates that more than half of Malaysian population (Middle and bottom classes) are vulnerable to poverty. Even though the average monthly income of the Bottom 40 households has increased by 12% per annum between 2009 and 2014, its income share of total household income only increased marginally from 14.3% in 2009 to 16.5% in 2014 (HDI, 2014). This led HDI in 2014 to classify China, Malaysia and Uganda as countries that have witnessed high inequality and the poorest end of growth in consumption (HDI 2014). This finding has been supported by data from the (EPU, 2015). Furthermore, the Gini coefficient of Malaysia was decreased from 0.52 in 1970 to 0.431 in 2012. But during 1997- 2004 the income inequality was increasing very sharply from 0.459 to 0.462 despite the fact that the incidence of poverty is decreasing from 6.1% to 5.7% in the corresponding years. These contradicting figures showed clearly that there is no correlation between the income inequity and reduction of poverty in Malaysia.

### **Gender Inequality**

Malaysia is progressing well in addressing gender equality particularly in issues related to education and job accessibility. According to the HDI (2014) female primary schools enrolment has reached 48.6% in 2012 while female university enrolment is approaching 58.2% in the same year. Despite its progress in gender matters, still the participation of female in socio-economic and political arena is below the standard of the developed nation. According to HDI (2014) the gender inequality index value for Malaysia is 0.210 ranking number 39. Moreover, female share of seats in parliament is only 13.9% compared to male. Added to that labor force participation rate of age 15 and older is 44.3% for female while is 75.3 % for male and the total female employed is 36.4%. The gender bias will be higher if we considered the percentage of female population. According to the department of statistic the sex structure in 2012 is 48.6% for female and 51.4% for male. Not only that even the incidence of

poverty among female is higher compared to male. With the reference to the EPU (2013) the incidence of poverty in 2012 it reached 1.6% for male while is 2.1% for female. Moreover, the mean monthly income for female is 3,671 while is 5,248 for male in the same year of 2012.

### **Regional Disparities**

The existence of ethnic, economic and regional disparities in Malaysia is to large extending related to the policy adopted during the colonial area. At early years of independence, the Malaysian map has shown that each ethnic group was segregated in terms of geographical area. Therefore most of *Bumiputera* were found in rural areas at the east northern part, along the coasts and riverbanks, in states like Terengganu, Kelantan, Kedah and Perlis in Peninsular Malaysia, and Sabah, and Sarawak (Henderson et al., 2002). Economically they have engaged mostly in subsistence economy particularly rice cultivation, fishing, and rubber tapping. On the other hand Chinese and Indians are occupying urban areas at the western coastal plains around the tin mines, agricultural estates, and urban centres in states like Selangor, Negeri Sembilan, Perak and Pulau Pinang, which are relatively more developed compared to north eastern states.

Currently, Malaysia's poor are mainly concentrated in the states of Kelantan, Terengganu, Kedah, Perlis, and Sabah, and in particular in the rural areas of those states (Samat et. al. 2014). In 2012 there some states like Melaka, Penang, selangor and Putrajaya have reached or in the way to record zero poverty status in nearly coming years. In other states like Sabah still the number of people living under poverty line is higher compared to the rest as it reached 8.1 per cent in 2012 (See table 1 below). The inequality between states led Malaysia to classify poor people differently. For example, in 2013 a Malaysian household can be categorized as poor if their income is below 830; while is below 840 for urban and below 790 for rural areas. Moreover in Sabah and Sarawak the measurement is quite differ, as 1090 for Sabah and 920 for Sarawak (EPU, 2013). The disparities among states has been justified by (Mohamed and Xavier 2015) who stated that the west coast states of Peninsular Malaysia are more developed and have tended to attract more foreign direct investment compared to the other which is less developed. Moreover, the incidence of poverty also varied between urban and rural till higher among rural areas. By 2012, just one per cent of urban households were living in poverty compared to 3.4 % of rural areas. This rate of rural poverty is a bit higher than the national poverty rate which is 1.7%. Although the urban poverty rate is very low, rapid urbanization might increase the number of poor people (see Samat et al, 2012 for more details).

### **Illegal Migration**

The above mentioned information indicates that Malaysia is progressing well in addressing the internal issue regarding poverty reduction. But Malaysia has to think carefully about the external factor like the massive rate of uncontrolled illegal migration. To be an only developed nation in 2020 among several poor countries will speed up the process of illegal and legal migration. The influx of migration coupled with threat of open economy is challenging the achievement of being a country with zero poverty in 2020. It is clear to say that, illegal immigrant issues has become one of the major problems worldwide, Malaysia has no excuse. With the existence of attractive pull factors, Malaysia is and will always be the ultimate destination of illegal immigrants. Statistical data indicated that there are around 3 million of illegal immigrant people in 2012 staying in Malaysia. Most are coming from neighbouring and surrounding countries like Indonesia (Tajari and Affendi, 2015). This phenomena if not controlled and addressed will destroy all effort made to ensure better economic growth and poverty eradication.

Table 1: Incidents of Poverty by Ethnicity, Strata and State, Malaysia, 1970-2012

Year	1970	1984	1992	1997	2002	2009	2012	hardcore
<b>Malaysia</b>	49.3	20.7	12.4	6.1	6.0	3.8	1.7	0.2
<b>Ethnic</b>								
Bumiputera	64.8	28.7	17.5	9.0	9.0	5.3	2.2	0.3
Chinese	26.0	7.8	3.2	1.1	1.0	0.6	0.3	0.0
India/Indian	39.2	10.1	4.5	1.3	2.7	2.5	1.8	0.2
Lain-Lain/Others	44.8	18.8	21.7	13.0	8.5	6.7	1.5	-
<b>Strata</b>								
Bandar/Urban	21.3	8.5	4.7	2.1	2.3	1.7	1.0	0.1
Luar Bandar/Rural	58.7	27.3	21.2	10.9	13.5	8.4	3.4	0.6
<b>Negeri/State</b>								
Johor	45.7	12.2	5.6	1.6	2.5	1.3	0.9	0.1
Kedah	63.2	36.6	21.2	11.5	9.7	5.3	1.7	0.1
Kelantan	76.1	39.2	29.5	19.2	17.8	4.8	2.7	0.3
Melaka	44.9	15.8	8.5	3.5	1.8	0.5	0.1	-
N.Sembilan	44.8	13.0	8.1	4.7	2.6	0.7	0.5	0.1
Pahang	43.2	15.7	6.9	4.4	9.4	2.1	1.3	0.2
Pulau Pinang	43.7	13.4	4.0	1.7	1.2	1.2	0.6	0.0
Perak	48.6	20.3	10.2	4.5	6.2	3.5	1.5	0.2
Perlis	73.9	33.7	19.8	10.7	8.9	6.0	1.9	0.5
Selangor	29.2	8.6	4.3	1.3	1.1	0.7	0.4	0.0
Terengganu	68.9	28.9	25.6	17.3	14.9	4.0	1.7	0.2
Sabah/F.T.Labuan		33.1	27.8	16.5	16.0	19.2	7.8	1.6
Sarawak		31.9	19.2	7.3	11.3	5.3	2.4	0.3
F.T.Kuala Lumpur		4.9	1.7	0.1	0.5	0.7	0.8	0.1

Source: Economic Planning Unit (2013)

### Uncertainties in the Global Economy

Economically, Malaysia is based mostly on the external trade which accounts for more than 200 per cent of its GDP. The export revenues has shifted from RM 5,163 million in 1970 to RM94.50 billion in 1991 and reached RM702.2 billion in 2012 (EPU, 2015). The global and regional competitiveness will make the country vulnerable to any external chocks. For example, during the Asian financial crisis of 1997, the real GDP of Malaysia fell by over 7 per cent and the incidence of poverty rate has increased from 6.1% in 1997 to 8.5 % in 1999 then start to decrease in the following years till it reached 1.7 % in 2012 (EPU, 2015). Another issue related to the economy need to be tackled is the fact that still Malaysian economy to some extend is driven by labour intensive. To compete with other (China) and be a developed nation in 2020 Malaysia has to move to capital intensive and knowledge base economy. Malaysia has embarked on that and introduced several programmes to increase the awareness of its population and move to the implementation of knowledge based economy. These include ICT training, improving education and shifting to government. Despite these positive factors, the diffusion of ICT is still uneven within Malaysia (UNDP, 2005). Still in Malaysia there is spatial and social 'digital divide' as not all the entire population access ICT facilities equally.

### CONCLUSION

Malaysia is considered as one of outstanding Asian economy and representing an excellent example in eradicating poverty among developing countries. The secret behind such success is the adoption of

wise economic policy that ensures all are benefiting equally regardless of the ethnicity and location. Despite this positive progress, still the incidence of poverty is not equally distributed across states and within ethnic groups. At the times when Penang approaching zero poverty, states like Sabah and Sarawak are lacking behind. Malaysia has to overcome several constraints if it is serious in joining the developed nation with zero poverty in 2020. Malaysia is in urgent need to address poverty of and among Bumiputera (Orang Asli) particularly in localities like Sabah and Sarawak, poor in rural areas, single female-headed households and the elderly especially those not covered by pension schemes. Also addressing urban people is necessary especially in the process of rapid expansion of unplanned urbanization. To compete with other (China) and ensure competitive economy, Malaysia has to shift to knowledge based economy. The external factors like the collapse of global economy and influx of illegal migration if not well addressed they will destroy all the previous efforts made to eradicate poverty and make 2020 ambition of being developed nation challenging. the government need to implement serious immigration policy and support the neighbouring counties into being developed nation. To be an only developed nation in the region where the surrounding is poor, It is a handicap for Malaysia rather than something advantage.

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### **References**

- Abdul Hakim, R., Abdul Razak, N. A., & Ismail, R. (2010). Does Social Capital Reduce Poverty? A Case Study of Rural Households in Terengganu, Malaysia. *European Journal of Social Sciences*, 14(4), 556-566.
- Economic Planning Unit EPU. (2013). *The Malaysian Economic Figure*. Prime Minister Department.
- Economic Planning Unit EPU. (2015). *The Malaysian Poverty Figure 1970-2012*. Prime Minister Department.
- Elhadary, Y., & Samat, N. (2012). Political Economy and Urban Poverty in the Developing Countries: Lessons Learned from Sudan and Malaysia. *Journal of Geography and Geology*, 4(1).
- Henderson, J., Hulme, D., Phillips, T., & Nur, N. M. (2002). Economic Governance and Poverty Reduction in Malaysia. *Globalisation and Poverty Report*.
- Human Development Report HDI. (2014). *Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience*: UNDP.
- Mohamed, M. Z., & Xavier, J. A. (2015). Poverty Alleviation Strategies and New Economic Model in Malaysia. *International Academic Research Journal of Economics and Finance*, 3(3).
- Muhamed, K., & Haron, S. (2011). Poverty Mapping: An Effective Approach in Determining The Poor Area—Case Study Of Johor. *Department Of Statistics, Putrajaya, Malaysia*. Retrieved from <http://www.statistics.gov.my/portal/download-journals/files/2011/volume1/contents-poverty-mapping-effective.pdf>.
- Nair, S. (2010) Moving Forward: Its Poverty Agenda Challenges, Dilemmas and Options for Malaysia, Paper prepared for CPRC 2010 Conference, 8-10 September 2010.
- Samat, N., Elhadary, Y. A. E., Hijles, F. M., Ghazali, S., & Sirat, M. (2012). Poverty And Deprivation: Using Geographic Information System In Evaluating The Accessibility Of Households To Food Retailers In Penang State, Malaysia. *E-Bangi*, 7(2), 328.
- Samat, N., Ghazali, S., Sirat, M., & Khoo, S. L. (2014). *Meeting Basic Needs of Urban Low Income Population: Example of the Community Shop in Malaysia*. Paper presented at the International Conference on City Futures 2014, 18/6/2014 - 20/6/2014, Paris.
- Tajari, A., & Affendi, N. (2015). *Illegal Immigrant and Security Crisis in Sabah (Malaysia)*. Paper presented at the International Conference on Social Science Research (ICSSR), 8 & 9 June 2015, Meliá Hotel Kuala Lumpur, Malaysia.

Torii, T. (1997). The New Economic Policy and the United Malays National Organization - With Special Reference to the Restructuring of Malaysian Society. *The Developing Economies*, XXXV(3), 20-39.

United Nations Development (UNDP), (2005). *Malaysia achieving Millennium Development Goals: challenges and successes*. Kuala Lumpur, Malaysia.

United Nations Development Programme (UNDP), (2014). *Malaysia Human Development Report 2013 Redesigning an Inclusive Future*, 50490 Kuala Lumpur, Malaysia

## **SUSTAINABLE WELLBEING INDICATORS FOR MALAYSIA AN ALTERNATIVE TO CURRENT MALAYSIA WELLBEING INDICATORS**

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**ABSTRACT:** This study is a part of an ongoing research which aims to discover appropriate social indicators in determining the sustainable well-being of Malaysians. The indicators will serve as an alternative to the Malaysia Quality of Life Indicators (MQLI), published in 1999, 2002, 2004 and 2011, as well as the current Malaysia Well-being Indicators (MWI) published in 2013, developed by the Economic Planning Unit of Malaysia (EPU). This paper aims to highlight and discuss the issues observed from the government's current approach in measuring the country's quality of life and well-being. Additionally, potential solution will also be recommended. The MQLI and MWI gauge the commitment towards providing a holistic approach to an all-inclusive and a well-balanced development concentrating on all aspects of life which includes economic, social and psychological aspects. Indicators and components selected for every ensuing report have been ever-changing. EPU's continuous efforts in gauging Malaysia well-being through regularly revised social indicators are commendable. Some of the indicators though in line with the commitment of the government to improve the well-being of Malaysia, but they hardly measure the outcome of the commitments. This paper further discussed the issues found in the Malaysia Quality of Life and Well-being Reports in an attempt to propose an alternative solution. The solution was drawn from Hierarchy of Needs that prioritise social development before pursuing other needs. The study anticipates that by recognising and fulfilling the hierarchy of needs of the citizens, sustainable well-being is attainable.

*Keywords:* social indicators, hierarchy of needs, sustainable well-being

### **INTRODUCTION**

The Economic Planning Unit Malaysia (EPU) is the principal government agency in the Prime Minister's Department tasked with preparing and publishing Malaysia Quality of Life Reports (MQLR) and Malaysia Well-being Report (MWR). The first report published by EPU to gauge the selected social indicators was MQLR 1999. The second report was MQLR 2002, followed by MQLR 2004 and MQLR 2011. MWR 2013 was the latest report published (MQLR, 2002; MQLR, 2004; MQLR 2011; MWR, 2013). MQLR and MWR are EPU's committed approaches to measure the impact of economic development on Malaysia's social progress through a set of social indicators categorised under economic well-being and social well-being. The numbers of indicators and components used from the earliest to the latest reports have undergone many changes. In the latest report, 14 components were used to demonstrate the different aspects of social development in Malaysia. Five of the components, namely, transport, communication, education, income and distribution, and working life represent economic well-being. The remaining nine indicators, namely, housing, leisure, governance, public safety, social participation, culture, health, environment, and family represent social well-being. However, the selection of the indicators in representing the components of well-being in terms of appropriateness and comprehensiveness is still questionable. Additionally, EPU's supposition that sustainability of social development highly depends on the increase in GDP is somewhat arguable. This study responds to EPU's uncertainty on what matters most to the citizens as mentioned in one of the latest MWR presentation as well as in some of the published quality of life and well-being reports.

### **THE CHARACTERISTICS AND DEVELOPMENT OF SOCIAL INDICATORS**

Development of social indicators is a two-way process. The indicators stem from policy objectives but they also concretise and shape the policies in return. So, developing indicators cannot be a purely technical or scientific process. Rather, it should be an open communication and policy process (Baird, 2011). For indicators to reflect the components that they are measuring, indicators must be simple and directionally clear. To be simple, the number of indicators must be limited, and the method of

calculating them must be transparent. Directionally clear means that they should indicate items and trends obviously relevant in terms of importance for sustainability, sensitivity and ability to signal progress or the absence of progress (Baird, 2011).

Studies on social indicators or development indicators address that the dimension of indicators exists in two ways. There are objective indicators and subjective indicators. Both objective and subjective indicators are measured quantitatively or qualitatively based on the nature of the data and the purpose of the measurement (Bauer, 1966). Objective indicators alone cannot sufficiently measure a component without subjective indicators (Bauer, 1966; Rapley, 2003). Subjective well-being is a system of decisions that allows researchers to observe, predict and manipulate the consequence of changes in the society (Rapley, 2003).

Indicators can be direct or indirect. Indirect indicators are also known as proxy indicators. Direct indicators correspond to the program outcome precisely at any performance level. For example, housing ownership rate is a direct measure of low-cost housing programmes. Alternatively, indirect or proxy indicators are utilized to show change or results when direct measures are not possible. For instance, number of cinema goers is an indirect measure of leisure activities (Clifford and Rixford, 1998).

Clifford and Rixford (1998) indicate that there are six levels of measurement that performance indicators can demonstrate. At the bottom of the hierarchy are the input indicators that only measure the resources provided by a program or a component, such as the percentage of graduate school teachers. Process indicators measure the progress of activities in a determined programme and the way the activities are carried out, such as school participation rate. Output indicators recognise the quantity, quality, and timeliness of the products, goods or services of the implemented programme, such as school survival rate. Outcome indicators indicate the intermediate results generated by the programme outputs, such as national average grades for UPSR, PMR or SPM. They usually correspond to any changes in people's behaviour as a result of a programme. Finally, at the top of the hierarchy are the impact indicators that measure the long-term results from the output of a certain program or component, such as literacy rate. For Stern, Wares, Orzell and O'Sullivan (2014), whether to utilise input or output indices, this depends on the availability of data and specific problems addressed. Table 1 shows the mixtures of indicators used by EPU to represent the components of well-being in MWR 2013.

The movement of social indicator exploration can be traced back to as early as the late 17th century (Leiby, 1960; Cobb and Rixford, 1998). Historical events relating to the social indicator movement occurred from late 17th century to late 18th century and they provided significant contributions to understand how social indicators are recognised presently (Campbell, Converse and Rogers, 1976; Cobb and Rixford, 1998; Land, 1999). The lessons from the past informed current practitioners of four conflicting principles in managing social indicators (Cobb and Rixford, 1998) are: (1) The first principle recognises the distinction between prescriptive indicators and descriptive indicators. Prescriptive indicators refer to indicators that provide guidance for improvement. Descriptive indicators refer to indicators that highlight the conditions that could have been overlooked. (2) The second principle recognises the distinction between deductive method and inductive method. The deductive method produces indicators based on abstract model for a testable hypothesis. Inductive method compiles the data on the condition of the society before producing generalisations. (3) The third principle recognises the distinction between an impartial process (also known as non-partisanship approach) and an ideological process (also known as partisanship approach). The impartial process or popularly known as pseudo-objectivity suggests that the data gathered from the social indicators are solely the result of experimentation and are not subjected to any feelings or opinions. The ideological process suggests that the data presented favours one side of efforts or opinions and disregard other possibilities that may contribute to the social condition. (4) The fourth principle recognises the distinction between two purposes of the social indicators that are tools for understanding and tools for practical action. Academicians utilise social indicators as tools to enhance understanding, hence, it is believed that the data must be compiled for a certain period of time. This

means that there is a timeframe to which data are reliable to be assessed. For academicians, data that are released before the allocated time frame are premature. On the contrary, practitioners need to make judgement, thus, up-to-date or allegedly premature data can be useful.

## **HIERARCHY OF NEEDS**

The hierarchy of needs introduced by Abraham Maslow in 1943 has identified the stages of human growth. The stages of human growth often depicted in a hierarchical pyramid are recognized in five levels of motivational needs. The five motivational needs are also categorized under basic needs and growth needs. The basic needs or also known as deficiency needs refer to the Biological and Physiological Needs, Safety Needs, Love and Belonging Needs and Esteem Needs, arranged from most urgent to fulfil. The growth needs refer to self-actualization. In order to motivate people, the basic or the deficiency needs must first be fulfilled. The longer the duration that the deficiency needs are denied, the more urgent it became to fulfil them. Maslow (1943) believed that for a person to progress to the higher level of the hierarchy of needs, the lower level of the deficiency needs has to be fulfilled. Once the person is satisfied with the fulfilment of the lower level of the deviancy needs, he or she can progress to the next level and ultimately to the growth needs, that is self-actualization. During the 1960s and 1970s, the five stages of hierarchy needs extend to eight stages of hierarchy needs. Maslow (1968) slotted in Cognitive Needs and Aesthetic Needs respectively between deficiency needs and growth needs. Later, Maslow (1970) added transcendence needs as the eighth and final stage to the hierarchy of needs.

Social Progress Index (SPI) is a commendable example of social indicators that are modelled based on Maslow's hierarchy of needs. In developing the social indicators, Stern et al., (2014) inquired three meaningful questions: (i) Does a country provide for its people's most essential needs? (ii) Are the building blocks in place for individuals and communities to enhance and sustain wellbeing? (iii) Is there opportunity for all individuals to reach their full potential?. The three dimensions of SPI are (i) Basic Human Needs; (ii) Foundation of Human Needs; and (iii) Opportunity, and they represent the components and indicators of SPI.

## **ISSUES IN MALAYSIA QUALITY OF LIFE AND WELL-BEING REPORTS**

The selection and organization of indicators and components in MQLR and MWR are questionable. Four issues were discovered in the quality of life and well-being reports. First, there is a mixture of input, process and output indicators that fail to interpret the true performance of well-being components (refer to Table 1). The hierarchy of performance indicators varies from input indicators that measure quantity, quality and timeliness of services provided, to impact indicators that measure quality and quantity of long term results. In between input indicators and impact indicators are process indicators, output indicators, and outcome indicators. Process indicators measure progress of the programs implemented. Output indicators measure short-term results of the programs implemented. Outcome indicators measure the intermediate results that allow a projection to determine if the desired outcome has been achieved. The selection of the indicators is dependent on the availability of data, and specific problems addressed. Some of the components in the MWI, such as the housing component lack output indicators. Consequently, the performance of housing component is unable to indicate if housing concerns in Malaysia are heading towards improvement or otherwise. One of the examples is the indicator of low-cost housing provision, which recognise government commitments in resolving housing ownerships in Malaysia. Unfortunately, the indicator cannot confirm if the housing ownership issues are improving or worsening. An alternative or additional indicator could be the output indicator, housing ownership rate, which is not available from the report.

Second, the absence of a hierarchy of needs in structuring the objective indicators has clouded priorities in measuring well-being and sustainability. The components and indicators of the MQLI and MWI reports across the years have been ever changing in terms of quantity and measurement. EPU's efforts in revising the components and indicators from time to time are creditable. Still, without

recognising what is most needed by the nation, the priorities of the efforts in gauging well-being seems unclear. EPU defines QoL as the improvement of standard of living that exceeds the fulfilment of basic needs and psychological needs towards achieving well-being. In MWI 2013, well-being refers to acquired benefits and life satisfaction associated with social, environmental and economic aspects that elevate quality of life. Putting both definitions together, it is the improvement of standard of living by balancing resources and basic needs towards achieving social, environmental and economic improvements for the country and the citizens. In an attempt to achieve the aspiration, components and indicators are increasing across the reports. Since the decisions on the indicator selection is based on three intertwining criteria: i) importance, ii) accuracy, and iii) data availability, the number of components and indicators will undoubtedly continue to grow in future reports as more data become available. If control is not exercised over the selection of indicators based on (i) survival needs, (ii) enhancement to sustain QoL and (iii) conditions to which the nation can reach its full potential, future assessment of well-being will not be able to fulfil the priorities of the nations.

Third, the absence of reliable subjective well-being indicators that can capture non-quantifiable aspects of well-being has disregarded intangible aspects of well-being. This is particularly true for measuring human relationships with other humans and the environment. Well-being is currently measured through material goods and services provided. The satisfaction of the citizens is often neglected. Surprisingly in MQLI 2002, subjective indicators were supplemented as an effort of the government to increase transparency to the public. However, out of 59 subjective indicators, there were only four indicators which recognise satisfaction in quality of life that can be related to the environment (rivers, forests, air and drinking water). Consequently, the notion of sustainability was somewhat biased towards societal well-being (Hezri, 2004). Sustainable well-being theory on subjective well-being suggests that personal well-being exists interconnectedness with humans and is interconnected with the environment. Sustainable well-being is more than just satisfaction with the environment or the material goods, rather, it is the collective balance of fulfilment shared with other human beings and the environment.

Fourth, there exists narrow understanding of progress due to strong reliance on the correlation between components of well-being and GDP. EPU claimed that fluctuations of well-being indices in MQLI and MWI depended on economic growth and levels of income. Due to this concept, the progress of every well-being component in MWI is observed as good when they are positively correlated with GDP. If the component is negatively correlated with GDP, they are observed as deteriorating. In other words, improvement in social development is due to increase in GDP. This has led to a narrow and misleading understanding of social and economic progress. The typical measurement of GDP is by adding (i) national personal consumption expenditures, that is the payment by households for goods and services, (ii) government expenditures, that is the public spending on the provision of goods and services, infrastructure, debts and others, and (iii) net capital formation, that is the increased values of the nations' total stock of monetized capital goods. Since the introduction of GDP, economists familiar with GDP have long emphasised that GDP is only a measure of the progress of economic activity and not economic well-being. Additionally, there are still many economic activities excluded from GDP. This includes depletion of natural resources, voluntary work, social capital formed through a healthy family unit, costs of crimes and many more. Additionally, out of 14 components of well-being in MWR 2013, family life component, and environment component negatively correlate with GDP. Social participation component and health component also did not show strong positive or negative correlation with GDP. Although economic growth partially contributes in improving well-being, GDP in this sense is unlikely to be the best representation of economic growth.

Table 1 shows Malaysia Well-being Indicators arranged among types of social indicators. The use of a mixture of indicators can lead to misunderstanding between government's commitments and actual social reality. The input indicators are the resources. The process indicators are the actions or quantities of the inputs. Output indicators are the products or services generated from the process. Outcome indicators are the medium-term results, or products and services to specific beneficiaries. Impact indicators are the long-term results of achieving specific outcomes.

Table 1: Malaysia Wellbeing Indicators arranged in Types of Indicators

Components of MWI	Types of Indicators				
	Input	Process	Output	Outcome	Impact
Transport	- Road Development Index (RDI) (+) - Road length per capita (km) (+)	- Private motorcar and motorcycle (/’000 pop.) (+) - Commercial vehicles (/’000 pop.) (+) - Rail ridership (million) (+)	<i>Unavailable</i>	<i>Unavailable</i>	
Communication	- # hotspot locations (+)	- Fixed and mobile telephone line subscriptions (per ’000 pop.) (+) - Internet subscribers (per ’000 pop.) (+) - # domain name (per ’000 pop.) (+)	<i>Unavailable</i>	<i>Unavailable</i>	
Education	- % graduate teachers in primary schools (+) - % graduate teachers in secondary schools (+) - # lecturers with PhD (+)	- Pre-school participation rate (+) - Primary school participation rate (+) - Secondary school participation rate (+) - Tertiary participation rate (+)	- Primary education survival rate(+) - Secondary education survival rate (+)	- National Average Grade (UPSR)(+) - National Average Grade (SPM)(+)	- Literacy rate (+)
Income and Distribution	<i>Unavailable</i>	- Real per capita income (GNP) (RM) (+) - Gini coefficient based on disposable income (-)	- Incidence of poverty (-)		
Working Life	<i>Unavailable</i>	- Trade disputes (-) - Average working hours (-)	- Man-days lost due to industrial action (’000) (-) - Industrial accidents (-)	<i>Unavailable</i>	
Governance	<i>Unavailable</i>	- % cases solved by Biro Pengaduan Awam (+)	- % e-Filing users (+) - # e-payment transactions (million) (+)	- % corruption cases prosecuted (+)	<i>Unavailable</i>
Housing	- % low-cost housing units to bottom 40% (+)	- % households with treated water(+) - % households with electricity (+) - % households with garbage collection services (-)	- Crowdedness (no. of persons per room) (-)	<i>Unavailable</i>	<i>Unavailable</i>
Leisure	<i>Unavailable</i>		- # households with paid TV subscription (’000) (+) - Domestic hotel guests (per ’000 pop.) (+) - Recreational parks visitors (per ’000 pop.) (+) - Cinema goers (per ’000 pop.) (+)	<i>Unavailable</i>	<i>Unavailable</i>
Culture	<i>Unavailable</i>		- Membership in public libraries (per ’000 pop.)(+) - # Istana Budaya visitors (per ’000 pop.) (+) - # Museum visitors (per ’000 pop.) (+) - # Kompleks Kraf visitors (per ’000 pop.)(+)	<i>Unavailable</i>	<i>Unavailable</i>
Public Safety	<i>Unavailable</i>	<i>Unavailable</i>	- Road accidents (per ’000 vehicles) (-) - Crime rate (per ’000 pop.) (-)	<i>Unavailable</i>	<i>Unavailable</i>
Social Participation	<i>Unavailable</i>	<i>Unavailable</i>	- % registered voters (per pop. aged 21 years and above) (+) - # registered non-profit organisations (per ’000 pop.) (+) - # registered residents’ associations (+) - Membership in RELA and RakanCop (per ’000 pop.)(+)	<i>Unavailable</i>	<i>Unavailable</i>

Health	<ul style="list-style-type: none"> <li>- # beds in hospitals (per '000 pop.) (+)</li> <li>- Doctor to pop. ratio(-)</li> </ul>	<ul style="list-style-type: none"> <li>- Hospital waiting time for out-patients (minute) (-)</li> </ul>	<i>Unavailable</i>	<ul style="list-style-type: none"> <li>- Infant mortality rate (per 1,000 live births)(-)</li> <li>- Maternal mortality rate (per 100,000 live births) (-)</li> <li>- Non-communicable disease cases ('000 pop.) (-)</li> </ul>	Life expectancy at birth (+)
Environment	<i>Unavailable</i>	<ul style="list-style-type: none"> <li>- Quantity of scheduled waste generated (tonnes/year)/pop. (-)</li> <li>- Maximum mean temperature (°C) (-)</li> </ul>	<ul style="list-style-type: none"> <li>- Air quality (% station with API&lt;50) (+)</li> <li>- Water quality (% clean river monitored) (+)</li> <li>- % forested land (+)</li> </ul>	<i>Unavailable</i>	
Family Life	<i>Unavailable</i>	<i>Unavailable</i>	<ul style="list-style-type: none"> <li>- Mean monthly household income (RM)(+)</li> <li>- Household debt per capita (RM) (+)</li> </ul>	<ul style="list-style-type: none"> <li>- Domestic violence cases (per '000 pop.) (-)</li> <li>- Divorce rate (% pop. aged 18 and above) (-)</li> <li>- Domestic violence cases (per '000 pop.) (-)</li> <li>- Juvenile crimes (% pop. aged 10 -18) (-)</li> </ul>	Dependency ratio (-)

### POTENTIAL SOLUTION TO MALAYSIA WELL-BEING INDICATORS

Table 2 shows an attempt to rethink the available social indicators in the latest Malaysia Well-being Report through a set of dimensions and components based on the hierarchy of needs. The new social indicators are selective and some of the indicators in Malaysia Well-being Report are excluded.

There exist three dimensions of well-being that need to be recognised in gauging the performance of a nation. They are the (i) basic necessities, which measure the survival resources of the nation, (ii) complimentary needs, which measure whether the society is able to improve and sustain their lives, and (iii) desired opportunities, which measure the opportunity and freedom of the citizens to make their own choices. The three dimensions of sustainable well-being provide a better focus in fulfilling necessities of the citizens. Fulfilment of basic or survival necessities of the nation enable citizens to attempt to shift their priority from focussing on material fulfilments to focusing on sustainable livelihoods (Stern et al., 2014).

### CONCLUSION AND FUTURE DIRECTION

This paper revised the current approach in measuring Malaysia well-being. Four major issues discovered in the MWI are (i) mixtures of input and output indicators which made it difficult to interpret true progress of well-being, (ii) absence of a hierarchy of needs to prioritise more important components and indicators, (iii) absence of reliable subjective well-being indicators that can capture non-quantifiable aspects of well-being, and (iv) narrow conceptualisation of national progress with strong reliance on GDP growth. In light of these issues, an alternative viewpoint is proposed on the way to understand national progress. Economic sustainability can also be contributed by social growth. It is believed that social development can play a part in long-term economic success. The direction for future study is to revise and improve the proposed alternative and discover the subjective social indicators in realising sustainable well-being.

Table 2: Potential Arrangement of Social Indicators

	Components	Potential Indicators From Existing Indicators of MWI and MQLR
Basic Necessities	Nourishment and Essential Medical Care	Life expectancy at birth (+)
		Infant mortality rate (per 1,000 live births)(-)
		Maternal mortality rate (per 100,000 live births) (-)
	Water and Sanitation	Percentage of housing units with piped water (+)
Percentage of housing units with treated water (+)		
Percentage of households with garbage collection services (-)		
Shelter and Housing	Average housing price (-)	
	Average Price of Medium-Cost House to Average Household Income (-)	
	Percentage of low-cost houses to total low-income households (+)	
	Percentage of low-cost housing units to bottom 40% (+)	
	Percentage of housing units with electricity (+)	
Safety and Security	Crowdedness (no.of persons per room) (-)	
	Crime rate (per '000 population) (-)	
Complimentary Needs	Access to Elemental Education	Road accidents (per '000 vehicles) (-)
		Primary and Secondary school teacher-student ratio (-)
		Pre-school participation rate (+)
		Primary and Secondary school participation rate (+)
		Literacy rate (+)
		Percentage of graduate teachers in primary and secondary schools (+)
	Information Transmission and Communication	National average grade (UPSR and SPM)(+)
		Primary and Secondary education survival rate(+)
		Fixed and mobile telephone line subscriptions (+)
	Health and Basic Wellbeing	Internet subscribers (per '000 population) (+)
		Number of hotspot locations (+)
		Number of domain name (per '000 population) (+)
		Non-communicable disease cases ('000 population) (-)
	Sustainable Environment	Number of beds in hospitals (per '000 population) (+)
		Doctor to population ratio(-)
Hospital waiting time for out-patients (minute) (-)		
Air quality (Percentage of station with API<50) (+)		
Water quality (Percentage of clean river monitored) (+)		
Desired Opportunities	Access to Advanced Education	Percentage of forested land (+)
		Quantity of scheduled waste generated (tonnes/year) /population (-)
	Personal Rights	Maximum mean temperature (°C) (-)
		Tertiary education participation rate (+)
		Number of lecturers with Ph.D (+)
	Freedom of Choice	Percentage of registered voters (+)
		Number of registered non-profit organizations (per '000 population) (+)
Number of registered residents' associations (+)		
Membership In Selected Voluntary Organizations; Malaysian Red Crescent Society and St. John Ambulance Malaysia (per population aged 18 - 50) (+)		
Freedom of Choice	Membership in RELA and Rakan Cop (per '000 population) (+)	
	Percentage of corruption cases prosecuted (+)	
	Number of e-payment transactions (million) (+)	
Freedom of Choice	Percentage of cases solved by Biro Pengaduan Awam (+)	
	Percentage of e-Filing users (+)	

## REFERENCES

- Baird, C. M. (2011). *Social indicators: statistics, trends and policy development*. Nova Science Publishers.
- Bauer, R. A. (1966). Detection and anticipation of impact: the nature of the task. *Social indicators*, 1-67.
- Campbell, A., Converse, P. E., & Rodgers, W. L. (1976). *The Quality of American Life: Perceptions, Evaluations, and Satisfactions: Perceptions, Evaluations, and Satisfactions*. Russell Sage Foundation.
- Clifford, C., & Rixford, C. (1998). The Uses and Abuses of Social Indicators. Paper presented at the *CSLS Conference on the State of Living Standards and Quality of Life in Canada*, October 30-31, Ottawa, Ontario. Retrieved 23 May 2012 from [www.csls.ca](http://www.csls.ca) under conferences.
- Cobb, C. W., & Rixford, C. (1998). *Lessons learned from the history of social indicators* (Vol. 1). San Francisco: Redefining Progress.
- Hezri, A. A. (2004). Sustainability indicator system and policy processes in Malaysia: a framework for utilisation and learning. *Journal of environmental Management*, 73(4), 357-371.
- Land, E. (1999). Social Indicators. In E. F. Borgatta & R. V. Montgomery (Eds.), *Encyclopedia of Sociology*, revised edition. New York: MacMillan.

- Leiby, J. (1960). *Carroll Wright and labor reform: The origin of labor statistics* (No. 46). Harvard University Press.
- Malaysia Quality of Life Report (2002). *The Malaysian Quality of Life Index 2002*. Putrajaya: Economic Planning Unit, Prime Minister's Department.
- Malaysia Quality of Life Report (2004). *The Malaysian Quality of Life Index 2004*. Putrajaya: Economic Planning Unit, Prime Minister's Department.
- Malaysia Quality of Life Report (2011). *The Malaysian Quality of Life Index 2011*. Putrajaya: Economic Planning Unit, Prime Minister's Department.
- Malaysia Wellbeing Report (2013). *The Malaysian Wellbeing Index 2013*. Putrajaya: Economic Planning Unit, Prime Minister's Department.
- Maslow, A. H. (1943). A theory of human motivation. *Psychological review*,50(4), 370.
- Maslow, A. H. (1968). Toward a psychology of being. *New York: Van Reinhold*. Masten, A. & Coatsworth, JD (1998). *The development of competence infavorable and unfavorable environments: lessons from*.
- Maslow, A. H., Frager, R., & Cox, R. (1970). *Motivation and personality* (Vol. 2). J. Fadiman, & C. McReynolds (Eds.). New York: Harper & Row.
- Rapley, M. (2003). *Quality of life research: A critical introduction*. Sage.
- Stern, S., Wares, A., Orzell, S., & O'Sullivan, P. (2014). Social Progress Index 2014 Methodological Report. *Social Progress Imperative*.

## **URBAN INEQUALITY A CASE OF PUBLIC HOUSING ESTATES IN NIGER STATE, NIGERIA**

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**ABSTRACT:** The vision of any housing policy is to provide liveable housing be it for the high, middle or low-income groups that are always underserved in terms of basic amenities. In the 21<sup>st</sup> century, the nature of living conditions in most of the public housing estates in Nigeria and Niger state in particular seems to be not any better off. The quality of living places, or cities, neighbourhoods or housing estates are linked with their physical environment, safety, social cohesion and infrastructure provided in the area. Studying the residential neighbourhood quality of public housing estates, the people living there are important. People living in a particular place receive direct effects from the changes of environment and development in their area. They know whether their housing environment status is either good or bad or change from time to time. Housing encompasses all that is necessary to make a living in a particular place pleasurable, and not a burden. It is however seen as an extension of the human frame that should respond to the needs of its inhabitants. Thus, housing serves as one of the best indicators of a person's standard of living. Considering the above, satisfaction with housing neighbourhood environment indicates an environment that meets the needs and aspirations of the users and dissatisfaction means the needs and aspirations of the users were not met. No housing programme or policy can be considered successful only in terms of quantity constructed. Equally as important are the suitability of the residential environment, facilities and services to the users. Therefore, this study examined neighbourhood living conditions in three public low-income housing estates using data derived from household survey involving 366 respondents out of 400 questionnaires distributed based on stratified proportional sampling technique. The structured questionnaires were distributed face-to-face and collected back after completion either immediately or the following day. The data sought through questionnaires include different dimensions and indicators of good neighbourhood quality (liveability) as elicited from the literature review. Based on desktop literature, the study used both subjective and objective measurements to investigate the liveability of the selected housing estates. Issues examined include the home environment, neighbourhood amenities, economic vitality, social environment and civic protection. The data analysis techniques used include descriptive statistics, factor analysis and structural equation modelling (SEM). The outcome of the perception of residents' in these selected housing estates can give a clue to the quality of the environment and serves as a feedback to be injected to housing policy for future development. Further, it could be used as an improvement tool as the study reveals the situation of the estates investigated.

*Keywords:* neighbourhood quality, satisfaction, public low-income housing, factor analysis, Nigeria

### **INTRODUCTION**

*Plato wrote that "any city however small, is in fact divided into two, one the city of the poor, the other of the rich," (Edward, Matthew and Kristina, 2008)*

Public housing development is a global trend. The right to adequate housing, which is considered safe, secure, healthy, available and inexpensive, was enshrined in the Habitat Agenda. Nigeria as a lower middle income country alongside twenty other African Countries (World Bank, 2012) have a deficit of housing unit above seventeen million (Akuffo, 2009; Chike-obi, 2013). Evidently, Nigerians are under-housed. Nevertheless, the Nigerian government at different times tackled the housing shortage in the Country through various housing policies. Nigeria's current housing policy is to ensure that all Nigerians own or have access to decent, safe, secure and healthy environment with infrastructure services at affordable prices, and with security of tenure (National Housing Policy, 2012). Affordable housing/public low-income housing programs are undertaken by the Federal and State governments in Nigeria. Public low-income housing provisions is therefore viewed as a policy concept which is well designed, planned, articulated, and implemented to ameliorate the problem of

housing shortage in terms of quantity and quality in order to improve social conditions. It aims at providing subsidized housing that is decent in order to enhance the living standards of the people and restore the aesthetic value of the physical environment.

Niger State is one of the thirty-six states of the Federal Republic of Nigeria and its state government have been developing low-income housing for its citizens over the years. Despite all the efforts by the state government, some of the housing estates developed in the state can be described as a modern day planned slum, and the inhabitants have to live in slums in its inferior and degenerated unhealthy living environment. As planned housing estates, much is expected in terms of housing infrastructure to alleviate undue stress that characterised unplanned area. Access to the basic amenities like electricity, drinking water, good roads, environmental sanitation, health care facilities, schools, public transportation and solid waste management are critical determinants of urban quality of life. These infrastructures serve as an integral part of human life. Evidence from previous studies has shown that facilities are unequally distributed in our cities such that many people are caught in a never ending struggle to gain access to infrastructures in order to improve their quality of life (Aderamo and Aina, 2011; Parry, Kuchav, Ganaie and Bhat, 2013). Apparently, previous studies have examined inner city/peri-urban or rural-urban inequalities, but there is a paucity of empirical studies on the inequalities within neighbourhoods of public low-income housing estates especially in Nigeria and Niger State in particular. This study argues that apart from inequality in the city's development in which most of the public low-income housing estates are located, these housing estates also face infrastructures inequalities and these pose threats to the lives of the inhabitants. This study is guided by the following objectives:

- i. To analyse the status of the neighbourhoods' amenities in the selected estates
- ii. To determine the level of disparity in the neighbourhood facilities of the selected estates
- iii. To validate the measurement items used for the study

## **CONCEPT OF HOUSING, INFRASTRUCTURE AND INEQUALITY**

The word housing connotes the provision of a large number of homes on a permanent basis with adequate physical infrastructure and social services that are well planned, decent and safe with a good neighbourhood sanitary system that meet the basic and special needs of the inhabitants. In addition, it is supported by sustainable maintenance of the built environment for the day-to-day living and activities of individuals and families within the community (National Housing Policy of Nigeria, 2006). Therefore, housing transcends beyond the four walls of a building and as a result, neighbourhood infrastructures become a factor that drives housing satisfaction or liveability. Moreover, infrastructure is regarded as the aggregate of all facilities that enable a society to function effectively. It provides an enabling environment within neighbourhoods and city. This enhances quality of life in the neighbourhood and economic growth in the city. An outline of basic housing neighbourhood/city infrastructure was found in the study conducted by Akujuru (2004), they include:

1. Transportation options – roads, railways, airways, airports, seaports and waterways
2. Water supply – water works and dams
3. Electricity – power stations
4. Telecommunications – postal, telephone and telex
5. Health care – hospitals, maternity homes and health centres
6. Sanitation and solid waste disposal
7. Drainages and embankments

Inequality is defined in Cambridge Advanced Learner's Dictionary (2008) as a situation in which there is no equal or fair treatment in the sharing of wealth or opportunities between different groups in the society. Oluwatayo (2008) views inequality as the dispersion of a distribution either in terms of consumption, income or any other qualities or attributes that demonstrate the welfare status of a population. In this study, inequality is seen as the differences in the neighbourhood facilities of the planned housing estates. In other words, the level of satisfaction or the perception of the residents of

the selected housing estates about the liveability of their housing estates will determine the spatial equality or inequality in terms of housing neighbourhood infrastructure in similar low-income housing estates. Studies have shown that there is inequality in the distribution of neighbourhood facilities in the informal housing sector (Omuta, 1988; Howley, Scott and Redmond, 2009; Godwin, 2012). Inequality of accessibility to social infrastructures within the population of a society has existed since the dawn of civilization (Aderamo and Aina, 2011). Variations in infrastructure provision resulted in spatial disparities in living standards both within and between regions, states, and local government areas including public low-income housing communities.

## **METHODOLOGY**

This research is based on a quantitative approach which includes descriptive statistics and factor analysis. Household survey was adopted for the collection of primary data based on stratified random sampling with the intent to select various homes in three public low-income housing estates selected. Based on the table of sample size selection of Krejcie and Morgan (1970), a total of 400 housing units out of 1000 housing units in the study area were selected for the survey. The questionnaire design for the study includes the dimensions and attributes established from past literature as depicted in Table 1.

Table 1: Dimensions and attributes for good neighbourhood

<b>Housing Unit Characteristics</b>	<b>Neighbourhood Facilities</b>	<b>Safety Environment</b>	<b>Economic Vitality</b>	<b>Social Interaction</b>
House size, Living area size, Dining size, Bedroom size, Kitchen size, No of bathroom, No of toilets, House Ventilation, Affordability, Parking lots, Road network, Estate cleanliness, Housing condition	Children education, Heath care centres, Shopping centres, Garbage collection, Water supply, Open/Green space, Electricity supply, Nature of roads, Public transport, Drainage system, Community hall	Crime safety, Accident safety, Property safety, Police protection, firefighter service, Vigilante services, Street lights.	Total monthly income, Daily cost of transportation, Effect of loan on income, Effect of rent on income, Access to public transport, Standard of living.	Communication with neighbours, Voluntary association, Comm. Activity participation,

Source: Authors' survey of literature and compilation (2015)

In addition, a 5-point Likert scale was used and each variable was assigned weight value ranging from 5 indicating the highest rating, and to 1 indicating the lowest rating (Marques, Pinheiro, Matos and Marques, 2015; Mohit and Hannan, 2012). Out of the 400 questionnaires administered in the study areas, namely: M.I. Wushishi Estate, Bosso Estate and Tunga Low-Cost. A total of 366 (91.7 per cent) was duly returned and the data were analysed in the SPSS version 22 with AMOS 22. The descriptive statistics conducted to determine the mean values and percentages relevant for descriptions. Also, factor analysis and CFA structural equation model were carried out to establish uni-dimensionality and good fit of the dimensions and attributes element of good neighbourhood. The study also involves visual inspection, which forms an assessment of the condition, functionality, and need for repair actions. Thus, data are presented in photographic view for comparison between the selected housing estates and a view from high income housing area.

## **RESULTS AND DISCUSSIONS**

### **Respondents Profile**

The respondents were predominantly male (79 percent). The average age of the respondents was 43 years old, and about 94 percent completed tertiary institution. Married respondents constituted 85 per cent and the average household size in the study area stood at seven people. Over two-third of the respondents were gainfully employed while the majority 63 per cent earned N100, 000.00 monthly. On the length of stay, 73 percent indicated less than ten years. The above demographic details have

shown that the participants in the survey have sufficient knowledge of their neighbourhood environment, and therefore, the data elicited from them could be regarded as reliable.

### **Descriptive Statistics**

Table 2 shows the similarities and differences in the residents' perception of their neighbourhood liveability. Evidence from Table 2 revealed the similarities in the residents' perception of their housing unit characteristics, economic vitality, neighbourhood facilities and social interaction in three housing estates. The respondents were satisfied with the housing unit characteristics and economic vitality, but dissatisfied with neighbourhood facilities and their level of social interaction is low. However, on the safety of the environment, while the residents' of Tunga Low-Cost perceived their housing estate to be safe, the residents of M.I. Wushishi and Bosso Estates, expressed low levels of satisfaction regarding their safety in housing estates.

Table 2: Overall Mean Satisfaction with Liveability Dimensions in Each Estate

	<b>Housing Unit Characteristics</b>	<b>Neighbourhood Facilities</b>	<b>Safety Environment</b>	<b>Economic Vitality</b>	<b>Social Interaction</b>
M.I. Wushishi Estate	3.10	2.62	2.82	3.18	2.65
Bosso Estate	3.54	2.60	2.93	3.37	2.70
Tunga Low-Cost	3.58	2.91	3.16	3.71	2.57

### **Level of Satisfaction with Neighbourhood Liveability Indicators**

Analysing the housing unit characteristics (see Figures 1a, c and d), Tunga Low-Cost and Bosso Estate found it to be fairly well accepted given that the assessment of each element's average score sat at above 3.00 out of a possible 5-point scale with the exception of the road network at Bosso Estate with an average value of 2.98. However, the following were lacking or in poor conditions as expressed by the residents of M.I. Wushishi Estate such as road networks, parking lots, estate cleanliness and house conditions (average score ranges from 1.91 to 2.91). For neighbourhood facilities, the results show a lack of the following neighbourhood facilities in all selected estates. These include: open/green space, shopping centres, community hall and road/drainage systems were in poor conditions (see Figures 1a and 1c). Essentially, there is general satisfaction across the three housing estates in terms of access to child education services, healthcare services and garbage disposal (average score greater than 3.00). However, there is inequality in terms of water supply, electricity supply and access to public transportation. Evidence from the result revealed that Tunga Low-Cost is better served in terms of water supply compared to other estates. Also, Tunga Low-Cost and M.I. Wushishi Estate were fairly served with electricity supply while residents of Bosso Estate face lack of electricity supply. In addition, residents of Bosso Estate and Tunga Low-Cost have good access to public transportation while residents of M.I. Wushishi Estate lack access to public transportation due to non-en route. On the safety of environment, the results show that the three housing estates lack security operatives/apparatus for the safety of life and properties. The average satisfaction scores for police protection, vigilante protection, fire brigade and street lights were less than 2.90 out of a 5-point Likert scale. It was observed during the reconnaissance of the study area that street lights were virtually non-existent. This poses a security threat, especially in the night time in all the selected housing estates.

On sense of community (social interaction), above 70 percent affirmed that there is good communication between neighbours in the study areas, but this does not translate to having voluntary activities to help their community as only about 30 per cent of the respondents in the study areas affirmed/participated in voluntary activities in the estate. On economic vitality, above 60 per cent of the respondents are satisfied with their economic liveliness, meaning that they either pay rent as a tenant or are repaying loans as owner, this does not affect the household daily livelihood.



a. Street at M.I. Wushishi and Housing Type



b. High-income area at F-Layout



c. Bosso Estate road 16 and Housing Type



d. Tunga Low-Cost housing type

Figure 1: Housing Unit Characteristics and Neighbourhood Facilities

### Liveability Ranking of the Estates

This section presents the liveability index (LI), calculated to rank the housing estates as perceived by the respondents. Thus, the equation below denotes the summation of the mean value for each of the dimensions of liveability for each housing estate divided by the total number of respondents in all the five dimensions. Here, HE, NF, SE, EV, and SI respectively denote (HE: Housing characteristics, NF: Neighbourhood facilities, SE: Safety environment, EV: Economic vitality, and SI: Social interaction).

$$LI = \frac{\sum_{i=1}^N HEi + \sum_{i=1}^N NFi + \sum_{i=1}^N SEi + \sum_{i=1}^N EVi + \sum_{i=1}^N Si}{N \times 5}$$

Where LI = Liveability index

N = Number of respondents

HEi, NFi, SEi, EVi and Si represent actual mean satisfaction scores of the ith

Table 3: Liveability Index

Housing Estates	Liveability index	Ranking
M.I. Wushishi Estate	2.18	3rd
Bosso Estate	2.63	2 <sup>nd</sup>
Tunga Low-Cost	2.70	1 <sup>st</sup>

Given the above equation, Table 3 presents the liveability index of the housing estates in ascending order. The result corroborates findings from previous studies that the older the residential environment, the more the residents are attached to the area and the higher the satisfaction. Tunga Low-Cost is the oldest estate built during 1980/1981 and emerges 1<sup>st</sup> in the ranking, Bosso Estate was built in 1990 and M.I. Wushishi Estate was occupied in 2010 (see Table 3 for ranking).

### FACTOR ANALYSIS/STRUCTURAL EQUATION MODEL

The validation of the measurement items was conducted through the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). As part of data cleaning, the Cronbach's alpha supported four-factor constructs based on the alpha value of > 0.7 (Pallant, 2007). Consequently, the data satisfied the thresholds for EFA as found in the literature such as multi-collinearity, singularity problem, Kaiser-Meyer-Olkin (KMO) and Bartlett's Test for sample adequacy. Hence, the four-factor extracted based on eigenvalues of 1 has a cumulative variance explained as 67 per cent.

On the other hand, the four-factor model was confirmed in Table 4 with the conduct of CFA. Based on the thresholds such as factor weights < 0.6 were removed, and the Root Mean Square of Approximation (RMSEA) value is < 0.1 (Yuet, Yusof and Mohamad, 2014; Marques *et al.*, 2015), the Comparative Fit Index (CFI) value is > 0.9 (Richard, 2007; Navabakhsh and Motlaq, 2009), the Chi-square range between 1-5 based on scale used for data collection.

Table 4: Model Goodness of fit indices

	<b>Chi-square</b>	<b>P-value</b>	<b>Chi-square</b>	<b>CFI</b>	<b>RMSEA</b>
Model	570.892	0.000	4.426	0.907	0.097

Note: CFI= Comparative Fit Index; RMSEA= Root Mean Square of Approximation

## CONCLUSION

This study examined urban housing inequality of public low-income housing in Nigeria with three selected housing estates in Niger State. The results show that there is a lack of basic neighbourhood amenities in the study areas compared to other planned areas of high-income housing in Niger State. On this, residents are dissatisfied with neighbourhood facilities in these housing areas such as the deplorable state of roads in the housing estates, irregular water supply and electricity supply failure. There is also lack of security services as expressed by the residents of the study areas and social interaction is very low among the residents. Conversely, from Table 2 it can, therefore, be inferred that government housing programme so far for the low-income group in the state have been fairly successful in terms of housing unit characteristics and affordability. However, there is evidence of poor management of the housing estates, especially in terms of roads maintenance. The residents also failed to come together to form associations that would champion the maintenance of facilities in their estates and press on government to provide their needs. The liveability ranking of the estates confirmed the saying that, the older the age of housing, the higher the liveability perception of the inhabitants due to perceived neighbourhood attachment. Therefore, the relevant government authority should improve roads in these housing estates and maintain it. Also, water and electricity supply should be improved, security of life and property should be strengthened in order to remove the residents' apprehensiveness over security. Furthermore, street lights should be fixed in these housing estates so as to enhance security of the areas during night time. To improve social interaction of the inhabitants of these housing estates, recreation facilities must be provided. Finally, the measurement items used in this study are validated with the satisfaction of the thresholds as found in the extant literature for EFA and CFA. Hence, the measurement items with four factors as validated in this study have potential for other future research.

## REFERENCES

- Aderamo, A. J., & Aina, O. A. (2011). Spatial Inequalities in Accessibility to Social Amenities in Developing Countries: A Case from Nigeria. *Australian Journal of Basic and Applied Sciences*, 5(6), 316-322.)
- Akuffo, A. (2009). Private Housing Finance in Africa. *Annual Conference and General Meeting of African Union for Housing Finance Joaquim Chissano International Center 8-10 September 2009, Maputo - Mozambique*
- Akujuru, V.A. (2004). Land administration and infrastructure management for urban development *Lead paper of the 34th Annual Conference of the Nigerian Institution of Estate Surveyors and Valuers, March 30 – April 4, 2004, NICON Hilton Hotel Abuja.*
- Dictionary, C. (2008). Cambridge advanced learner's dictionary.
- Chike-Obi, M. (2013). Housing Finance: Stakeholders Query Mortgage Refinance Company's Role. *The Punch – Nigeria's Most Widely Read Newspaper.*
- Edward, L G., Matthew, G.R. & Kristina, T. (2008). *Urban Inequality*. Working Paper, National Bureau of Economic Research 1050 Massachusetts Avenue Cambridge, MA 02138. Retrieved from <http://www.nber.org/papers/w14419> [Assessed 12/08/2015]
- Godwin, E. K. O. P. (2012). An assessment of the interrelationships among housing quality variable sets in Calabar metropolis. *Journal of Geography and Regional Planning*, 5(14), 375.

- Howley, P., Scott, M., & Redmond, D. (2009). Sustainability versus liveability: an investigation of neighbourhood satisfaction. *Journal of environmental planning and management*, 52(6), 847-864.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educ psychol meas.*
- Marques, D., Pinheiro, M. R., Matos, A. P., & Marques, C. (2015). Confirmatory Factor Analysis of the QRI Father's Version in a Portuguese Sample of Adolescents. *Procedia-Social and Behavioral Sciences*, 165, 267-274.
- Mohit, M. A., & Hannan, M. H. E. (2012). A study of crime potentials in Taman Melati terrace housing in Kuala Lumpur: issues and challenges. *Procedia-Social and Behavioral Sciences*, 42, 271-283.
- National Housing Policy (2006). Federal Republic of Nigeria
- National Housing Policy (2012). Federal Republic of Nigeria
- Navabakhsh, M., & Motlaq, M. (2009). Effects of urban information and communication technology on sustainable development. *Journal of Food, Agriculture & Environment*, 7(3&4), 891-897.
- Oluwatayo, I. B. (2008). Explaining inequality and welfare status of households in rural Nigeria: evidence from Ekiti State. *Humanity & Social Science Journal*, 3(1), 70-80.
- Omuta, G. E. (1988). The quality of urban life and the perception of livability: A case study of neighbourhoods in Benin City, Nigeria. *Social Indicators Research*, 20(4), 417-440.
- Pallant, J. (2007). SPSS survival manual: A step-by-step guide to data analysis using SPSS version 15. *Nova Iorque: McGraw Hill*.
- Parry, J. A., Kuchay, N. A., Ganaie, S. A., & Bhat, M. S. (2013). Spatial Analysis of Urban Amenities in Srinager City Jammu and Kashmir. *Global Journal of Arts Humanities and Social Sciences*, 1(1), 20-31.
- Sawatzky, R. (2007). *The measurement of quality of life and its relationship with perceived health status in adolescents* (Doctoral dissertation, Trinity Western University).
- World Bank (2012). World Bank List of Economies
- Yuet, F. K. C., Yusof, H., & Mohamad, S. I. S. Confirmatory Factor Analysis of the Niche-Malaysian Teacher Leadership Measurement Model.

## **SUSTAINABLE URBAN PUBLIC TRANSPORTATION SYSTEM IN MALAYSIA A COMPARISON OF BUS SERVICES IN KUANTAN AND PENANG**

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**ABSTRACT:** Transportation refers to the mobility of activities and goods from all economic sectors. Transportation is the key towards sustaining goods, services and people mobility in economic activities. Public buses in Malaysia, in general, and Kuantan and Penang, in particular, have faced many challenges, including dwindling number of passengers. This research focuses on the passengers' perspective of the bus services from the aspects of frequency, travel time, as well as comfort and convenience. It aims at analysing passengers' aspiration and perspectives of sustainable urban public transport and focuses on the assessment of Malaysian urban bus services within selected areas in Kuantan and Penang. Satisfaction of the current patronage is assessed against several measurements. Buses function as feeders to these socioeconomic traffic generators on a daily basis, especially for commuters. Thus, comparison of sustenance of passengers is also made of both Kuantan and Penang users. The research found that some socio-demographic and trip characteristics indeed influenced the current satisfaction level of the passengers. Recommendations have been made to the bus operators to ensure future sustainability of urban stage bus services in Kuantan and Penang.

*Keywords:* transport planning, public transport, passenger's aspiration, on-board survey

### **INTRODUCTION**

Inefficient public transportation relates to networking and accessibility issues that limit the choices of the users to access facilities and employment opportunities. Public transport is one of the optional modes to overcome many traffic issues including traffic congestion, reduce travel time and increase mobility level within the urban and rural activities (Kamba, Rahmat and Ismail, 2007). However, integration, co-ordination and monitoring of sustainable public transport planning as an efficient system is not being prioritised by the operators. This has contributed to the declining number of passengers using public transport as an alternative to private vehicles. There are also a number of issues such as limited facilities, use of low quality public transport facilities and interchanges, inconvenience of fleet, low passenger trips and long waiting time (Yaakub and Napiyah, 2011b). In short, the current public transport system deals largely with issues and problems in operation, infrastructure and facilities provided (Kamaruddin, Osman, Anizaliana, and Pei, 2012).

### **LITERATURE**

#### **Public Bus Service and Bus Rapid Transit (BRT) System**

An efficient public bus service will contribute towards rapid economic growth and healthy social development of a city. However, numerous researchers identified various issues relating to public bus services such as limitation of facilities, use of low quality public transport facilities and interchanges, inconvenience of fleet, low passenger trips and long waiting time which create adverse impacts on the economy, social and environment (Bachok, Ponrahono, Osman and Ibrahim, 2015; Chen, Yu, Zhang and Guo, 2009). This research aims to analyse public bus service performance in selected urban areas of Malaysia before generalising the issues existent in the system. Bus Rapid Transit (BRT) is one of the practical systems in the mass-rapid transit that allows urban travellers to use the bus at prescribed fare. It was developed in Brazil during the 1970s (Onatu, 2011) and it serves as a transit mode that is usually local in nature. Bus Rapid Transit System (BRT) is proven as a public transport system that provides consistent service and is able to overcome many issues of public bus system. It is a road-based system that replicates the railroad system, but purposely designed to provide high quality service which is affordable, fast, efficient and comfortable (Onatu, 2011). BRT system is profitable in terms of operation cost where the system can cater to a large number of passengers with higher

travelling speed. When higher travelling speed is achieved, it indirectly reduces the traffic emissions and delays in reaching the destination. The BRT system is also designed to capture the loss of boarding and alighting time during the bus fare collection with the intervention of smart ticketing system such as monthly electronic pass. Wright (n.d.) identified developed cities in Adelaide Australia, Brisbane Australia, Auckland New Zealand, Boston USA, Cleveland USA, Curitiba Brazil, Eugene USA, Cleveland USA, Los Angeles USA, Leeds UK, and Orlando USA as cities that have successfully implemented the BRT system. BRT system in general is an innovative public transportation system ideal in promoting cost-effective, higher passenger capacity and low infrastructure cost as well as time savings of boarding and alighting (Bührmann, Wefering and Rupprecht, 2011). This is due to the capacity of the system to cater to higher mobility level per unit of resources allocated (Sakamoto, Dalkmann and Palmer, 2010). Wright (n.d.) believes that BRT system offers many benefits to economic, societal, environmental, urbanization process as well as geo-politic as the system employs a more sustainable public transportation approach. In the Malaysia context, BRT system is an innovative initiative included in the National Land Public Transport Masterplan. Among the program outlined in the public transportation system transformation plan, the BRT project will implement the five bus expressway transit service and a detailed BRT network feasibility study will be carried out soon (Aziz and Amin, 2012; PEMANDU, 2012).

### **Public Bus Services Quality Performance and Passenger’s Satisfaction Assessment**

A quality assessment of bus services can be imposed from the aspect of standard Level of Service (LOS) of public bus operation or passenger satisfaction level (Noor, Nasrudin and Foo, 2014). Level of service (LOS) is a tool to measure the quality of service provided according to specific attributes. In this study, the standards (Tables 2, 3 and 4) for Level of Service (LOS) developed by Transportation Research Board (2013) are referred in assessing the bus services provided in Kuantan and Penang.

**Table 2: Fixed-route Hour of Service LOS**

<b>LOS</b>	<b>Hours of service</b>	<b>Remarks</b>
A	19-24	Night ‘owl’ service provided
B	17-18	Late evening service provided
C	14-16	Early evening service provided
D	12-13	Daytime service provided
E	4-11	Peak hour service only or limited midday service
F	0-3	Very limited or no service

Source: Yaakub and Napijah (2011a)

**Table 3: Fixed-route Service Frequency LOS**

<b>LOS</b>	<b>Average Headway (min)</b>	<b>Vehicle per hour</b>	<b>Remarks</b>
A	<10	>6	Passengers do not need schedules
B	10-14	5-6	Frequent service, passengers consult schedules
C	15-20	3-4	Maximum desirable time to wait if bus/train missed
D	21-30	2	Service unattractive to choice riders
E	31-60	1	Service available during the hour
F	>60	<1	Service unattractive to all riders

Source: Yaakub and Napijah (2011a)

Table 4: Passengers Loading LOS Thresholds

LOS	Passengers /Seat	Remarks
A	0.00-0.50	No passenger need to sit next to another
B	0.51-0.75	Passengers can choose where to sit
C	0.76-1.00	All passengers can sit
D	1.01-1.25*	Comfortable standee load for urban transit
E	1.26-1.50*	Maximum schedule load for urban transit
F	>1.50*	Crush load

*\*approximate values for comparison*

Source: Transport Research Board of National Academics TCRP Report 100 (TCQSM 2003) as cited in M. Napiah et al. (2010)

Additionally, the passengers' satisfaction survey on bus services from the aspects of frequency, affordability, safety and security as well as comfort and convenience can help to assess the quality of services provided by the bus operators. It is a tool to measure the performance and quality of bus service that can be the benchmark or an indicator of the current performance of these buses (Suwardo, Napiah and Kamaruddin, 2009). In passengers' satisfaction survey, attributes such as waiting time, reliability, service information, comfort, travel time, convenience, safety, security, affordability and frequency of service are assessed (Nakanishi, 1997).

## **OBJECTIVES**

The objectives of this research is to determine the Level of Services (LOS) of bus services in Kuantan and Penang and to analyse the bus passengers' preferences and aspirations toward bus services in these two cities.

## **METHODOLOGY**

The methodologies adapted are secondary data collection, on board survey, interviews and site visits or observation methods in order to obtain bus services data and information related to the study.

### **On-board Transit Survey**

On-board intercept face-to-face questionnaire survey method was used to capture the passengers' demographic and travel characteristics. On-board transit is the most accurate survey in getting reliable and detailed information (Yaakub and Napiah, 2011a). Standard questions about the respondent's background on age, ethnicity and gender were gathered from approachable respondents who are willing to give feedback during the on-board survey. Further questions were posed for the level of satisfaction with the bus services which aim to capture the passengers' preferences and expectations.

### **Sampling Unit**

The sampling population consists of all bus service users in Kuantan and Penang. Target respondents are on-board passengers who are aged between 15 and 55 years old which is the common user of these services. A total of 330 survey questionnaires was distributed and collected using convenience sampling method during the on-board survey on 24 selected routes. See Table 5 for distributions of respondents according to urban-rural centre:

Table 5: Respondents Distribution

Town Centre	Terminal	No. of Routes	Frequency	Percentage (per cent)
Kuantan	Hentian Bandar	11	130	38.2
Penang	Seberang Prai	7	100	29.4
	George Town	6	100	29.4
TOTAL		24	330	100

## LIMITATION

All findings in this study are subject to the data collected based on the limitation of the research and permission given by the main bus service operators in Kuantan and Penang. The data were collected during off-peak hours of public bus services within a week. Findings can differ if longer survey period is conducted, or if the survey is conducted during the day trips with no public or school holidays, or if on-board surveys were conducted more than once on a single trip/route with more enumerators. Despite the adaptability of methodology upon different case studies, the study is limited by various logistic and human resource factors such as several targeted operation time duration for data collection could not be realized during the comprehensive survey due to bus breakdowns, drivers' behaviour issues and changed timetable schedules, frequency and route de-fixing

## FINDINGS

An assessment on Level of Service (LOS) of fixed-route hour service for both bus services indicated that bus services in Penang correspond to LOS B to C, and bus services in Kuantan correspond to LOS B to E (see Table 6). Apart from that, the fixed-route service frequency LOS (see Table 7) of bus services in Penang correspond to LOS B to E, and bus services in Kuantan correspond to LOS D to E. These indicate that the services provided in Penang and Kuantan are considered acceptable and within desirable waiting time. Only certain routes categorized as "social obligation routes" upon which the bus service run during every 60 minutes interval. Additionally, the LOS of passenger threshold (see Table 8) calculated based on the number of passengers on-board during the survey, the bus services in Penang correspond to LOS C to F and bus services in Kuantan correspond to LOS A to F. Most of LOS F occurred during the peak hour trips and most of Penang bus route services face the issue of the crush load passengers situation on weekdays or weekend's trip.

Table 6: Summary of Fixed-Route Hour Service LOS between Bus Services in Kuantan and Penang

Case Studies	Fixed-route hour service LOS	Indication	
		Shortest service hour	Longest service hour
<b>Penang</b>	B to C	16 hours 30 mins	18 hours
<b>Kuantan</b>	B to E	11 hours 40 mins	17 hours 20 mins

Table 7: Summary of Fixed-route Service Frequency LOS between Bus Services in Kuantan and Penang

Case Studies	Fixed-route Service Frequency LOS	Indication	
		Highest LOS	Lowest LOS
<b>Penang</b>	B to E	Every 10-20 minutes	Every 25-40 minutes
<b>Kuantan</b>	D to E	Every 20-30 minutes	Every 60 minutes

Table 8: Summary of Passengers Threshold LOS between Bus Services in Kuantan and Penang

Case Studies	Indication	
	Weekday	Weekend
<b>Penang</b>	C to F	F
<b>Kuantan</b>	A to F	B to F

From the survey of 330 passengers, some 40 per cent of passengers surveyed were male in both Kuantan and Penang areas. Commonly, female passengers are higher because they were captive riders, most not owning a vehicle or having access to alternative modes of transport (Krizek & El-Geneidy, 2007) (see Table 9). Apparently, there are also higher number of respondents from 19-28 years old and 29-49 years old which indicate that the ridership of bus services in Kuantan and Penang is mostly from captive riders of college and university student and young working group who do not have access to private car or must use public transportation to travel (see Table 9). It can be concluded that the categories of respondents were mostly passengers on the commuting trip that use bus services as a mode to travel between repeated locations, particularly to reach workplaces and educational institutions. Additionally, the survey also found that in both Kuantan and Penang, bus services attracted more Malay (58.5 per cent) passengers compared to other ethnicities in the area. Some 11.2 per cent of the total respondents were tourists that used the bus services to reach tourism spot like Teluk Chempedak, Kuantan and around George Town, Batu Feringghi and Penang Hill in Penang. The study found that bus services in Penang and Kuantan attract more local and international tourists. This may be due to the characteristic of Kuantan and Penang cities. Based on the literature, the passengers' demographic profiles and readership profiles contribute to the ridership of the services and need to be factored in when designing an effective and efficient bus service.

Table 9: Bus Service Ridership Profile in Kuantan and Penang

Variables	Penang		Kuantan		TOTAL	
	Frequency	%	Frequency	%	Frequency	%
<b>Gender</b>						
Male	78	39	54	41.5	132	40
Female	122	61	76	58.5	198	60
TOTAL	200	100	130	100	330	100
<b>Age Group</b>						
13-18 years old	23	12.5	13	10	38	11.5
19-28 years old	39	19.5	92	70.8	131	39.7
29-49 years old	102	51	24	18.5	126	38.2
Above 50 years old	34	17	1	0.8	35	10.6
TOTAL	200	100	130	100	330	100
<b>Ethnicity</b>						
Malay	95	47.5	98	75.4	193	58.5
Chinese	23	11.5	15	11.5	38	11.5
Indian	47	23.5	15	11.5	62	18.8
Tourist	35	17.5	2	1.5	37	11.2
TOTAL	200	100	130	100	330	100

In Table 10, the analysis shows that respondent from Kuantan and Penang found that the bus condition was good (73.6 per cent) and only 15.5 per cent of the respondent gave negative feedbacks on the condition of buses. Table 11 shows that the respondents (55.8 per cent) were dissatisfied with the overall services in both areas. This dissatisfaction showed that the quality of bus services in both localities were low. When probed in detail, the study found (see Table 12) that 55.5 per cent of the respondents from both areas were dissatisfied with the punctuality and frequency of the current bus services. Another 30.3 per cent of respondents have issues related to reliability and safety of the buses while the remaining respondents also stated issues on poor comfort level and cleanliness of these buses. A high number of respondents in both areas want the service to be improved in term of punctuality (on-time service) and frequency.

Table 10: Satisfaction towards Bus Condition among Bus Service Passengers in Kuantan and Penang

Bus Condition	Penang		Kuantan		TOTAL	
	Frequency	%	Frequency	%	Frequency	%
Good	146	73	97	74	243	73.6
Average	20	10	16	12.3	51	10.9
Not Good	34	17	17	13.1	36	15.5
TOTAL	200	100	130	100	330	100

Table 11: Satisfaction Level among Bus Service Passengers in Kuantan and Penang

Satisfaction Towards Bus Service	Penang		Kuantan		TOTAL	
	Frequency	%	Frequency	%	Frequency	%
Satisfied	34	17	18	13.8	52	15.8
Between Satisfied and Dissatisfied	70	35	24	18.5	94	28.4
Dissatisfied	96	48	88	67.7	184	55.8
TOTAL	200	100	130	100	330	100

Table 12: A Comparison of Passengers' Aspiration and Future Intents of Sustainable Urban Public Transportation in Malaysia among the Kuantan and Penang Bus Rider

Aspiration And Future Intents	Penang		Kuantan		TOTAL	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
Punctuality and Frequency	100	50	83	63.8	183	55.5
Comfort and Cleanliness	20	10	27	20.8	47	14.2
Reliability and Safety	80	40	20	15.4	100	30.3
TOTAL	200	100	130	100	330	100

## CONCLUSION

Bus service quality assessment through a standard Level of Services (LOS) indicates that the bus services provided in Penang and Kuantan are good overall. However, the passengers' satisfaction survey indicates that aspects of frequency, punctuality, safety and security as well as comfort and convenience need improvements. From the transformation of public bus services in Penang and Kuantan, it shows a rapid change in the overall level of service of public transportation system in the town. Modern and advanced technology, and well-executed operation plans have been deployed by the bus service providers to increase the efficiency and effectiveness of the bus service performance.

The initiative and improvement programmes for buses in George Town, Seberang Prai and Kuantan have benefitted the locals in their daily commute, especially for city residents in terms of higher mobility, greener transportation system and more reliable public transport system. The promotion of sustainable public transportation system in urban areas requires tremendous political will and public acceptance. As the demand on public bus service is high, the current public bus services should be improved in aspects such frequency and more routes to residential area to achieve a high level of sustainable bus service system.

## REFERENCES

- Aziz, A. B. A., & Amin, N. F. M. (2012). Transforming the Land Public Transport System in Malaysia. *Sharing Urban Transport Solutions*, 30.
- Bachok, S., Ponrahono, Z., Mohamed, M., & Ibrahim, M. (2015). Bus Services: Governance in Five Malaysian States. In M. M. Osman & S. Bachok (Eds.), *Malaysian Case Studies of Urban and Regional Planning* (First., pp. 156–172). Gombak: IIUM Press.
- Bührmann, S., Wefering, F., & Rupprecht, S. (2011). *Guidelines: Developing and implementing a sustainable urban mobility plan*. Rupprecht Consult-Forschung und Beratung GmbH.
- Chen, X., Yu, L., Zhang, Y., & Guo, J. (2009). Analyzing urban bus service reliability at the stop, route, and network levels. *Transportation research part A: policy and practice*, 43(8), 722-734.
- Kamaruddin, R., Osman, I., & Pei, C. C. (2012). Customer expectations and its relationship towards public transport in Klang Valley. *Journal of ASIAN Behavioral Studies*, 2(5).
- Kamba, A. N., Rahmat, R. A. O. K., & Ismail, A. (2007). Why do people use their cars: a case study in Malaysia. *Journal of Social Sciences*, 3(3), 117-122.
- Krizek, K. J., & El-Geneidy, A. (2007). Segmenting preferences and habits of transit users and non-users. *Journal of Public Transportation*, 10(3), 5.
- Napiah, M., Farid, Amirah Suriati A., & Suwardo. (2010). Trip Productivity Evaluation of Bus Service: Medan Kidd Bus Station.
- Nakanishi, Y. (1997). PART 1: bus: bus performance indicators: on-time performance and service regularity. *Transportation Research Record: Journal of the Transportation Research Board*, (1571), 1-13.
- Noor, H. M., & Foo, J. (2014). Determinants of Customer Satisfaction of Service Quality: City Bus Service in Kota Kinabalu, Malaysia. *Procedia-Social and Behavioral Sciences*, 153, 595-605.
- Onatu, G. O. (2011). A new approach to sustainable transport system: a critical appraisal of the Rapid Bus Transit System (BRT) in South Africa.
- PEMANDU. (2012). Government Transformation Programs. Retrieved from [http://www.pemandu.gov.my/gtp/upload/GTP2\\_ENG.pdf](http://www.pemandu.gov.my/gtp/upload/GTP2_ENG.pdf)
- Sakamoto, K., Dalkmann, H., & Palmer, D. (2010). A paradigm shift towards sustainable low-carbon transport: Financing the vision ASAP. *Institute for Transportation & Development Policy*.
- Suwardo, M. B. N., & Kamaruddin, I. B. (2009). On-time performance and service regularity of stage buses in mixed traffic. *Int. J. bus. Econ. Financ. Man Sci*, 3(7), 942-950.
- Transportation Research Board. (2013). Part 2 Bus Transit Capacity. In *Transit Capacity and Quality of Service Manual Third Edition*. Retrieved from <http://www.trb.org/main/blurbs/169437.aspx>
- Wright, L. (2002). Bus Rapid Transit, sustainable transport: A sourcebook for policy-makers in developing cities. *Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ), Eschborn*.
- Yaakub, N., & Napiah, M. (2011, September). Public bus passenger demographic and travel characteristics a study of public bus passenger profile in Kota Bharu, Kelantan. In *National Postgraduate Conference (NPC), 2011* (pp. 1-6). IEEE.
- Yaakub, N., & Napiah, M. (2011). Public Transport: Punctuality Index for Bus Operation. *World Academy of Science, Engineering and Technology*, 5, 857-862.

## **AN ASSESSMENT OF THE LOCAL RESIDENTS' PERCEPTIONS ON THE SOCIO-ECONOMIC IMPACT OF ISKANDAR MALAYSIA**

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**ABSTRACT:** This paper discusses the perceptions of the local residents on the socio-economic changes of Iskandar Malaysia. The study investigates the local people's knowledge and perception towards Iskandar Malaysia development as one of the main economic accelerators in the southern part of Peninsular Malaysia. A survey involving semi-structured questionnaire on 916 respondents was carried out among the local people within Iskandar Malaysia and interviews with the local authorities and stakeholders were also conducted to assess their perceptions toward the development. Results from the study revealed that the majority of the respondents lacked the necessary awareness and avenue to participate in the Iskandar Malaysia's decision making process. The findings of the study showed that the new regional development area is under Malaysian government's directive and used complete top-down approach in its implementation approach.

*Keywords:* regional development, regional economic development, perceived impacts, Iskandar Malaysia

### **INTRODUCTION**

Regional planning has been one of the ways to enhance economic growth in Malaysia, as claimed by Ngah, (2010) and Salleh (2002). Thus, since the introduction of regional development in Malaysia, various types of regional developmental authorities have been established at local and international levels (Eskandarian and Ghalehtimouri, 2011; Ngah, 2010; Krimi, et. al, 2010). What differentiate Iskandar Malaysia from other regional development in Malaysia, is the large developmental scale and direct financial injection from Federal level amounted to RM 1.92 billion and RM 0.92 billion under the 9th and 10th Malaysia Plans respectively. EPU (2014) highlighted that the total investment allocation for Iskandar Malaysia is the highest among regional economic corridors under the 9th Malaysia plan. The study focuses on Iskandar Malaysia development due to several reasons as listed below.

Formerly known as the Southern Region, Iskandar Malaysia has been formed as a region at the state of Johor in the 5th Malaysia Plan (1986-1990). Consequently, Iskandar Malaysia along with other regions was rebranded as economic regions under the 9th Malaysia Plan. Again, the Southern region has been renamed and restructured as the Southern Johor Economic Region (SJER) (2006-2025), which covers the district of Johor Bahru and part of the Pontian district. Kassim (2006) claimed that the establishment of SJER is a sign of Johor state's aggressive agenda to achieve economic growth. A Comprehensive Development Plan (CDP) and development blueprints were prepared and Iskandar Regional Development Authority (IRDA) was established along in the IRDA Act 20071 under the Federal Act (Act 664). This is to assist the local authorities in the region and it makes Iskandar Malaysia unique in term of its regional form, structure as well as its developmental organisation.

Numerous studies on Iskandar Malaysia development have been conducted (Ibrahim and Ali, 2014; Ali and Ahmad, 2009) but research that evaluates the perceived impacts of the local population on Iskandar Malaysia is limited. One of the ways to assess the stakeholders' perception on the impact of the developmental is through the employment of semi-structured questionnaire survey (Salleh et. al, 2013). Numerous researchers (Olajoke, Aina and Ogini, 2013; Türker and Öztürk, 2013; Aref, Redzuan and Gill, 2009) believed that perception study is useful and significant to bring changes to the population.

## **LITERATURE REVIEW**

### **Review of Regional Planning and Development in Malaysia**

Some researchers (Wood, 2005; Aslam and Hassan, 2003) found that the objectives of regional developmental strategies in Malaysia have been successfully implemented. On the other hand, other researchers (Eskandarian and Ghalehtimouri, 2011) argued that most of the regional developmental areas implemented under the Federal system may not achieve their objectives due to the unequal distribution of wealth between the States involved in the development. Moreover, according to Jusoh (1992), the attainment of regional objectives has been proven to be elusive, especially when the economic activities are not directly under the control of the federal government. Although the establishment of regional developments in Malaysia is said to be consistent with rapid economic growth, as mentioned by Lee (2004), the issue of regional and urban-rural disparities is still one of the pertinent issues in Malaysia. Nevertheless, review of past literature indicates that the implementation of regional economic development is still unable to solve the socio-economic issues and high cost of living among residents (Salleh, 2002). In addition, unequal income and economic developmental distribution are among the problems that affected the quality of life of Malaysian population (Ragayah, 2008) and past research also indicates that there is a strong connection between economic growth and social well-being (Ülengin et. al, 2011).

### **The Iskandar Malaysia Development**

In line with the establishment of Iskandar Malaysia in 30th July 2006, a single authority, Iskandar Regional Development Authority (IRDA) was established in 2007, under the Federal Act (Act 664). Fundamentally, the town planning system in Malaysia practised a three-tier governmental levels namely federal, state and local levels. At the federal level, the national planning sets out the general policies and directions for the planning and development of the country. Meanwhile, as discussed by Abdullah, Harun and Abdul (2011) and Talhah (2007), the decision making process in Malaysia are mostly using top-down approach. Iskandar Malaysia was developed based on Comprehensive Development Plan (CDP) which has been divided into seventeen chapters and adopted by the relevant Federal authorities and State agencies (Ramli and Akmal, 2006). In addition, Iskandar Malaysia has several blueprints that are formulated to 'provide detailed guidance in terms of development policies, strategies and implementation on subjects such as land use, economy, environment and infrastructure' (IRDA, 2011).

### **People's Perception on Developmental Impacts**

According to Olajoke, Aina and Ogini (2013), the scales and degrees of individuals' perceptions vary according to their social and economic backgrounds. Socio-economic factors refer to income (Arth, Lam and Broadwin, 2002), educational level (Turner et al., 2008), occupation (Baum, 2004) and age (Turner et al., 2008). Limited literature was found on the impacts of developments including: Mensah (2012a, 2012b) and Chindo (2011). Generally, individuals with higher educational backgrounds are more likely to have positive perceptions and receptive towards changes of development (Turner et al., 2008). Literature also illustrates that the increase in job opportunities and the level of income affect individuals' perception and individuals who receive economic gain or personal benefits from the development are more likely to have positive perceptions. Additionally, younger generations tend to be more supportive and have positive expectations on the impacts of development. These findings summarised the relationships between individuals' socio-economic backgrounds and their perceptions towards developmental impacts. (Arth, Lam and Broadwin, 2012, Turner et al., 2008) and Chindo (2011).

## **METHODOLOGY**

The data collection method used in this research is based on the formulated research questions and objectives. The research questions of the study are as follows:

RQ1: What are the types of developmental impacts? RQ2: What are the developmental impacts of Iskandar Malaysia? RQ3: What are the socio-economic factors influencing the local people's perceptions towards the impact from Iskandar Malaysia? From the research questions, two main research objectives were developed which are: RO1: to evaluate the developmental impacts of Iskandar Malaysia development, and RO2: to investigate the local people's perceptions on the developmental impacts in relation to their socio-economic background.

This study used semi-structured questionnaires that were distributed to local residents within the 5 flagship zones of Iskandar Malaysia. According to Yamane (1973), at least 400 samples need to be collected to represent the total population of 1,055,328 in order to achieve 95 per cent of confidence level. Initially, 2,000 questionnaires were distributed based on convenient sampling. However, only 916 questionnaires were fully completed representing 0.087 percent of the total population in the study area. By using convenient sampling, various methods were employed to collect data including face-to-face survey, mail, telephone survey and also structured interview with local authorities and developmental agencies in Iskandar Malaysia. The combination of these methods is either known as the mixed-method as mentioned in Mertens and Hesse-Biber (2012) and Onwuegbuzie, Leech and Collins (2012), while some define it as the triangulation method (Fielding, 2012; Meijer et. al, 2002). Overall, mixed method data collection was applied in the study to validate the findings and complement the methods to gather information for the research.

## **ANALYSIS AND FINDINGS**

This section discusses the data analysis and findings based on the data collected from the population in the study. The socio-characteristics of respondents in the study area are presented in Table 1 below. As shown in Table 1 below, a large number of respondents were Malay females with tertiary education. The majority of the respondents were within the age range of 19 to 78 years with an average monthly household income of RM 18,000. This shows that there is an imbalance in the respondents' ethnicity, education and gender distribution. Thus, the survey result could not represent the population in the study area accurately. However, 54.9 per cent of the respondents claimed that they have stayed in Iskandar Malaysia for more than 6 years. This indicates that respondents have experienced developmental changes in the study area.

### **Analysis on Development Impacts in Iskandar Malaysia**

The Relative Importance Index (RII) was used to determine the rank of the perceived developmental impacts by the respondents in Iskandar Malaysia. Hence, a list of 24 developmental impacts on economic, social and environment aspects were listed in the questionnaire and the respondents rated the developmental impacts based on a scale of 0 - 4, with 0 as no knowledge, 1 as the lowest score or totally disagree and 4 as the highest or totally agree. The result of RII of the developmental impacts in Iskandar Malaysia is shown in Table 2 below.

Based on the results shown in Table 2, there was an increase in respondents' perception towards the ability of the project to attract more international investors (0.711), create more job opportunities (0.699) and provide more business centre and areas for local people (0.683). In relation to social developmental impacts, respondents believed that Iskandar Malaysia helped to reduce poverty problem among the local population (0.723) and increase infrastructure development (0.698) followed by improvements in public health centre and facilities (0.686). These findings show that respondents believed Iskandar Malaysia did help to improve the social well-being of population in the study area.

Results in Table 2 also show that the RII score of 0.713 on environmental impact due to development of Iskandar Malaysia where respondents believed the development in Iskandar Malaysia did caused negative effects to the climate of the local area (0.550). Thus, although Iskandar Malaysia development has been claimed to improve the economic and social well-being of the local population, at the same time, respondents believed that it caused adverse environmental effect to the area.

In referring to results in Table 3 above, a Pearson's r correlation test on respondents' perceptions on developmental impacts with their age found Pearson's correlation coefficient (r) are in negative values and ranged between  $-0.066^*$  to  $-0.127^{**}$ . According to the Guildford's (1973) Rule of Thumb, this would suggest a negative and low relationship indicating the younger generation perceived the developmental impacts in Iskandar Malaysia more positively when compared to the older generation. In addition, as shown in Table 3, Pearson's correlation coefficient (r) results for respondents' perception on developmental impacts with their monthly income indicate positive values ranged between  $-0.080^*$  to  $0.136^{**}$ . Based on Guildford's (1973) Rule of Thumb, the positive values indicate that the population from middle and high income group has perceived developmental impacts in the study area more positively as compared to low income group. Similarly, the results from Spearman rho correlation coefficient (r) indicates positive values ranged between  $0.070^*$  to  $0.156^{**}$ . This shows that as respondents' education level increase, respondents' perception on developmental impacts in Iskandar Malaysia will also increase. In other words, respondents with higher education background perceived the development impacts more positively as compared to those with lower education background. These findings are in line with findings from past literature

**Table 1 Socio-economic Characteristics of Respondents**

Characteristics	Categories	Frequency	%	Mean	Skewness
Age in years	Less than 20 years old	3	0.3	36 years old	0.60
	21 – 30 years old	309	33.7		
	31 – 40 years old	368	40.2		
	41 – 50 years old	161	17.6		
	51 and above	75	8.2		
Ethnicity	Malay	680	74.2	1	1.78
	Chinese	172	18.8		
	Indian	60	6.6		
	Others	4	0.4		
Highest Educational level	Never attended School	5	0.5	4	-1.13
	Primary school	43	4.7		
	High School	319	34.8		
	Tertiary Education	549	59.9		
Marital status	Single	215	23.5	2	0.76
	Married	673	73.5		
	Divorced	7	0.8		
	Widowed	21	2.3		
Households' Monthly income (RM)	No Response	23	2.5	RM 2,808	2.17
	Unemployed / student	26	2.8		
	Less than RM 1000	59	6.4		
	RM 1001 – 2000	267	29.1		
	RM 2001 – 3000	280	30.6		
	RM 3001 – 4000	137	15		
	RM 4001 – 5000	58	6.3		
	RM 5001 – 6000	25	2.7		
RM 6001 and above	41	4.5			
Gender	Male	359	39.2	2	-0.44
	Female	557	60.8		
Duration of stay in Iskandar Malaysia (years)	No Response	49	5.3	11 years	0.38
	Less than 1 year	36	3.9		
	1 – 5 years	328	35.9		
	6 – 10 years	195	21.3		
	11 – 15 years	84	9.2		
	16 – 20 years	56	6.1		
More than 20 years	168	18.3			
Occupation	No Response	82	9	4	0.93
	Farmer	2	0.2		
	Self-employed	37	4		
	Government employee	316	34.5		
	Private employee	201	21.9		
	Housewife	153	16.7		
	Odd Jobs	22	2.4		
	Unemployed	76	8.3		
	Retirees	11	1.2		
	Student	16	1.7		

Table 2: Economic Developmental Impacts in Iskandar Malaysia

Development Impacts	Frequency of Respondents										RII Score	Rank
	No knowledge (Score of 0)		Strongly Disagreed (Score of 1)		Disagreed (Score of 2)		Agreed (Score of 3)		Strongly Agreed (Score of 4)			
	F (%)	Score	F (%)	Score	F (%)	Score	F (%)	Score	F (%)	Score		
The development of Iskandar Malaysia reduce poverty problem of the local people	100(10.9)	0	57(6.2)	57	169(18.4)	338	464(50.7)	1392	126(13.8)	864	0.723	1
The development project and economic activity proposed changes the physical environment in Iskandar Malaysia	87(9.5)	0	22(2.4)	22	77(8.4)	154	482(52.6)	1446	248(27.1)	992	0.713	2
The development of Iskandar Malaysia attract more investors from abroad	95(10.4)	0	28(3.1)	28	58(6.3)	116	476(52)	1428	258(28.2)	1032	0.711	3
The development of Iskandar Malaysia provide more job opportunities to the local people	89(9.7)	0	32(3.5)	32	78(8.5)	156	495(54)	1485	222(24.2)	888	0.699	4
The development of Iskandar Malaysia increase the development of infrastructure in the local area	83(9.1)	0	26(2.8)	26	82(9)	164	533(58.2)	1599	192(21)	768	0.698	5
Iskandar Malaysia includes the development of public health centre and facilities	89(9.7)	0	32(3.5)	32	81(8.8)	162	497(54.3)	1491	217(23.7)	868	0.697	6
Iskandar Malaysia includes the provision of public transportation	97(10.6)	0	30(3.3)	30	100(10.9)	200	472(51.5)	1416	217(23.7)	868	0.686	7
The development of Iskandar Malaysia reduce social and crime problem in the local area	118(12.9)	0	31(3.4)	31	89(9.7)	178	415(45.3)	1245	263(28.7)	1052	0.684	8
The development of Iskandar Malaysia includes the provision of business centre and area for local people	97(10.6)	0	39(4.3)	39	108(11.8)	216	439(47.9)	1317	233(25.4)	932	0.683	9
Iskandar Malaysia includes the development of public institution and education centre	114(12.4)	0	28(3.1)	28	121(13.2)	242	413(45.1)	1239	240(26.2)	960	0.674	10
The development of Iskandar Malaysia open the job opportunities for local people in rural area	88(9.6)	0	38(4.1)	38	123(13.4)	246	485(52.9)	1455	182(19.9)	728	0.673	11
The development of Iskandar Malaysia improves the social well-being of local people in Iskandar Malaysia	93(10.2)	0	32(3.5)	32	133(14.5)	266	489(53.4)	1467	169(18.4)	676	0.666	12
The development of Iskandar Malaysia increase income of the local people	93(10.2)	0	37(4)	37	142(15.5)	284	479(52.3)	1437	165(18)	660	0.660	13
The development of Iskandar Malaysia increase local business productivity and profitability	107(11.7)	0	39(4.3)	39	126(13.8)	252	491(53.6)	1473	153(16.7)	612	0.650	14
The development proposed in Iskandar Malaysia affects conservation of natural heritage and culture of the local people	113(12.3)	0	52(5.7)	52	149(16.3)	298	385(42)	1155	217(23.7)	868	0.648	15
The development of Iskandar Malaysia increase the provision of housing for local people	131(14.3)	0	114(12.4)	114	151(16.5)	302	341(37.2)	1023	179(19.5)	716	0.588	16
Impacts on minorities or indigenous people since 2009	198(21.6)	0	121(13.2)	121	168(18.3)	336	220(24)	660	209(22.8)	836	0.533	17
The development proposed in Iskandar Malaysia caused negative effect on climate	187(20.4)	0	123(13.4)	123	147(16)	294	237(25.9)	711	222(24.2)	888	0.550	18
The development proposed in Iskandar Malaysia caused adverse effects on residential areas	186(20.3)	0	114(12.4)	114	183(20)	366	211(23)	633	222(24.2)	888	0.546	19
The development proposed in Iskandar Malaysia includes the exploration of forest areas, virgin forest	213(23.3)	0	118(12.9)	118	140(15.3)	280	197(21.5)	591	248(27.1)	992	0.540	20
The development proposed in Iskandar Malaysia caused noise emissions	201(21.9)	0	111(12.1)	111	173(18.9)	346	211(23)	633	220(24)	880	0.538	21
The development proposed in Iskandar Malaysia caused changes in farmland	219(23.9)	0	130(14.2)	130	143(15.6)	286	215(23.5)	645	209(22.8)	836	0.518	22
The development proposed in Iskandar Malaysia caused improper discharge of waste water	210(22.9)	0	129(14.1)	129	172(18.8)	344	227(24.8)	681	178(19.4)	712	0.509	23

Notes: F: Frequency, %: Percentage

Furthermore, the study also tested respondents' perceptions on the developmental impacts in Iskandar Malaysia against their socio-economic background. The result of analysis is illustrated in Table 3 below.

Table 3 Respondents' Socio-economic Background and their perception on Development Impacts

Development Impacts	Age		Monthly Income (since 2009)		Education	
	Correlation Coefficient	Sig. (2-tailed)	Correlation Coefficient	Sig. (2-tailed)	Correlation Coefficient	Sig. (2-tailed)
Perceived Economic impact						
The development of IM provides more job opportunities to the local people	-0.123**	0.000	0.085*	0.010	0.110**	0.001
The development of IM encourages more establishment of local business	-0.123**	0.000	0.103**	0.002	0.138**	0.000
The development of IM increases local business productivity and profitability	-0.087**	0.008	0.021	0.538	0.106**	0.001
The development of IM increases income of the local people	-0.094**	0.004	0.057	0.088	0.074*	0.024
The development of IM opens the job opportunities for local people in rural area	-0.123**	0.000	0.082*	0.014	0.120**	0.000
The development of IM attracts more investors from abroad	-0.046	0.167	0.136**	0.000	0.118**	0.000
Perceived Social impact						
The development of IM improves the social well-being of local people in IM	-0.104**	0.002	0.063	0.058	0.070*	0.033
The development of IM improves access to public facilities and amenities	-0.078	0.018	0.107**	0.001	0.093**	0.005
The development of IM increases the development of infrastructure in the local area	-0.083*	0.012	0.126**	0.000	0.097**	0.003
The development of IM increases the provision of housing for local people	-0.127**	0.000	0.037	0.268	0.108**	0.001
The development of IM reduces poverty problem of the local people	-0.088**	0.007	0.040	0.227	0.072*	0.028
The development of IM reduces social and crime problem in the local area	-0.066*	0.044	0.053	0.115	0.047	0.151
Perceived Environmental impact						
The project and economic activity proposed changed the physical environment in IM	-0.101**	0.002	0.103**	0.002	0.140**	0.000
The development of IM affects the minorities or indigenous people	-0.053	0.112	0.098**	0.003	0.090**	0.006
The development of IM effects on the local climate	-0.064	0.051	0.080*	0.016	0.094**	0.004
The development of IM increases the noise emissions	-0.098**	0.003s	0.109**	0.001	0.156**	0.000

## CONCLUSION AND RECOMMENDATION

This study has identified that the perceptions of the local population toward the impacts of Iskandar Malaysia on the aspects of economic, social and environment varies depending on the socio-economic factors of the respondents. While the previous regional development strategies in Malaysia have focused more towards agricultural activities and frontier development, the new Iskandar Malaysia has been devised to focus on high-impact economic activities. The study found that greater economic gains or personal benefits received by a person will influence their perception toward the development and therefore an effective and meaningful bottom-up approach, would promote the acceptance of the local people toward new development projects.

## REFERENCES

- Abdullah, A. A., Harun, Z., & Abdul Rahman, H. (2011). Planning Process of Development Project in the Malaysian Context: A Crucial Brief Overview. *International Journal of Applied Science and Technology*, 1(2).
- Ali, H., & Ahmad, S. (2009). Why poor regions remain poor? Evidence from Malaysia. *International Review of Business Research Papers*, 5(1), 340-351.
- Aref, F., Redzuan, M. R., & Gill, S. S. (2009). Community perceptions toward economic and environmental impacts of tourism on local communities. *Asian Social Science*, 5(7), 130.
- Arth, A.A., Lam, R., & Broadwin, R. (2002). Impact of socioeconomic factors on residential indoor air quality and human health, In *Knowledge base for sustainable development, An insight into the Encyclopedia of Life support Systems*, Volume II, UNESCO Publishing, EOLSS Publishers, Oxford, UK. 757-780.
- Aslam, M., Hassan, A. A. G., & Kedah, D. A. (2003). Development planning and regional imbalances in Malaysia. *University of Malaya, FEA Working Paper*, (2003-5).
- Baum, S. (2004). Measuring socio-economic outcomes in Sydney: an analysis of census data using a general deprivation index. *Australasian Journal of Regional Studies*, The, 10(1), 105.
- Chindo, M. I. (2011). Communities Perceived Socio-economic Impacts of Oil Sands Extraction in Nigeria. *Human Geographies*, 5(2), 69.
- Economic Planning Unit (EPU). (2014). Iskandar Malaysia Development. Retrieved from [www.epu.gov.my](http://www.epu.gov.my)
- Eskandarian, I., & Ghalehtimouri, K.J. (2011). 50 years regional planning in Malaysia: A review. *The Journal of Sri Krishna Research & Educational Consortium*, 1(4), ISSN 2231-4571.

- Fielding, N. G. (2012). Triangulation and mixed methods designs data integration with new research technologies. *Journal of Mixed Methods Research*, 6(2), 124-136.
- Guildford, J. P. (1973). *Fundamental Statistics in Psychology and Education* 5<sup>th</sup> Edn. Mc Graw-Hill, New York.
- Ibrahim, P., & Ali, M. (2013). Foreign direct investment affluences in Iskandar Malaysia. Iskandar Regional Development Authority (IRDA). (2011). *Iskandar Malaysia Blueprint Agenda*. Retrieved from <http://www.irda.com.my/IRDA>
- Jusoh, H. (1992). The application of Williamson's hypothesis to regional development in Malaysia. *Regional development in Malaysia: Issues and challenges*, 15-30.
- Kassim, Y. R. (2006). The Shenzhen-Hongkong Model: Singapore and the South Johore Economic Region. *IDSS Commentaries*, 96, 2006.
- Krimi, M. S., Yusop, Z., & Hook, L. S. (2010). Regional development disparities in Malaysia. *Journal of American Science*, 6(3), 70-78.
- Lee, H. A. (2004). Development in Malaysia: economics and politics of an idea. *Akademika*, 64, 65-81.
- Meijer, P. C., Verloop, N., & Beijgaard, D. (2002). Multi-method triangulation in a qualitative study on teachers' practical knowledge: An attempt to increase internal validity. *Quality and Quantity*, 36(2), 145-167.
- Mensah, C. (2012a). Residents' Perception of Socio-economic Impacts of Tourism in Tafi Atome, Ghana. *Asian Social Science*, 8(15), 274.
- Mensah, C. (2012b). Residents' Perceptions of Socio-economic Impacts of a Regional Trade Fair in Ghana. *Journal of Social and Development Sciences*, 3(7), 245-253.
- Mertens, D. M., & Hesse-Biber, S. (2012). Triangulation and mixed methods research provocative positions. *Journal of Mixed Methods Research*, 6(2), 75-79.
- Ngah, I. (2010). Rural Development In Malaysia. Retrieved 4 December 2011 from <http://www.fab.utm.my/download/Monograph%20%20-%20rural%20development.pdf>
- Olajoke, A., Aina, A.T., & Ogini, K.O. (2013). Residents' Perception on Environmental Impacts of Urban Informal Enterprises in Ibadan, Nigeria, *Research on Humanities and Social Sciences*, 3(19), 21-27, ISSN 2222-1719 (Paper) ISSN 2222-2863 (Online)
- Onwuegbuzie, A.J., Leech, N.L. & Collins, K.M.T. (2012). Qualitative Analysis Techniques for the Review of the Literature, *The Qualitative Report*, 17(56), 1-28.
- Ragayah, H. M. Z. (2008). Income Inequality in Malaysia\*. *Asian Economic Policy Review*, 3(1), 114-132.
- Ramli, Abdul Rahim, & Akmal, Alizatul (2006). South Johor Economic Region (SJER) Comprehensive Development Plan. Industry & Cultural Integration Tour, Shibaura Institute of Technology, Japan
- Salleh, D. (2002). Regional development strategy and demography structural change: a lesson from Malaysia experiences.
- Salleh, N. H. M., Idris, S. H. M., Othman, R., & Adnan, M. A. (2014). Sustainable Livelihood and Community Perception of Tourism Development: A Case Study of Langkawi Island, Malaysia. *IAMURE International Journal of Social Sciences*, 8(1).
- Talhah, K. (2007). The heritage master plan for Kuala Terengganu city – A case study of a top down approach.
- Türker, A. N., & Öztürk, A. S. (2013). Perceptions of Residents Towards The Impacts of Tourism in the Küre Mountains National Park, Turkey. *International Journal of Business and Social Science*, 4(2).
- Turner, N., Wuetherick, B., & Healey, M. (2008). International perspectives on student awareness, experiences and perceptions of research: Implications for academic developers in implementing research-based teaching and learning. *International Journal for Academic Development*, 13(3), 199-211.
- Ülengin, F., Kabak, Ö., Önsel, S., Aktas, E., & Parker, B. R. (2011). The competitiveness of nations and implications for human development. *Socio-Economic planning sciences*, 45(1), 16-27.
- Wood, R. S., & Seminar, S. I. D. I. (2005, May). Strategies of development: Indonesia and Malaysia 1960–present. In *S AIS I-Dev Integrating Seminar*. Retrieved on March (Vol. 14, p. 2009).
- Yamane, T. (1973). *Statistics: an introductory analysis*-3.

## **THE LIFE OF SEAWEED FARMERS IN SELAKAN ISLAND, SEMPORNA, SABAH**

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**ABSTRACT:** The beauty of Sabah with surrounding islands is undeniable and receives world-wide recognition. The revenue generated through solar resources, mineral from the ocean and ecosystem which allows Sabah to increase the economic resources through a wide range of industries including tourism, fisheries, agriculture and aquaculture. One of the aquacultural activities carried out is seaweed cultivation. This study focused on seaweed industry's importance to social and community development. The study examines the life of seaweed farmers, which includes the location and geographical structure, the history of the race, social organization, activity, employment, social activities and community, and religion. Documentation of the life of seaweed farmers is an entry-based studies conducted with ethnography which is a suitable method to understand their culture, values, and religion. Data were collected through structured and unstructured interviews and participating observation which was carried out for almost two years. Data collections were also conducted periodically. The study provides an overview of the life of seaweed farmers in Selakan Island that is very different from farmers on the mainland.

*Keywords:* life, seaweed farmers, Selakan Island, Sabah, ethnography

### **INTRODUCTION**

Seaweed cultivation has long been a tradition in Semporna district since the discovery of the sea plants in 1978 in Karindingan Island, Semporna (Md. Nor et al., 2012). Seaweed cultivation is one of the economic resources of the Semporna District apart from fisheries. Before this, farmers used traditional methods to plant seaweed. When the seaweed was expanded and can be commercialized, cultivation technology also improved such as management system, crop yields system, tiding system and maintain their local ecosystem. Seaweeds can be used in different ways besides being served as food for the locals. According to McHugh (2003), one of the functions of seaweed is to serve as a source of hydrocolloid used in manufacturing food supplement, fertilizer, animal feed, biofuels, cosmetics and medicines because seaweed produces carrageenan gel that is used for the emulsion agents or become binders as well as a stabilizer in products that have large scale, such as food processing, pharmaceutical and cosmetic industries (Bixler and Porse, 2011).

Seaweed cultivation industry involves both upstream and downstream levels. Upstream level involves the process of cultivation of seaweed until the process of drying and sold to the operators of seaweed-based company. While the downstream level involves the production of seaweed-based products until the seaweed products are released. In Semporna, most local farmers are involved in the upstream stage. Seaweed cultivation also forms part of the livelihood of the community in Semporna. They are still holding fast to their beliefs and taboos during the planting process. This unique feature of custom and culture preservation by the Semporna Bajaus is worth exploring.

Seaweed cultivation was upgraded to Seaweed Cultivation Project, introduced by the Department of Fisheries Malaysia in 1999, which includes two phases involving Kudat and Semporna district (Ismail, 2004). Zulkafli (2009) explains that the cultivation project at Semporna is due to the districts that fulfil several requirements for carrying out large scale commercial seaweed cultivation. According to him, among the factors include possession of protected sea waters, wave height of 1-2 feet, 30-35 ppm salinity, marine water quality and rocky reefs.

In 2011, Universiti Malaysia Sabah (UMS) conducted a pilot seaweed planting project with systematic management. Plantation demonstration and commercial cultivation farm has opened up an opportunity for communities in Semporna (Hossin et al., 2013). The project was known as a Seaweed Mini Estate System, headed by the Director of Seaweed Research Unit, Assoc. Prof. Dr. Suhaimi Mad Yasir, The first project was in Sebangkat Island, Semporna. However, there are several factors that

prevent it from continue operating there, and it was later moved to Selakan Island, which is also under the area of Sabah Parks.



Figure 1: Platform of Seaweed Cultivation in Mini Estate Project and Demonstration Farm Estate, Selakan Island

Source: Fieldwork (October 2014)

At Selakan Island, seaweed cultivation project in mini estate was conducted through collaboration between the UMS, private companies and community. This cooperation is consistent with the national objective under the Economic Transformation Programme (ETP) and implementation through Entry Point Project 3 (EPP 3) to increase national income, improving the socioeconomic of the community, providing new job opportunities, promote industrial sector as well as the downstream environment to maintain the eco-system.

There are many differences in the way of life of the community that lived on the land with the community living near the oceans. For example, in terms of sources of livelihood, they carry out activities involving fishing and farming. In addition, inherited customs are still widely practiced to this day. For Semporna Bajaus, seaweed cultivation has been a part of their culture and lives practiced from generation to generation. Despite the introduction of many new technologies to increase the production of seaweed, the locals still hold their faith and taboos during planting seaweed. Therefore, this paper will review and explore many unique aspects of the community's life.

## **METHODOLOGY**

The main source of the data was obtained through Design Ethnography, a qualitative method. As stated by Creswell (2007), ethnography is a qualitative design that allows researchers to explain and interpret something shared and learned about the culture, values, behaviours and language clusters that share culture (Creswell, 2007). Ethnography method usually uses participant observation, where researchers participate and live with the cluster in daily life, through observations and interview with focus group using structured or unstructured questions.

Data was gathered from participant observation where researcher lived with villagers starting from October 2014 until May 2015. Observation of daily activities started early in the morning until late night. Aspects observed and recorded include employment, social activities, nutrition, application, custom, language, behaviours. All data acquired directly or indirectly were recorded in daily notes. Researcher also interviewed a few farmers based on the interview protocol and unstructured interview to gather more information. The data has been analysed by using coding and thematic analysis.

## **Physical Background of Selakan Island**

Selakan Island is one of eight islands listed under the Tun Sakaran Marine Park which is the ground seventh gazetted under Sabah parks in 2004. Travelling to this island requires about thirty to forty minutes by boat from the jetty in Semporna Town. The island is surrounded by coral reefs and the ocean and close to several other islands including Bodgaya Island, Maiga Island, Sebangkat Island, Bohey Dulang Island. From a geological perspective, the island was formed of quaternary pyroclastic

material where the formation of the island was the result of explosive volcanic activity. Therefore, the island is rich in natural resources because of the fertile soils and plenty of marine sources.



Figure 2: Selakan Island.

Source: Fieldwork, December 2014

### **Living Patterns of Seaweed Farmer on Selakan Island**

Seaweed farmers comprise individuals of different age group, such as teenagers, adults and elderly and most of them are related to one another. The majority of those who live in Selakan Island area come from few ethnic groups which include Bajau Semporna, Bugis and others. A small number of Selakan Island residents originated from Pulau Banggi, Kudat which is typically resided by those belonging to Bajau Ubian ethnic. They have migrated from Kudat to work and some of them get married with the locals and continue to reside there.

The opening pilot project - Mini Estate Seaweed System by UMS which was initially located at Sebangkat Island provided the opportunity to work in Semporna. In the past, they worked in Banggi Island, Kudat under the research project by UMS. Then project transferred the operations to Semporna. From Sebangkat Island, the project was moved to Selakan Island which is one of the nearer islands due to the strategic location, more potential to be developed as well as having better facilities.

In terms of basic facilities, Selakan Island have a few facilities such as community hall, *surau*, primary school and preschool, cemeteries, field, rig, pier, the electrical power sites set up by SESB and others. Position and arrangement of the houses of the residents there are concentrated near the coastal ocean. Most of their houses are built on the water surface. Almost every home has a private boat which serves the dual purpose of work as well as transport to the town for basic needs and to other islands. Residents on Selakan Island also have almost complete home furnishings such as electrical appliance for daily use.





Figure 3: Facilities, houses at Selakan Island and their community  
Source: Fieldwork, December 2015

### **Working Activities**

While staying with the villagers on Selakan Island, there are many things that can be observed on the work carried out there. The working activities were carried out in phases with clear division of labour. Based on the observations and information provided by the farm managers, their duties according to the job description proposed under Seaweed Systems Mini Estate was introduced by UMS. The work includes seedlings, tying the seeds, fertilizing, and lead rope ready to be planted in the field. After the run phase, harvesting is done when the seaweed matures in 30-45 days, depending on the growth of the seaweed. Then, farmers brought the harvested seaweed to the rig, to undergo the process of drying and cleaning the strap of any foreign objects to be reused.

Based on the data collected, they begin their daily work as early at 7.30am in the morning. Two farmers will arrange and inspect the boat engines to ensure that the boat they will use on that day is in good condition. Then, both of them took other farmers using the boat which is already waiting in jetty at Pulau Selakan village to start the task on that day. This is the daily routine for employees working under UMS Research Division, located at the back of the Selakan Island.

For seaweed farmers who work under the company, they will work on the rigs in their own villages. The platform is used for training of new company that want to open a farm. Seaweed cultivation training process for the new company provide training on how to manage all the system. During the training, the company will provide 50 ropes for the early phase. Trainees will learn how to manage the farm and receive training by UMS staff on the process of cultivation and effective management system.

When all seaweeds have been planted, farmers will modify the new rope. They have to bind a new float over 100 meters each. These works involve all employees and are carried out according to the respective tasks.





Figure 4: Seaweed farmers and their working activities  
Source: Fieldwork, March 2015

### Social Activities and Interaction of Seaweed Farmers in Selakan Island

Seaweed farmers have different leisure time activities. On weekdays, after they finish performing their duties, they will be doing recreational activities such as playing football, or doing any other works such as cleaning or fixing the boat. For women, they will sit mingling with neighbours near their home, have a tea time together.

During holidays, some of them will be going to sea and do some activities together likes fishing, finding clams and '*memanah ikan*', shooting fish with arrow. The experience of participating with them was amazing. They will find a place with coral reefs in the water in the boat ride and jumping off the boat while diving to find the fish. The capability has the island's people in diving is remarkable as they do not require oxygen tank. The other villagers will go down to the town of Semporna by boat for about 40 minutes to buy daily necessities and other goods along their supply on the island.

Based on observation, the researcher found that this community have social interaction with others beyond the island because the communication system has been improved. They use social media such as Facebook, WhatsApp and Wechat to communicate. So, they do not have many problem in interacting through long distance with people from the mainland of Semporna.



Figure 5: Fish catches of the '*memanah ikan*' activities  
Source: Fieldwork, May 2015

### Community Activities, Culture and Arts

Semporna Bajaus are rich in tradition and culture. Community activities often involve cultural elements that represent their ethnic groups. Culture adopted by them to this day include dance, traditional clothing, food and the arts of their boat called '*Perahu Lepa-Lepa*'.

During the researcher's stay with the seaweed farmers on Selakan Island, it was found that they really hold on to their culture and arts, namely Semporna Bajaus. Regardless of their age, they will participate in any activities involving culture and the arts. The researcher even managed to experience events organised by the villagers such as *gotong royong* which means all villagers work together to

clean out the island, New Year celebration, and birthday celebration which are infused with their traditional culture such as dance, traditional clothing and traditional food.

They also perform the Bajau traditional dances such as *Daling-Daling* and *Igal-Igal* which is danced by man, women and children. These dances are becoming increasingly popular as a result of promotion and presented during a big ceremony such as *Regatta Lepa* began in 1996.

Community activities also take place during the wedding ceremony. This dance is also performed during weddings. Weddings of Semporna Bajaus are full of traditional and cultural customs. Similarly, seaweed farmers who live in the same community. Based on the interviews conducted by the author with one of the seaweed farmer, Julaiha (46 years), there is a long-standing custom carried out during the wedding ceremony known as '*berbedak*' where the bride will bathe and put powder on their face for 7 days before the ceremony. They are also not allowed to go out from the room and have to wear white clothing until the wedding days. Weddings were also under way with vibrant accompanied by dance, will wear custom dresses and treated with traditional food.

Arts of Semporna Bajaus are also reflected in tombstones carved patterns. On Selakan Island, carving patterns in tombstones can still be seen in the cemetery located in the village. The pattern has a distinctive emblem and their meaning according to the type of carving. According to Haji Rabani (65 years), tombstones are known as '*tunjuk*' by the Bajau communities in Semporna.



Figure 6: Cultural activities in Selakan Island  
Source: Fieldwork, May 2015

### **Religious Practice**

All seaweed farmers in Island Selakan are Muslims. Based on interviews conducted with Hj. Rabani bin Imam Isnin, 65 years, elders in the village learn about Islamic practices from their parents. For the younger generation who go to school, they receive formal education at primary and secondary school, but most of them do not continue their study. Based on observations, seaweed farmers on Selakan Island practice Islam as others do. However, due to limited knowledge of their religion, they only perform according to their rather limited knowledge of Islam. The practice of prayers, fasting, recitation, performance of Umrah and Hajj, *Hari Raya Aidilfitri celebration* and *Hari Raya Aidiladha celebration* are carried out as usual.

Religious and cultural assimilation is also reflected in the seaweed farmers. Cultural practices among Semporna Bajaus ethnic are still strong and practiced to this day. Examples can be seen in the community's practice in marriage, death, feast such as *kenduri arwah*, *kenduri kesyukuran* and more. There are a few beliefs involving the cultivation of seaweed. For example, the ritual for facing disease and disaster, they still practice a ritual called '*patulak*', releasing small boats tied with yellow cloth to exorcise ghosts and demons. This information is obtained through narration of younger generation in this community. The practices are also related to the belief in they called '*tolak bala*'. The community also have rituals for opening new areas. The ceremony begins with a white feather chicken, the feather at the chicken's head and tail were removed and a small amount of blood is drawn. After that, the chicken is released. The chicken cannot be caught again by the same person. According to

interviews with UMS Research Officer, Norazwan Juri, 28 years old, during the process of construction of the UMS building starts, they receive advice from the villagers to perform these ceremonies so that building will 'safe'.

## **CONCLUSION**

The life of seaweed farmers in Selakan Island, Semporna is unique and needs further exploration by future research. Their lives should also be documented in the form of expanded academic knowledge in social sciences. Seaweed farmers were the main contributor to the increase in production of the seaweed. With research of seaweed from various fields, hopefully, economic of this community could be increased.

## **REFERENCES**

- Bixler, H.J. & Porse, H. (2011). A decade of change in the seaweed hydrocolloids industry. *Journal of Applied Phycology*. 23, 321-335.
- Creswell, J.W. (2007). *Qualitative inquiry and research design: Choosing among five approaches (2nd ed.)*. Thousand Oaks, CA: Sage.
- Hossin, Aisah, Salleh, Norhuda & Tamring, Budi Anto (2013). Estet mini rumpai laut: program ke arah peningkatan taraf hidup isi rumah berpendapatan rendah, Semporna Sabah. *Prosiding PERKEM VIII*. 3, 1167 – 1176.
- McHugh, D. J. (2003). *A guide to the seaweed industry*. FAO Fisheries Technical Paper, No.441. Rome : FAO.
- Mohd. Nor, Adibi Rahiman, Lim, Phaik Eem, Tan, Ji, & Phang, Siew Moi. (2012). *Transformasi Industri Rumpai Laut Negara*. Putrajaya: Jabatan Perikanan Malaysia.
- Ismail, Rosnah (2004). *Kesedaran dan Sikap Masyarakat Terhadap Pengkulturan Rumpai Laut di Pulau Bangi, Kudat*. Kota Kinabalu: Universiti Malaysia Sabah.
- Zulkafli, Shahzunizam (2009). Projek Rumpai Laut PPK Semporna. *Berita Transformasi Pertanian*. Bil 09 / 2009 Edisi September. Kuala Lumpur: Lembaga Pertubuhan Peladang.

## **Interview**

- Hj. Rabani bin Imam Isnin, 65 years old. Imam's Kg. Pulau Selakan. December 2014
- Julaiha, 46 years old. Seaweed Farmers. Selakan Island. December 2014.
- Norazwan Juri, 28 years old. Research Officer, Seaweed Research Unit, UMS. Selakan Island. March 2015.

## **QUINTUPLE HELIX MODEL AND URBAN DEVELOPMENT: A SURVEY OF STRATEGIC COOPERATION BETWEEN UNIVERSITY AND INDUSTRY**

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**ABSTRACT:** A strong innovation ecosystem is important for the success of the urban development based on innovation and knowledge. The extent of strategic cooperation between universities and the industries affect economic, societal, and environmental balance. This article elaborates on the concept of generating innovation based on the Quintuple Helix Model and the knowledge city. The Quintuple Helix Model is based on the Triple Helix Model, to form innovation ecosystem through cooperation among universities, industries and the government. The Quadruple Helix Model is the addition of the fourth helix of the social and cultural context and while the fifth helix in the Quintuple Helix Model is the environment. The Triple Helix Model development is in line with the concept of developing a knowledge city consisting of the economic, social, and environmental aspects. The basis for this model and concept are innovation and knowledge. The main focus in driving development based on innovation and knowledge is to increase productivity and global competitiveness.

*Keywords:* Innovation, knowledge, knowledge city.

### **INTRODUCTION**

Innovation and knowledge function are twin drivers in urban development. An effective innovation ecosystem is critical in ensuring successful innovative initiatives among institutions of higher learning (Striukavo and Rayna, 2015). Innovation ecosystem can be defined as an environment and economic development and diffusion model formed by an ecology of actors whose goals are to create, store and transfer knowledge, skills and artefacts which define new technologies, enable technology development and innovation (e.g. industry, academia and government) (Rabelo et al., 2015). Universities as '*engines of innovation*' (Drucker and Goldstein, 2007) create talent and foster relationships and connectivity between citizens within the knowledge pool (Martinez- Fernandez and Sharpe, 2008). Universities are no longer ivory tower but has become a catalyst to stimulate national growth (Benneworth and Hospers, 2007; Gilman and Serbanica, 2015). Their roles are no longer confined to human capital development but encompass building research capabilities, technology development, commercialisation and innovation (Hershberg et al., 2007). Universities need to interact with others in order to be remain relevant and contribute to the urban development, especially in Knowledge Based Urban Development (KBUD) (Yigitcanlar and Lönnqvist, 2013). Quintuple Helix (QH) Model is used for clustering level strategic cooperation University and Industry (U-I) in urban development in order to identify social-spatial inequalities. The cooperation has become one of the agenda within higher education policy making as university research plays an important role in industrial innovation (Cohen et al., 2002; Mansfield, 1991).

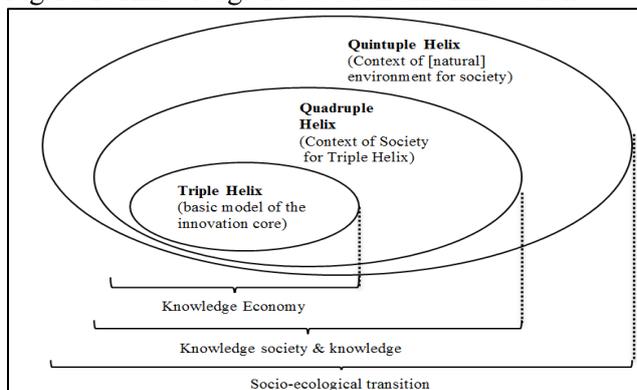
QH Model is in line with the concept of developing a knowledge city encompassing economic, social, and environmental aspects. The knowledge city concept represents the knowledge based urban development (Yigitcanlar and Lönnqvist, 2013). The first part of this article aims to elaborate on the concept of generating innovation based on the QH Model and knowledge city. The second purpose of this paper is to examine the levels of universities' and the industries' strategic cooperation which contribute to economic, social and environmental development in Malaysian context. Malaysia's urban development is currently at a transition stage moving from the second stage, efficiency-driven, to the third stage, innovation-driven. Malaysia is categorised as an upper middle income country by the value of GDP per capita (Global Competitiveness Report, 2013).

## QUINTUPLE HELIX MODEL AND URBAN DEVELOPMENT

The important roles of knowledge are multi-dimensional and one of the factors that leads toward urban development (Yigitcanlar, 2005). Knowledge provides the impetus to inspire higher levels of innovation. There are two phases in the innovation process. First, innovation means invention, discovery, research and development (R&D). The incentive to innovate lies in the supply and demand equation of whether it will be applied in U-I strategic cooperation. Second, innovation is defined as diffusion, adjustment, adoption and imitation which will then turn into application and introduction in the market (Lambooy, 2006). There are currently six existing models of knowledge creation and innovation creation (Carayannis et al., 2012) focusing on urban development growth. (i) Mode 1 focuses on “the traditional role of university research in an elderly”, ‘linear model of innovation’ understanding”, and success in mode 1 ‘is defined as a quality or excellence that is approved by hierarchically established peers’ (Carayannis and Campbell, 2010). (ii) Mode 2 can be characterised by the following five principles: ‘knowledge produced in the context of application’, ‘transdisciplinary’, ‘heterogeneity and organizational diversity’, ‘social accountability and reflexivity’ and ‘quality control’.

Figure 1 illustrates the knowledge production and innovation. 1<sup>st</sup> helix, the TH explicitly acknowledges the importance of higher education for innovation. However, in one line of interpretation it could be argued that the TH places the emphasis on knowledge production and innovation in the economy so it is compatible with the knowledge economy. 2<sup>nd</sup> helix, the Quadruple Helix already encourages the perspective of the knowledge society, and of knowledge democracy for knowledge production and innovation (Carayannis and Campbell, 2010). In the perspectives of Quadruple Helix, the sustainable development of a knowledge economy requires co-evolution with the knowledge society. Then the last helix which is QH stresses the necessary socioecological transition of society and economy in the twenty-first century. The QH models are connected to mode 3, whereby a university can simultaneously follow or alternate between mode 1 and mode 2. The QH model is also considered as a way to overcome the major obstacles in cooperation between academia and industry (Carayannis and Rakhmatullin, 2014; Jonsson et al., 2015).

Figure 1: Knowledge Production and Innovation



Source: Carayannis et al. (2012), Etzkowitz and Leydesdorff (2000)

(iii) The ‘Triple Helix (TH) overlay provides a model at the level of social structure for the explanation of Mode 2 as a historically emerging structure for the production of scientific knowledge and its relation to Mode 1’, and it is a “model of ‘networks and hybrid organizations’ of ‘U-I-G relations’” (Etzkowitz and Leydesdorff, 2000). (iv) Mode 3 is more inclined to emphasise the co-existence and co-evolution of different knowledge and innovation modes. Mode 3 pointed to pluralism and diversity of knowledge and innovation modes as necessary conditions for the advancement of societies and economies. (Carayannis and Campbell, 2010).

(v) ‘The Quadruple Helix Model is based on the TH Model, adds as 4<sup>th</sup> helix the ‘public’, more specifically being defined as the ‘media-based and culture-based public’ and civil society. This “4<sup>th</sup>

helix associates with ‘media’, ‘creative industries’, ‘culture’, ‘values’, ‘life styles’, ‘art’, and perhaps also the notion of the ‘creative class’ ” (Carayannis and Campbell, 2009). (vi) The QH Model is based on the TH Model and Quadruple Helix Model and adds as 5<sup>th</sup> helix the ‘natural environment’. The QH is a ‘five-helix model’, ‘where the environment or the natural environments represent the 5<sup>th</sup> helix’. The QH can be proposed as a framework for transdisciplinary (and interdisciplinary) analysis of sustainable development and social ecology’ (Carayannis and Campbell, 2010).

Table 1: The Benefits of Knowledge City and Quintuple Helix Model in Different Contexts

<b>Context</b>	<b>Benefits Knowledge City</b>	<b>Quintuple Helix Model</b>
<b>Economic and organisational</b>	<ul style="list-style-type: none"> <li>- Creation of more rewarding and well-paid employment</li> <li>- Higher growth in community’s income and wealth</li> <li>- A more sustainable economy, by technological innovation and off-shore investment; revitalization of traditional industry</li> <li>- Reinvestment of local capital into the local economy</li> <li>- Promotion of measured risk-taking – build entrepreneurial culture</li> <li>- Creation and innovation are central elements of its development</li> <li>- Constant connection between universities, enterprise and creators</li> </ul>	Knowledge economy
<b>Social and Culture</b>	<ul style="list-style-type: none"> <li>- Greater opportunities to share wealth through investment in the public domain and better funding of social safety nets</li> <li>- Creation of knowledge communities that will provide ‘just in time’ knowledge when it is needed</li> <li>- Better education services and connected network of school</li> <li>- Creation of a tolerant environment towards minorities and immigrants</li> <li>- Leader in cultural production and the cultural industry</li> <li>- Instrument that make knowledge accessible to citizen</li> <li>- Access to the new communication technologies for all citizens</li> </ul>	Knowledge society and Knowledge democracy
<b>Physical and environmental</b>	<ul style="list-style-type: none"> <li>- Leader in the incorporation premise of the digital area</li> <li>- Urban design and architecture that incorporate the new technologies</li> <li>- Uses and exploits its monumental, architectural and natural heritage to attract visitors</li> <li>- Improved capacity to enhance and repair natural and built environment</li> <li>- Greater community commitment to environmental decision making</li> </ul>	Sociological transition

Sources: Carayannis et al., (2012), Etzkowitz and Leydesdorff (2000) and Yigitcanlar (2005)

The concept of ‘knowledge city’ may refer to all aspects of social, economic and culture of a city. Knowledge city as a city which aims for knowledge-based development by encouraging the continuous creation, sharing, evaluation, renewal and update of knowledge (Ergazakis et al., 2004). KCs are incubators of knowledge and culture, forming a rich blend of theory and practice within their boundaries driven by knowledge workers through strong knowledge production (Work Foundation 2002). The main benefit of KCs is that they function in such a way that is in favour of their knowledge-based development. Table 1 illustrates the benefits of knowledge city in the economic, societal and environmental contexts. KCs can be measured by the level of innovation, amount of patents and R&D spending that a city-region generates as technology, science and innovation are considered the ‘top section’ of the knowledge economy (van Winden et al., 2007).

### **UNIVERSITY–INDUSTRY STRATEGIC PARTNERSHIP**

The significant symbiotic relationship between U-I fosters economic development as well as community development and nature conservation of a nation (Jonsson et al., 2015). Wright et al. (2008) examine the types of U-I interaction which include spin off company, licensing, contract research, consulting and graduate and researcher mobility. In contrast, Tapsir et al. (2011) used a different set of indicators i) industrial funding of university researches and collaborative projects, ii) patenting by universities, iii) start-up companies from universities, iv) joint-publication of articles from U-I research, and v) internship programmes between universities and industries. There are several stages or levels in the process of knowledge transfer between universities and industries

contributing to innovation, economy, social and environment. Baraldi et al. (2013) created a typology of U-I interactions based on increasing depth, intensity and importance for the parties. From shallow 'contacts' (acquainted) to 'participation' in meetings and discussions (with minimal exchange of resources) to actual 'cooperation' (entailing knowledge exchange and joint activities). This is followed by deeper 'collaborations' (entailing closer combinations of resources towards a common goal) and finally 'full-blown relationships', characterised by extended interaction, resource adaptations and high levels of interdependence (Jonsson et al., 2015). The typology described the different levels of interaction between universities and industries to determine the impact achieved. For example, collaboration of Uppsala University and the National University of Agricultural Sciences (SLU) with industries formed a platform to stimulate industry with limited or no previous academic experiences to use the knowledge and expertise at the university for developing new methods and products. This project provided financial support to about 30 SMEs to establish academic collaborations with the assumption that they would benefit from academic research and thus stimulate economic growth (Jonsson et al., 2015).

### **Success Story of University-Industry (U-I) Strategic Partnership**

There are various methods and practices in the management of U-I linkages to ensure a successful strategic partnership. A strong strategic partnership between universities and industry will positively impact economic, societal and environmental development.

#### **United States of America (USA)**

In the United States (US), the passage of the Bayh-Dole Patent and Trademark Amendments Act of 1980, followed by additional amendments in 1984 represent part of a broad policy shift towards more comprehensive intellectual property rights (Mowery and Sampat 2004). Universities in the US have generally embraced the goal of economic development in addition to their traditional missions of education, research, and public service. The prospect of supplementary earnings from patents, licensing, and industrial collaborations has acted as an additional lure in a period of tight public education budgets (Drucker and Goldstein, 2007). According to a survey, there may be upwards surge of 1,000 U-I linkage of various types in the US, accounting for a significant fraction of industry-supported academic research. Stanford University set up the Office of University Corporate Relation to manage U-I collaboration. Harvard University through Office of Technology Development (OTD) has brought technologies for public use and generated funds for continued research and accomplished mission while maintaining its academic standing, research activities and principles. Major products in a wide variety of industries have been developed through U-I partnership such as internet search engines, the Boyer-Cohen "gene-splicing" technique that launched the biotechnology industry, diagnostic tests for breast cancer and osteoporosis, music synthesizers, computer-aided design (CAD), and environmentally-friendly technologies (Siegel et al., 2004).

#### **United Kingdom (UK)**

The formation of the Alvey Programme in early 1980s was a significant attempt to ensure UK industries and academia catch up with the US and Japan in areas concerning Information Technology. During the 1990s, UK government increasingly focused on the impact of interactions between universities and industries. With the introduction of Realizing Our Potential: Higher Education - Business and Community Interaction Survey (HE-BCI), it highlighted an increase in the overall exchange of knowledge between UK higher education institutions and the public, private and third sectors with 5% financial growth rate from 3401 million in 2011-12 to 3570 million in 2012-13.

#### **Japanese**

Efforts concerning policy regulation to promote U-I collaboration started fairly early. The Ministry of Education, Culture and Sport, Japan, established the Office of Collaborative Research in 1982 and started the Collaborative Research Scheme in 1983. To facilitate interaction between universities and

companies, the Ministry established Collaborative Research Centres in national universities in 1987. In 1995 and 1996 when Sciences and Technology Basic Law was passed and the 1<sup>st</sup> Science and Technology Basic plan was launched, the sum of public R&D expenditure was raised to 17 trillion yen within the following 5 years. Seven major programmes were launched with each managed by a special public cooperation. For instance, 'Comprehensive Joint Research' was managed by special Coordination Funds for Promoting Science and Technology of the Science and Technology Agency (STA); Exploratory for Advanced Technology of the Research Development Cooperation of Japan (JRDC) was similarly managed by STA; Large Scale Industrial Technology Research Development Programme of Ministry of International Trade and Industry (MITI) and the New Energy and Industrial Technology Development Organization (NEDO).

## **Malaysia**

The idea of strategic partnership between U-I in Malaysia was first mooted in the mid-1980s, when researchers and academics need to commercialise their R&D product via related industry. The first national Science, Technology and Innovation (STI) policy was implemented in 1980s and Intensification of Research in Priority Area (IRPA) grant was established. In line with Malaysia's Vision 2020, the government planned to focus on the development of high value-added and technology based industries, with equal emphasis on agro-based and resource based industries. The National Mission in the 9<sup>th</sup> Malaysia Plan is to raise the country's capacity for knowledge, creativity and innovation. The total research funding was also increased to support R&D. Research funding for the 7<sup>th</sup> Malaysia Plan (1996-2000) was RM 1 billion while during the 8<sup>th</sup> Malaysia Plan (2001-2005) is RM 2 billion. The 9<sup>th</sup> Malaysia Plan allocated RM 3.9 billion for R&D activities and intend to focus on producing more Researchers, Scientist, and Engineers (RSE), targeting 50 RSEs in every 10,000 members of the labour force by 2010 (Tapsir et al., 2011).

Taking heed of the success stories from other developed countries, Malaysian Ministry of Higher Education has listed U-I collaboration as one of its critical agenda (MOHE, 2010). A range of initiatives have been accomplished such as The Lab2Market Commercialization Programme, the Cradle. One of the strategies in Eleventh Malaysia Plan (RMK 11) for translating innovation to wealth is the strengthening of industry-academia collaboration through intermediaries by encouraging local and international collaboration including strategic alliances with MNCs and SMEs to facilitate technology transfer.

## **DISCUSSION**

The concept of generating innovation based on the QH Model can overcome existing challenges through the application of knowledge and know how as it focuses on the social exchange and knowledge transfer inside the subsystems of a specific state or nation state. There are five subsystems; i) *education system*, ii) *economic system*, iii) *natural environment*, iv) *media based and culture based public*, and v) *political system* (Carayannis et al., 2012; Etkowitz and Leydesdorff, 2000). All systems in a QH Model influence each other to stimulate new knowledge. Knowledge is the most important 'commodity' to QH Model as well as in the making of knowledge city. In the knowledge city concept, city aims at knowledge based development by encouraging continuous creation, sharing, evaluation, renewal and update of knowledge (Ergazakis et al., 2004).

We will now discuss how all systems in the helix influence each other with knowledge through new, advanced and pioneering innovation. First subsystem is the *education system*, which refers to academia, universities, higher education system and school. Human capital in this helix of state is being formed by diffusion and research of knowledge, which is like students, teachers, scientist, researchers and academic entrepreneurs. When investment are put into *education system*, it will produce output such as new equipment, new places for scientists and teacher, and greater research opportunities. The output of new knowledge through human capital will turn to input in the helix of *economic system* which is the second subsystem referring to industry/industries, firm, services and bank. The helix focuses on the economic capital of a state like entrepreneurship, machines, products, technology and money. The input of new knowledge can develop opportunities for sustainable future-

oriented, green economy, knowledge creation, new types of job, new green product and services, also new and decisive impulse for green and greener economic growth (Carayannis et al., 2012).

The natural environment as 3<sup>rd</sup> subsystem is crucial for a sustainable development and provides people with ‘natural capital’ such as resources, plants and a variety of animals. The goal of this helix should be to live in balance with nature, to develop regenerative technologies and to use available, finite resources sustainably and in a sensitive approach to form new green know-how for humans. This know-how as output of the subsystem of the natural environment can provide more environmental protection and quality of life to people. The development of new environmental friendly technologies can reduce the carbon dioxide (CO<sub>2</sub>) emissions and can aid in diminishing climate change (Carayannis et al., 2012). Then the output is a green know-how (Barth, 2011).

The fourth subsystem, *media-based and culture-based public*, integrates and combines two forms of ‘capital’. First, through the culture-based public such as tradition, and values which are forms of ‘social capital’. Second, the helix of media-based public such as television, internet and newspapers contains also ‘capital of information’ such as news, communication and social networks (Carayannis and Campbell, 2010; Jonsson et al., 2015). Green know-how input should be spread through media especially information about a new green consciousness and the human lifestyle.

The political system, as a 5<sup>th</sup> subsystem, is also of crucial importance because it formulates the ‘will’, where the state is heading toward in the present and the future. This helix has a ‘political and legal capital’ such as ideas, laws, plans and politicians. The input of new knowledge in the political systems is necessary impulses for knowledge creation. The new output of knowledge and know-how of the political system leads across the circulation of knowledge back again into the *education, economic system, natural environment, and media-based and culture-based public*. (Carayannis et al., 2012).

It thus provides a step-by-step model to cover the quality and effective development, recover balance with nature and generate diversity on earth. (Barth, 2011) The QH innovation model has shown the socioecological transition where the natural environments of society and the economy also should be seen as drivers for knowledge production and innovation. That’s why QH made possible a win-win situation between ecology, knowledge and innovation, creating synergies between economy, society, and democracy. Based on the discussion, the subsystem *education system* and *economic system* could be describing the relationship between U-I. The subsystem will be reflecting the impact of the economic, societal and environmental development based on knowledge creation and diffusion.

## CONCLUSION

In summary, the QH Model demonstrates that investment on knowledge creation will have positive impact on all subsystems and on the society as a whole. Investment in knowledge and promotion of knowledge production make crucial impulses for innovation, know-how and the advancement of society. It is important to promote private financing of research, development, commercialisation and innovation by increasing access to private sources of financing, and developing a framework for risk mitigation and management of crowdfunding activities. U-I partnerships in Malaysia still requires a lot of efforts to foster effective collaboration for economic, societal and environmental development. A strong innovation ecosystem is important for the success of the urban development based on the innovation and knowledge.

## REFERENCES

- Baraldi, E., Forsberg, P., & Severinsson, K. (2013). *Crafting University-Industry Interactions: a typology and empirical illustrations from Uppsala University, Sweden*. Amsterdam: Proceedings of the Second University- Industry Interaction Conference.
- Barth, TD (2011). The Idea of a Green New Deal in a Quintuple Helix Model of Knowledge, Know-how and Innovation. *International Journal of Social Ecology and Sustainable Development*, 1(2), 1–14.
- Benneworth, P., & Hospers, G.J. (2007). Urban Competitiveness in the Knowledge Economy: Universities as New Planning Animators. *Progress in Planning*, 67(2), 105–197.

- Carayannis, E. G., Barth, T. D., & Campbell, D. F. (2012). The Quintuple Helix Innovation Model: Global Warming as a Challenge and Driver for Innovation. *Journal of Innovation and Entrepreneurship*, 1, 2.
- Carayannis, E. G., & Campbell, D. F. J. (2009). "Mode 3" and Quadruple Helix: Toward a 21<sup>st</sup> Century Fractal Innovation Ecosystem. *International Journal of Technology Management*, 46 (3/4), 151-156.
- Carayannis, E. G., & Campbell, D. F. J. (2010). Triple Helix, Quadruple Helix and Quintuple Helix and How Do Knowledge, Innovation and the Environment Relate To Each Other? *International Journal of Social Ecology and Sustainable Development*, 1(1), 41-69.
- Carayannis, E. G., & Rakhmatullin, R. (2014). The Quadruple/Quintuple Innovation Helixes and Smart Specialisation Strategies for Sustainable and Inclusive Growth in Europe and Beyond. *Journal of the Knowledge Economy*, 5, 212-239.
- Cohen, W. M., Nelson, R. R., & Walsh, J. P. (2002). Links and Impacts: The Influence of Public Research on Industrial R&D. *Management Science*, 48 (June 2015), 1-23.
- Drucker, J., & Goldstein, H. (2007). Assessing the Regional Economic Development Impacts of Universities: A Review of Current Approach. *International Regional Science Review*, 30(1), 20-30.
- Ergazakis, K., Metaxiotis, K., & Psarras, J. (2004). Towards Knowledge Cities: Conceptual Analysis and Success Stories. *Journal of Knowledge Management*, 8, 5-15.
- Etzkowitz, H., & Leydesdorff, L. (2000). The Dynamics of Innovation: from National Systems and "Mode 2" to a Triple Helix of University-Industry-Government Relations. *Research Policy*, 29(2), 109-123.
- Global Competitiveness Report 2013-2014 (2013). Geneva: World Economic Forum.
- Gilman, M., & Serbanica, C. (2015). University-Industry Linkages in the UK: Emerging Themes and "Unanswered" Questions. *Prometheus*, (August 2015), 1-37.
- Hershberg, E., Nabeshima, K., & Yusuf, S. (2007). Opening the Ivory Tower to Business: University-Industry Linkages and the Development of Knowledge-Intensive Clusters in Asian Cities. *World Development*, 35(6), 931-940.
- Jonsson, L., Baraldi, E., Larsson, L.-E., Forsberg, P., & Severinsson, K. (2015). Targeting Academic Engagement in Open Innovation: Tools, Effects and Challenges for University Management. *Journal of the Knowledge Economy*, 6(3), 522-550.
- Lambooy, J. G. (2006). Knowledge Dissemination and Innovation in Urban Region: An Evolutionary Perspective. In F. J. Carrillo (Ed.), *Knowledge Cities: Approaches, Experiences and Perspectives*. Oxford: Elsevier.
- Mansfield, E. (1991). Academic research and industrial innovation. *Research Policy*, 20(1), 1-12.
- Martinez-Fernandez, C & Sharpe, S. (2008). Intellectual assets and knowledge vitality in urban regions: the role of universities. In T Yigitcanlar, K Velibeyoglu and S Baum (eds.). *Creative Urban Regions: Harnessing Urban Technologies to Support Knowledge City Initiatives*. Hershey: IGI Global, PA.
- MOHE (2010). *Agenda Kritisikal - Perhubungan Industri dan Akademik (Critical Agenda -Industry and academic relation)*. Retrieved, June 2014, from <http://jpt.mohe.gov.my>.
- Mowery, D. C., and B. N. Sampat. (2004). The Bayh-Dole Act of 1980 and University-Industry Technology Transfer: A Model for other OECD Governments?. *Journal of Technology Transfer* 30: 115-27.
- Rabelo, R. J., Bernus, P., & Romero, D. (2015). Innovation Ecosystems : A Collaborative Networks Perspective. In *Risk and Resilience of Collaborative Networks* (pp. 323-336). Springer International Publishing.
- Siegel, D. S., Waldman, D. A., Atwater, L. E., & Link, A. N. (2004). Toward a Model of the Effective Transfer of Scientific Knowledge from Academicians to Practitioners : Qualitative Evidence from the Commercialization of University Technologies. *Journal of Engineering and Technology Management*, 21, 115-142.
- Striukavo, L., & Rayna, T. (2015). University-Industry Knowledge Exchange: An Exploratory Study of Open Innovation in UK Universities. *European Journal of Innovation Management*, 18(4), 471-492.

- Tapsir, S. H., Mokhtar, N. A., Ismail, A. F., Mirasa, A. K., Sanip, S. M., & Manan, F. A. (2011). *University-University Partnerships: Fostering Strategic Linkages at Institutions of Higher Learning in Malaysia*. Penerbit UTM Press.
- van Winden, W., van den Berg, L., & Pol, P. (2007). European Cities in the Knowledge Economy: Towards a Typology. *Urban Studies*, 44(3), 525–549.
- Work Foundation (2002). *Manchester: Ideopolis? Developing a Knowledge Capital*. London: The Work Foundation
- Wright, M., Clarysse, B., Lockett, A., & Knockaert, M. (2008). Mid-range Universities' Linkages with Industry: Knowledge Types and the Role of Intermediaries. *Research Policy*, 37(8), 1205–1223.
- Yigitcanlar, T. (2005). The Making of knowledge cities : lessons learned from Melbourne. In: *International Symposium on Knowledge Cities 2005*, 28-30 November 2005, Medina: Saudi Arabia.
- Yigitcanlar, T., & Lönnqvist, A. (2013). Benchmarking Knowledge-Based Urban Development Performance: Results from the International Comparison of Helsinki. *Cities*, 31, 357–369.

## **SOCIO-SPATIAL INEQUALITY OF PRIVATISATION APPROACH TO SERVICE DELIVERY OF ELECTRICITY IN NIGERIA**

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**ABSTRACT:** The pursuit of the public welfare should be of paramount concern to any good government to alleviate poverty in tandem with the Millennium Development Goals. As developing nations in the world aspire to meet the vision 20:2020, it is imperative that whatever economic approach, model or strategy adopted must not be at the expense of the welfare of the citizens. In western industrialised world, privatisation is used to improve the lives of citizens where market competition in the provisions of goods and services thrive for the benefit of an egalitarian and equitable society. However, the outcomes of privatisation in most developing countries are not as intended, as the social costs far supersede its benefits, owing to some reasons the paper is out to discuss. As a conceptual paper with discussions based predominantly on secondary data sources cum literature, this paper seeks to explain the socio-inequality and poverty laden outcomes of privatisation policy of service delivery of electricity in Nigeria. Privatisation policy has been claimed to adversely impinged the welfare of the populace, making the poor, poorer. Based on identified theoretical gap of non-harmonising policies with actual situation on ground, this paper argues that the issues of social inequality are occasioned by privatisation policy, and identifies the shortcomings of this approach to service delivery of electricity. The paper recommends taking areal reality and spatial dimension into consideration for decision making, policy resolution and implementation in Nigeria.

*Keywords:* Socio-inequality, Privatisation, Electricity Service-delivery, Nigeria

### **INTRODUCTION**

The issue of socio-spatial inequality is borne out from the understanding of social geography involving the knowledge of the impact of spatial dimension on social well-being and social groups as well as the implication of spatial outcomes of development policy and planning. The social-oriented geographers is primarily concerned with the distribution pattern of these resources and seek to understand who gets what, where, how and when in the process of the material and non-material resources distribution within the society. "Who" refers to all categories of individuals and groups within the society, while 'what' concerns the resources obtainable for delivery among individuals and groups in society irrespective of their birth place or location, sex difference, ethnic or religion background. 'Where' answers the geographical fundamentals of space and time in terms of the chance or opportunity which individuals and socio-cultural groups in particular places or areas have to share and when to share in all aspects of society's resources and their negative externalities. The question of "how" probes into the process or system by which the elements of development is equitably, fairly and justly shared between people and places segregated by religion, status, sex, ethnic or linguistic connections (Adedayo, 2012).

In spatial inequalities, location strongly influences chances of service delivery of resources. One's place of birth and abode have lasting impacts on their lifelong opportunities. While there is much heterogeneity across countries, spatial disparities generally cut across all countries (United Nation, 2013). Indication from recent empirical research, for instance, shows that, "the poorest geographical regions of middle-income countries are, on average, are poor as low-income countries" (Alkire, Roche and Seth (2011) as cited in United Nations (2013)). Essence of living and growth depends on the extent a person's ability to find necessities such as food, water, clothing, and shelter. However, finding basic life necessities requires accessibility to some other facilities among which are electricity, and the service delivery of these basic facilities including electricity which is fundamental to quality of life. These basic facilities are not equally spread over space, (Aderamo and Aina, 2011; GCCC, 2007 as cited in Teriman and Yigitcanlar, 2011)). The issue of unequal distribution among the people has been empirically supported by Eyles (1996) and Oyerinde (2006), as cited in Aderamo and Aina, 2011). Public utilities such as electricity supply and its effective service delivery is essential and

fundamental to the overall welfare of people (Okoye and Onwuka, 2014; Investopedia, 2015 and Kahn, 1979). Distribution of basic utilities which adhere to spatial planning principles would directly or indirectly demystify the issues of socio-spatial inequality most especially in an emerging and growing economy nation like Nigeria (Aderamo and Aina, 2011; Sullivan and Sheffrin, 2003; Olayiwola, Adeleye and Adeleke, 2005).

However, the poor condition of electricity supply and its adverse effect on industrial sector as observed by Kanayo (2014), retrenchment of workers and loss of job occasioned by privatisation as observed by Chotten (2000, as cited in Aminu and Peterside, 2014), all culminated to major causes of prevailing socio-spatial inequality in terms of poverty in Nigeria, (Edukugbo, 2014; Obasi and Ayansina, 2013; Leech, 2011), and creation of social gap, resulting from a spatial concentration of socially relegated groups occurs, as submitted by Kühn (2015). Hence, the need for spatial planning as opined by Wächter (2013), Klein, Klug and Todes (2012) and spatial data availability, as advocated by and Okuku, Bregt and Grus (2014) to avert skewed distribution of prosperity and to ensure sustainable development,

## **LITERATURE REVIEW-CONCEPTUAL THEORETICAL ISSUES**

### **Concept of Privatisation Policy to Public Utility Service Delivery**

Privatisation is the process of transferring ownership of a business, enterprise, agency, public service or public property from the public sector to the private sector (In the Public Interest, 2015; Investopedia, 2015; Sepehr, 2013; England, 2011; Poole, 2008). Margaret Thatcher's regime in the early 1980's in UK happened to be the pioneer adopting privatisation of the state owned enterprise following the origination of the ideological movement of the neo-classical and neo-liberal economists 'wealth of nations' by Adam (1936). Subsequent to this, was the spread of the economic policy to both advanced countries like; Canada, USA, France, Italy, Spain, Western Europe and developing Asia and some African countries. These countries privatised some areas of their public service delivery based on different economic reasons and needs of each nation (Hussain, 2014; Sepehr, 2013; Flynn and Asquer, 2013; McKenzie and Mookherjee, 2003; Salimi et al., 2012; Gilroy, 2010; Kosar, 2006; Rondinelli and Iacono, 1996).

### **Concept of Socio-Spatial Inequality**

Social inequality is a reflection of the distributive pattern of available resources within the whole society. When certain resources, and basic public services such as: water and electricity among others, become exclusively preserved for certain group of people in the society, it leads to socio-inequality, (EAPN, 2015). Historically, advent of colonial administration in Nigerian heralds social inequality during the one hundred year colonial period in the country. The dichotomous spatial arrangement and the residential plans were to the colonial master's advantage as against the indigene (Aderamo and Aina, 2011; Nnoli, 1978; Ayeni and Mabogunje 1982). This was further strengthened by subsequent political leaders after the nation's independence.

### **Marginalisation and Social Exclusion: Conceptualised Indices of Socio-Spatial Inequality**

The term marginalisation prominence in sociological research, (Kuhn, 2015), depicts socio-spatial inequality, social exclusion, non-access to power and participation, as explained by (Bernt and Colini, 2013; Danson and De Souza, 2012; Leimgruber and Nel, 2007 as cited in Kuhn, 2015). It also explains the disparity in between urban and rural electricity supply in Nigeria (Oguzor, 2011).

Social exclusion, conceptualised by Poverty and Social Exclusion in the United Kingdom (PSE, 2012), is explained as lack or denial of Quality of life (Teriman and Yigitcanlar, 2011), access to public and private goods and services, social resources, material or economic resources, rights, and participation in the usual basic social relationships and activities available to the majority of people (IILS, 1998, as cited in Matheison, 2008; Levitas, 2006; Walker, 1997; Mack and Lansley, 1985).

### **Imperative of Spatial Dimension of Electricity Service Delivery: The Research Theoretical Gap**

The importance of electric facilities and service delivery in shaping the social and economic progress cannot be underestimated. Ale et al. (2011) opine that availability of these resources serve as the forerunner of economic development, Egbetokun, (2009), Oguzor, (2011), Oisasoje and Ojeifo, (2012) supported the view as capable of revamping the economy and transforming the nation if diversified.

The need to consider spatial dimensions in the equitable service delivery of electricity cannot be under-estimated. Klein et al. (2012) posit appropriate electric facilities distribution, Wächter, (2013) opine indispensability of spatial planning to avert skewed distribution of prosperity and ensure sustainable development, Okuku et al. (2014) submit that the availability of spatial data would serve as guide to the government decision makers or the private corporate body's decision making in planning for public service delivery of electricity. While Nichols, (2010), observes the forgo of proper due diligence procedure to the selection of ill equipped contractors, Afify, (2001) notes insufficient information about people's socioeconomic background coupled with inadequate spatial data as setback of privatisation of service delivery to address the issue of spatial inequality, as observed by (Nichols, 2010; World Bank, 2004; Nightingale and Pindus, 1997. Supporting the theoretical gap, American Society of Civil Engineer (ACSE, 2013), advocates for a well nurtured infrastructure with collaborative effort of all the stakeholders, as an enhancer for a healthy, strong, financially successful, and wealthy nation, similarly, the work of Jahan and McCleery (2005) and Olaseni and Alade (2012) respectively were also in consonance with the theoretical gap to address the above explained problem statement of the paper.

### **Review of Relevant Literature**

Past literatures reviewed, averred that power reform has failed to address the issues of rural electrification and urban poor, as observed by Karekezi and Kimani (2002). Socio-spatial inequality in Nigeria could be attributed to the foregoing, as it leads to deprivation of the less privileged from access to electricity supply. Privatisation of electricity service delivery, as opined by Pavanelli, (2015) has biting effect on the less privilege. Its poor performance has led to the impoverishment of the nation's economy as observed by Okekale (2015), Aminu and Peterside (2014) and Mahmoud (2005). It also hampered engagement of small scale enterprises to boost their standard of living, according to (Etieyibo, 2011; Adeyemi, 2007 as cited in Okafor, 2008).

### **Privatisation of electricity and its social-inequalities outcomes in Nigeria**

Electricity service delivery in Nigeria is in a deplorable condition, as submitted by (Joseph, 2014). This has virtually affected all facets of live since economic development and the growth of any nation is solely dependent on its effectiveness as observed by (Joseph, 2014; Oghogho et al., 2014; Amoo and Fangbale 2013; Newsom, 2012; and Oyedepo, 2012). While a good number of industries and establishments have packed up due to poor electricity supply, (Adeyemi, 2007), the majority of other functioning industries are running their activities using generator on daily bases, (Edukugbo, 2014; Obasi and Ayansina, 2013; Leech, 2011). The negative implication of this kind of economy is hydra-headed; ranging from high production cost, downsizing and rightsizing of labour, outright lay off of workers, increase in unemployment rate, pauperisation and poverty development leading eventually to social inequality (Briceno-Garmendia, and Shkaratan, 2011). It has been observed that the outcome of privatisation further impoverish the poor and widen socio-spatial inequality in the nation (Aminu and Peterside, 2014; Tetteh, 2013). Deprivation and social exclusion, (Economic and Social Inclusion Corporation, 2015) of some social groups from access to some public and private services such as, light, among other indicators of poverty mentioned by Townsend (1979), has been observed as one of the outcomes of privatisation causing socio-spatial inequality in Nigeria.

## **CONCLUSION AND RECOMMENDATION**

### **Conclusion**

The social implication of the privatisation approach to electricity service delivery in Nigerian context has formed the background for its major criticism as it has no social face, not having inclination for people's welfare. The reason for this is the skewed distribution of electric facilities over the space, long time disinvestment in electric facilities. Moreover, the arrangement of these facilities was not in consonance with the neighbourhood setting and also does not follow population expansion and developmental trend. These led to deterioration of these facilities and overstretching of available ones thereby causing total breakdown of the facilities.

### **Recommendations**

Few recommendations put forward are:

- Development policies and decision making on the privatisation of electricity service delivery should not be independent of social welfare and equity.
- Comprehensive strategy that will integrate implementation of electric facilities distribution alongside with different social groups should be embarked upon.
- It is therefore required that, a level playing ground for everyone from the poorest to the wealthiest individual within the society be given equal right and opportunities when it comes to service delivery of public utility such as electricity supply.
- Carrying out the procedure of privatisation of public utilities service deliveries like electricity with due diligence as against the disjointed, muddling through, trial-by-error kind of planning and policy implementation the kind of power reform process be embraced. In doing so, every fabrics of the society would be given equal consideration.
- Socio-spatial inequality would be easily addressed, where human centred policy, realistic tendency, and social welfare undertone, forms the fundamental focus of the policy makers and are guided in the course of implementing its privatisation approach, such as public utility like electricity supply.

## **REFERENCES**

- Adam, S. (1936). *The Wealth of Nations: The most comprehensive analysis ... form of Keynes's General Theory of Employment, Interest and Money.*
- Adeyemi, A.O. (2012). How the other Half Live. *The One Hundred And Nineteenth (119th) Inaugural Lecture.* The Library and Publications Committee University of Ilorin, Ilorin, Nigeria: Unilorin Press.
- Aderamo, A. J., & Aina, O. A. (2011). Spatial Inequalities in Accessibility to Social Amenities in Developing Countries: A Case from Nigeria. *Australian Journal of Basic and Applied Sciences*, 5(6), 316-322.
- Adeyemi, B. (2007). Eight years of Obasanjo: Foundation laid for Industrial Revival. *The Guardian.*
- Afify, A.S. (2001). *Privatization: problems of implementation in Egypt.* (PhD thesis). Aston University.
- Ale, M. O., Abisuwa, T. A., Ologunagba, F. O., & Ijarotimi, O. (2011). Rural infrastructural development, food security and city congestion in Nigeria. *Journal of Research in National Development*, 1(9), 124-130.
- Alkire, Roche & Seth (2011) in United Nations (2013). *Inequality Matters.* Department of Economic and Social Affairs Report of the World Social Situation. United Nations publication, New York. Retrieved from <http://www.un.org/esa/socdev/documents/reports/InequalityMatters>.
- Aminu, I., & Peterside, Z. B. (2014). The Impact of Privatization of Power Sector in Nigeria: A Political Economy Approach. *Mediterranean Journal of Social Sciences*, 5(26), 111–118

- Amoo, O. M., & Fagbenle, R. L. (2013). Renewable municipal solid waste pathways for energy generation and sustainable development in the Nigerian context. *International Journal of Energy and Environmental Engineering*, 4(1), 1-17.
- ASCE (2013). *Report card for America's infrastructure by America Society of Civil Engineers*. USA. Retrieved from <http://www.asce.org/Infrastructure/Why-is-Infrastructure-Important/>
- Ayeni, B., & Mabogunje, A. L. (1982). *Political processes and regional development planning in Nigeria* (Vol. 82, No. 7). Bernan Press (PA).
- Bernt & Colini (2013) in Kuhn, 2015 Peripheralization: Theoretical Concepts Explaining Socio-Spatial Inequalities. *European Planning Studies*, 23(2), 367–378.
- Briceno-Garmendia C. & Shkaratan M. (2011), *Power Tariffs: Caught between Cost Recovery and Affordability*. World Bank Policy Research Working Paper No 5904. The World Bank, Africa Region, Sustainable Development Unit. The World Bank, Washington, D.C.
- Chotten (2000) in Aminu, I., & Peterside, Z. B. (2014). The Impact of Privatization of Power Sector in Nigeria: A Political Economy Approach. *Mediterranean Journal of Social Sciences*, 5(26), 111–118.
- Danson & De Souza (2012) in Kuhn (2015). Peripheralization: Theoretical Concepts Explaining Socio-Spatial Inequalities. *European Planning Studies*, 23(2), 367–378.
- European Anti-Poverty Network (EAPN, 2015). OSE | Social Investment in the Shadow of the Crisis. Retrieved from, [www.eapn.eu](http://www.eapn.eu).
- Economic and Social Inclusion Corporation (2015), Government of New Brunswick.
- Edukugbo, E. (2014, 1st March). Power Sector Reform: Electricity mess persists as consumers lament extortion. *Vanguard*. Retrieved from <http://www.vanguardngr.com/2014/03/power-sector-reform-electricity-mess-persists-consumers-lament-extortion/>
- Egbetokun, O. A. (2009). Provision of Rural Infrastructures Oyo State Nigeria. *Agricultura, agricultural practice and science journal*, 69(1-2).
- England, E. (2011). Privatization: Analyzing the Process of Privatization in Theory and Practice. *Student Pulse*, 3(8). Retrieved from <http://www.studentpulse.com/articles/566/privatization-analyzing-the-process-of-privatization-in-theory-and-practice>
- Etieyibo, E. (2011). The Ethics of Government Privatisation in Nigeria Thought and Practice: A *Journal of the Philosophical Association of Kenya (PAK) New Series*, 3(1), 87-112
- Eyles, (1996) in Aderamo, A.J. & Aina, O.A. (2011). Spatial Inequalities in Accessibility to Social Amenities in Developing Countries: a Case from Nigeria. *Australian Journal of Basic and Applied Sciences*, 5(6), 316-322
- Fulmer, Jeffrey (2009). *What in the world is infrastructure?* PEI Infrastructure Investor (July/August): 30–32.
- Flynn and Asquer, (2013). In K. Tetteh (Ed). *The Pros and Cons of Privatization: A Critical Assessment* Munich, GRIN Publishing GmbH. Retrieved from <http://www.grin.com/en/e-book/263720/the-pros-and-cons-of-privatization>
- GCCC (2007) in Teriman, Tan Yigitcanlar, (2011), Social Infrastructure Planning and Sustainable Communities: Example from South East Queensland. *Australia World Journal of Social Sciences*, 1(4), 23-32.
- Gilroy, L. C. (2010). *Local Government Privatization 101*. Policy Brief 89. Reason Foundation. Retrieved from <http://reason.org/news/show/local-government-privatization-101>
- Hussain, A., (2014). State Owned Enterprises and Private Firms in A Competitive Environment: A Case of Pakistan. *City University Research Journal*, 4(1). Retrieved from <http://www.cityuniversity.edu.pk/curj/Journals/Journal/Jan%202014/08%20Arif%20Hussain.pdf>
- In the Public Interest* (2015) 1825 K St. NW, Suite 210, Washington, DC 20006, 202-429-5091 [info@inthepublicinterest.org](mailto:info@inthepublicinterest.org)
- International Institute for Labour Studies (IILS) (1998). Annex I: issues for discussion. In J.B. Figueiredo & A. de Haan (Eds). *Social exclusion: an ILO perspective*. International Institute for Labour Studies Research Series 3. Geneva: International Labour Organisation.
- Investopedia, (2015). Privatization. Retrieved from <http://www.investopedia.com/terms/p/privatization.asp>
- Jahan, S., & R. McCleery (2005). Making infrastructure work for the poor, UNDP. Retrieved from [www.undp.org/poverty/docs/fpage/Synthesisreport.pdf](http://www.undp.org/poverty/docs/fpage/Synthesisreport.pdf). In T.P. Ogun (2010)

- Ogun, T. P. (2010, August). Infrastructure and poverty reduction: Implications for urban development in Nigeria. In *Urban Forum* (Vol. 21, No. 3, pp. 249-266). Springer Netherlands.
- Jones, Leimgruber & Nel (2007) in Kuhn(2015). Peripheralization: Theoretical Concepts Explaining Socio-Spatial Inequalities. *European Planning Studies*, 23(2), 367–378.
- Joseph, IseOlorunkanmi O. (2014) Issues and challenges in the Privatized Power Sector in Nigeria *Journal of Sustainable Development Studies*, 6(1), 161-174.
- Kahn A. (1979). *Social Policy and Social Services. 2nd Ed.* New York: Random House. 28
- Kanayo, O. (2014) Poverty Incidence and Reduction Strategies in Nigeria: Challenges of Meeting 2015 MDG Targets. *Journal of Economics*, 5(2), 201-217. Kamla-Raj.
- Karekezi, S. & Kimani, J. (2002). Status of Power Sector Reform in Africa: Impact on the Poor. *Energy Policy*, 30(11-12).
- Klein, G., Klug, N., & Todes, A. (2013). Spatial planning, infrastructure and implementation: implications for planning school curricula. *Town and Regional Planning*, 60, 19-30.
- Kosar, K. R. (2006). *Privatization and the Federal Government: An Introduction*. Congressional Research Committee (CRS) Report for Congress. Retrieved from <https://www.fas.org/sgp/crs/misc/RL33777.pdf>
- Kühn, M. (2015). Peripheralization: Theoretical Concepts Explaining Socio-Spatial Inequalities. *European Planning Studies*, 23(2), 367–378.
- Leech, N. (2011). *Privatization: The Public Policy Debate*. Washington DC, USA: League of Women Voters. Retrieved from <http://lwv.org/content/privatization-public-policy-debate>
- Levitas, R. (2006). The concept and measurement of social exclusion. In C. Pantazis, D., Gordon, & R. Levitas (Eds.) *Poverty and Social Exclusion in Britain*, Bristol:Policy Press.
- Mack, J. & Lansley, S. (1985). *Poor Britain*. London: George Allen & Unwin.
- Mahmoud, D. (2005). Privatization and Poverty Reduction in Nigeria. Paper presented at a two day meeting of on *Pro-Poor Growth in Nigeria*, Overseas Development Institute, London.
- Matheison, J. et al, (2008). *Social Exclusion Meaning, measurement and experience and links to health inequalities A review of literature*. WHO Social Exclusion Knowledge Network Background Paper 1, Institute for Health Research Lancaster University, UK. Social Exclusion Knowledge Network, WHO Commission on the Social Determinants of Health (CSDH).
- McKenzie, D., Mookherjee, D., Castañeda, G., & Saavedra, J. (2003). The distributive impact of privatization in Latin America: Evidence from four countries [with comments]. *Economia*, 3(2), 161-233.
- Meyerman (2004) in Mahmoud D (2005). Privatization and Poverty Reduction in Nigeria. Paper presented at a two day meeting of on *Pro-Poor Growth in Nigeria*, Overseas Development Institute, London
- Newsom, C., (2012). The Sungas Project, International Institute for Environment and Development. In Nwofe, P.A. (2014).Utilization of Solar and Biomass Energy- A Panacea to Energy Sustainability In A Developing Economy. *International Journal of Energy and Environmental Research*, 2(3), 10-19. European Centre for Research Training and Development
- Nichols, R. (2010). *The Pros and Cons of Privatizing Government Functions*. Management & Labour
- Nightingale, D.S. & Pindus, N.M. (1997). *Privatization of Public Social Services: A Background Paper*. Washington DC, USA: Urban Institute. Retrieved from <http://webarchive.urban.org/publications/407023.html>
- Nnoli, Okwudiba (1978) *Ethnic Politics in Nigeria* Fourth Dimension Publishers, Enugu. In Aka, E. O. (1995). Regional Inequalities in the Process of Nigeria's Development: Socio-Political and Administrative Perspective. *Journal of Social Development in Africa*, 10(2), 61-80.
- Obasi,S. & Ayansina, C. (2014,January 28). Nigeria: Power Supply Worsens in Q4 2013 – NOIPolls. *Vanguard*. Retrieved from <http://www.vanguardngr.com/2014/01/power-supply-worsens-q4-2013-noi-polls/>
- Oghogho, I., Sulaimon, O., Adedayo, B.A., Egbune, D., Kenechi, A.V. (2014). Solar energy potential and its development for sustainable energy generation in Nigeria: a road map to achieving this feat. *International Journal of Engineering and Management Sciences*, 5(2), 61.
- Oguzor, Nkasiobi Silas (2011). A spatial analysis of infrastructures and social services in rural Nigeria. *GeoTropico*, 5(1), 25-38.<http://www.geotropico.org/> A peer-reviewed online journal

- Okafor, E.E. (2008). Development Crisis of Power Supply and Implications for Industrial Sector in Nigeria. *Studies of Tribes and Tribals*, 6(2), 83-92. New Delhi: Kamla-Raj.
- Okekale, M. (2015). *Governance, Pains of epileptic power supply*. Nigeria's Largest Newspaper Directory. <http://www.opinions.ng/pains-of-epileptic-power-supply/>
- Okuku, J., Bregt, A., & Grus, L. (2014). Assessing the Development of Kenya National Spatial Data Infrastructure (KNSDI). *South African Journal of Geomatics*, 3(1), 95-112.
- Okoye, C.O. & Onwuka, S.U. (2014) Basic Physical Infrastructure Facilities in Awka Public Housing Estates. *Civil and Environmental Research*, 6(4), 61-71.
- Olaseni, M., & Alade, W. (2012). Vision 20: 2020 and the challenges of infrastructural development in Nigeria. *Journal of Sustainable Development*, 5(2).
- Olayiwola, L., M; Adeleye, O. and Adeleke, O. (2005). Spatial Variation in Residential Land Value Determinants in Lagos Nigeria. *5th FIG Regional Conference Accra*, Ghana, March 8-11, 2006
- Oisasoje, O.M. and Ojeifo, S A. (2012). The Role of Public Infrastructure in Poverty Reduction in the Rural Areas of Edo State, Nigeria. *Research on Humanity and Social Sciences*, 2(7).
- Oyedepo, S.O. (2012). On energy for sustainable development in Nigeria. *Renewable and Sustainable Energy Reviews*, 16(5), 2583–2598.
- Oyerinde, (2006) in Aderamo, A.J. & Aina, O.A. (2011). Spatial Inequalities in Accessibility to Social Amenities in Developing Countries: a Case from Nigeria. *Australian Journal of Basic and Applied Sciences*, 5(6), 316-322
- Pavanelli, R. (2015). *Public Services International*. Last modified on Wednesday 18 March 2015 09
- Poole Jr., R.W. (2008). Privatization. *The Concise Encyclopedia of Economics*. Library of Economics and Liberty. Retrieved from <http://www.econlib.org/library/Enc/Privatization.html>
- Poverty and Social Exclusion-PSE (2012). *PSE UK Working papers*. Retrieved from <http://www.poverty.ac.uk/pse-research/pse-uk-2012>
- Rondinelli, D. A., & Iacono, M. (1996). Strategic management of privatization: a framework for planning and implementation. *Public Administration & Development (1986-1998)*, 16(3).
- Salimi, M., Soltanhosseini, M., Padash, D. & Khalil, E. (2012). Prioritization of the Factors Effecting Privatization in Sport Clubs: With AHP & TOPSIS Methods - Emphasis in Football. *International Journal of Academic Research in Business and Social Sciences*, 2(2).
- Sepehr, V. (2013). The impact of privatization on the macroeconomic variables. *Advances in Environmental Biology*, 7(9), 2341-2347.
- Sullivan, Arthur and Sheffrin, Steven M. (2003). *Economics: Principles in action*. Upper Saddle River, New Jersey 07458: Pearson Prentice Hall.
- Teriman, S. & Yigitcanlar, T. (2011). Social Infrastructure Planning and Sustainable Communities: Example from South East Queensland, Australia. *World Journal of Social Sciences*, 1(4), 23-32
- Tetteh, K. (2013). *The Pros and Cons of Privatization: A Critical Assessment*. Munich, GRIN Publishing GmbH. Retrieved from <http://www.grin.com/en/e-book/263720/the-pros-and-cons-of-privatization>
- Townsend, P. (1979) *Poverty in the United Kingdom*. London: Allen Lane and Penguin Books.
- United Nations (2013). *Inequality Matters*. Department of Economic and Social Affairs Report of the World Social Situation. New York: United Nations. Retrieved from <http://www.un.org/esa/socdev/documents/reports/InequalityMatters.pdf>
- Vogt, (2009) in Kühn, M. (2015). Peripheralization: Theoretical Concepts Explaining Socio-Spatial Inequalities. *European Planning Studies*, 23(2), 367–378.
- Walker, A. (1997). Introduction: the strategy of inequality. In A.Walker & C. Walker (Eds.). *Britain Divided: The Growth of Social Exclusion in the 1980s and 1990s*. London: Child Poverty Action Group. Ref: Muddiman, D. Theories of Social Exclusion and the Public Library Dave Muddiman
- Wächter, Petra (2013) The Impacts of Spatial Planning on Degrowth. *Sustainability*, 5(3), 1067-1079
- World Bank (2004). An Assessment of Privatization. *World Bank Research Observer*, 19(1), 87-118

## **SOCIO-SPATIAL INEQUALITIES IN SARAWAK: THE ROLE OF SARAWAK CORRIDOR OF RENEWABLE ENERGY (SCORE)**

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**ABSTRACT:** The failure of the colonial government to develop the economic sector for this state was due to the adoption of a biased development approach. The biased approach focused on the potential of existing urban areas, and on economic growth oriented rather than distributed growth. Various economic development projects had been implemented since Sarawak became part of Malaysia. As the biggest state in the country with multi-ethnic population, Sarawak definitely needs more strategic development approach and attention from the central government. The Ninth Malaysia Plan has shown that spatial inequality in Sarawak has widened and needs attention. The launching of Sarawak Corridor of Renewable Energy (SCORE) marked the shift to the new approach of development in improving the spatial inequality in Sarawak through regional development strategy. This paper discusses the spatial inequality in Sarawak and explore the potential role of SCORE in regional development.

*Keywords:* inequality, corridor development, regional development, economic growth, spatial inequality

### **INTRODUCTION**

Sarawak was colonised by Brooke regime, and has faced socio-spatial inequalities in the development of space, similar to what Peninsular Malaysia experienced after British colonisation. The differences of population settlement and development inequality in Sarawak are due to the historical factors where the colonial had developed the most profitable areas such as Kuching, Sibul, Bintulu and Miri. Bintulu and Miri divisions are abounded with natural resources such as oil and gas while Kuching is important for business and administration activities. Meanwhile, Sibul was developed by the colonial to produce rubber raw materials for international export during the Korean War between 1950 and 1953, and was then continued by timber industry. The Sarawak government estimated that 3,200 kilometres square of the land was not suitable for agriculture; it is peat soil, sandy and extremely acidic (Lee, 1970).

The livelihood of the rural people such as the Iban, Bidayuh, Malay and Melanau were often not profitable and it included swamp and wet land rice cultivation, sago and coconut growing and fisheries activities. Farming activity is commonly a small-scale, low-yielding and low value system whereby majority of the farmers were involved in subsistence production and shifting cultivation of rice (King and Jawan, 1992). Apart from low income and low productivity, rural development in Sarawak also faces other challenges related to land tenure systems and administration approach by the colonial regimes. The Brooke development policy has lead to negative impacts to development in Sarawak, that includes spatial and development inequality. The land development policy introduced also led to the increased poverty rates among farmers in Sarawak (King and Jawan, 1992) especially among Bumiputera minorities (Berma, 2001; Ngidang 2002; Jawan, 2000; Nair, 2000). At the same time, the colonial dualisme development approach (Foo, 1990) also contributed to the spatial inequality among rural and urban peoples (Jomo and Kin Woon, 1987). In the end, the gaps of income distribution in Sarawak also increased to the highest rate especially between Malay and Bumiputra minorities. For example, the household income gap ratio between the Iban and Malay was 1:1.88; and Bidayuh and Malay 1:1.60 (Berma, 2004). This phenomenon did not only occur at ethnic level but also in the context of urban and rural (Minos, 2000; Ishak, 2000). Although the rural population in Sarawak is higher than the urban population by about 75 per cent, the former contributes less than 10 per cent of the Gross Domestic Product (GDP) (Berma, 2004). The implementation of the New Economic Policy (1971-1990) and the National Development Policy (1991-2000) have been called into question as poverty rates among the Bumiputera in Sarawak are still high (Berma, 2003 and

Berma et al., 2006). It clearly shows that the spatial development inequality and poverty in the state are affecting peoples' socioeconomic status especially among the minority ethnic groups due to factors including topography, soil quality and altitude as mentioned by the previous scholars such as Jackson (1968), Lee (1970) and Hatch and Lim (1979). In terms of administration, the state of Sarawak is divided into twelve divisions which are of higher hierarchy than districts (see Table 1).

Table 1: Sarawak Administrative Divisions and Districts

<b>DIVISION</b>	<b>DISTRICT</b>
Kuching	Kuching, Bau, Lundu
Kota Samarahan	Samarahan, Simunjan, Asajaya
Serian	Serian, Tebedu
Sri Aman	Sri Aman
Betong	Betong, Saratok
Sarikei	Sarikei, Pakan, Julau, Meradong
Kapit	Kapit, Song, Belaga
Sibu	Sibu, Kanowit, Selangau
Mukah	Mukah, Dalat, Matu dan Daro
Bintulu	Bintulu, Tatau
Miri	Miri, Marudi
Limbang	Limbang, Lawas

Source: Unit Perancang Ekonomi Negeri Sarawak (2014) and Borneo Post Online (2015)

Each division is headed by a resident while district is headed by a district officer who is responsible for the district development. The formation of divisional and district offices enables Sarawak Government manage every division effectively, while considering its topographical features and scattered population distributions. Sarawak Government also establishes sub-district offices such as Beluru Small District Office, Long Lama Small District Office and Niah Small District Office to ensure that the rural communities' accessibility to socioeconomic information such as agricultural aids, subsidies and any government programmes, hence enabling rural communities to, among others, lodge complaints related to development or socioeconomics issues

## **SOCIO-SPATIAL INEQUALITIES IN SARAWAK**

Socio-spatial inequalities in poverty, health, income and education present significant economic and political challenges for the governments in many developing countries. According to Kanbur and Venables (2005) and Kanbur et al., (2006), the systematic evidence on the extent of socio-spatial inequality in developing countries is still relatively scarce. A growing body of work has documented the existence of socio-spatial inequalities in many forms in various countries in Asia, Europe, Africa and Latin America because rapid economic growth is often associated with uneven regional and urban development, policy makers are also concerned that development is likely to exacerbate rather than reduce socio-spatial inequalities. Yet, despite these concerns, there seems to be little consensus on the causes of socio-spatial inequality and how policy makers should respond to address these socio-spatial inequalities. Globally, the impact of this phenomenon to economic system and socio-spatial development in developing country become an important issue and the impacts to regional and rural development has been discussed widely (Lee, 1970 and McGee, 1995). The development inequality phenomenon in Sarawak is also associated with cultural system of the local ethnic groups, land tenure systems, topography and soil quality that is not for agricultural activities (Jackson, 1968; Hatch and Lim, 1979). King (1992) also emphasised that the issue of sparsely populated land. The government also faces torrential rain that causes flooding and soil erosion, and also some areas of land in Sarawak are less acidic.

Bumiputera's involvement in Sarawak economy especially in high profitable sectors such as business, manufacturing and construction remains a low 8.4 per cent (Berma, 2004). Although Sarawak is one of the petroleum exporters in this region, local workers only constitute 1.1 per cent of the total workforce (Unit Perancang Ekonomi Negeri Sarawak, 2009). About 14.7 and 32.5 per cents of Sarawak population are involved in the secondary and tertiary sector respectively (Unit Perancang Ekonomi Negeri Sarawak, 2007). The high participative rate in tertiary sector was due to the demand

from tourism and tourism-based industries in the state. In terms of settlement, the majority of Sarawakians live in rural areas and the pattern of these settlements is closely related to the type of work involved. According to Walton (1990) and Unit Perancang Ekonomi Negeri Sarawak (2007), about 75 per cent of Sarawakians live scattered in rural areas and 25 per cent in main cities such as Kuching, Miri, Sibul and Bintulu. The majority of the rural populations are Bumiputera (Unit Perancang Ekonomi Negeri Sarawak, 2007). In term of settlements, most of the Malays lives in Kuching and Miri divisions and work in fisheries and subsistence farming. The Melanaus are more concentrated in coastal areas of Mukah, Sibul and Bintulu and involve in the sago industry and fisheries. Meanwhile the Ibans are largely concentrated in Miri, Kuching, Sibul, Kapit, Kuching and Sri Aman; they depend on agricultural activities such as rice, rubber, coconut and palm oil cultivation as their main economic activity.

The Bidayus are also settled in Kuching and Samarahan divisions especially in Lundu, Bau, Padawan, Penrissen, Kuching and Serian (James, 2003; Rensch et al., 2006). However, there are also Bidayus residing in other divisions due to their skills to work in certain fields such as in the services and manufacturing sector (Minos, 2000). The Bidayuh's economic activity do not differ too much whereby they are also involved in cultivating low land and high land paddy and commercial agricultural activities like planting corn, palm oil, pepper, pineapple, cocoa and small scale rubber plantation (Minos, 2000). Generally, Dayak ethnic groups and other minority of Bumiputera such as Kelabit, Kayan, Kenyah, Orang Ulu, Penan, Lun Bawang settled in the highlands in rural areas. Researchers have looked at the factors such as the suitability of land for agriculture and their culture as the determining factors of the different settlement location among the ethnic groups in Sarawak. The main economic activity of this group is shifting cultivation and they practise traditional technology inherited from ancestors (Unit Perancang Negeri Sarawak, 2007). There are also the Dayaks and other minorities like Kelabit and Melanau running small-scale businesses such as opening a retail stores, food stalls, selling handicrafts, forest products and agricultural products such as fruits and vegetables (Minos, 2000). The Chinese mostly settled in urban area and are involved in large-scale business activities. Similarly, those who live in rural areas are also involved in a small-scale businesses and cultivate pepper, gambier and involved in mining and construction sector (Minos, 2000). Poverty is one of the major developmental issues in Sarawak. Minos (2000) and Ngidang (2002) refer the issue of rural poverty as greatly influenced by the government's attitude which does not give recognition to the status of Native Customary Rights land (NCR) belonging to the indigenous people in rural areas. When an area needs to be developed, residents will be asked to move out and were given no compensation at market price as practiced in the city. Dissatisfaction with the status of land ownership has resulted in decreased productivity of farmers in developing NCR land for agricultural activities like planting large scale of oil palm and pepper (Ngidang and Abdul, 1999; Minos, 2000; Ngidang, 2002). Other problems also include difficulty in obtaining loans from banks and other government financial agencies (Minos, 2000). According to Berma (2004), Abdul Rahman (2006) and Faisal (2009), the cause of poverty in rural areas was a result of behavioural factors, culture and nature of the natives who were resistant towards change, dependent on others and with conservative mindset and bashful attitude.

Lian (2004) and Minos (2003) believe that the issue of poverty is due to the shortage of basic facilities in rural areas such as roads, clean water, electricity, unproductive land, high production costs, lack of accessibility to credit and market opportunities and low incomes from non-farm sources. However, Berma (2004) asserts that the level of education and low skills are the main contributors to poverty in rural areas. In Sarawak, the system of land ownership, Indigenous Land Code is an obstacle to development in the country (King and Mohd Jali, 1992) even though the system is seen as a good approach to protect land owners. The system is also linked to low agricultural productivity among farmers in Sarawak besides the land administration system available. At the moment, the number of agency staff and a number of implementing agencies in Sarawak which is equal to the number of groups in the states in Peninsular Malaysia may not be sufficient in the context of Sarawak (Minos, 2000 and Ngidang, 2002). This is due to the size of Sarawak as the largest state in Malaysia, as King and Jawan (1992) has mentioned, it is also one of the major challenges for development in Sarawak.

## **METHODOLOGY**

This paper utilised qualitative research method such as secondary data from government agencies, previous study and related data on development history, economic report, population census and other documents. According to Hinds et al., (1997), analysis of existing data aims to find answers to research questions that differ from the questions asked in the original research. Cnossen (1997) referred to it as one of the data analysis or information that was either gathered by someone else such as institutions, researchers, NGOs, etc. or for some other purpose than the one currently being considered, or often a combination of the two. In this study, data were gathered from previous study on Malaysia's development reports in Sarawak context, such as state economic reports, and regional development report by RECODA<sup>1</sup>. The literature review of Sarawak historical development (e.g. rural, urban and regional development issues etc.), populations and related data was gathered by previous study from local and international researchers.

## **THE ROLE OF REGIONAL DEVELOPMENT IN SARAWAK - SARAWAK CORRIDOR OF RENEWABLE ENERGY (SCORE)**

As the country's previous development policies have yet to adequately address the problems of uneven development in Malaysia, the failure of this conventional development strategy has been followed by the government intervention to address this issue whereby the idea of regional development through the establishment of development corridors has been officially launched under the Ninth Malaysia Plan (2006-2010). There are five Regional Development Economic Corridors consisting of the East Coast Corridor of Economic Region (ECER), Northern Corridor of Economic Region (ECER), Iskandar Malaysia, Sabah Development Corridor (SDC) and Sarawak Corridor of Renewable Energy (SCORE). In the subjective view, the concept of regions is derived from particular purpose while objective view identified regions according to geographical and physical features (Glasson (1974). In the early 1980s, Glasson and Marshall (2007) and Dawkins (2003) define the region based on developmental approaches. The implementation of regional-based development is an attempt to reduce development imbalances between regions in the country through simulation of new growth centres based on major economic thrusts. In implementing SCORE, there are a few goals namely: to solve the problem of economic imbalances, to promote economic growth in the high chain, to strengthen institutional capacity and implementation as well as increasing the capacity for knowledge (Unit Perancang Ekonomi Negeri Sarawak, 2009). Through SCORE, Sarawak Government estimates a project developments; and an increase in employment opportunities by 2.5 fold from 0.9 million in 2006 to 2.5 million in 2030 (Unit Perancang Ekonomi Negeri Sarawak, 2009). SCORE is located in the central region, covering the total land area of over 320 kilometres from the coastal area of Tanjung Manis in Sarikei to Samalaju in Bintulu, inclusive of both the surrounding area as well as the interior. This large-scale and long-term developmental project is expected to cover the total area of 70,709 square kilometres, lasting until 2030, and involving a population of 607,800 people. There are 10 targeted primary industry will contribute to this corridor such as aluminium, glass, marine engineering, based Metal, petroleum-based products, wood products, aquaculture, livestock, palm oil and tourism (Unit Perancang Ekonomi Negeri Sarawak, 2014).

In terms of revenue, SCORE is expected to increase five growth poles of Sarawak's GDP to RM118 billion and increase per capita income to RM97,400.00 by 2030 (RECODA, 2015). SCORE is a major initiative undertaken to develop the central region of the state in line with the nation's Vision 2020. Based on the Growth Poles theory by Perroux (1955) where the attraction of activities and the concentration of growth in poles, from where the diffusion of growth is expected to occur towards the

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<sup>1</sup>The Regional Corridor Development Authority (RECODA) is the agency tasked with overseeing and managing SCORE. The Chief Minister of Sarawak is the RECODA board and RECODA has board representation from all of the relevant federal and state agencies to ensure swift decision making and traditional government procedural delays are avoided. RECODA have to promote SCORE effectively by creating and stimulating new and existing markets and to work towards achieving the ambitious investment goals set by the State (RECODA, 2015).

secondary growth poles (Perroux, 1955; Aydalot, 1965; Boudeville, 1968); Baleh, Murum, Samarakan, Long Lama, Semop, Balingian, Selangau, Bakun and Nanga Merit stand to benefit greatly from the development of the major growth nodes and from the spatial development of the SCORE region as a whole. The major objective has been the increase of the industrial product and the concentration of development in large urban centres such as Samalaju, Tanjung Manis, Baram, Mukan and Tunoh (Figure 1) which had the necessary prerequisites such as infrastructure, labour force, market and so on for the attraction and operation of large industrial complexes propulsive industries (Lasuen, 1969). Thus, the concept of “top-down” intervention prevails, which means that state intervention should be intense through the means of regional policy, so as to boost the process of concentration and diffusion of growth from the pole out to the other areas (Hadjimichalis, 1992; Christofakis, 2001). On a theoretical level, the explanation of regional disparities by Myrdal as well as the concentration and dispersion theories, as mainly expressed by Christaller (1933), Perroux (1955) and Boudeville (1968) have greatly supported the formation of the growth poles and diffusion model (Rodrigue et al., 2006). Growth poles, metropolitan centres and growth axes are the main forms of polar concentrations (Vinuela-Jimenez et al., 2010).

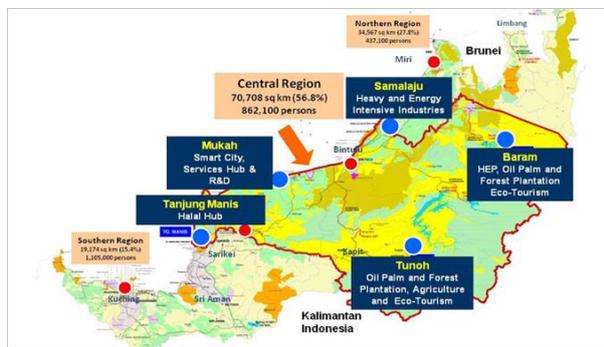


Figure 1: The Main Focus Area of SCORE Projects in Sarawak Regional Development  
Source: RECODA (2015)

In the case of SCORE, it is expected that Samalaju will develop rapidly and will bring more socioeconomic benefits to surroundings area due to its successful industrial development and abundant of natural resources, infrastructure, basic facilities being the first regional growth centre in Sarawak introduced by the federal government in 1990's (Sulehan, 1992). It is targeted to balance Sarawak population and offers more job opportunities to the local especially from less developed areas in SCORE targeted area. The concept of this regional approach is to reduce migration from city to city and between regions. SCORE development programmes should not repeat the mistakes that have been experienced by the other region in Peninsular Malaysia whereby the population is not enough to support new settlements and lead to the failure of the establishment of new town in regional development programme during that time. In addition, low wage rates in oil palm sectors also led the population to migrate to other economic sectors and thus make the settlement efforts a failure (Wong, 1989). In 2015, the government announced Baram Growth Node that consists of numerous Integrated Upland Agricultural Stations (Talip, 2015). An initial amount of RM6 million was allocated for the construction of access roads and farm roads. The selection of Baram as a new growth nodes is timely as it has resources that can be explored and it is expected to spread the effects of development goals to the less develop area. This growth can also reduce the migration of people from rural areas to urban areas such as from rural area to Miri which has been developed by oil industry and service sector that has been attracting rural and outside people over the years.

## CONCLUSION

SCORE is a government effort to address the socio-spatial and developmental inequalities in Sarawak. Low participation of local people in the highly profitable economic sectors such as petroleum, oil and gas-based industries clearly show the negative socio and economic developmental impact on local community. The government should ensure greater participation of locals i.e. the Bumiputera in the planned and structured SCORE's development socio and economic activities. The

government should disperse industrial development through rural urbanisation program, private investments and entrepreneurial development among Bumiputera. It is important to ensure that this regional developmental project brings better quality of life to the locals by sustaining the environment, culture and local economy.

## REFERENCES

- Aydalot, P. (1965). Note sur les economies exterenes et quelques notions connexes. *Review Economique* 16, pp. 944-973.
- Abdul Rahman E. (2006). Rethinking development and development studies. *Akademika Journal*, 68: pp.1-4.
- Berma, M. (2001). Iban Poverty: A Reflection on its Causes, Consequences: and Policy Implications. Paper presented at *Borneo 2000 Conference*, Organised by UNIMAS on 10-14 July 2000 at Crown Plaza Riverside Hotel, Kuching.
- Berma, M. (2003). Toward National Vision Policy: Review of NEP and NDP among the Bumiputera Communities in Sarawak. Paper presented at the *Seminar on the Bumiputera Policy: Dynamics and Dilemma*, Organised by Universiti Sains Malaysia at Hotel Equatorial Penang, on 23-25 September, 2003
- Berma M. (2004). Towards the National Vision Policy: Review of the Economic Policy and New Development Policy among the Bumiputera Communities in Sarawak. *Journal of Malaysian Studies*, 21(1), 211-256.
- Berma, M., Shahadan, F. & Abdul Ghafor, S. (2006). Alleviating Bumiputera Poverty in Sarawak: Reflections and Proposal. *Malaysian Research Group International Conference MRG-IC2006: Unity of Mindset: A driving Force for Synergy and Development of Solid Research*, 19-21 Jun 2006, University of Salford, United Kingdom
- Borneo Post Online (2015, Sept 23). *Penyerahan kuasa kepada Residen Serian, 1 Oktober*. Retrieved from: <http://www.theborneopost.com/2015/09/23/penyerahan-kuasa-kepada-residen-serian-1-oktober/>
- Boudeville, J.R. (1968). *L' espace et les poles de croissance*. Paris: PUF.
- Christaller, W. (1933). *Central Places in Southern Germany*, translated by Carlisle W. Baskin (1966), Englewood Cliffs, N.J.: Prentice-Hall.
- Christofakis, M. (2001). *Local Development and Regional Policy*. Athens: Papazisis.
- Crossen, C. (1997). *Secondary research: learning paper 7*. School of Public Administration and Law, the Robert Gordon University.
- Dawkins, C.J. (2003). Regional Development Theory: Conceptual Foundations, Classic Works, and Recent Developments. *Journal of Planning Literature*, 18(2), 131-172.  
doi:10.1177/0885412203254706
- Foo, A.K. (1990). Land classification and land tenure in Sarawak in relation to land development. *Sarawak Gazette, CXII, No. 1496*: pp.17-21.
- Faisal. S.H. (2009). The politics of development in Sarawak. *Akademika Journal*, 77: pp.91-111.
- Glasson, J. (1974). *An introduction to regional planning (Second edition.)*. London: Hutchinson & Co. (Publishers) Ltd.
- Glasson, J., & Marshall, T. (2007). *Regional Planning*. London: Routledge Taylor and Francis Group
- Hadjimichalis, C. (Ed.). (1992). *Regional Development and Policy, Texts from the International Experience*. Athens: Exantas.
- Hatch, T. & C.P. Lim. (1979). *Shifting Cultivation in Sarawak*. A report based upon the workshop on shifting cultivation held in Kuching on 7-8<sup>th</sup> December, 1978. (Eds.). Soils Division, Research Branch, Department of Agriculture, Sarawak.
- Hinds P.S., Vogel R.J. & Clarke-Steffen L. (1997). The possibilities and pitfalls of doing a secondary analysis of a qualitative dataset. *Qualitative Health Research* 7(3): 408-424.
- Ishak, S. (2000). Economic Growth and Income Inequality in Malaysia, 1971-95. *Journal of the Asia Pacific Economy*, 5(1&2), 112-124.
- Jackson, J.C. (1968). *Sarawak: A Geographical Survey of a Developing State*. London: University of London Press.

- James, D.M. (2003). Cohesiveness towards a common goal-a knowledgeable and progressive community. In James. D.M, Ahi, A.S & Nicholas A. (Eds.). *Creating a new Bidayuh identity*. Dayak Bidayuh National Association, Sarawak.
- Jawan, J. (2000). Nationalizing Regional Politics. *Paper presented at the BORNEO 2000 Conference*, organized by UNIMAS on 10-14 July 2000 at Crown Plaza Riverside Hotel, Kuching.
- Jomo. K.S. & Kin Woon, T. (1987). Sifat pemerintah di Malaysia dan implikasinya untuk perancangan pembangunan. Dalam Sains Sosial Malaysia (Eds.). *Pembangunan di Malaysia: Perencanaan, Pelaksanaan dan Prestasi*. Persatuan Sains Sosial Malaysia.
- Kanbur, R. & Venables, A. J. (2005). Spatial Inequality and Development. In R. Kanbur & A.J. Venables (Eds.). *Spatial Inequality and Development*. Oxford: Oxford University Press.
- Kanbur, Ravi, Venables, Anthony J. & Wan, Guanghua. (2006). *Spatial Disparities in Human Development: Perspectives from Asia*. New York: United Nations.
- King, V. (1992). *In-Situ Development Land in Rural Sarawak*. In *Issues in Rural Development in Malaysia*.(Eds). Dewan Bahasa dan Pustaka, Kuala Lumpur.
- King, V.T. & Jawan, J. (1992). Resettlement in Sarawak. In V.T. King & N.M. Jali (Eds.). *Issues in Rural Development in Malaysia* (pp 145-170). Kuala Lumpur: Dewan Bahasa dan Pustaka.
- King, V. & Mohd Jali, Nazaruddin (Eds.) (1992). *Issues in Rural Development in Malaysia*. Dewan Bahasa dan Pustaka, Kuala Lumpur.
- Lasuen, J. R. (1969). On Growth Poles. *Urban Studies* 6(2), pp. 137-161.
- Lee, Y. L. (1970). Natural Regeneration and Reforestation in the Peat Swamp Forests of Sarawak. *Tropical Agriculture Research Series* 12, 51-60.
- Lian, F.J. (2004). The Bumiputera policy-dynamics and dilemma: the Orang Ulu perspectives. *Journal of Malaysia Studies*, 21(1&2), pp. 303-314
- Minos, P. (2000). *The Future of the Dayak Bidayuhs in Malaysia*. Kuching, Sarawak: Lynch Media and Services.
- Minos, P. (2003). Culture and economic progress the Bidayuh experience. Dalam James, D.M., Ahi, A.S. & Nicholas, A. (Eds.). *Creating a new Bidayuh identity*. Dayak Bidayuh National Association, Sarawak.
- McGee, T.G. (1995): System of Cities and Networked Landscapes: New Cultural Formations and Urban Built Environments in the Asia-Pacific Region, *Pacific Rim Council on Urban Development, Conference Proceedings*, Brisbane.
- Nair, S (2000). *Poverty in the New Millennium: Challenges for Malaysia*. Paper presented at the DEVNET 2000 Conference, New Zealand.
- Ngidang, D. & Abdul, R. A. (1999). Rural Cooperative Societies and Community Development in Sarawak. In Victor T. King (Eds.), *Rural Development and Social Science Research: Case Studies from Borneo*, pp.251-267. Borneo Research Council
- Ngidang, D. (2002). Contradictions in land development schemes: the case of joint venture in Sarawak, Malaysia. *Asian Pacific Viewpoints*, 43(2): 157-80.
- Perroux, F. (1955). Note sur les notion de pole de croissance. *Economie Appliquee* 7(1-2), pp. 307-320
- Rensch, C. R., Rensch, C. M., Noeb, J., & Ridu, R. S. (2006). *The Bidayuh language: Yesterday, today and tomorrow*. Kuching: DBNA.
- Rodrigue, J.-P., Comtois, C. and Slack, B. (2006). *The Geography of Transport Systems*. New York: Routledge.
- RECODA (2015). *Project Information*. Retrieved from: <http://www.recoda.com.my/invest-in-score/score-areas/>
- RECODA (2015). *Project Information*. Retrieved from: <http://www.recoda.com.my/invest-in-score/project-information/>
- Sulehan, Junaenah. (1992). Regional development in Sarawak: issues and challenges, the way ahead. In Regional development in Malaysia: *Issues and Challenges*. Mohd. Yaakub Hj. Johari (Ed.). Kota Kinabalu: Institute for Development Studies (Sabah).
- Talip, Z. (2015, May 15). Baram Growth Node gets federal nod. *New Sarawak Tribune*.
- Unit Perancang Negeri Sarawak (UPEN) (2007). *Sarawak facts and figures*. Unit Perancang Negeri, Jabatan Ketua Menteri, Wisma Bapa Malaysia. Kuching: Government Printing Office, Sarawak.

- Unit Perancang Negeri Sarawak (UPEN) (2009). *Sarawak facts and figures*. Unit Perancang Negeri, Jabatan Ketua Menteri, Wisma Bapa Malaysia. Kuching: Government Printing Office, Sarawak.
- Unit Perancang Negeri Sarawak (UPEN) (2014). *Sarawak facts and figures*. Unit Perancang Negeri, Jabatan Ketua Menteri, Wisma Bapa Malaysia. Kuching: Government Printing Office, Sarawak.
- Vinuela-Jimenez, A., Rubiera-Morollon, F. and Cueto, B. (2010). An analysis of urban size and territorial location effects on employment probabilities: The Spanish case. *Growth and Change* 41(4), pp. 495-519.
- Walton, J. R. (1990). The economic structure of Sarawak, in King, V. T. and Parnwell, M. J. G.M (Eds.). *Margins and Minorities: The Peripheral Areas and Peoples of Malaysia*, UK: Hull University Press.
- Wong, Tai Chee (1989) *The Resource Frontier Strategy in Peninsular Malaysia: Case Studies of Pahang Tenggara and KESEDAR Regions*. (Ph.D Thesis, The Australian National University).

## **SOCIAL ACCESSIBILITY OF KEDAI RAKYAT 1MALAYSIA AMONG LOW INCOME GROUP IN URBAN PENANG, MALAYSIA**

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**ABSTRACT:** With increasingly higher cost of living in urban areas, various strategies have been undertaken to ease the financial burden, especially of the low income population residing in urban areas. The Malaysian Government, for example, has launched an affordable community shop program, known as *Kedai Rakyat 1Malaysia (KRIM)*, that sells goods with quality comparable to those available at supermarkets or other retail stores but priced at 30 to 40 percent cheaper than the latter. However, previous studies have shown that these stores are less popular among the low income population as their locations are less accessible. There is also the stigma of being associated with poor migrant workers. This study takes into consideration distance as a factor in shopping at *KRIM*. Therefore it aims to investigate whether stigma has hindered low income population from shopping at *KRIM*. A quantitative survey was conducted on 57 households of Flat Taman Seri Pinang, Teluk Air Tawar, Butterworth, Pulau Pinang, which is located approximately 290 metres away from the *KRIM*. The findings indicated that the majority of low income respondents, with monthly household income ranging between RM1,001 and RM2,000 did visit *KRIM*. Furthermore, more than 60 per cent of the respondents strongly disagreed that stigma has led them to be ashamed of shopping at *KRIM*. The findings indicated that most of the respondents would choose to shop at the nearest groceries stores. Thus, in planning for more *KRIM* in the future, location should be taken into consideration to make it more accessible to the targeted group.

*Keywords:* low income, accessibility, KRIM, Malaysia

### **INTRODUCTION**

The increased cost of living within urban area has caused heavy financial burden especially on the low income population. The government has thus undertaken various strategies in attempt to ease the burden of low income population in particular, those living in urban areas. One of the examples is the launch of community shop or store which sells goods at lower prices. However, accessibility to these stores were difficult among low income population since the location of these shop are at the peri-urban areas which was inaccessible to those living within urban centers or rural areas (Samat et al., 2014). As a result, the low income earners, especially those living within inner-city areas, rural areas, and some older suburbs have difficulties in obtaining cheap and healthy food items (Wrigley, 2002). The study conducted by Bell and Standish (2009) for example, found that as many as 23.5 million people in low income communities do not have access to a supermarket or large grocery store within a mile from their residential area. The strategy in United Kingdom and Australia, for example, is to have 'Community Shop' and 'Social Shop'. These stores are opened specifically for the low income group, and entry to these stores is restricted to this group only. Similarly, in Malaysia, *Kedai Rakyat 1Malaysia (KRIM)* was launched to assist low income group by easing off pressure from the rising prices of goods and basic needs (Samat et al., 2014). This strategy by the Malaysian government targets to provide basic needs among low income population especially in urban areas. The government's primary objective in establishing *KRIM* is to help alleviate the burden of low income group, in addition to providing assistance to small-medium entrepreneurs (Sinar Harian, 2014). All *KRIM* products are labelled with 1Malaysia brand logo and sold in *KRIM*, which has established many new branches nationwide throughout the years.

Notably, *KRIM* does not restrict access to target group of population. It differs from the Community Shop in United Kingdom, where entry to the shop is restricted to low income earners and the poor only (Latham, 2013). The Community Shop limits its consumers to registered member with a special access card. Postcode was used to divide customers based on their area of residence. Members obtain benefits from the special discount of up to 70 percent. Due to the exclusive discount enjoyed, the windows of the community shop are frosted to overcome any potential stigma from the surroundings

communities. In Malaysia no such restriction was imposed, the study by Samat et al. (2015) on *KRIM*, found that spatial accessibility to this shop had been limited due to the location of this store at the urban fringe areas. In addition the study also found that stigma among the population deters some people from shopping at *KRIM*, based on response from one respondent interviewed. Therefore, further study should be conducted to investigate whether there exist social barrier to shopping at *KRIM*. The aim of this study is thus to investigate socio-spatial accessibility to *KRIM* in urban Penang, Malaysia.

## BACKGROUND OF THE STUDY

Accessibility can be defined as the degree of ‘accessible’ or ‘get-at-able’ to something or some places (Moseley, 1979). The degree of ‘accessible’ or ‘get-at-able’ would be different based on physical and social dimensions of accessibility (Murad, 2007). The study by Peters et al. (2008) described accessibility as consisting of four main dimensions namely geographic accessibility, availability, financial accessibility and acceptability. Each of these four main dimensions has different supply-and-demand elements. First, geographic accessibility is assessed by examining the physical distance or travel time from services to users’ location. Second, availability is defined as the accessible type of services and also duration of time such as operating hours and waiting times for end users to obtain the services. Third, financial accessibility refers to the user’s willingness and affordability to pay for the price of services without resulting in any economic consequences. Finally, acceptability refers to the users’ responsiveness toward the services they accessed. Moreover, acceptability also takes into account the social and cultural expectations of both individuals and communities. Among the four dimensions of accessibility, geographic accessibility is the easiest to measure.

In addition to spatial accessibility, social stigma may also deter consumers from accessing available services. Stigma is defined as a characteristic which is seen to be embarrassing or shameful and leading to a lower social status (Ben et al., 2012). There are three different types of stigma, namely, personal stigma, social stigma and institutional stigma. Personal stigma could be described as the feelings of the consumer who feels that benefits received are shameful. Social stigma refers to judgements from others who claim that the benefit is embarrassing and confers a lower social status. Institutional stigma arises from the process of claiming benefits. Stigmatization results in negative impacts on stigmatized individuals’ quality of life as well as placing them at a disadvantaged position in many of their life domains (Bo et al., 2010) (refer to Figure 1). Stigmatized individuals are confronted by devalued identity within a particular context, leading them to a variety of stressors such as discrimination, prejudice and exclusion (Crocker et al., 1998).

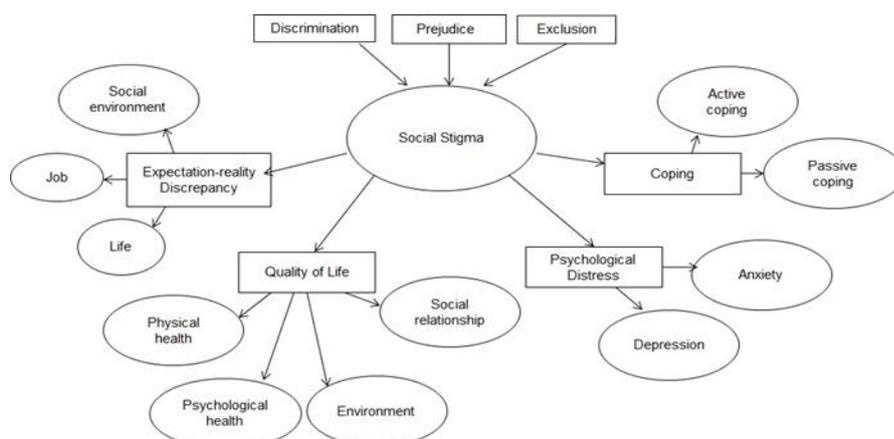


Figure 1: Hypothesized Model of Social Stigma  
Source: Adapted from Bo et al. (2010)

Different from community stores in United Kingdom, even though *KRIM* aims to provide basic food items at cheaper prices to reduce financial burden of low income group and the poor, it is not restricted to a particular targeted group. Community stores or social stores offer discounts up to 70 per

cent of the actual prices due to food sold were those rejected by grocers as they might have been mislabelled, with damaged packaging or close to expiry date (Graslie, 2013). Meanwhile, *KRIM* sells generic products with reduced production cost.

## METHODOLOGY

Penang is the second smallest state in Malaysia comprising approximately 6 per cent of the entire Malaysian population (Penang Institute, 2015). Taking into account the quality of life, isolation, social network, climate, health services, political tensions, leisure facilities and infrastructures, Penang was declared as the eighth most livable city in Asia (ECA International, 2012). As Penang is considered an urban state in Malaysia, households with monthly income below RM940 are perceived as poor (Mohd, 2014). Penangites are currently facing high cost of living and it is quite a heavy burden for low income earners and the poor who live in Penang, especially in inner city areas to meet their basic needs. Aware of this problem, the government established *KRIM* to help ease the burden of low income group. This study aimed to monitor the social accessibility of *KRIM* in Penang state. There are three operating *KRIM* in Seberang Perai region of the Penang state, namely in Taman Kota Permai, Bukit Mertajam; Taman Sri Pinang, Butterworth; and Tasek Gelugor (Figure 2). Among these three *KRIM*, *KRIM* in Taman Sri Pinang, Butterworth is situated nearest to low cost residential areas at 290 metres away from Flat Taman Seri Pinang, a low cost flat. The rest were less accessible, for instance, *KRIM* in Taman Kota Permai, Bukit Mertajam is situated 4.3 kilometres from low-cost residential areas, while *KRIM* in Tasek Gelugor is situated at rural area. As the study aimed to investigate the social accessibility of *KRIM* among low income group in urban Penang, Flat Taman Seri Pinang was chosen as the study area. Quantitative survey was conducted on 57 respondents or 22.8 per cent of the population from 250 households who live in Flat Taman Seri Pinang, Butterworth, Penang, Malaysia. Respondents were randomly selected among the breadwinners and homemakers who aged above 20 years old. Data obtained were analysed using the Statistical Package for Social Science (SPSS) for frequency and crosstabs data.

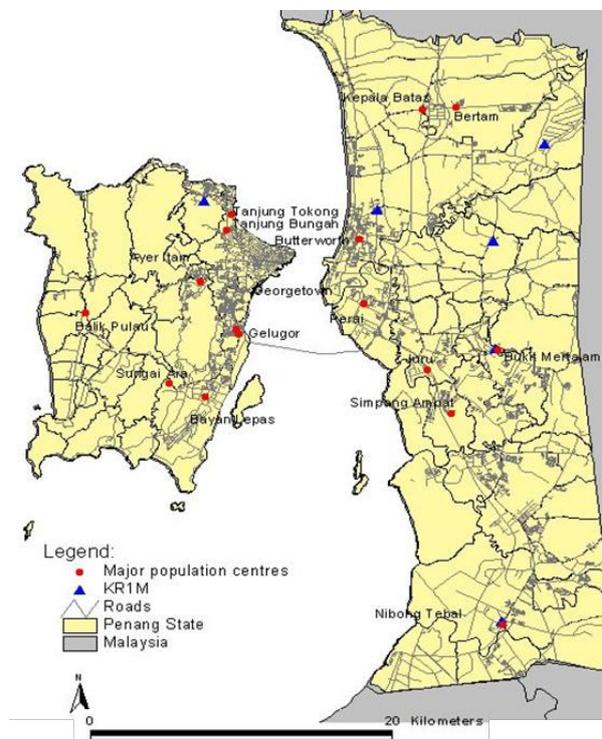


Figure 2: KR1M Outlets in Penang

## RESULTS AND FINDINGS

As this study takes distance as a determining factor for customers to shop at *KRIM*, all of the respondents chosen reside 290 metres from *KRIM* Taman Seri Pinang, Butterworth. Approximately, 93 per cent of the respondents are Malays, with 7 per cent consisting of Indians. About 45.6 per cent of the respondents aged 20 to 39 years old, 35.1 per cent aged 40 to 49 years old and 19.3 per cent aged above 50 years old. Female respondents constitute 77.2 per cent and male respondents 22.8 per cent. The majority 80.6 per cent, of the respondents completed secondary education, 10.6 per cent has received tertiary education and 8.8 per cent with primary education only. The study investigated barriers that hindered low income population from shopping their basic necessities at *KRIM*. Two main things discussed were pattern of visit to *KRIM* and stigma on *KRIM*.

### Pattern of Visit to *KRIM*

In this section, the pattern of visit to *KRIM* by respondents based on monthly household income will be discussed. Respondents are classified into five monthly household income groups, namely below RM500, between RM501 to RM1000, between RM1001 to RM2000, between RM2001 to RM3000 and between RM3001 to RM4000. The data obtained from the quantitative survey were tabulated according to frequency of visitations. The study investigated the pattern of visit to *KRIM* based on monthly household income. As shown in Table 1, the majority of the low income respondents with monthly household income below RM3000 did visit *KRIM*. 14.04 per cent of the respondents with monthly household income between RM1001 to RM2000 visited *KRIM* once to thrice a week. In addition, 5.26 per cent and 10.53 per cent of the respondents with monthly household income below RM500 and between RM501 to RM1000 respectively visited *KRIM* once to thrice a week. Nevertheless, the findings indicated that the respondents with monthly household income above RM3000 rarely visit *KRIM*.

Table 1: Visit Pattern to *KRIM* among Flat Taman Seri Pinang Residents

Frequency of Visit within a Week	RM500 – RM1000	RM1001- RM2000	RM2001- RM4000	Total
1-3 times	9(37.50%)	8(33.33%)	0(0.00%)	17(70.83%)
4-6 times	1(4.17%)	2(8.33%)	1(4.17%)	4(16.67%)
7-9 times	1(4.17%)	0(0.00%)	0(0.00%)	1(4.17%)
More than 10 times	1(4.17%)	1(4.17%)	0(0.00%)	2(8.33%)
<b>Total</b>	<b>12(50.00%)</b>	<b>11(45.83%)</b>	<b>1(4.17%)</b>	<b>24(100.0%)</b>

Findings above indicated that *KRIM* established by the Malaysian Government, as one of the more affordable community shop program, has reached their targeted group. As the objective of establishing *KRIM* is to help alleviate the burden of low income groups due to the increasing cost of living, it seems a strategic initiative to intensify the distribution of *KRIM* in the low income group and poor residential areas, especially in urban areas. According to Bell and Standish (2009), as many as 23.5 million people in low income communities do not have access to a supermarket or large grocery store within a mile of their residential area. Hence, the initiative to establish *KRIM* should be focused on the targeted population.

### Stigma on *KRIM*

This study then investigated stigma on *KRIM* using quantitative survey with Likert scale. Six stigmas predicted to arise from shopping at *KRIM* was investigated as tabulated in the Table 2.

Table 2: Stigma on *KRIM*

Stigma on <i>KRIM</i>	SD	D	NS	A	SA	NA	Total
I feel ashamed to shop at <i>KRIM</i>	64.9%	19.3%	14.0%	1.8%	0.0%	0.0%	100.0%
I am afraid if I will be regarded as a poor when shopping at <i>KRIM</i>	66.7%	19.3%	7.0%	3.5%	3.5%	0.0%	100.0%
<i>KRIM</i> are of low standard and shopping there will make people look down at me	61.4%	15.8%	12.3%	7.0%	1.8%	1.8%	100.0%
The entrance to <i>KRIM</i> should be restricted to low income group and poor only	49.1%	26.3%	8.8%	8.8%	7.0%	0.0%	100.0%
<i>KRIM</i> is more suitable for foreign workers to shop for their needs	59.6%	24.6%	12.3%	1.8%	0.0%	1.8%	100.0%
It is better for government to introduce coupon system to purchase food and basic needs instead of establishing <i>KRIM</i> as a way of helping low income group and the poor	28.1%	12.3%	17.5%	24.6%	15.8%	1.8%	100.0%

*SD = Strongly disagree; D = Disagree; NS = Not sure; A = Agree; SA = Strongly agree; NA = Not agree*

This study also investigated social accessibility to *KRIM*. Stigma is one of the social barriers faced by shoppers at *KRIM*. As found by Samat et al. (2015), stigma arises due to the perception that *KRIM* was frequented by migrant workers. In this study, stigma on *KRIM* was also investigated to determine whether the stigma arise from respondents and to determine if stigma is a factor that has restricted respondents from accessing *KRIM* (refer Table 2).

Based on the survey, a majority 64.9 per cent of the respondents strongly disagreed that they felt ashamed to shop at *KRIM*, even though they knew that *KRIM* was established by the government to help alleviate the financial burden of the socio-economically disadvantaged people. Further, about 66.7 per cent of the respondent strongly disagreed that they are afraid they will be regarded as poor if they shop at *KRIM*. 61.4 per cent of the respondents strongly disagreed that *KRIM* are low standard and that if they shop at *KRIM* people will look down at them. Approximately 59.6 per cent of the respondent of the respondents also strongly disagreed that *KRIM* is more suitable for foreign workers to obtain their necessities.

As discussed earlier, community shop in United Kingdom restricted their customers to socio-economically disadvantaged groups who lived in certain postcode areas and are provided with special access card to enter the shop. On the contrary, at *KRIM*, accessibility is not limited to a targeted group of customers despite its aim to help socio-economically disadvantaged people in obtaining their basic needs especially food. Survey done found that 49.1 per cent of the respondents strongly disagreed with the idea that *KRIM* should impose entrance restriction for low income group and the poor only. In addition, 38.6 per cent of the respondents strongly disagreed that *KRIM* should be located at the villages and low-cost residential only. These results indicated that most of the respondents prefer *KRIM* to be made accessible to all people from any socio-economic background.

## CONCLUSION AND IMPLICATION

The study undertaken through quantitative survey in Penang State, Malaysia to investigate whether *KRIM* has high social accessibility among target population. Social accessibility of *KRIM* indicated that *KRIM* should be located in locations where it can be easily accessed by the targeted group. Based on the findings, stigma does not hinder the respondents from visiting *KRIM*. Instead, most of the respondents shop at *KRIM* as it was the nearest groceries shop in their residential area. Hence, in future planning for *KRIM*, the location needs to be taken into consideration to ensure its accessibility by the targeted group.

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## **REFERENCES**

- Bell, J., & Standish, M. (2009). Building Healthy Communities through Equitable Food Access. *Community Development Investment Review*, 75-87.
- Ben, B., Kate, B., Declan, G., Rachel, D., Clancy, H., & Danial, S. (2012). *Benefits Stigma in Britain*. Britain: Elizabeth Finn Care.
- Bo, W., Xiaoming, L., Bonita, S., & Xiaoyi, F. (2010). The Influence of Social Stigma and Discriminatory Experience on Psychological Distress and Quality of Life Among Rurau-to-urban Migrants in China. *Social Science & Medicine*, 71, 84-92.
- Crocker, J., Major, B., & Steel, C. (1998). Social Stigma. In D. Gilbert, F. S. T., & G. L. (Eds.), *Handbook of Social Psychology* (pp. 504-553). Boston: McGraw Hill.
- ECA International. (2012, April 17). Retrieved from [http://www.eca-international.com/news/press\\_releases/7647/#.VZMXQkaRYpU](http://www.eca-international.com/news/press_releases/7647/#.VZMXQkaRYpU)
- Graslie, S. (2013, December 12). *the salt*. Retrieved from <http://www.npr.org/sections/thesalt/2013/12/11/250185245/social-supermarkets-a-win-win-win-for-europes-poor>
- Latham, C. (2013, December 9). Retrieved from Metro News: <http://metro.co.uk/2013/12/09/members-only-supermarket-for-lowincome-families-launches-4223446/>
- Mohd, S. (2014). Poverty Issues Among Malaysian Elderly. *Social Sciences Research ICSSR 2014*, (pp. 123-132). Kota Kinabalu.
- Moseley, M. (1979). *Accessibility: The Rural Challenge*. Methuen, London.
- Murad, A. (2007). A GIS Application for Modeling Accessibility to Health Care Centers in Jeddah, Saudi Arabia. *GIS for Health and the Environment: Development in the Asia-Pacific Region*, 57-70.
- Penang Institute. (2015, January). Penang's Economy: Redividing The Pie. *Penang Economic Indicators*, p. 6.
- Peters, D., Garg, A., Bloom, G., Walker, D., Brieger, W., & Hafizur Rahman, M. (2008). Poverty and access to health care in developing countries. *Annals of the New York Academy of Sciences*, 161-171.
- Samat, N., Ghazali, S., & Suet Leng, K. (2015). Spatial Accessibility of 1Malaysia People's Store among Low income Group in Urban Penang, Malaysia.
- Samat, N., Ghazali, S., & Khoo, S. (2014). Spatial Accessibility to Urban Amenities: Investigating Accessibility of Low-income Population to Kedai Rakyat 1Malaysia in Penang Island, Malaysia. *City Futures*. Paris
- Sinar Harian. (2014, Oktober 13). *Kedai Rakyat 1Malaysia (KRIM) Bantu Rakyat Jimat*. Retrieved April 16, 2015, from Sinar Harian: <http://www.sinarharian.com.my/sinar-tv/laporan-khas-berita-semasa/kedai-rakyat-1malaysia-kr1m-bantu-rakyat-jimat-1.323985>
- Wrigley N. (2002) "Food Desert" in British Cities: Policy Context and Research Priorities' *Urban Studies*, 39(11), 2029-2040.

## **GENDER, SPACE AND ENTREPRENEURSHIP: A CASE STUDY OF FELDA WOMEN ENTREPRENEURS IN JOHOR, MALAYSIA**

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**ABSTRACT:** Since the establishment of FELDA (Federal Land Development Authority) in 1956, a series of entrepreneurship programs and incentive have been introduced through its Entrepreneur Development Department with the objective to improve and strengthen the knowledge and skills of entrepreneurs and potential entrepreneurs in FELDA. It is estimated that there are 1.97 million women in FELDA throughout Malaysia and 4,725 of them are women's entrepreneurs, involving in various business sectors. Several studies have been done on women entrepreneurship in FELDA, however, knowledge about the places from which women entrepreneurs operate and its relations to gender roles is still under research. The ability of entrepreneurs to establish a productive business is very much determined by factors such as who they are, where they are located, and how they interact within space. By using gender analyses, this paper will be examining women entrepreneurs' lived experiences, how entrepreneurship space is created and how women's use of space as a survival strategy through entrepreneurship. Using in-depth interviews and observation, 16 women entrepreneurs were selected in FELDA Ulu Tebrau to share their entrepreneurship activities and experiences. The preliminary finding shows that most women entrepreneurs locate their businesses close to home either inside the house, in the house compound or just beside the roadside in front of their houses as they are not being relieved from the household work. Gender roles are likely inhibiting women entrepreneurs' spatial range and therefore their business location. The existing government policies may not capture all of the impediments to women's business growth. Therefore, more attention is needed to understand and address the gendered role of place and space to ensure that women entrepreneurs have equal opportunity to expand their business's growth.

*Keywords:* gender, space, entrepreneurship, FELDA women entrepreneurs, Malaysia

### **INTRODUCTION**

In Malaysia, small-scale food enterprises have played an important role in the Malaysian economy and out of more than 9000 processing factories in Malaysia (Chee, 1986), 95 percent are categorized as small-scale enterprises. However, the rate of women in entrepreneurship is quite low when only 16 percent of businesses in Malaysian SMEs in 2005 are owned by women entrepreneurs (Ministry of International Trade and Industry, 2009). For women, embarking into business has different motivations. To many women, particularly vulnerable and poor women, entrepreneurship is a vehicle to respond to their poverty situations and as a livelihood strategy to sustain their lives. Although there is an increase number of vulnerable women participating in micro-businesses, only a small number actually succeed in developing their enterprise and generating sustainable living from it (Pingle, 2005). Study on the performance of micro-enterprises has shown that majority of micro-entrepreneurs were in the category of 'survivalist' (Pingle, 2005; Nor Hafizah, 2011).

With the aim of improving the quality of life and the socio-economic condition of the settlers, FELDA (Federal Land Development Authority) as one of the Malaysian government agencies is taking the initiative to transform the FELDA community into entrepreneurial community. As part of the effort, FELDA has been actively offering loans particularly to the new generation of FELDA to expand businesses under the FELDA Entrepreneur Incentive Scheme. To date, there are around 2,000 new generations involved in various fields such as farming, plantation, manufacturing, aquaculture, trading and crafts. Since the establishment of FELDA in 1956, a series of entrepreneurship programs and incentive have been introduced through its Entrepreneur Development Department with the objective to improve and strengthen the knowledge and skills of entrepreneurs and potential entrepreneurs in FELDA. It is estimated that there are 1.97 million women in FELDA throughout Malaysia and 4,725 of them are women's entrepreneurs, involving in various business sectors (FELDA, 2011).

Several studies have been done on women entrepreneurship in FELDA, however, knowledge about the places from which women entrepreneurs operate and its relations to gender roles is still under research. The ability of entrepreneurs to establish a productive business is very much determined by factors such as who they are, where they are located, and how they interact within space. By using gender analyses, this paper will be examining women entrepreneurs' lived experiences, how entrepreneurship space is created and how women's use of space as a survival strategy through entrepreneurship among women entrepreneurs in FELDA Ulu Tebrau, Johor. This paper argues that space and place will enable and constrain entrepreneurship activities that lead to the creation of gendered spaces

## **FELDA SETTLEMENT AND ENTREPRENEURSHIP ACTIVITIES**

FELDA was formed in 1956 and the first FELDA settlement was launched in 1957 in Kelantan. The main objective of FELDA was to develop rural areas as a viable agricultural areas and resettlement of poor and landless into newly developed areas where 94 per cent of FELDA population in 1970 were Malays (Abdul Hamid et al., 1987). It is a scheme to ensure an improved living and economic conditions of the settlers (Golam Hassan et al., 1999; Sutton, 2001). By 2000, FELDA had cultivated 9,000 square kilometres of land, mostly oil palm plantations. There are about 112, 635 settlers all around Malaysia which involved 11 states (FELDA, 2011). In Johor, the number of settlers is 28,971 with women settlers is only 5,591 compared to men settlers, 23,380. The gap is not surprising considering the nature of the scheme which prioritized men to be selected and acknowledged as settlers and owners of the land at the beginning of the programme (Jamilah, 1992). Basic amenities and facilities that are available in FELDA also include 24-hour electricity, water supply, community halls, sports facilities, schools and tele-centre.

In terms of entrepreneurship development, FELDA management has started the FELDA Entrepreneurship Incentive Scheme (SIUF) for the younger generation of FELDA settlers to encourage them to get involved in non-farm activities such as processing or manufacturing poultry, seafood, fruits or vegetable businesses. To date 34,029 entrepreneurs have participated in the businesses involving RM46.48 million pay-out (Media Relations and event Management, 2015). This involvement has provided additional revenues varying from RM 500-2000 month per settler. In March 2013, the FELDA Women's Association (WADA) was also established as a platform to mobilize transformation and to empower FELDA women through entrepreneurship. As a business spatial environment, FELDA is a unique spatial environment for settlers to embark into business as huge number of settlers has created a big demand on various products.

## **FELDA ULU TEBRAU (FUT): THE STRUCTURE AND THE SOCIETY**

In terms of structural organization, FELDA community is organized and arranged based on several layers of *peringkat* (phase). FELDA Ulu Tebrau is divided into 6 phases (*peringkat*), and each of the phases is headed by a Phase Leader (*Ketua Peringkat*). Each phase consists of 2–8 blocks and each one of them is headed by a Block Chief (*Ketua Blok*). Each block has around 15–20 households. There are a total of 624 households in FUT. Among the six phases, the phase C is considered to be the most systematic in terms of its arrangement as it has proper signboard at the entrance and exit of the blocks. The list of FELDA settlers' name is written on the signboard together with a map showing the structure of the block. According to one of the resident interviewed, it was the Phase C that initiated the construction of the signboard at every house in FUT. There is one police station and one mosque at FUT that has become the centre of cultural and religious activities particularly in organizing various religious talks and ritual and hosting a national-level Ramadhan event for FELDA's committee.

## **RESEARCH METHODOLOGY**

Using in-depth interviews and observations, 16 women micro-entrepreneurs, aged between 25–60, were selected in FELDA Ulu Tebrau, Johor to share their entrepreneurship activities and experiences. Respondents of this study were selected through snowballing technique. 9 respondents are involved in

food and pastries businesses, 4 in clothing businesses, 2 of them own grocery stores and 1 is involved in transportation business. The observation was carried out to analyse the spaces used by the women entrepreneurs, and how the structure of FELDA affected the entrepreneurship activities at the village. A mapping out of entrepreneurship activities were also carried out in FELDA Ulu Tebrau which consists of 624 households. The instruments used in this study are interview guide. Data from the survey was analysed using SPSS software and the qualitative data of IDI was analysed using thematic analysis. During the research process, ethical conduct were observed and considered and the informed consent was obtained from all participants.

## **LITERATURE REVIEW**

There have been substantial studies on women entrepreneurship in general including studies on the factors that influence their participation. Although, there are quite a number of studies have been done on women in FELDA (Zaireeni, 2014; Ahmad Rozelan et al., 2014; Idris, et al., 2014) only a small number of studies are basically looking at gender and women entrepreneurship in FELDA. Even these studies are mainly focusing more on the motivational factors such as the effect of person-environment on entrepreneurial success among FELDA youth (Ahmad Rozelan et al., 2014). Meanwhile a study by Siti Normala (2012) surveyed the levels of entrepreneurship knowledge based on the perception of women entrepreneurs in FELDA Ulu Tebrau. The study reported that majority of the entrepreneurs have not attended any course related to entrepreneurship. One significant aspect that is lacking in the literature of women and entrepreneurship in FELDA is gender analysis and sex disaggregated data on entrepreneurship.

Gender differences can especially be seen in entrepreneurship activities. Female entrepreneurs have different motivations in involving in businesses from male entrepreneurs. Among the main factors women embarking into businesses are self-fulfilment, autonomy, pursuit of social missions as main factors women embarking into business (Bruni et al., 2004). Others such as Teasdale et al. (2011) cite tackling social issues, meeting local needs and 'making a difference' are all gendered attributes 'associated with women'. Study on gender differences in entrepreneurial activity have been explored, for example, by Pfefferman and Frenkel (2001). Gendered business activities are also described in the study of family farm forestry. Based on the work of Umaerus et al. (2013), traditional forestry is the main task for both male and female Family Farm Forestry owners, however, women engage more often than men in service-oriented business activities. In terms of business survival, study by Kalleberg and Leicht (1991) in South Central Indiana, found that businesses headed by women were not more likely to go out of business, nor less successful, than those owned by men.

According to Hovorka (2005), entrepreneurs' ability to create a productive business is premised on who they are, where they are located, and how they interact within space. Möller (2012) explores women's livelihood strategies and the economic and lifestyle-oriented motives in embarking into entrepreneurship within tourism in Latvia. Her study illustrates women's day-to-day livelihood practices and how they organize their lives in time and space and reveals how women negotiate their 'livelihood action space', which includes a number of paradoxes between the quest for independence while facing both economic and social restrictions. Study by Noritake (2008) examine how spatial, social and gender relations affect the emplacement and process of place making among female street entrepreneurs, and how they negotiate space and gender in everyday life in contemporary Seoul, Korea. Gender concerns need to be brought more explicitly into the sustainable livelihoods approach as the term 'sustainable livelihoods' is itself both a space that women gained and then lost over the years (Harcourt, 2012). It has been argued that women's participation in self-employment generally is still under-theorised (Blake, 2006; Ahl, 2006; Lewis, 2006) and therefore effort need to be done to consider within this, the social construction of gender, time, space, economy and culture (Buzar et al., 2005)

## **FINDINGS AND ANALYSIS**

### **Profile of Respondents**

#### *Age of respondents*

Majority of respondents (50 percent) are between the ages of 31 – 40 years old while 25 percent of them are between the ages of 41 – 50 years old. The youngest respondents are between the ages of 21 – 30 years old (18.8 percent).

#### *Types of Businesses*

There are 56.3 per cent of respondents involved in food production business which is mainly in food and pastries. Second popular business among the respondents is in clothing business (25 per cent) while 12.5 per cent of them are operating grocery shop. Meanwhile, 6.3 percent of the women entrepreneurs are in transportation industry.

#### *Main Factor to Embark into Entrepreneurship*

More than 50 per cent of respondents decided to get involved in entrepreneurship due to family commitment. The decision to become micro entrepreneur is very much influenced by the gender roles of the respondents who are housewives. Majority of them prefer to do business so that they have more flexible time with their families particularly in managing the household chores and taking care of their children. Meanwhile, 25 per cent of them choose to become entrepreneurs due to personal interest in the business industry.

#### *Technology Used in Entrepreneurship Activities*

The two most important technology used for entrepreneurship activities are Whatsapp (the most popular) 56 per cent and Facebook (50 per cent), followed by Instagram (37.5 per cent) and 31 per cent of the respondents prefer to use just phone call. Twitter is being the least popular of social media used for entrepreneurship. Only 6 per cent of entrepreneurs do not use any kind of social media and their business marketing is mostly done through the 'word of mouth'.

### **Business location**

In terms of location, most of the business premises owned by women are located either within their homes (in the house or at the balcony area), within the house compound, at the roadside in front of the house or within the close proximity of the house. They are basically involved in home-based enterprise such as producing frozen food (such as frozen samosa and currypuff) and various types of crisp such as banana crisp. The farthest businesses premises are about 5-10 mins from their houses. For women entrepreneurs, business location is an important aspect in ensuring the sustainability of the business. In this case, gender roles and expectation have been the main factors that influence the selection of business location and also the level of their business performance. These two aspects can be best described by the two case studies as presented below.

#### **Case study 1: Sumi Enterprise**

Sumi Enterprise is run by a dedicated housewife, Ros, who wanted to establish her own business with her husband. Ros has been in the business for almost 6 years. According to Ros, doing business is one of the best way to strengthen her family's income while at the same time be able to take care of her own children without depending on her parents for child care. That was why she chose to have her business production in her own house. Based on observation, there were several important equipment including fridges and a big table for the women to produce the samosas/currypuff that were being placed in area of her living room. She has a total of six women workers who were also staying in her

own neighbourhood. They would usually start the production process from 10 am until 4 pm everyday. Although, the room seemed to be a bit crowded with household stuff and at the same time have to make some space for her six workers, Ros felt that was the best option rather than to have her business premise away from her home. The workers were also seemed to be happy to work at Ros's house as they have flexible working hours and they can go back to their houses to check on their families as most of their houses are just within walking distance. Interestingly, although all the production are carried out in her own home, her products have been marketed to overseas such as Singapore.

### **Case study 2: Waffles Shop**

Hamidah, the owner of a waffle shop, was a former factory worker who decided to quit her job after getting married to her husband. At first, she opened a toy store at one of the business premises about 20 minutes from her house. Everyday, she would ride her motorbike to her shop and then she also needed to travel back and forth to pick up her children from school, to prepare lunch and to make sure that her children were safe at home. During this time, she would leave her shop and let her friend to look after the shop. However, this routine work has some impact on her business performance when she was often not around at the shop. She was then decided to sell off the shop and later opened a new stall selling waffles, located in front of her house. Based on the interview, Hamidah was glad with her decision as she felt that she finally be able to "become a full time housewife". Hamidah often used the word "*sambil-sambil*" or more like "hobby" several times to describe her business activities. She admitted that she was not in a desperate need for money and the waffle business was only a temporary (*sambil-sambil*) business because she knew that she could not go beyond her house to expand her business as she is tied with family commitment. She said, "*...it is much easier to open a shop in front of my house as I can watch my children while I'm serving my customer*".

### **ANALYSIS**

Based on the case above, it shows that women entrepreneurs have strategically chosen a location that is convenient to them, while taking care of their families and children. Literature review on women entrepreneurship has discussed in length the challenges faced by women entrepreneurs. Ekinsmyth (2012), for example, argues that business creation, embedded in family spaces and borne out of desire to manage work and life balance is a growing phenomenon. Meanwhile study by Palanivelu and Jahan (2014), emphasis the great responsibility for women to maintain both business and family. They argue that since the boundaries between the business and the family tend to be vague, women operating family businesses face a unique set of issues related to personal identity, role conflict, loyalties, family relationships, and attitudes towards authority.

#### *Business Marketing and the Use of Social Media*

Despite the fact that many of the women businesses are homebased, some of their products are being marketed to outside FELDA. The marketing of the products are beyond the FELDA area. For example, Sumi Frozen Curry Puffs are exported to Singapore and received high demand from supplier outside FELDA. Almost all of the respondents are using social media as part of their promotion strategies. Whatsapp, Facebook and Instagram are being the most popular social media used to promote and market their products. FELDA provides computer and multi media technology such as Pusat Komputer 1 Malaysia (PK1M) for entrepreneurship activities but the respondents prefer to use their own smartphone for their businesses. According to Ekinsmyth (2012), business creation embedded in family spaces are increasingly made possible by information and communication technologies that expand the boundaries of business possibility to a new level.

#### *Women mobility*

Majority of women entrepreneurs are quite mobile in their business activities. They are able to meet customers or sell product using several type of transport, motorcycles being the most popular transport among the respondents, other than buses and cars. Women entrepreneurs are mainly multi-tasker as they have to do all the housework, caring for the children while dealing with the business matters. For

example, all respondents shared the same view that they have to do all the business transactions and they have to take around 30 mins to get to the nearest ATM machine to withdraw or deposit money. Therefore buying groceries or business materials will require these women to be mobile as the nearest supermarket is located outside the FUT, about 30 minute drives from the FUT. Although in other countries such as in India, Muslim women entrepreneurs has been subjected to extreme restriction due to traditional religious and caste institutions and has impacted on their business activities (Field et al., 2015), the case is different in FELDA Ulu Tebrau. All of the respondents are free to go about doing their businesses, provided that are able to perform their gender roles expectation at home. The study above shows that the type of business and business location are very much influenced by the gender roles and expectation. It also shows that women's businesses are different to men's (Ahl, 2006; Hanson, 2003; Hanson and Blake, 2005) in terms of their nature, location, type and the way that business is done.

## **CONCLUSION**

The two cases provided above highlight important aspects in an area that has been under researched. The study shows that most women entrepreneurs locate their businesses close to home as they are not being relieved from the household work. Downing and Daniels (1992) argue that women locate their businesses close to home as a consequence of their spatial entrapment. Such location constraints can entail a double marginalization reality: a peripheral location within a peripheralized community. Gender roles likely inhibit women entrepreneurs' spatial range and therefore their business location. It shows that space and place will enable and constrain entrepreneurship activities that lead to the creation of gendered spaces. Only a small percentage of women entrepreneurs have the motivation to market their products beyond FELDA while majority of them still considered their business as "temporary" business (*niaga sambilan*). The existing government policies may not capture all of the impediments to women's business growth. Therefore, more attention is needed to understand and address the gendered role of place and space to ensure that women entrepreneurs have equal opportunity to expand their business's growth. From a policy perspective, it is important to understand how best to ensure that mundane family and neighbourhood spaces provide the breeding ground, support and resources necessary for entrepreneurial imagination, new business formation and local economic growth.

## **Acknowledgement**

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## **REFERENCES**

- Abdul Hamid, A., Rahimah, A. A. & Sulong, M. (1987). Development and Socio-Cultural Changes in Rural Malaysia. *Akademika*, 30, 29-48.
- Ahl, H. (2006). Why Research on Women Entrepreneurs Needs New Directions. *Entrepreneurship: Theory & Practice*, 30(5), 595 - 621.
- Ahmad Rozelan, Y., Aris, A & Abdul Majid, I (2014) *FELDA Youth Entrepreneurs and Personality Environment Congruency*. Faculty of Technology Management and Technopreneurship, Universiti Teknikal Malaysia Melaka.

- Blake, M. (2006). Gendered lending: gender, context and the rules of business lending. *Venture Capital*, 8(2), 183-201.
- Bruni, A., Gherardi, S. & Poggio, B (2004). Doing gender, doing entrepreneurship: an ethnographic account of intertwined practices. *Gender, Work & Organization*, 11, 406 - 429.
- Buzar, S., Ogden, P. & Hall, R (2005). Households matter: the quiet demography of urban transformation. *Progress in Human Geography*, 29, 413 - 436.
- Chee, P. (1986). *Small Industry in Malaysia*. Kuala Lumpur: Berita Publishing Sendirian Berhad
- Downing, J. & Daniels, L. (1992). The Growth and Dynamics of Women Entrepreneurs in Southern Africa. GEMINI Technical Report No. 47, Washington, DC: United States Agency for International Development
- Ekinsmyth, C. (2012) *Family-friendly entrepreneurship: new business formation in family spaces*. *Urbani Issiv*, 23 (Supp 1). S115-S125. ISSN 0353-6483.
- FELDA (2011). *Laporan Tahunan 2011*. Laporan Tahunan. Lembaga Kemajuan Tanah Persekutuan (FELDA).
- Field, E., Jayachandran, S., Pande, R. & Rigol, N. (2015). Friendship at Work: Can Peer Effects Catalyze Female Entrepreneurship. National Bureau Working Paper Series. NBER Massachusetts. Massachusetts Avenue Cambridge, MA 02138.
- Golam Hassan, H., Mahani, M., Noor Al-Huda, A. & Hassan, A. (1999). *Kemiskinan dan agihan Pendapatan di Tanah Rancangan Felda*. Kedah: Universiti Utara Malaysia Press.
- Hanson, S. (2003) Geographical and feminist perspectives on entrepreneurship. *Geographische Zeitschrift*, 91, 1-23.
- Hanson, S. & Blake, M. (2005) Changing the gender of entrepreneurship. In L. Nelson & J. Seager (Eds). *A Companion to Feminist Geography*. Oxford: Blackwell, 179 -193.
- Harcourt, W. (2012) *Women reclaiming sustainable livelihoods: Spaces lost, spaces gained*. NY: Palgrave Macmillan.
- Hovorka, A. (2005). The (re)production of gender positionality in Botswana's commercial urban agriculture. *Annals of the Association of American Geographers*, 95, 294-313.
- Idris, N., Salleh, N. & Endut, W. (2014) Downstream Activities at the Felda Land Development Scheme: Analysis on Motivational Factors of Women's Participation in Business. *Asian Social Science*, 10(15), 143 – 152.
- Jamilah, I. (1992). *Women and Development in Malaysia*. Selangor: Pelanduk Publications
- Kalleberg, A. L. & Leicht, K. T. (1991) Gender and Organizational Performance: Determinants of Small Business Survival and Success. *Academy of Management Journal*, 34(1), 136-161.
- Lewis, P. (2006). The quest for invisibility: Female entrepreneurs and the masculine norm of entrepreneurship. *Gender, Work & Organization*, 13, 453- 469.
- Media Relations and Event Management (MREM).(2015), Press Release - Bernama. Retrieved from <http://mrem.bernama.com/viewsm.php?idm=23511>, October 2015.
- Ministry of International Trade and Industry (2009). Malaysia International Trade and Industry Report 2009, Retrieved from <http://www.miti.gov.my/miti/resources/auto%20download%20images/55555e1816f94.pdf>
- Möller, C. (2012). Transforming geographies of tourism and gender: Exploring women's livelihood strategies and practices within tourism in Latvia. *Karlstad University Studies*, 2009, 9 - 450
- Nor Hafizah et al. (2011). Survival through entrepreneurship: Determinants of successful micro-enterprises in Balik Pulau, Penang Island, Malaysia. *British Journal of Arts and Social Sciences*, 3(1), 23-37.
- Noritake, A. (2008). Negotiating Space and Gender: Female Street Entrepreneurs in Seoul. *Intersections: Gender and Sexuality in Asia and the Pacific*, 17, 75 – 107.
- Palanivelu, V.R. & Jahan, M.R. (2014). Women Entrepreneurship in the Context of Gender Competitiveness, Opportunities, and Hurdles. *International Conference on Arts, Economics and Management (ICAEM'14)*. March 22-23, 2014 Dubai (UAE).
- Pfefferman, T. & Frenkel, M. (2001). The Gendered State of Business: Gender, Enterprises and State in Israeli Society. *Gender, Work and Organization*, 22 (6), 535.
- Pinglé, V. (2005). *Micro- Business and Sustainable Livelihoods*. Paper presented at World Bank Conference "New Frontiers of Social Policy", Arusha, Nigeria, December 12-15.

- Siti Normala, J. (2012) *Tahap pengetahuan keusahawanan dari persepsi usahawan di salah satu tanah rancangan FELDA di Johor Darul Takzim*. Tesis Master, Fakulti Pendidikan, Universiti Teknologi Malaysia.
- Sutton, K. (2001). Agribusiness on a Grand Scale – FELDA's Sahabat Complex in East Malaysia. *Singapore Journal of Tropical Geography*, 22, 90 - 10.
- Teasdale, S., McKay, S., Phillimore, J. & Teasdale, N. (2011). Exploring gender and social entrepreneurship: women's leadership, employment and participation in the third sector and social enterprises. *Voluntary Sector Review* 2(1), 57-76.
- Umaerus, P., Lidestav, G., Eriksson, L., & Nordin, M (2013). Gendered business activities in family farm forestry: From round wood delivery to health service. *Scandinavian Journal of Forest Research*, 28(6), 596 – 607.
- Zaireeni, A. (2014). The Concept of Gratitude (*Budi*) in Women's Political Participation: The Case Study of Women in FELDA Ulu Tebrau, Johor. *International Journal of Arts and Sciences*, 7(5), 525 – 535.

## **ECONOMIC INEQUALITY IN MALAYSIA: THE ENEMY WITHIN**

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**ABSTRACT:** The worsening inequalities across and within many countries have been an important part of the discussions among the international community in general and welfare economists in particular. The frequency of the recent economic crises across the globe had demonstrated that certain social groups are the hardest hit and disabled from recovering satisfactorily, despite swift national efforts and regional support. This research paper is part of a larger project viewing the current inequalities prevalent in Malaysia from a normative perspective through the lenses of Islamic Economics. It is aimed at providing complementary policy prescriptions in managing the widening socio-economic inequalities between the different marginalized groups. Given the conceptual nature of this research work, the emphasis remains in the critical literature reviews and latest report findings, both national and international. The ultimate objective of this study is to better understand the reality of economic inequalities and their long-term adverse effects on society perceived as vulnerable. Thus the main concern of the present work is to be clearly aware of the dangers of socio-economic inequalities and the various alternatives existing under the Islamic Economic System in managing inevitable inequalities. Key findings of this research paper include the recent relevant evidences of increasing economic inequality globally and Malaysia, the need for the stakeholders in Malaysia to begin considering the implications of economic inequalities critically and the effective application of several readily available schemes and tools in Islamic economics.

*Keywords:* equity, inequality, inclusiveness, human capital development, rights

### **INTRODUCTION**

The extent of inequality, and what to do about it, are among the most hotly debated issues in economics. Equality matters because it carries an intrinsic value for most of the world's faiths and ideologies, religious or secular. Every faith and ideology has normative views on how much inequality is tolerable, or desirable. Islam for instance, permits inequalities resulting from differences in natural endowments such as talent and other God given faculties. It is equity that Islam emphasizes upon, although extreme inequalities are among the major concerns of redistributive schemes laid out by the *Shariah*. Normative theories of social arrangements that have stood the test of time also seem to demand equality of something. Some forms of inequality generate costs to society whereas others entail benefits. Arguably, inequality is a type of market failure which is said to occur when there is an inefficient allocation of resources in a free market. On the one hand, inequality is necessary for providing incentives in a free market economy, for without a degree of inequality there would be economic stagnation and lack of enterprise. Inequality promotes reward based performance, i.e. productivity and encourages entrepreneurs to take risks and set up new business. The challenge lies in the ability to identify the turning point at which the costs of inequality start to exceed its benefits.

Debates on inequality seem to become more intense in periods of rapid structural transformation, both in advanced economies and in developing countries. While discussions are often framed in either-or terms as to whether the government should tackle inequality or boost growth first, there is also a tendency to focus on simple, aggregate indicators of inequality which hide as much as they reveal (Le Houérou, 2015).

The World Bank Report (2015) on 'Addressing Inequality in South Asia' takes a fresh look at inequality in one of the most dynamic regions in the world, by focussing on well-being, exploring both monetary (income, consumption and wealth) and non-monetary (basic services in health, education, and infrastructure, as well as subjective assessments) dimensions of inequality. Apparently, some countries that do not appear to be particularly unequal when focusing on consumption per person are host to both extravagant wealth at the top and appalling human development outcomes at the bottom. When standard monetary indicators are taken at face value, South Asia has modest levels of inequality, with Gini coefficients for consumption per capita ranging between 0.28 and 0.40, much

lower than in China, Mexico, or South Africa. Comparisons are suspected to be tainted by the nature of the monetary indicators used, with advanced countries and many Latin American countries using the income per capita, while South Asian countries continuing to rely on consumption per capita data. Nevertheless, the nonmonetary indicators of well-being in some South Asian countries convey a more striking story. For example, the share of children under five who are stunted among the poorest quintile is 50 per cent in Bangladesh and 60 per cent in India. The latter and Pakistan also report the highest infant mortality rates across comparators.

The extent of inequality is another matter of concern, especially in countries where it depends primarily on policy choices. The use of nonmonetary indicators of inequality captures the dispersion in human capabilities (an idea proposed and strongly defended by Sen; 1980, 1992). A multi-dimensional approach to human functioning that takes into account disparities in asset holdings, net worth and vulnerability offers a bigger and better understanding of the state of distribution of well-being of a nation. Inequality continues to be interesting and a challenging concern for the economists world around, given its implications on tangible matters related to achieving sustainable growth and development. The objective of this paper is to explain the economic situations in Malaysia that entails inequality done via review of policies and analyses of current economic situations.

### **Global Perspective of Inequality**

As the international community shapes its vision for a post-2015 global development agenda, worsening inequalities across and within many countries have been an important part of the discussions. There is a growing recognition among all that economic growth is not sufficient to sustainably reduce inequality if it is not inclusive. Across the globe, people living in poverty and vulnerable social groups have been hit particularly hard by the global financial and economic crisis. There is urgency in finding ways to effectively reduce inequality involving an inclusive approach. Growing inequalities can be curbed by integrating policies that are universal in principle, but with particular attention to the needs of disadvantaged and marginalized populations. In reality, inequality affects not only the poor, but can also be detrimental to growth, stability and well-being in general. World leaders, in adopting the Millennium Declaration in 2000, pledged to create a more equitable world. Disparities in education, health and other dimensions of human development remain large despite, marked progress in reducing the gaps. Various social groups suffer disproportionately from income poverty and inadequate access to quality services. The failure to pursue a comprehensive, integrated approach to development perpetuates such a predicament in the long run.

According to Stiglitz (2012), inequality leads to a less stable, less efficient economic system that stifles economic growth and the participation of all members of society in the labour market. Inequalities also pose serious barriers to social development by slowing the pace of poverty reduction and increasing the vulnerability of particular groups within societies to economic crises and prolonging the time it takes to recover from such crises.

Globally, the distribution of income remains very uneven. In 2010, high-income countries that accounted for barely 16 per cent of the world population were estimated to generate 55 per cent of global income. Low-income countries created just above one per cent of global income even though they contained 72 per cent of global population. Poor people in more unequal countries can have lower living standards than poor people in countries with lower average incomes but less unequal distribution. Between 1990 and 2012, inequality in disposable income, increased in 65 out of 130 countries for which data trends were available.

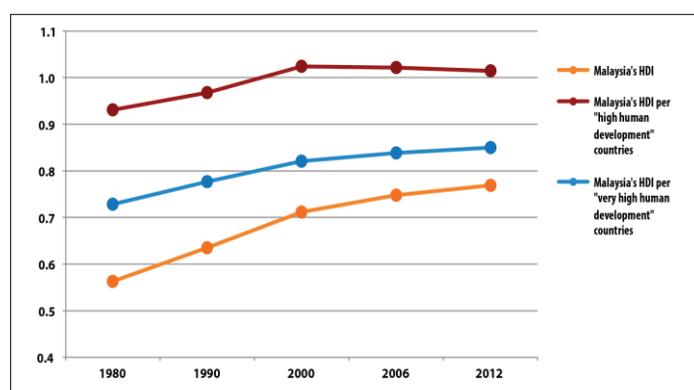
Palma (2011) observed that, in absolute terms, the top 10 per cent of the population in middle-income countries has succeeded in catching up with the top 10 per cent in rich countries, while the bottom 40 per cent of the population of middle-income countries is still far below its counterpart in rich countries. The author proposed an alternative to the Gini coefficient for measuring income inequality: the ratio of the top 10 per cent of the population's share of income to the bottom 40 per cent's share.

In addition, the wage gap between top and bottom earners has also increased in the majority of developed countries and in many developing countries. Labour-saving technologies have also had a negative impact on the earnings of less-skilled workers in developed countries (Stockhammer, 2012). Well-designed minimum-wage policies can have very significant, positive effects in reducing wage inequality.

Income inequality measures do not capture all household wealth which may include ownership of capital, including physical assets (land, housing) and financial assets. While the two are highly correlated, the distribution of wealth is typically more unequal than the distribution of income. Household debt is a new form of liability that plagues the urban poor than the rural poor. Regional and national trends in economic inequality suggest that there is no clear relationship between inequality and development. According to the empirical literature, social transfers have had a larger redistributive impact than taxes. Wang and Caminada (2011) estimated that social transfers accounted for 85 per cent of the observed reduction in inequality. Both social transfers and taxes should have immediate, direct effects on income distribution, although the magnitude of their impact will depend on the degree of progressiveness of the tax system and on the degree to which the poor benefit from social transfers and social insurance.

### Malaysia's Situation

Contemporary Malaysia sees persisting inequalities, especially of regional, gender and ethnic dimensions, and a lagging development of human capability, institutions fostering inclusiveness and effective governance. The World Bank's (2010) *Malaysian Monitor: Inclusive Growth* broadly outlined the theme, making three principal proposals: i) Increasing economy-wide income-earning opportunities; ii) Promoting investment in human capital and iii) Providing social protection for the poor and vulnerable. Inclusive growth entails lifting households out of poverty and facilitating upward, especially inter-generational mobility. It is defined as comprising equitable distribution of the benefits of economic growth and of social spending across distinct income groups and the poor irrespective of their group membership; robust generation of broadly accessible opportunity for economic participation and safeguards for the vulnerable; and inclusion of citizens in policy formulation and implementation, towards minimising social exclusion and increasing social cohesion. Although Malaysia's growth from 1971 to 2012 meets the criteria of inclusiveness to a considerable degree, its average annual Human Development Index (HDI) growth has slowed down from 1.21 per cent in 1980-1990 to 0.64 per cent in 2000-2012. This means despite the inclusive economic growth often claimed to eventually include development and welfare effects in the form of participation of commercial activities and inclusiveness, the rate of growth of HDI in general is deteriorating.



**Figure 1: Malaysia's Human Development Index: score and relative position**

Source: UNDP (<http://hdrstats.undp.org/en/indicators>).

Note: There are four categories of human development: very high, high, medium and low. The values are based on consistent indicators, methodology and time-series data, thus showing real changes in values and ranks over time reflecting the actual progress countries have made.

The Malaysian case study of inclusive growth shows that state sponsorship through human resource development, institutional and infrastructural amenities has brought tremendous social change and transformation to the nation. The educational process should be embedded with motivational content based on local knowledge so as to develop an individual's self-efficacy. A cross-sectional regression exercise shows that the better an individual education, activity status, location strata, occupation and age, the higher the purchasing power they would enjoy. Furthermore, men do better than women, all else equal, the married or widowed is better off than a single person or a divorcee, and a Bumiputera is relatively worse off than a Chinese or an Indian, all else equal. (MHDR, 2013: App. B6.3, pg. 305).

## **FINDINGS**

Historically, Asia has experienced lower inequality than other developing regions. However, despite remarkable growth and impressive declines in extreme poverty, the region has seen widespread increases in income inequality at the national level, as well as in both urban and rural areas. Between 1990 and 2012, income inequality rose in 18 out of 31 countries accounting for over 80 per cent of the region's population. In countries where inequality has declined, two key factors have contributed to such declines: the expansion of education, and public transfers to the poor. The share of income owned by the top quintile of the population increased in the majority of countries (61 out of 111) although it did not increase globally from 1990 to the mid-2000s (Ortiz and Cummins, 2011).

In many developing countries, the distribution of land ownership has been particularly relevant in explaining inequality. Land concentration remains particularly high in Latin America, followed by Western Asia and Northern Africa (Vollrath, 2007; World Bank, 2005). In addition, the wage gap between top and bottom earners has also increased in the majority of developed countries and in many developing countries with data (Galbraith, 2012; ILO ILS, 2008; OECD, 2011). A significant part of the difference observed in disposable income disparities across countries can be explained by the redistributive impact of social transfers and taxes. In some cases, the negative effects of indirect taxes on the incomes of the poor, or nearly-poor, can be stronger than the positive effects of cash transfers (Lustig, 2012).

### **The Current Scenario for Malaysia**

Although the doctrine of 'pro-poor growth' of the 1990s is increasingly seen as a flawed idea, the role of the state in managing distribution in the case of Malaysia has enjoyed unprecedented endorsement from economists and policy makers. However, the context of identifying the best indicators of national development, and ways to capture these indicators calls for looking beyond the standard approach of income and economic growth in explaining the development (Stiglitz et al., 2009). The Tenth Malaysia Plan Targets (2010) explicitly spelled out the equality related objectives of the New Economic Model (NEM) as follows:

Table 1: Distributive Targets of NEM

<b>POLICY AIM</b>	<b>2009</b>	<b>2015</b>
To reduce the incidence of poverty	3.8%	2.0%
To improve overall income inequality by reducing the Gini coefficient	0.441	0.420
To increase the mean income of the bottom 40 per cent households	RM1,440	RM2,300
To increase the percentage of bottom 40 per cent households with SPM qualification and above	30%	45%

The rapid increase in relative poverty of Malaysians from 17.4 per cent (2007) to 19.3 per cent (2009) and 20 per cent in 2012 contradicts the claims of successfully reduction of absolute poverty to 1.7 per cent in 2012, from 49.3 per cent in 1970. (MHDR, 2013). While the Gini was reduced by about seven per cent from its original 0.453 before the minimum wage intervention, the compulsory secondary education reduced the Gini by almost four per cent. The least effective method to reduce inequality is the cash handout known as the Bantuan Rakyat 1Malaysia (BRIM) which only reduced Gini by 2.3

per cent to 0.443 for RM1,200 cash offer per head, and by 0.96 per cent to 0.449 with the cash offer of RM500.

According to The Malaysia Human Development Report (MHDR) 2013, the case study of inclusive growth experienced in Malaysia shows that it is state sponsorship through human resource development, institutional and infrastructural amenities that had brought tremendous social change and transformation of the nation. The inaugural report commissioned by the United Nations Development Programme (UNDP) instead maintains that poverty is best measured against what households earn in general, rather than by a fixed minimum level. Available evidence of the national distribution of income indicates a steady decline in inequality; the Gini coefficient dropped by about 16 per cent from 0.51 in 1970 to 0.43 in 2012. Despite the improvement in income disparity, the income gap between the top 20 per cent and bottom 40 per cent of households when measured in absolute terms, has actually increased during the period from 1970 to 2012. For instance, the income gap between the rich and the poor jumped 13 times from RM659 in 1970 to RM10,312 in 2012. The absolute gap between the urban and rural also widened, from RM228 in 1970 to RM2,262 in 2012, an increase by about 11 times.

In terms of ethnicity, the highest gap in absolute terms was registered among Bumiputeras, where the income gap jumped by nearly 20 times compared to 11 times for the Chinese and the Indians during the period of 1970 to 2009. Importantly, the widening gap appears to have come from increased income disparities within the groups, be it on the basis of ethnic, strata or gender. Another interesting finding is that rural Sarawak has a lower educational attainment capability than rural Sabah. This signifies that the official income poverty rate of Sarawak, which is substantially lower than that of Sabah, may not be a true reflection of all the important aspects of its socioeconomic development. The human capability mapping by the Ministry of Human Development and Resource (MHDR, 2013) confirms this reality, as Sarawak continues with its largest urban-rural gap for Malaysia. The chart below clearly shows that as of 2010 the total enrolment in tertiary education, as a percentage of the 20-24 years old population was approximately 34 per cent with East Malaysia starkly lagging behind the Peninsular. Undoubtedly, the bottom 40 per cent of households which are of grave concern are concentrated within the region of Sabah and Sarawak.

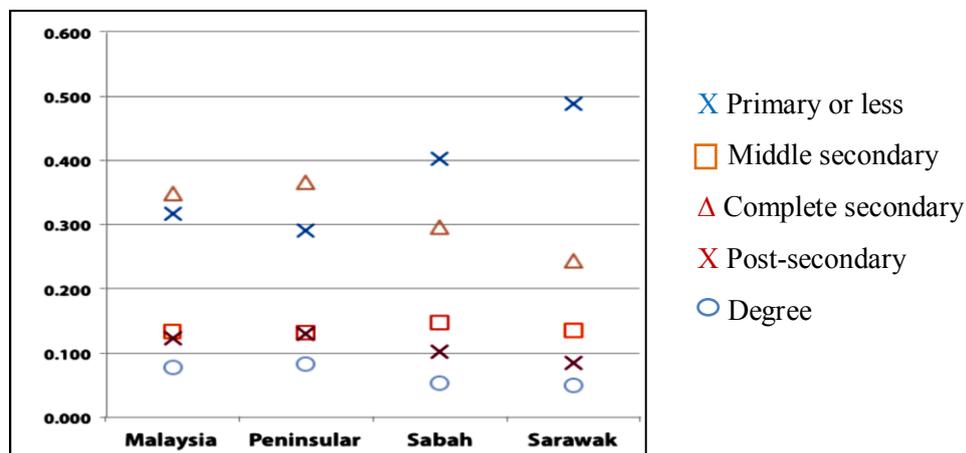


Figure 2: Educational Attainment of Adult Population

The growth in higher formal qualifications corresponds with an increasing proportion of workers in occupations demanding more skills, knowledge and expertise. But the degree of inclusiveness in attaining human capabilities is most appropriately evaluated not at the household level, but at the personal level. Sizeable disparities hold between Peninsular Malaysia and East Malaysia, with Sarawak registering the lowest educational profile. Urban and rural disaggregation accentuates the disparities, with rural Sarawak, with 64 per cent of adults having only primary schooling or less, lagging far behind the rest.

## **RECOMMENDATIONS**

The decline in international inequality is due largely to the more rapid growth of a relatively small number of large countries. Therefore, international cooperation to create an international environment that enables poor countries to grow faster is important for reducing aggregate global inequality. Experiences show that while the national context is important for policy effectiveness in combating inequality, elements such as universalism in the provision of social services, reducing social exclusion and intergenerational disadvantage, renewed emphasis on universal social protection, investing in education and strengthening labour-market institutions, prudent fiscal and monetary policies, creating more and better-paying jobs and reducing asset inequalities are key.

Given these guidelines and the unique character of Malaysia which practices dual laws, Civil and Syariah, it may be worth experimenting on readily available Islamic economic mechanisms and institutions in place. Zakat, a pillar in Islam plays an important role in ensuring that income and wealth circulates from the well-offs to less so. When implemented and if necessary enforced accordingly, the institution of zakat is expected to at the least reduce extreme inequalities originating from inherited poverty which then transforms into a vicious cycle of lost opportunities among the vulnerable. The zakat fund ought to be used to create lasting influences on lifelong chances for the zakat recipients through expansion of educational and business opportunities. They are referred to *asnafs* by the Quran; *"The alms are only for the poor and the needy, and those who collect them, and those whose hearts are to be reconciled, and to free the captives and the debtors, and for the cause of Allah, and (for) the wayfarers; a duty imposed by Allah. Allah is knower, Wise."* (9:60)

The successful functioning of Lembaga Zakat Selangor in uplifting the lives of thousands of previous zakat recipients serves as a testimony that setting Zakat goals beyond helping the poor and needy to fend them has a number of by-products. The obvious success being the significant reduction in gross inequalities. Then there are the lagging external effects of improved healthcare towards prolonged life-expectancy and higher productivity and later on reducing inequalities further. At the other end, lies the relevance of property rights, equal opportunities to fulfilling basic needs and equitable returns based on efforts as the cornerstones of the economic justice in Islam. The disparities between urban and rural areas, known as spatial inequalities, in the case of Sabah and Sarawak might yield positive results with the introduction of land reforms as recommended by the Syariah. In the absence of an active market for land added by the heavy acquisition through inheritance are the common factors to land idleness and concentration.

Islam is a way of life, providing us with an array of choices to manage all aspects of our lives. It prescribes all the necessary aids for one to cope with life challenges. Therefore, it becomes the collective responsibility of Muslim scholars specializing in the areas of welfare economics to explore, create awareness and promote the Islamic Economic System as a viable alternative to understand and manage the various types of economic inequalities prevalent in Malaysia.

## **CONCLUSION**

Despite the broad expectation that inequalities should decline systematically as societies develop, inequality trends have not followed a universal pattern. In fact, the empirical evidence suggests that much depends on country-specific conditions and national policymaking. The vulnerable are more likely to benefit where pro-poor national policies are in place, growth is equitable, and labour markets inclusive. Countries that have used redistributive fiscal policy measures, developed universal social protection programmes, or even wide-ranging social assistance, with emphasis on education and health spending, and those that have increased labour-market opportunities for those at the bottom, have weathered better than others.

At the risk of oversimplifying, some degree of monetary inequality is needed to create incentives for people to study and accumulate human capital, to work instead of taking leisure, to save for the future, and to invest in risky businesses. Returns to education are a clear example of a differentiation in

labour earnings that spur the accumulation of human capital and economic growth, but at the same time results in inequality in outcomes. However, incentives may fail to change behaviour when economic mobility is lacking. In countries where inequality had declined, two key factors contributed to such declines: the expansion of education, and public transfers to the poor.

Based on the discussions with regards to Malaysia, one can conclude that despite the numerous ongoing government efforts to increase economic equality by expanding inclusiveness through the promotion of equal opportunity, certainly more needs to be done for equity to play an active and leading role in national development plans. The adoption of the readily available Islamic Economics mechanism in Malaysia can facilitate the fine-tuning of the existing distributive justice initiatives aimed primarily at reducing economic inequality between ethnics, region or other demographic traits. Fostering greater inclusion in the quest to reduce inequality between the urban and rural demands attention to a focussed development of the latter in East Malaysia.

The conventional ways of dealing with economic inequalities which, if left unattended may cause social unrest, has proven to be ineffective in responding to the rising inequality among fellow Malaysians. Some have migrated to greener pastures, resulting in a considerable brain drain, whereas the remaining many are beginning to demand solutions to reverse the predicament. In my humble opinion, there is much at stake if we wish to capitalize from our sizable labour force. A majority of which that appear to fall into identified as disadvantaged social groups. They include youth, (whom having lost their protection as children), are seen as a generation at risk, older citizens (in the form of income insecurity and insufficient access to quality health care), persons with disabilities, the indigenous (face inequalities in land rights and environmental challenges) and migrants.

Therefore, it is timely to introduce and establish other economic institutions readily available in the Islamic economic system, besides existing institutions of *zakah* and *waqaf* which (to the author's mind) can be improved in terms of their respective functions and achievements. The formalizing *al-Hisbah* (the independent market regulator) is a good start to ensure that government policies aimed at reducing extreme inequalities in income and wealth within the society are implemented accordingly. The success of Islamic banking and finance and the rapidly growing interest in businesses related to halal hub are in fact evidences of non-Muslims Malaysians to accept and support efforts geared towards narrowing the socioeconomic inequalities at national level.

## REFERENCES

- Galbraith, J. K. (2012). *Inequality and Instability. A Study of the World Economy just before the Great Crisis*. New York: Oxford University Press.
- International Labour Organization International Institute for Labour Studies (ILO ILS). (2008). *World of Work Report 2008: Income Inequalities in the Age of Financial Globalization*. Geneva: International Labour Office.
- Le Houérou, P. (2015) Foreword to Addressing Inequality in South Asia Report. In M. Rama, T. Béteille, Y. Li, P.K. Mitra and J.L. Newman (Eds.). *Addressing Inequality in South Asia. South Asia Development Matters*. Washington, DC: World Bank.
- Lustig, N. (2012). Taxes, transfers and income distribution in Latin America. *Inequality in Focus*, 1(2) (July), 1-5. Washington, D.C.: The World Bank.
- Organization for Economic Cooperation and Development (OECD). (2011). Old-age income poverty. In *Pensions at a Glance 2011: Retirement- income Systems in OECD and G20 Countries*. OECD Publishing. Retrieved from: [http://dx.doi.org/10.1787/pension\\_glance-2011-28-en](http://dx.doi.org/10.1787/pension_glance-2011-28-en)
- Ortiz, I. & Cummins, M. (2011). Global inequality: beyond the bottom billion. A rapid review of income distribution in 141 countries. *Social and Economic Policy Working Paper (April)*. New York: UNICEF.
- Palma, José Gabriel (2011). Homogeneous Middles vs. Heterogeneous Tails, and the End of the "Inverted-U": It's All About the Share of the Rich. *Development and Change*, 42(1), 87-153.
- Sen, A. (1980). Equality of What? In S. McMurrin (Ed.). *The Tanner Lectures on Human Values*, 1, 353-69. Cambridge: Cambridge University Press.

- Sen, A. (1992). *Inequality Reexamined*. New York: Oxford University Press.
- Stiglitz, J. E., Sen, A. & Fitoussi, J. P. (2009). Report by the Commission on the Measurement of Economic Performance and Social Progress.
- Stiglitz, J. E. (2012). *The Price of Inequality: How Today's Divided Society Endangers our Future*. New York: W.W. Norton & Company, Inc.
- Stockhammer, E. (2012). Rising inequality as a root cause of the present crisis. *PERI Working Paper No. 282 (April)*. Amherst, Massachusetts: University of Massachusetts, Amherst, Political Economy Research Institute.
- Tenth Malaysia Plan. (2010). *Tenth Malaysia Plan 2011-2015*. Putrajaya: The Economic Planning Unit.
- The Malaysia Human Development Report (MHDR). (2013). *Redesigning an Inclusive Future*. Malaysia: United Nations Development Programme (UNDP).
- Vollrath, D. (2007). Land distribution and international agricultural productivity. *American Journal of Agricultural Economics*, 89(1), 202-216.
- Wang, C. & Caminada, C. (2011). Disentangling income inequality and the redistributive effect of social transfers and taxes in 36 LIS countries. *LIS Working Paper Series, No. 567 (July)*. Luxembourg: Luxembourg Income Study (LIS).
- World Bank (2005). *World Development report 2006: Equity and Development*. Washington D. C.: World Bank & New York: Oxford University Press.
- World Bank (2010). *Malaysia economic monitor: inclusive growth*. Malaysia Economic Monitor. Washington, DC: World Bank.
- World Bank Report (2015). *Addressing Inequality in South Asia*. Washington, DC: World Bank.

## **THE QUESTION OF BUMIPUTERA PARTICIPATIONS IN URBAN RETAIL SECTOR: TOWARDS URBAN LIVABILITY**

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**ABSTRACT:** Retail sector is one of the important components in urban economic activity for urban livability. Livability of the urban area contributes to the sustainability of urban retailing. Since retail sector is the *lung of economy* for urban areas, an in-depth study to understand the framework of this sector should be emphasized. This paper discusses the participation of Bumiputera in urban retail sector focusing on the Seremban Municipal Centre (SMC) as the designated study area. The purpose of this paper is to examine the role of the New Economic Policy (NEP) in bringing economic equity by ensuring 30 per cent of Bumiputera participation in urban retail sectors and to look into the pattern of Bumiputera consumers buying goods in SMC. Bumiputera participation in retail activity is still low as compared to the NEP target. While the NEP was established (in 1970), the targeted results are still unclear. To achieve sustainable quality of life from the economic perspective, local economic equilibrium plays an important role. Economic balance for every ethnic group should be emphasized in order to achieve economic equality and cohesion between ethnic groups. The results obtained through primary and secondary data indicated that Bumiputera retailers' involvement constitutes only 7 per cent, while the remaining 93 per cent are from non Bumiputeras (Chinese 80 per cent and India 13 per cent). In addition, the trend for the past three decades shows a mere 6 per cent increase in Bumiputera participation in retail sector in SMC. Bumiputera retailers' are involved in specific businesses such as restaurant, beauty care, travel and insurance agency, tuition centre, boutique and also private clinics. The result shows that Bumiputera participation in retail sector is still low and urban planners should play bigger roles to ensure Bumiputera's retail activities are sustainable in the SMC. Based on consistent development of Bumiputera retailers over the past 33 years, we extrapolated that the quality of life of this group is sustainable and consistent as compared to other ethnic groups. 80 per cent of Bumiputera consumers tend to choose services while visiting this area. Therefore, it shows the relationship between Bumiputeras' consumption pattern and the economic status for their retailers in SMC area. This consistency plays an important role in maintaining the culture, tradition and quality of life of the Bumiputera group, as far as availability of goods and services is concerned.

*Keywords:* Urban Livability, Retailing, Economic Equity, Bumiputera, Sustainability

### **INTRODUCTION**

Retailing is a main component in urban lifestyle. It contributes to the economy and social wellbeing by creating interactions between people. It also affects the development of a city and accessibility in urban space (Balsas 2004; Rotem-Mindali, 2012). Retailing is also a factor that promotes a city's vibrancy because it is one of the attractions for consumers to visit the business area for all kind of purposes, not just shopping but also as a place for recreations. A vibrant city will contribute to the livability of the urban area and also promotes good quality of life.

In a livable city, the city people and visitors find the city attractive, walkable, ecologically healthy, with clean air and clean water, green with trees and flowers, and generally there is happiness around with the urbanites having basic needs - their own shelters, jobs, access to good education at all levels, ease of mobility and access to goods and services. All these needs are set in a city design that allows people to reflect more on the blessings of good life than on the negativities (Pacione, 2001).

In this study, retailing and its contribution to the Bumiputera's economy were observed. The group consumer behaviour is the main scope of this research, there is a real need now to examine in depth the human aspects of city livability. According to Idrus et al. (2013), conceptually livable city should provide physical accessibility to the basic infrastructures for the people. The livability of Bumiputera group should be seen in this context too.

## **THE ARGUMENT**

Bumiputera participation in retail activity is still far from achieving the New Economic Policy (NEP) target. Although the NEP was implemented since 1970, the result is still unclear. To achieve sustainable quality of life from the economic perspective, local economic equilibrium plays an important role. Economic balance for every ethnic group should be emphasized in order to achieve economic equality and cohesion between different ethnic groups which is crucial in multi-ethnic Malaysia.

The issue of ethnic adjustment in the economic sectors started in 1970 and was mentioned in the NEP. The NEP was established with the objective to improve the economic status of the Bumiputera, as well as their special privileges. This is due to the situation that Bumiputeras were being left behind in economic activities (Faaland et al., 2002). During the colonial era, the Malayan economy was dominated by the Chinese community who lived in urban areas. The British colonial administration also developed mining, plantation and agriculture (Mohd Said, 2004). The Malays lived in the village and work in agricultural field while plantation estate activities were dominated by the Indian community (Mohd Zainudin and Zulkifly, 1982). The historical segregation has caused economic inequalities in ethnic participation with its effect lasting till today.

Despite the funds and supports provided for Bumiputera entrepreneurs throughout the years, their participation in the economic sector is still low. Large number of agencies has been created to help the Bumiputera, such as MARA, Bank Bumiputera, Amanah Saham MARA, Amanah Saham Bumiputera, Urban Development Authority (UDA), Bumiputera Entrepreneurs Corporation (PUNB), Bumiputera Transformation Roadmap program, TERAJU, and many others (Bushra 1993; Rostam, 2001). All these organizations, agencies and aid funds given are to help the Bumiputera to be on par with other ethnic groups in retail sector, but until today Bumiputera participation in retailing has yet to reach a satisfactory level.

In order to understand the relationship between retailing and consumerism, a study on consumer behaviour is crucial. Through this observation, a researcher might be able to find out the relationship between retailer and consumer in terms of its sustainability in contributing to today's urban economy.

## **STUDY AREA**

This study was conducted in Seremban, Negeri Sembilan, Malaysia. Seremban is a developed township which is about 70 km south of Kuala Lumpur. Seremban City Centre is located in the Bandar sub-district and is categorized as an old town district. The function is similar to the central business district (CBD) because of the criteria based on Proudfoot (1959), CBD exists in area with a high level of business over the surrounding area and there are multi-storey buildings. There are 1442 commercial lots available in this area. This area consists of a mixture of old and new buildings with two to five storey (Department of Town and Country Planning, 2010). Due to the ongoing development of the surrounding area, Seremban area has been affected in terms of housing development, infrastructure, transportation and also retail activities. Study on the development of this area is crucial in order to monitor urban dynamics within the region.

## **METHODOLOGY**

This study used both primary and secondary data. Primary data were collected through field work and secondary data taken from a manuscript of data and documents from the Seremban Municipal Council (SMC). The collections of primary data were used to clarify the retail activities as well as information about the type of business and ownership. The data used focused only on small-scale retailing. Hypermarket or supermarkets nearby are not included in this study. From a total of 1442 shops in SMC, only 768 shops were chosen for this study due to the type of ownership (there is no ethnic information for some retailer) and the data constraints from the SMC. The 768 shops included in this

study were shops that provide retail activity and services, such as franchise, vacant shops and office are not involved.

In order to review the Bumiputera's consumer behaviours in buying product, interviews were conducted using purposive sampling. This sampling method was chosen because the survey applied to only a focus group of visitors who come to the study site. The selection includes all categories of Bumiputera visitors such as students, government and non-governmental employees, housewives, tourists and businessmen who were willing to be interviewed. The interview aimed to obtain visitors' responses on which product they tend to buy in SMC among 10 products and services that are set by the researcher such as health care, information and communication technology (ICT goods), home and electrical appliances, restaurant, groceries, beauty care, services, clothing and shoes and repairing vehicles. A total of 91 Bumiputera respondents in SMC were interviewed and the data were analysed using descriptive analysis to show the patterns of Bumiputera's buying habits.

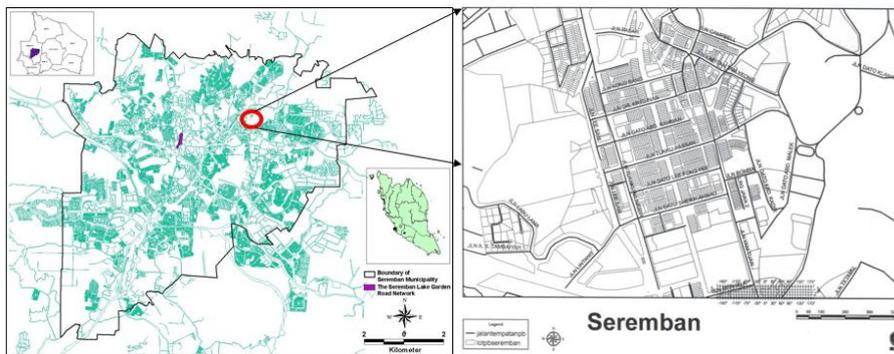


Figure 1: Location of study area through Malaysia map and close-up shop lots in SMC

## RESULTS AND DISCUSSIONS

The results showed that only 7 per cent of the overall retail shops in SMC is owned by Bumiputera whereas Chinese and Indian ethnic group consists of 80 per cent and 13 per cent respectively (Figure 2). In line with Malaysia's history, the Chinese community is still dominating the country's economy (Bushra 1993; Faaland et al. 2002; Ahmad Idris, 1990). This study on the SMC found the pattern has changed little during the last three decades.

For the past three decades, the involvement of Bumiputerans has shown increment of only 2 per cent compared to the previous study by Mokhtar (1979). Whereas, from 2008 until 2012, the participation of Bumiputera in retail sector at SMC increased by 4 per cent. Through the participation pattern showed by the Bumiputera's retailer, it can be concluded that the Bumiputera retailers are trying to increase participation in the retail sector in SMC.

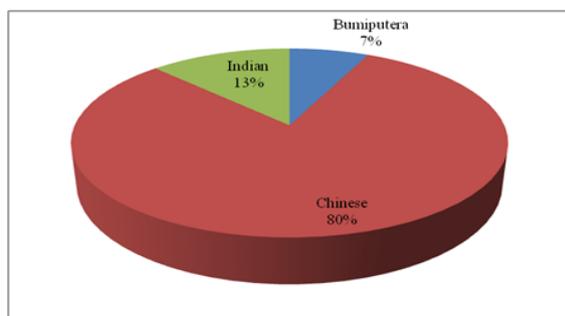


Figure 2: Participation among ethnic group in retailing at Seremban Municipal Center

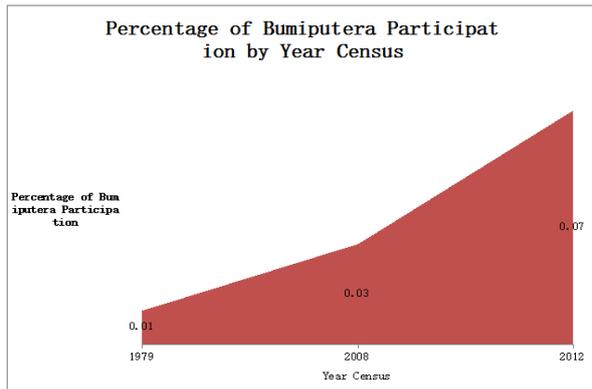


Figure 3: Percentage of Bumiputeras’ participation by year census

Based on the observations made in this research, the participation of each ethnic group in retail sector is associated with the density of local population. This is proven through census in Seremban District. The census showed that the Chinese population has dominated this area from 1991 until 2010 (Figure 4) followed by the Indians, Bumiputera’s, non-Malaysian and others.

According to Table 1 below, all ethnic groups are experiencing positive growth. Bumiputera population increased drastically in the past 10 years by 123 per cent. Changes in the Bumiputera population growth explained why Bumiputera participation has doubly increased within a short period of time (2008-2012) (Figure 3). However, the table shows normal growth for the Chinese and Indian population together with changes in their retailers’ participation in retail business as well.

Table 1: The dynamics of population growth following the ethnic from year 1991-2010

Ethnic	1991	% Growth	2000	% Growth	2010
Chinese	10150	26	12802	31	16797
Indian	3926	40	5500	20	6579
Bumiputera	2772	28	3542	123	7886

Source: Department of Statistics, Malaysia (1991, 2000 and 2010)

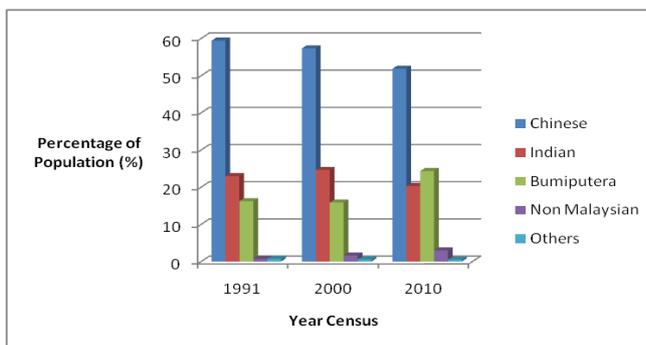


Figure 4: The dynamics of population in Seremban District (1991 to 2010)

This study also revealed that Bumiputera retailers are involved in businesses such as furniture trade, boutiques, clothing, cosmetics, beauty, health equipment, computer parts, grocery stores and other services such as photocopy services, banks, restaurants, salon, telecommunications, travel agencies as well as insurance, dental clinic, pawnbrokers and tuition centre. Bumiputera businesses are already experiencing changes within the types of business conducted over the past three decades as they undergo the process of adaptation to the new environment and compete with the current retail development (Hadi et al, 2012). There are two to six storey buildings in the SMC, but the distribution of Bumiputera participation can only be seen on the ground floor, first floor and second floor. When compared with the findings from previous studies, Mokhtar (1979) showed that almost all retail businesses owned by Bumiputera are small and medium size and almost all shops are located away

from the strategic locations (the core and walkways). The study found that only 1 per cent of commercial floor space in Seremban is occupied by Bumiputera retailers. Hadi et al. (2008) observed that the presence of Bumiputera in business is visible in small-scale or dealing with MARA bazaars which are supported by the government. Bumiputeras' businesses usually focus on selling daily needs such as agricultural production, fruits and vegetables, groceries, food and drinks. In conclusion, the business owned by Bumiputeras mainly focus on trades that require small capital with low risk. In addition, the types of businesses owned by Bumiputera retailers have changed over the past 33 years. For example from small scale eateries, the Bumiputera started to get involved in businesses that were previously dominated by Chinese such as beauty parlour. This shift of business interest is probably to fulfil demand for this kind of service for the ever changing and dynamic culture, where more Bumiputeras are visiting beauty parlours. This shift of business type also further supported our speculation that the Bumiputera business community's existence is to cater for Bumiputera residents.

### **The Patterns of Bumiputera Consumers Buying Products**

Study about consumer buying products is essential in retailing to observe urban retail resilience. Urban retail resilience is defined as the ability of stores and shopping districts to tolerate and adapt to changing environments that challenge the retail system's equilibrium, without failing to perform its functions in a sustainable way (Barata-Salgueiro and Cachinho, 2011; Wrigley and Dolega, 2011). The result on the patterns of Bumiputera consumers buying products is shown in Figure 5. The Bumiputera consumers tend to choose services (80 per cent) in SMC, the two types of products that are popular among customers are electrical (63 per cent) and home appliances (62 per cent).

Based on past studies about ethnicity and its relation with the retailers, consumers tend to choose retailers who are from the same ethnic group (Eroglu, 2002). This reinforces the findings of the present study which showed that the dominant ethnic group in Seremban District also has the most number of retailers in retail area at SMC and vice versa. Findings from these studies also showed that there was ethnic cleavage in the distribution of retailer in terms of their ethnicity within the retail sectors in SMC. However, in this regard, the issue of balance is already in place in Seremban, where the participation of retailers according to ethnic group, is consistent with the size of its population size. In order to achieve the livable city that can give equality and equity among ethnic groups, the balance of ethnic involvement in the economy is important to keep the people comfortable, happy and prosperous. Based on the consistency of the Bumiputera retailers development over the past 33 years, we extrapolated that the quality of life of this group can be considered to be sustainable. In addition, this consistency in participation plays an important role in maintaining the culture, tradition and quality of life of the Bumiputera, as far as the availability of goods and services is concerned.

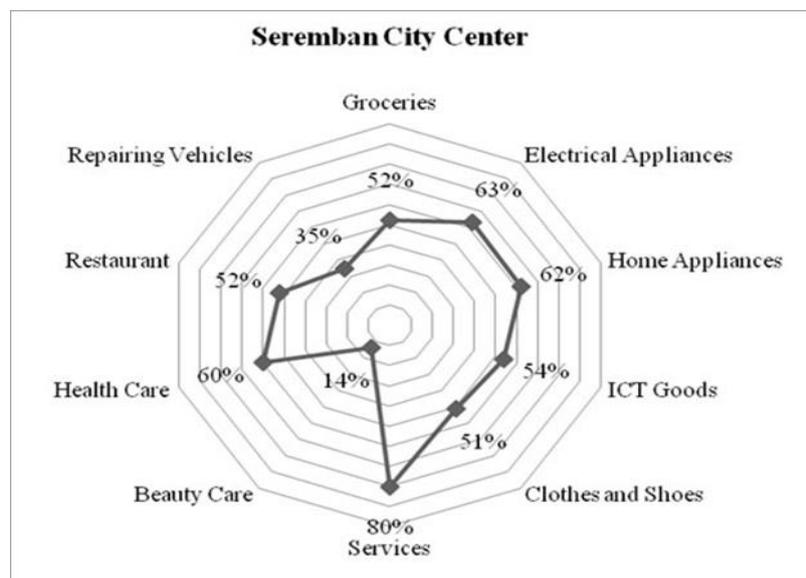


Figure 5: The tendency of Bumiputera consumers buying products in SMC

## CONCLUSION

The results showed that retailers from each ethnic group increased alongside with the size of its population. Inequalities based on ethnic participation in retailing at the study area is appropriate to the proportion of the population. The largest population living in the Seremban district in terms of ethnic classification is Chinese. They attained highest participation in retailing sector at SMC. Based on the balance between the number of Bumiputera retailers, its population and the demand from its consumers, a trend which is also reflected on other ethnic groups, economic equality and equity among the different ethnic groups in the retail industry in SMC cannot be measured to gauge the livability of a city. Based on the finding, we concluded that the implementation of NEP approach is inappropriate in the study area. This situation requires more attention from city planners who should play a role in ensuring and also maintaining the livability and sustainability of Bumiputera retailers in the retail sector at SMC.

## REFERENCES

- Ahmad Idris, M. N. (1990). *Malaysia's New Economic Policy*. Petaling Jaya: Pelanduk Publications.
- Balsas, C. J. L. (2004). Measuring the Livability of an Urban Centre: An Exploratory Study of Key Performance Indicators. *Planning, Practice & Research*, 19(1), 101-110.
- Barata-Salguiero, T., & Cachinho, H. (2011). The resilience of urban retail areas. In T. Barata Salgueiro & H. Cachinho (Eds.), *Retail planning for the resilient city: Consumption and urban regeneration*. Lisbon: CEG. 19-44.
- Bushra, Y. (1993). Dasar Ekonomi Baru. In Yusof, I. and Khayati, I. (Eds.). *Dasar-dasar Kerajaan Malaysia; Tinjauan Menyeluruh*. Kuala Lumpur: A.S. Noordeen.
- Department of Statistics, Malaysia. (1991). *Population Distribution by Local Authorities and Mukims*. Kuala Lumpur. Government Printed.
- Department of Statistics, Malaysia. (2000). *Population Distribution by Local Authorities and Mukims*. Kuala Lumpur. Government Printed.
- Department of Statistics, Malaysia. (2010). *Population Distribution by Local Authorities and Mukims*. Kuala Lumpur. Government Printed.
- Department of Town and Country Planning (2010). Rancangan Tempatan Daerah Seremban, 2015. 'Sebuah Daerah Metropolitan Menjelang Tahun 2015'. Jilid I: Bahagian A. *Pelan Panduan Pembangunan Daerah Seremban, 2015*. Negeri Sembilan.
- Faaland, J., Parkinson, J., & Saniman, R. (2002). *Dasar Ekonomi Baru; Pertumbuhan Negara Dan Pencapaian Ekonomi Orang Melayu*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- Eroglu, S. (2002). Impact of Ethnic Minority Retailers on Urban Revitalization. *Journal of Shopping Center Research*, 9(2), 53-75.
- Hadi, A.S., Idrus, S., Harman Shah, A.H., Othman, M.R. & Mohamed, A.F. (2012). Tindak Balas Setempat Terhadap Penghomogenan Globalisasi: Pembudayaan Bandar Berkemanusiaan. *Prosiding Seminar Antarabangsa Ke-5 "Ekologi Habitat Manusia dan Perubahan Lingkungan di Alam Melayu"*. Pekanbaru, Indonesia: Ur Press.
- Hadi, A.S., Idrus, S., Harman Shah, A.H. & Mohamed, A.F. (2008). *Dayahuni Bandar*. Bangi: Penerbit Universiti Kebangsaan Malaysia.
- Mohd Said, Z. (2004). *Peruncitan*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- Mohd Zainudin, S., & Zulkifly, O. (1982). The Economy Structure. In Fisk E.K. and Osman-Rani, H., (ed.). *The Political Economy of Malaysia*. Kuala Lumpur: Oxford University Press.
- Mokhtar, M.H. (1979). *Aktiviti Retail: Penyertaan Bumiputera dalam Bidang Perniagaan di Bandar Seremban. Saiz, Pola dan Kedudukan*. (Tesis Sarjana Muda Kepujian dalam Bidang Geografi). Fakulti Sains Sosial dan Kemanusiaan, Universiti Kebangsaan Malaysia, Bangi (Unpublished).
- Pacione, M. (2001). *Urban Geography - A Global Perspective*. Routledge: London.
- Proudfoot, M. J. (1959). In Mayer, H. M. and Kohn, C. F. (Eds.). *City Retail Structure*. Chicago: The University of Chicago Press. 625.
- Rostam, K. (2001). *Dasar dan Strategi Petempatan dalam Pembangunan Negara*. Bangi: Penerbit Universiti Kebangsaan Malaysia.

- Rotem-Mindali, O. (2012). Retail fragmentation vs. urban livability: Applying ecological methods in urban geography research. *Applied Geography*, 35, 292-299
- Idrus, S., Hadi, A.S., Harman Shah, A.H. & Sulaiman, S.U. (2013). Kemunculan Kuala Lumpur Sebagai Wilayah Perbandaran Mega Diperluas: Menongkah Dayahuni dan Kelestarian. *Jurnal Sains Sosial dan Kemanusiaan, Geografi, Universiti Pendidikan Sultan Idris*, 1(1), 31-45.
- Wrigley, N. & Dolega, L. (2011). Resilience, fragility and adaptation; New evidence on the performance of UK high streets during global economic crisis and its policy implications. *Environment and Planning*, 43(10). 2337-2363.

**LOCAL ECONOMIC DEVELOPMENT – ASSESSMENT OF LOCAL ATTITUDES  
TOWARDS CONSERVATION AND TOURISM AROUND ROYAL BELUM-TEMENGGOR  
FOREST COMPLEX, PERAK, MALAYSIA**

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**ABSTRACT:** This paper shall present and discuss findings from an investigation of locals' attitude toward conservation and sustainable ECT in two Orang Asli villages around Royal Belum and Temenggor Forest Complex (BTFC), Perak. Twenty respondents participated in the questionnaire-guided surveys i.e. twelve and eight respondents from Semelur and Sungai Tiang respectively. The results from the questionnaire survey unveiled positive attitudes of the community towards tourism (92 per cent level of agreement) and strong support for biodiversity conservation (95 per cent level of agreement). The economic fulfilments of the household and income generation are amongst reasons given by the local for future ECT projects. New local jobs will be created and poverty addressed, as indicated by 0.95 Relative Importance Index (RII) value. Similarly, we observed RII value for environmental reason and a growing concern for protecting natural and cultural resources from over-exploitation and extinction (with RII value of 0.95). This study found that benefits resulting from the protected conservation area might substantially increase local supports for better conservation. This paper conclude by putting forth two recommendations to be considered for designing and implementing more comprehensive framework and operational need for sustainable ECT and conservation namely: (1) determination of local community needs and readiness towards sustainable ECT through comprehensive and collaborative research, and (2) organisational and capacity building aimed at preparing community and their stakeholders in realising sustainable ECT development and conservation efforts in protected area.

*Keywords:* eco-culture tourism, local economic development, orang asli, poverty, Royal Belum-Temenggor Forest Complex

## **INTRODUCTION**

Promoting sustainable rural development (including sustainable tourism and biodiversity conservation programmes in this context) at a local community level is strongly dependent on the informed and strong participation from host community and their stakeholders (Kamarudin, 2013a). As United Nations World Tourism Organization (Graci and Dodds, 2010) highlighted:

“Sustainable tourism development requires the informed participation of all relevant stakeholders, as well as strong political leadership to ensure wide participation and consensus building”.

The statement expressed that a successful local economic development (LED) including sustainable tourism and biodiversity conservation projects require strong and continuous support, and ‘buy-in’ from local community and their stakeholders. Therefore, the assessment of local attitudes towards LED programmes have become more important as it will provide vital information regarding the level of awareness, understanding and acceptance toward certain LED programmes, which in turn, would determine the outcome of any LED programmes including sustainable tourism and biodiversity conservation programmes which are the focus of this study.

With its core principle being the promotion of local community development through biodiversity conservation, the relationship between tourism benefits and local support for conservation especially in BTFC has not been thoroughly explored. Despite high recognition received by BTFC, very few attempts have been made to establish and analyse the link between local attitude and support for conservation and tourism (Razak et al., 2015; Kamarudin et al., 2014b; Abdullah et al., 2013; Ang and

Chan, 2009). This gap, in turn, has provided a strong justification for this study to be conducted in BTFC area. The overall structure of this paper is as follows. First, it begins with a brief explanation of the strategy for rural development through the concept of inclusiveness, followed by the discussion on local economic development and conservation through sustainable ECT. The subsequent section then addresses methods of data collection and analysis technique, followed by another section discussing the results and findings. The final section would report conclusion and recommendations.

## **LITERATURE REVIEW**

### **“Inclusiveness” as a Strategy for Local Economic Development**

One of the key focus highlighted in the 11th Malaysia Plan (2016-2020) is the urgent need to tackle the issue of housing for those with income at the bottom 40 per cent (herein referred as B40 group) through inclusive developmental strategies. The term “inclusiveness” is used to address development that focused on the need of 2.7 million household in Malaysia identified as B40 in year 2014 (EPU, 2015). As a response to these targets, current and continuous initiatives for overcoming the following issues; i) combating poverty, ii) rising cost of living, and iii) promoting social justice have been introduced by the Government Transformation Programme (GTP) such as 1Malaysia Clinic, 1Malaysia People Menu, 1Malaysia People Shop, 1Malaysia Textile Shop and 1Malaysia People Agrobazaar Shop. The aforementioned programmes should be maintained and more facilities/services are expected to be developed in other areas during the 11MP period (PEMANDU, 2013; EPU, 2015).

Apart from provision of necessary infrastructure and services, reducing poverty and rising the household income for B40 is very challenging and require a reliable strategy. An integrated research is much needed to improve the aforementioned issues through education, training programmes and diversification of local economic base, aiming at high-income generation through innovation. There is a need to diversify rural economic activities to improve socio-economic and wellbeing of B40 group under GTP and 11MP. Similar focus for inclusive development should be delivered for every citizen equally and without any exception, in this case, the Orang Asli B40 community of Malaysia.

Regarded as one of the minority ethnic group in Malaysia’s plural society, Orang Asli population in 2008 only comprises 0.005 per cent of the nation’s total population (or 141,230 people) (Ministry of Regional and Rural Development online statistics<sup>2</sup>). The level of poverty among Orang Asli recorded in 2008 is very high that is more than 88 per cent of its total population<sup>3</sup>. This alarming situation put this community directly under the most vulnerable ethnic group and under the B40 group and therefore, a specific study on locals’ attitude towards conservation and rural developmental project through tourism programme is being initiated as part of inclusive development strategy for Orang Asli community.

### **Sustainable Eco-Culture Tourism: An inclusive strategy for local economic development and conservation**

According to Kamarudin (2007), sustainable ECT can be defined as “an individual or a certain human group travel to enjoy the nature’s beauty and also the unique cultural diversity of human populating the earth, where the relationship between both elements (nature and the local community’s culture) happens symbiotically”. The definition also strengthens the core principle of sustainable ECT which is to promote local community development through biodiversity conservation and to maintain a symbiotic relationship between host community, tourists and local tourism resources (see Figure 1).

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<sup>2</sup> <http://www.rurallink.gov.my/wp-content/uploads/2015/05/127.pdf>

<sup>3</sup> <http://www.rurallink.gov.my/wp-content/uploads/2015/05/66.pdf>

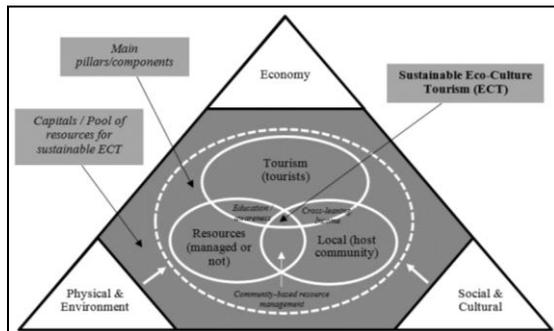


Figure 1: Conceptual model for sustainable eco-culture tourism

Source: Kamarudin et al. (2015), Kamarudin and Ngah (2007) and Kamarudin (2007)

The development of sustainable ECT programmes is primarily driven by the host community's desire to fulfil their economic objectives. A review of literature (see Kamarudin 2013b; Graci and Dodds, 2010; Sebele, 2010; Manyara and Jones, 2007; Sharpley and Sharpley, 1997) suggested the following direct and indirect benefits of conservation of unique natural and cultural resources with relation to sustainable ECT programme:

- 1) Provides both the financial resources and stimulus for the conservation, protection and improvement of the natural rural environment.
- 2) Supports the conservation and improvement of the historic sites and architectural character, including traditional houses.
- 3) Leads to environmental improvements in rural towns and villages infrastructures, such as solid waste disposal systems, sewage, traffic regulation and general improvements to buildings.
- 4) Promotes environmental awareness among members of the host communities. By observing interests showed by tourists in appreciating local natural beauty, this might increase the environmental awareness among host communities to protect and conserve their environment for tourism benefits.

Similarly, the development of tourism and tourism-related businesses by rural community and their stakeholders could contribute positively towards conservation of unique natural and cultural resources (Stone and Stone, 2011; Barna et al., 2011; Sebele, 2010; Manyara and Jones, 2007). Conservation of surrounding rural resources, for instance, the forest area and forest products, agriculture and water bodies will maintain attractive environment while reducing exploitation of natural resources. The promotion of conservation efforts could also educate the communities and their stakeholders on conserving their surrounding environment for tourism purposes (Kamarudin, 2013b). With respect to the direct and indirect economic and environmental benefits to the host communities, ECT programmes could act as a double-edged sword, as the development of sustainable ECT might potentially harm or damage local economics and its environment (natural and culture), depending on how the activities are developed and managed (Kamarudin, 2013b; Sebele, 2010).

## CASE STUDY OF TWO COMMUNITIES AND STUDY APPROACH

The study has selected two *Orang Asli* settlements as case study subjects namely Kampung Semelor of Temenggor Forest Complex and Kampung Sungai Tiang of Royal Belum State Park (Figure 2). Primary data and information were systematically gathered using both quantitative (via questionnaire-guided surveys) and qualitative approaches (via unstructured interviews and field observations) in June 2014. Meanwhile, secondary data and information were gathered from reviews of village census books and unpublished census records from the Department of Orang Asli Development (Jabatan Kemajuan Orang Asli, JAKOA, 2014) Gerik.

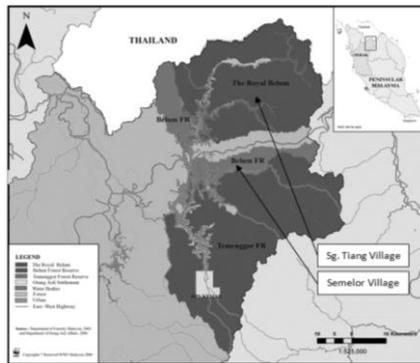


Figure 2: Map of the study areas located in Kampung Semelor and Kampung Sungai Tiang, Perak  
Source: WWF-Malaysia (www.wwf.org.my)

Twenty (20) respondents participated in the questionnaire-guided surveys i.e. twelve respondents from Kampung Semelor and eight respondents from Kampung Sungai Tiang. Two different approaches were adopted when conducting the survey on the local communities, and decisions were made based on different circumstances faced during visits to each village. A meeting was held with the respondents in the village community hall (*Balai Sewang*), Kampung Semelor. The ‘door-to-door’ interview sessions were done in Kampung Sungai Tiang, as it was impossible to meet respondents collectively during the time allocated for the field survey. Perhaps it is worth mentioning that the number of respondents present for the survey was very low and far from the initial target of 55 respondents (as suggested by a formula for a valid sample size). This low respondent rate can be contributed to the following two factors:

1. Lack of interest from the local people (and also due to timidity) to participate because they do not understand the purpose of this study.
2. Insufficient time allocated for the site visit and survey on the local community. The visit was very brief (one day to cover each village), hence the researchers were unable to capture sufficient tangible and intangible inputs from the communities. According to many ethnographic studies, a longer stay is required for each case study to build rapport with the community and potential respondents (Kamarudin and Ngah, 2007).

We examined the feedback by respondents regarding the most influential and/or the less influential and ranked them based on the attributes presented in the form of criticality. The analysis was assisted by the use of Statistical Package for Social Science (SPSS) where data were keyed into SPSS worksheet or database. The Relative Importance Index (RII) is computed as perceived by the respondents (see equation below) (see Muhwezi et al., 2014 for more discussions on RII):

$$RII = \frac{\sum W}{A * N} \quad (0 \leq RII \leq 1)$$

Where:

W – is the weight given to each factor by the respondents and ranges from 1 to 5, (where “1” is “not important” and “5” is “very important”)

A – is the highest weight (i.e. 5 in this case)

N – is the total number of respondents

## RESULTS AND DISCUSSIONS

In this section, we discuss the results of the assessment of local attitude towards local economic development, tourism and conservation.

### Local attitudes towards conservation and sustainable ECT

Table 1 of this study identified respondents' reasons for supporting sustainable ECT in the study area. The idea of sustainable ECT is shared between "the respondents' desire to increase opportunity in income generation – as a full-time job" and "the potential to enhance protection of local biodiversity and socio-culture" with RII value of 0.95, respectively (see Table 1). In this study, the respondents have also included "the need for acquiring suitable skills and experience in tourism-related activities through training" (RII=0.89), "as training ground for future leaders in managing sustainable ECT" (RII=0.87), "potential for receiving development funds by government/private investors" (RII=0.85). Meanwhile, three reasons were ranked as less influential by respondents reported as "potential for income generation – as a part-time job" and "potential for local facilities (physical and communication) improvement" which shared the RII value of 0.79, followed by "increase internal link for marketing of local ECT products and SME products" (RII=0.76).

Table 1: Reasons for supporting sustainable ECT programme (n=20)

Answers given by respondents	Likert scale					n=	RII	Rank
	1	2	3	4	5			
• Potential for income generation (as in full-time job)	0	0	1	3	16	20	0.95	1
• Potential for income generation (as in part-time job)	0	0	3	15	2	20	0.79	5
• Gaining experience/ skill in tourism-related activities through training (human capital development and entrepreneurship)	0	0	2	7	11	20	0.89	2
• Potential for local facilities improvement (physical and communication)	0	0	2	17	1	20	0.79	5
• Increase protection of local environment and socio-culture opportunities	0	0	0	5	15	20	0.95	1
• Increase internal link for marketing of local ECT products and SME products	0	0	7	10	3	20	0.76	6
• Training ground for future leaders in managing sustainable ECT	0	0	3	7	10	20	0.87	3
• Potential for receiving development funds by government/ private investors	0	0	0	15	5	20	0.85	4

Source: Research fieldwork in 2014.

Note: 1 denoted "not important" and 5 denoted "very important" / RII (Relative importance index)

### Possible challenges or constraints for adopting sustainable ECT

Based on Table 2, this study revealed the possible challenges or constraints for adopting sustainable ECT in the study area.

Table 2: Possible challenges/constraints of sustainable ECT (n=20)

Answers given by respondents	Likert scale					n=	RII	Rank
	1	2	3	4	5			
Tough competition with existing tourism players / operators from outside	0	0	7	10	3	20	0.76	5
Language barriers (English in communication)	0	0	3	15	2	20	0.79	4
Lack of access to the village (due to poor road and internet/communication coverage)	0	0	2	7	11	20	0.89	2
Lack of capital and organizational readiness (lack of local leaders / entrepreneurs)	0	0	1	3	16	20	0.95	1
Seasonality of activities and hard to maintain costumers (income instability)	0	0	3	15	2	20	0.79	4
Lack of training in tourism-related activities (past experience)	0	0	7	10	3	20	0.76	5
Modernization and culture distribution (influenced by visitors)	0	0	3	7	10	20	0.87	3

Source: Research fieldwork in 2014

Note: 1 denoted "not important" and 5 denoted "very important" / RII (Relative importance index)

The most severe challenges or constraints were caused by a lack of capital and organisational readiness (0.95 RII), followed by the limited accessibility to the village mainly due to poor road condition and limited internet or telecommunication coverage (0.89 RII), and modernization and culture distortion induced by interaction with visitors (0.87 RII). Other challenges or constraints factors have to do with language barriers – to communicate in English and seasonality of activities and difficulty to maintain customers resulting in income instability (0.79 RII). The low influential factors are recorded as a strong competition with existing tourism players or operators from outside and significant lack of proper training in tourism-related activities, with RII value of 0.76 respectively.

## **Discussion**

The questionnaire survey reported positive attitude of local community towards tourism (92 per cent level of agreement) and strong support for biodiversity conservation (95 per cent level of agreement). This study also revealed the acknowledgement of symbiotic relation between local economic development through sustainable ECT and the community in the protected area. It is worth mentioning that the reasons behinds local support for future sustainable ECT programmes are mostly driven by the economic factor especially for income generation and creation of new local jobs (both full-time and part-time) in the tourism-related sectors (see Table 1). Similarly, the respondents also expressed their concern towards protection of surrounding natural and cultural resources from over-exploitation and extinction. Respondents are well aware of strict regulations imposed by the Perak State Park Corporation for protecting environment and natural resources, even though some of the regulations imposed restriction on local physical and socio-economic development. One clear example is forest clearance activities for expansion of new or existing settlement and opening new agriculture land. Normally, local practice in opening new land may involve cutting trees and slash-burn activity. This traditional practice was considered as a disturbance agent to the pristine forest environment (Razak et al., 2015).

This research promotes active involvement of local community in the programme and conservation activities in the protected area. This effort is strongly supported by the benefits offered throughout the programme. The success of each activity and its deliverables are highly dependent on several issues, e.g. poverty, insufficient fund, poor financial assistance, selective incentive, limited land for economic activities, incapable leaders and low readiness of targeted groups. These factors subsequently affected the effectiveness of activities in the ECT business. An integrated local economic development initiative should be proposed for the future development planning of BTFC.

## **CONCLUSION**

In conclusion, this study unveiled positive responses from local communities regarding ECT programme especially on economic and conservation of environment prospects. Some possible challenges or constraints of ECT programme also highlighted some issues related to financial constraint due to high poverty, the contest for resources among members as a result of population increment and lack of integration (linkages) of local economic activities with surrounding development (Kamarudin et al., 2014b; Razak et al., 2015). Interestingly, this study highlighted the use of respondents' positive attitude towards tourism and their support for conservation in such a way of promoting a better park management and interaction between man-and-environment in the tropics.

The paper put forward two recommendations to be considered for designing and implementing a more comprehensive and collaborative framework and operational need for eco-tourism and conservation. The first recommendation would be the determination of local community needs and readiness towards sustainable ECT including determination of local tourism resources (culture, heritage and nature resources, assessing local community's acceptance and willingness to support and to participate in ECT development, determination of local knowledge, practices and skills which are suitable for supporting the development of ECT programme, and determination of capital capability and availability for executing ECT programme (financial strength). The second recommendation

includes organisational and capacity building process including encouragement of a direct local community and stakeholders' engagement into decision making process, establishment of potential linkages between local tourism with surrounding attractions and identification of types of training need and training module development suitable for sustainable ECT programme.

## REFERENCES

- Abdullah, A.R., Weng, C.N. & Mohamed, B. (2013). Potentials and Challenges of Involving Indigenous Communities in Ecotourism in Belum-Temenggor Forest Complex, Perak, Malaysia. *Proceedings of the International Conference on Tourism Development (ICTD2013)*, 4-5 February 2013, G Hotel, Penang.
- Ang, S.C. & Chan, N.W. (2009). The potentials, threats and challenges in sustainable development of Belum-Temenggor rainforest complex. *Proceedings of the 2<sup>nd</sup> National Conference on Society, Space and Environment 2009 "Towards Sustainable Heritage and Future"*, 2-3 June 2009, School of Humanities, Universiti Sains Malaysia, Penang.
- Barna, C., Epure, M. & Vasilescu, R. (2011). Ecotourism – conservation of the natural and cultural heritage. *Review of Applied Socio-Economic Research*, 1(1), 87-96.
- Economic Planning Unit (EPU) (2015). *The Eleven Malaysia Plan, 2016-2020*. Retrieved from <http://rmk11.epu.gov.my/pdf/Teks-Ucapan-RMK11.pdf>
- Graci, S. & Dodds, R. (2010). *Sustainable Tourism in Island Destinations*. London: Earthscan.
- Jabatan Kemajuan Orang Asli (JAKOA) Gerik (2014). *Maklumat bancian kampung-kampung Orang Asli daerah Hulu Perak*. Data tidak diterbitkan.
- Kamarudin, K.H., Ngah, I., Abd Wahid, S.N. and Razak, K.A. (2015). Readiness of Orang Asli Communities in Royal Belum-Temenggor Forest Complex, Perak towards Sustainable Eco-Culture Tourism (ECT) Programmeme. *Journal of Human Capital Development*. 8(1), 59-72.
- Kamarudin, K.H., Ngah, I. & Mohamad Omar, A. (2014a). Sustainable eco-culture tourism in Royal Belum-Temenggor: Emerging prospects and challenges for Orang Asli. *National Conference on Royal Belum (NCRB 2014)*, 9-10 December 2014, Gerik, Perak.
- Kamarudin, K.H., Ngah, I. & Abd Wahid, S.N. (2014b). Framework considerations for a sustainable eco-culture tourism (ECT) development for Orang Asli of Royal Belum-Temenggor Forest Complex, Perak. *National Conference on Royal Belum (NCRB 2014)*, 9-10 December 2014, Gerik, Perak.
- Kamarudin, K.H. (2013a). Local Stakeholders' Participation in Developing Sustainable Community Based Rural Tourism (CBRT): the case of three villages in the East Coast of Malaysia. *International Conference on Tourism Development (ICTD2013)*. Penang, Malaysia.
- Kamarudin, K.H. (2013b). *Criteria and Indicators for Sustainable Community Based Rural Tourism (CBRT) Development: Case study of East Coast Economic Region (ECER), Malaysia*. (PhD thesis). Department of Planning, Oxford Brookes University, Gipsy Lane, Oxford, UK.
- Kamarudin, K.H. & Ngah, I. (2007). *Pembangunan Mapan Orang Asli*. Johor: UTM Publisher.
- Kamarudin, K.H. (2007). Potensi Pelancongan Eko-Budaya Orang Asli: Tinjauan Ke Atas Komuniti Jahai Di Kelantan. *The 2<sup>nd</sup> International Conference on Tourism and Hospitality 2007*. Marriott Putrajaya. July 30 – August 1 2007.
- Manyara & Jones (2007). Community based Tourism Enterprises Development in Kenya: An Exploration of Their Potential as Avenues of Poverty Reduction. *Journal of Sustainable Tourism*, 15: 6, 628-644.
- Ministry of Regional and Rural Development (n.d). *Online statistics*. Retrieved from <http://www.rurallink.gov.my/web/guest/hal-ehwal-orang-asli>
- Muhwezi, L., Acai, J. & Otim, G. (2014). An Assessment of the Factors Causing Delays on Building Construction Projects in Uganda. *International Journal of Construction Engineering and Management*. 3(1), 13-23.
- PEMANDU (2013). *GTP Annual Report 2013 – Improving rural development*. Prime Minister Office Malaysia.
- Razak, K.A., Che Hasan, R., Kamarudin, K.H., Haron, H., Harun, H., Dziauddin, R., Omar, A.M. (Eds.) (2015). *UTM High Impact Research @ Royal Belum-Temenggor Forest Complex, Gerik*

- Perak: A compilation of scientific expedition activities in 2014* Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, ISBN 978-967-11814-9-2.
- Sebele, L.S. (2010). Community-based tourism ventures, benefits and challenges: Khama Rhino Sanctuary Trust, Central District, Botswana. *Tourism Management* 31, 136-146.
- Sharpley, R. & Sharpley, J. (1997). *Rural Tourism: An Introduction*. London: International Thomson Business Press.
- Stone, L.S. & Stone, T.M. (2011). Community-based tourism enterprises: challenges and prospects for community participation: Khama Rhino Sanctuary Trust, Botswana, *Journal of Sustainable Tourism*. 19(1), 97–114

## **INCOME INEQUALITY IN THE NORTHERN STATES OF MALAYSIA: AN ANALYSIS OF INCOME QUINTILE**

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**ABSTRACT:** Between 1990 and 2010, income inequality in developing countries rose 11 percent. Inequality is perceived as a considerable threat to human development because it reflects unbalanced economic opportunities and affect individual's well-being. The 2014 UNHDR indicates that two-thirds of the world's population are estimated to receive less than 13 percent of world income, while the richest 1 percent received nearly 15 percent of world income. In the Malaysian scenario the income inequality has improved only marginally. In 17 years from 1992 to 2009, the ratio of the mean income of the top 20 percent to the bottom 40 percent has improved slightly from 7.4 percent to 6.9 percent. Income inequality in Malaysia can be accessed using two measures; the income quintile (top 20 per cent, middle 40 per cent and bottom 40 per cent) and Gini Coefficient. While both measures are computed and updated regularly by EPU (Economic Planning Unit) for the whole country, the same are not done for individual states in Malaysia. The objective of this paper is to examine income inequality in the Northern States by using income quintile approach. Income quintiles are divided into three categories: top 20 percent, middle 40 percent, and bottom 40 percent. The 2009 household income survey reveals that the mean income of the top 20 percent, middle 40 percent, and bottom 40 percent are, RM 7,639, RM 2,862, and RM 1,206 respectively. A big proportion of the Northern States income is concentrated among the top 20 percent of the population. To further understand the situation, analysis by states, strata, and ethnicity is carried out. An interesting finding to note is that Perlis, the poorest state among the group has the highest inequality because a big proportion of the income goes to the richest 20 percent of its population. Rural areas and Bumiputera remain the disadvantaged groups with low mean income.

*Keywords:* income distribution, Northern States of Malaysia, income quintile

### **INTRODUCTION**

It is commonly observed that a nation's income increases as the economy progresses. Theoretically, economic growth and income distribution follows an inverted U shape. Kuznets (1955) concluded that economic growth first increases the spread in income distribution and later as the economy achieves a developed stage, the spread of income distribution declines. The implications of economic growth on income inequality in developing countries are often measured at the national level (Saari, Dietzenbacher, and Los, 2015). This measure obviously hides many important elements that constitute the details components of inequality, especially in multiracial countries with diverse economic activities across different states like Malaysia. While there is available macro data on income distribution and Gini coefficients by states and ethnic groups, the micro data on its components are almost unavailable. This study attempts to bridge the gap in microdata analysis of income distribution with an objective to examine income inequality in the Northern States by using income quintile approach. Northern States are chosen as focus of analysis for various aspects. Northern States consist of four states with various economic activities that highly influenced the economic growth of the states and the region. Perlis, the smallest state in the region and in the country, has very limited economic activities with great emphasis on agriculture and services. Kedah is the second largest states with great emphasis on paddy plantation and very little industrialization activities. The branding of agriculture during Prime Minister Abdullah Ahmad Badawi between the years of 2003 and 2009 promoted agro based industry to uplift agriculture has given a new dimension of industrialization in Kedah. Perak and Penang are the two states with intense economic activities. This has to do with the past where Perak was known as a mining city and Penang as port and commercial areas. However, given the loss in demand and natural resources Perak has lost its mining activities and now depend

much on services sector. Penang remains the developed state in Northern States with high income generated from productive economic activities from manufacturing and services.

### INCOME DISTRIBUTION IN THE NORTHERN STATES

Table 1 shows the gross income and Gini coefficient for the Northern States. In general, it could be observed that Gini coefficient declines and that gross income has shown some improvement over the years. In the early 70s, the Gini coefficient records a high number with values above 0.50 and Penang the highest with Gini of 0.61. Penang, too records the highest income among the four states with Perlis the lowest. There was a significant drop in the Gini coefficient of the states in 1987 with Gini coefficient between 0.41 and to 0.43. Penang remains the states with highest income and highest Gini. And the increase of income in all states almost double within 10 years. In 2009, the Gini Coefficient was around 0.40 with Perlis the highest at 0.43 but the gross income of Perlis was not among the highest of the four states. In 2012, Kedah and Penang records low Gini of below 0.40 with Penang recorded the highest income with low Gini of 0.37. Perlis remains the state with highest Gini of 0.46 but lowest gross incomes among the four states.

Table 1: Gross income and Gini coefficient

States	1976		1987		1997		2009		2012	
	Gross Income (RM)	Gini								
Perlis	338	0.50	711	0.41	1,507	0.41	2,617	0.43	3,538	0.46
Kedah	306	0.50	718	0.43	1,590	0.43	2,667	0.41	3,425	0.39
Penang	589	0.61	1,130	0.42	3,130	0.40	4,004	0.42	5,055	0.37
Perak	436	0.53	863	0.41	1,940	0.38	2,809	0.40	3,548	0.42

Source: Economic Planning Unit n.d(a) n.d(b)

In order of income increase over the years, we could arrange the order of countries as Perlis, followed by Kedah, Perak and Penang with the highest income. This is also a reflection of decreasing poverty incidence among the four states with Perlis, the highest poverty incidence followed by Kedah second highest, Perak and Penang the state with the lowest poverty incidence. Figure 1 shows the plot of income distribution and Gini coefficient for the four states over the years. It could be observed that Kedah and Penang somehow follows the inverted U shaped as proposed by Kuznets. But the inverted U shape for Kedah started at relatively low level of income as compared to Penang. But both are indicative that as income of the state's increases, the inequality decreases. Nevertheless, Perlis and Perak have a normal U shape pattern of income and inequality. The graph indicates that as the state's income progresses the inequality also increases.

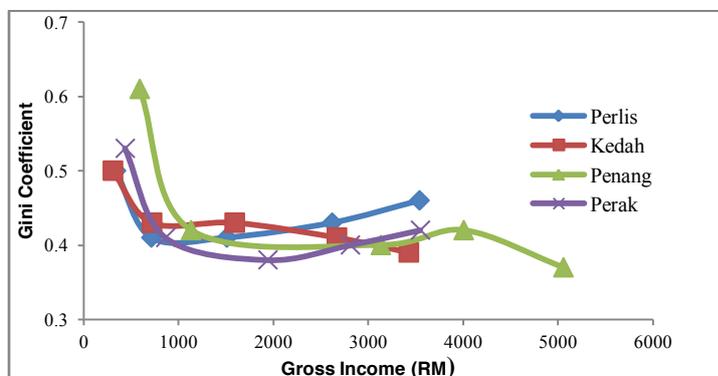


Figure 1: Plot of income distribution and Gini Coefficients for Northern States based on Table (1).

## METHODOLOGY

This study uses the Household Income Survey (HIS) data provided by the Department of Statistics. The data used is only 30 per cent of the total observations. There are a total of 53,199; 435,504; 374,602 and 557,396 households' observations in Perlis, Kedah, Penang and Perak respectively. The way the data was compiled limits our analysis of income distribution to household level. This is so because only one gross income is reported for one household. Income quintiles are computed for three groups of population of the Northern states; top 20 per cent, middle 40 per cent, and bottom 40 per cent. The incomes of all households within each group are totalled up and divided by the number of households to arrive at the average income for each group. The average incomes of the higher-income groups are compared with the average income of the lower-income group to see how many times the former exceeds the latter. The process is repeated across states, strata, ethnics, states and strata, states and ethnics, strata and ethnics, and states, strata and ethnics.

## RESULTS

It could be seen from Table 2 that the income of Top 20 per cent (T20) of the population is at least seven times the income of the Bottom 40 per cent (B40) and 3.5 times the income of the Middle 40 per cent (M40). The trend is almost observable in all the four states. As a state with low total income in reference to the other three states in the region, Perlis has income of T20 at least 7 times larger than B40. Perlis shares the same trend of worst income distribution with Penang with the ratio of T20 to B40 stands at 6.71 each. Obviously, a great proportion of wealth in the two states is accrued to the least number of populations. Incidentally, Penang is explained by high T20/M40 ratio of 3.03 and Perlis is explained by high M40/B40 ratio of 2.68. From the data, it could be concluded that Kedah and Perlis would probably have the best income distribution in the region with the income distribution of T20/M40 equals to 5.76 and 5.51 respectively. The income distribution of M40/B40 and T20/M40 are relatively equal. Kedah and Penang have the best income with Gini coefficient less than 0.40 in 2012. Perlis is reported to have the worst income and Gini coefficient at 0.46 in 2012.

Table 2: Income distribution by states (RM)

	<b>B40</b>	<b>M40</b>	<b>T20</b>	<b>M40/B40</b>	<b>T20/M40</b>	<b>T20/B40</b>
<i>All</i>	1,206	2,862	7,639	2.37	2.67	6.33
Perlis	1,061	2,846	7,133	2.68	2.50	6.71
Kedah	1,158	2,828	6,677	2.44	2.36	5.76
Penang	1,329	2,944	8,918	2.21	3.03	6.71
Perak	1,221	2,826	6,733	2.31	2.38	5.51

Source: Authors own calculation based on HIS2009 data

Note: B40 is Bottom 40 per cent; M40 is Middle 40 per cent; T20 is Top 20 per cent

The analysis of income quintile is further investigated by strata of urban and rural differences. Overall, it could be deduced that urban area has the worst income distribution with T20/B40 equals 6.11. And this is explained by a higher T20/M40 that is equal 2.71 compared to M40/B40 of 2.25. Rural area has a better income distribution with T20/B40 stands at 5.96. And this is due to the ratio of income distribution of M40/B40 and T20/M40 being relatively equal. A question raised here is that could urban area have a role in explaining income distribution among states. With the current definition of urban area as any area with population of at least 10,000 people, it could be concluded that majority of areas in Northern States are urban dominated. Hence, income distribution in urban areas is more equal given that majority of income comes from formal employment with a standard pattern of salary scale. Nevertheless, income in the rural areas mostly comes from informal employment that is subject to a lot bias and inequality in the distribution of income.

Table 3: Income distribution by strata

<b>Strata</b>	<b>B40</b>	<b>M40</b>	<b>T20</b>	<b>M40/B40</b>	<b>T20/M40</b>	<b>T20/B40</b>
Urban	1,280	2,885	7,822	2.25	2.71	6.11
Rural	1,147	2,815	6,834	2.45	2.43	5.96

Source: Economic Planning Unit n.d(c)

Table 4 further investigates the average income by quintile, states and strata. For all cases, it could be observed that urban income is greater than rural income with an exception of Perlis T20 and Penang M40 where rural income is larger than the urban income. A simple explanation for this is that Perlis population mostly stays in the rural areas and that Penang is dominated by middle income population, mostly dependable on employment income.

Table 4: Average income – states vs strata

<b>States &amp; Strata</b>	<b>B40</b>		<b>M40</b>		<b>T20</b>	
	<b>Urban</b>	<b>Rural</b>	<b>Urban</b>	<b>Rural</b>	<b>Urban</b>	<b>Rural</b>
Perlis	1,072	1,057	2,891	2,803	6,849	7,545
Kedah	1,237	1,124	2,901	2,761	6,795	6,397
Penang	1,337	1,310	2,938	2,973	9,052	7,607
Perak	1,285	1,159	2,830	2,816	6,731	6,726

Source: Economic Planning Unit n.d(c)

The differences between urban income and rural income in each case are quite small except for Penang T20, Kedah B40 and Perak B40. A better understanding of this situation is shown in Table 5. Table 5 shows the urban-rural ratio of income based on income quintiles. In general, the urban-rural ratio of income is greater than one indicating that urban income dominates the population. Perlis T20 and Penang M40 have urban-rural ratio of less than one indicating that rural income dominates the population. It could be further deduced that the differences between the urban and rural income are quite small around one except for Penang of 1.19, Kedah of 1.10 and Perak of 1.11.

Table 5: Urban-rural differences of average income

<b>States &amp; Strata</b>	<b>B40</b>	<b>M40</b>	<b>T20</b>
	<b>Urban/Rural</b>	<b>Urban/Rural</b>	<b>Urban/Rural</b>
Perlis	1.01	1.03	0.91
Kedah	1.10	1.05	1.06
Penang	1.02	0.99	1.19
Perak	1.11	1.01	1.00

Authors own calculation based on Economic Planning Unit, n.d(c)

The ratio of income groups between strata and states are as shown in Table 6. The data indicates that Perlis and Penang urban areas have the worst income distribution with the ratio of T20/B40 of 6.39 and 6.77 respectively. This indicates that the income of top 20 per cent of population living in Perlis and Penang urban area is at least six and almost seven times more than the income of the bottom 40 per cent. For the case of Penang, this huge disparity is perhaps due to the higher T20/M40 ratio of 3.08 while in Perlis it is due to the higher M40/B40 ratio of 2.70. It is observed that the income distribution in Kedah and Perak are better due to the relatively equal distribution of M40/B40 and T20/M40 income distribution. For rural area, Perlis has the worst income distribution with the ratio of T20/B40 stands at 7.13. This exceeds Perlis urban ratio of T20/B40 of 6.39. In addition to the reasons given above on the employment opportunities and income distribution in Perlis, this disparity is also attributable to the M40/B40 and T20/M40 ratios. For other states in the rural areas, income distribution is slightly better. Kedah's income distribution is slightly better than Penang and Perak. Kedah and Perak have a higher M40/B40 ratio than the T20/M40 ratio while Penang has a lower M40/B40 ratio than the T20/M40 ratio.

Table 6: Income distribution by strata

<b>States &amp; Strata</b>	<b>U (M40/B40)</b>	<b>R (M40/B40)</b>	<b>U (T20/M40)</b>	<b>R (T20/M40)</b>	<b>U (T20/B40)</b>	<b>R (T20/B40)</b>
Perlis	2.70	2.65	2.37	2.69	6.39	7.13
Kedah	2.34	2.46	2.34	2.32	5.49	5.69
Penang	2.20	2.27	3.08	2.56	6.77	5.81
Perak	2.20	2.43	2.38	2.39	5.24	5.80

Authors own calculation based on Economic Planning Unit, n.d(c)

Investigating income distribution based on ethnic group is not just interesting because Malaysia is a multiracial country, but also on the fact that income inequality is a major concern in multiracial countries because ethnically more homogenous populations tend to have more equal income distribution (Alesina and Glaeser 2004). It was also thought that ethnic heterogeneity induces social conflicts and violence, which in turn, affects economic growth (Easterly and Levine, 1997; Montalvo and Reynal-Querol, 2005). Based on Table 7, it could be deduced that Indians have the worst income distribution with the ratio of T20/B40 the highest of 6.56. This is explained by higher T20/M40 of 2.78 against the ratio of M40/B40 of 2.36. The Bumiputera and Chinese have equally bad income distribution of 6.02 and 6.09 respectively. For the Bumiputera, both the ratios of M40/B40 and T20/M40 contribute equally to the bad income distribution. For the Chinese, the bad income distribution is explained the higher ratio of T20/B40 of 2.81 as compared to the ratio of M40/B40, which is just 2.17. For the others ethnic group the income distribution is the best, by far, even though the ratio of T20/M40 is higher than the ratio of M40/B40.

Table 7: Income distribution by ethnicity

<b>Ethnicity</b>	<b>B40</b>	<b>M40</b>	<b>T20</b>	<b>M40/B40</b>	<b>T20/M40</b>	<b>T20/B40</b>
Bumiputera	1,165	2,837	7,012	2.43	2.47	6.02
Chinese	1,342	2,908	8,181	2.17	2.81	6.09
Indian	1,213	2,864	7,951	2.36	2.78	6.56
Others	1,318	2,686	6,487	2.04	2.42	4.92

Authors own calculation based on Economic Planning Unit, n.d(c)

Data on average income according to ethnicity and strata provides another view on the income disparity across ethnic groups and strata. In general, all ethnic groups in urban areas have higher incomes except for Indian M40 and Others B40 and T20. The data also indicates substantial urban-rural differences among the ethnic groups of Chinese T20, Indian B40, Indian T20 and Others M40.

Table 8: Average income according to ethnicity and strata

<b>Ethnicity &amp; Strata</b>	<b>B40</b>		<b>M40</b>		<b>T20</b>	
	<b>Urban</b>	<b>Rural</b>	<b>Urban</b>	<b>Rural</b>	<b>Urban</b>	<b>Rural</b>
Bumiputera	1,224	1,138	2,856	2,816	7,123	6,767
Chinese	1,363	1,269	2,926	2,785	8,273	7,207
Indian	1,270	1,079	2,858	2,894	8,129	5,531
Others	1,080	1,328	2,784	2,525	6,124	7,658

Authors own calculation based on Economic Planning Unit, n.d(c)

Ratio analysis of urban-rural based on income quintiles as shown in Table 9 provides another picture of the income disparity among ethnic groups and strata. All except Indian M40, Others B40 and Others T20 have urban-rural ratio of higher than one. This implies a greater income disparity for urban areas.

Table 9: Differences of average income according to ethnicity and strata

<b>Ethnicity &amp; Strata</b>	<b>B40 U/R</b>	<b>M40 U/R</b>	<b>T20 U/R</b>
Bumiputera	1.08	1.01	1.05
Chinese	1.07	1.05	1.15
Indian	1.18	0.99	1.47
Others	0.81	1.10	0.80

Authors own calculation based on Economic Planning Unit (2013)

The data on the ratio of income distribution according to ethnicity and strata provide a clearer picture on the income disparity among ethnic and strata. For urban areas, both the Chinese and Indian urban have the worst income distribution. Partly, this is explainable by higher T20/M40 over M40/B40. The income distribution of Bumiputera and Other ethnic groups are equally bad. For the Bumiputera, the ratio of M40/B40 and T20/M40 contribute almost equally. For other ethnic groups, it is due to higher M40/B40. For rural, all ethnic groups have worst income distribution. For Bumiputera rural, the ratio of M40/B40 and T20/M40 contribute almost equally. For Chinese and other ethnic groups rural they are due to the higher T20/M40.

Table 10: Ratio of income distribution according to ethnicity and strata

<b>Ethnicity &amp; Strata</b>	<b>U(M40/B40)</b>	<b>R(M40/B40)</b>	<b>U(T20/M40)</b>	<b>R(T20/M40)</b>	<b>U(T20/B40)</b>	<b>R(T20/B40)</b>
Bumiputera	2.33	2.47	2.49	2.40	5.82	5.94
Chinese	2.15	2.19	2.83	2.59	6.07	5.68
Indian	2.25	2.68	2.84	1.91	6.40	5.12
Others	2.58	1.90	2.20	3.03	5.67	5.77

## DISCUSSION

Gini coefficient has declined for all states from 1976 -2012. By 2009, Gini coefficient for all states reached the figures of around 0.40, but in 2012, Gini Coefficient for Perlis has shot back to 0.46, while GC for Kedah and Penang have gone below 0.40. According to the HIS data, Perlis and Penang have the worst income distribution with the ratio of T20/B40 of 6.71 each, while Kedah and Perak have better income distribution with the ratio of T20/B40 of 5.76 and 5.51 respectively. For Penang, the ratio of T20/M40 is higher than M40/B40, For Perlis, the ratio of M40/B40 is greater than T20/M40 while in Kedah and Perak, the ratios of M40/B40 and T20/M40 are about equal.

Urban has the worst income distribution compared to Rural. The value of T20/B40 in urban area is 6.11 compared to Rural's T20/B40 of 5.96. For Urban area, the ratio of T20/M40 is greater than M40/B40, while for Rural area, the ratios of M40/B40 and T20/M40 are relatively equal. Differences between urban and rural income are quite small except for Penang's T20, Kedah's and Perak's B40. For all cases, urban income exceeds rural income except for Perlis' T20 and Penang's M40. For Urban income distribution, Perlis and Penang have worse income distribution with the ratio of T20/B40 of 6.39 and 6.77 respectively. For Penang, the ratio of T20/M40 exceeds M40/B40, while in the case of Perlis, M40/B40 exceeds T20/M40. Kedah and Perak have better income distribution with M40/B40 and T20/M40 being relatively equal. For Rural income distribution Perlis has the worst income distribution with T20/B40 equal 7.13. This even exceeds Perlis' Urban's T20/B40. Both M40/B40 and T20/M40 are about equal. For Perlis, Rural contributes more than Urban. The distribution of rural income in other states is slightly better. The income distribution in Kedah is slightly better than Penang and Perak. For Kedah and Perak, the ratio of M40/B40 is greater than T20/M40 while for Penang, the ratio of M40/B40 is smaller than T20/M40.

For ethnic income distribution, the Indians have the worst income distribution as compared to other ethnic groups with T20/B40 equal 6.56 and the ratio of T20/M40 is greater than M40/B40. The

Bumiputeras and Chinese have equally bad income distribution of 6.02 and 6.09 respectively. For Bumi, both the ratios of M40/B40 and T20/M40 are about equal. For the Chinese, the ratios of T20/B40 is greater than M40/B40. For the income distribution of ethnic groups in the urban areas, both the Chinese and Indian have worst income distribution with T20/B40 equals to 6.07 and 6.40 respectively and T20/M40 greater than M40/B40. The Bumiputera urban's income distribution is also equally bad with T20/B40 equals 5.82 and M40/B40 and T20/M40 nearly equal. For ethnic's rural distribution, the Bumiputera and Chinese have the worst income distribution with Indians doing much better.

## **CONCLUSION**

The micro data analysis has shown that income distribution in the Northern States is highly influenced by strata and ethnic groups. There is no consensus on which ethnic groups are mostly affected by worst or bad income distribution as the data shows mixed results when analysis is done by strata. In fact, the paper writers believe that such analysis, interpreting income distribution using income quintile analyzed by states, strata and ethnic groups for the Northern States of Malaysia is the first to be conducted. In general, while it could be deduced that rural areas are still at the advantaged, data has shown that there is huge disparity of rural income between the top 20 per cent of the population and the rest of population. This scenario is best explained by Meltzer and Richard (2015) that most high income result from inheritance of wealth produced by an earlier generation and passed on. The income distribution in the urban areas are mostly stable and relatively equal given that most income are generated from employment income.

There is still much to be done to ensure an equitable distribution of income in the Northern States. The two distinct patterns of income distribution and inequality indicate that Malaysia can no longer adopt one policy that fit all. Obviously, in the Northern States, two different sets of policies need to apply for the different states. At least, Perak and Perlis need a distinctive policy to tackle the issue of growing inequality as income rises. Income disparity among different ethnic groups is apparent due to the large income gap between Bumiputera and other ethnic groups, particularly Chinese. Although the income gap has narrowed owing greatly to the government policies and program, the existence gap still needs to be tackled. This could be achieved through great intervention in the labour market and enforcement of stringent policies. Income gap between strata largely owes to the fact that employment opportunity and income level of household in the rural areas is usually lower than that of the urban areas. In short, further studies are needed to understand the causes of such income disparity among the different income groups, ethnicity and strata.

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## **REFERENCES**

- Alesina, A., & Glaeser, E.L. (2004). *Fighting poverty in the US and Europe: A world of difference* (p. 129). Oxford: Oxford University Press.
- Easterly, W., & Levine, R. (1997). Africa's growth tragedy: policies and ethnic divisions. *The Quarterly Journal of Economics*, 1203-1250.
- Kuznets, S. (1955). Economic growth and income inequality. *The American economic review*, 1-28.
- Meltzer, A.H., & Richard, S. F. (2015). A positive theory of economic growth and the distribution of income. *Research in Economics*.
- Montalvo, J.G., & Reynal-Querol, M. (2005). Ethnic diversity and economic development. *Journal of Development economics*, 76(2), 293-323.
- Saari, M.Y., Dietzenbacher, E., & Los, B. (2015). Sources of Income Growth and Inequality Across Ethnic Groups in Malaysia, 1970–2000. *World Development*, 76, 311-328.
- Economic Planning Unit. (n.d.a) Mean Monthly Gross Household Income by Ethnic Group, Strata and State, Malaysia. available at: [www.epu.gov.my](http://www.epu.gov.my) (accessed 12 March 2014).

Economic Planning Unit. (n.d.b) Incidence of Poverty by Ethnic Group, Strata and State, Malaysia, 1970-2014

Economic Planning Unit. (n.d.c) Mean Monthly Gross Household Income of Top 20%, Middle 40% and Bottom 40%, Strata and State, Malaysia, 1970-2014

## **RELATIONSHIP BETWEEN POVERTY AND INEQUALITY: A CASE STUDY OF BUMIPUTERA HOUSEHOLD IN THE NORTHERN STATES OF MALAYSIA**

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**ABSTRACT:** The relationship between poverty and inequality has never been straightforward. While some research found that poverty does not mirror inequality, others found that a change in income inequality definitely affects poverty. Malaysia has been applauded by international organizations for its success in alleviating poverty. However, inequality as measured by Gini coefficient has only shown a marginal drop from 0.46 in 1992 to 0.43 in 2012. This situation is more apparent when inequality is assessed according to ethnic groups. While the ethnic inequality measure has narrowed, the inequality for the Bumiputeras remains high. The Gini coefficient of the Bumiputeras stands at 0.42 in 2012, a drop of 0.02 from 1992. The Bumiputera, which is literally known as the 'son of the soil' is the largest ethnic group in Malaysia. In 2012, there is only 2.2 per cent Bumiputeras living in absolute poverty. This seems a small percentage but pockets of poverty among Bumiputeras remain. At present, there is a lack of research in understanding the relationship between poverty and inequality among the Bumiputeras, particularly in the Northern States of Malaysia. This study assesses the relationship between poverty and inequality of the Bumiputera Household in the Northern States of Malaysia using the Household Income Survey (HIS) data for 2009. A logistic probability function with values of 1 and 0 to represent households living in poverty and household not living in poverty respectively, is employed. Contextual inequality as measured by Theil Index is used as a proxy to inequality. The analysis found that per capita income and education attainment (except for tertiary education) significantly affect poverty. The study found no significant relationship exists between poverty and inequality. This provides an important implication towards policy formulation. Policy to tackle the issues of poverty and inequality need to be addressed separately, rather than pursued simultaneously.

*Keywords:* poverty, contextual inequality, Theil Index, Bumiputera household, Northern States of Malaysia

### **INTRODUCTION**

World Bank's definition of poverty is the inability to achieve minimum living standards (World Bank 2000). The United Nations Development Program (UNDP) defines poverty as the inability to expand the choices in life. Smith (1776, p.479) proposes a conceptual definition of poverty as missing "not only the commodities which are indispensably necessary for the support of life, but whatever the custom of the country renders it indecent for creditable people, even of the lowest order, to be without". Known as the father of modern economist, Smith sees poverty as more than just problems with access to the basic necessities to support one's life, but also as a social handicap.

However, according to Sen (1983, p.167), poverty is a standard at which one cannot "achieve adequate participation in communal activities and be free from public shame from failure to satisfy conventions". In general, he defines poverty, as the lack of what one needs to live within a society. Sen's more comprehensive definition completes Smith's approach. Townsend (1980) defines poverty as inequities in the distribution of five resources, including income, capital assets, occupational fringe benefits, current public services and current private services. Rowntree (1941) categorised poverty into two, which are primary and secondary poverty. Primary poverty is when an income is too low to buy necessities for the maintenance of physical efficiency, while secondary poverty is when an income, which by itself is sufficient but is unwisely spent.

The relationship between poverty and inequality has never been one that is straightforward. While some research finds that poverty does not mirror inequality, others find that a change in income inequality definitely affects poverty. Malaysia has been applauded by international organizations for

its success in alleviating poverty. However, inequality as measured by Gini coefficient has only shown a marginal drop from 0.46 in 1992 to 0.43 in 2012. This situation is more apparent when inequality is assessed according to ethnic groups. While the ethnic inequality measure has narrowed, the inequality for the Bumiputera remains high. The Bumiputera, which is literally known as the ‘son of the soil’ is the largest ethnic group in Malaysia. The ‘divide and rule’ policy adopted by the British during colonisation that placed the Bumiputera in the rural areas has led to high poverty incidence among them. The New Economic Policy (NEP) has been implemented to tackle the issue of income imbalances among all ethnic groups particularly that of the Bumiputera. In 2012, there is only 2.2 per cent Bumiputera living in absolute poverty. This seems a small percentage but pockets of poverty among the Bumiputera remains. At present, there is a lack of research in understanding the relationship between poverty and inequality among the Bumiputera particularly in the Northern States of Malaysia. This study assesses the relationship between poverty and inequality of the Bumiputera Household in the Northern States of Malaysia using the Household Income Survey (HIS) data for 2009.

### **BRIEF OVERVIEW OF INCOME DISTRIBUTION AND POVERTY IN THE NORTHERN STATES OF MALAYSIA**

Malaysia is one of the thirteen countries that successfully sustained growth of more than 7 per cent for at least 25 years since 1950 and is currently classified as an upper middle-income country. The mean income of the nation has doubled in 15 years from RM 2,020 in 1995 to RM 4,025 in 2009. The pattern of income distribution differs according to ethnic groups with the Chinese having the highest income as compared to other ethnic groups. In 2009, mean income of the Chinese was RM 5,011 while the Bumiputera and the Indian’s mean income was RM 3,624 and RM 3,999 respectively (Economic Planning Unit, n.d.a). The disparity of income distribution among ethnic groups is highly influenced by economic activities and strata. Most of the Bumiputera live in rural area and are involved in agricultural sector while the Chinese and the Indians dominate the industrial and commercial sectors and live in urban area (Lette, 2007).

In the Northern states of Malaysia, the mean monthly gross household income can be depicted from table 1. Table 1 indicates, there is a clear evidence of unequal distribution of income in the four states in the Northern Region of Malaysia. On the one hand, Penang has the highest mean monthly gross household income which is RM5,055 On the other hand, the other three states: Perlis, Kedah and Perak, have only about RM3,500 mean monthly gross household income and the lowest was Perlis (RM 3,538).

Table 1: Mean Monthly Gross Household Income (RM) and Gini Coefficient (GC) in Northern states of Malaysia, 1976-2012

States	1976		1987		1997		2009		2012	
	GInc (RM)	GC								
Perlis	338	0.50	711	0.41	1,507	0.41	2,617	0.43	3,538	0.46
Kedah	306	0.50	718	0.43	1,590	0.43	2,667	0.41	3,425	0.39
Penang	589	0.61	1,130	0.42	3,130	0.40	4,004	0.42	5,055	0.37
Perak	436	0.53	863	0.41	1,940	0.38	2,809	0.40	3,548	0.42

Source: Economic Planning Unit (n.d.a, n.d.b)

Penang also has the lowest Gini coefficient, which is 0.37. Even though the mean monthly income for Perlis, Kedah and Perak are close to one another, the three states have different Gini coefficient. The values of Gini coefficient for Kedah is 0.39, Perak is 0.41 and Perlis has the highest value of Gini coefficient, which is 0.46. This situation shows that even though the mean monthly income is almost the same for the three states (Perak, Kedah and Perlis), but the equality of income distribution can differ. .

Table 2: Incidence of Poverty in the Northern States (%) in year 1970-2012

Year	Perlis	Kedah	Penang	Perak	Year	Perlis	Kedah	Penang	Perak
1970	73.9	63.2	43.7	48.6	1997	10.7	11.5	1.7	4.5
1979	63.1	53.8	19.7	30.5	2002	8.9	9.7	1.2	6.2
1984	33.7	36.6	13.4	20.3	2004	6.3	7.0	0.3	4.9
1989	17.4	29.9	8.7	19.2	2009	6.0	5.3	1.2	3.5
1992	19.8	21.2	4.0	10.2	2012	1.9	1.7	0.6	1.5
1995	11.8	12.2	4.0	9.1					

Source: Economic Planning Unit (n.d.c)

From Table 2, all four states in the Northern States of Malaysia have high incidence of poverty in 1970, which are 43.7 per cent in Penang, 63.2 per cent in Kedah, 73.9 per cent in Perlis and 48.6 per cent in Perak and it keeps decreasing every year. Perlis has the highest incidence of poverty in 1970 (73.9 per cent), 1979 (63.1 per cent), 2007 (7.0 per cent), 2009 (6.0 per cent) and 2012 (1.9 per cent) while in the remaining years, Kedah has the highest incidence of poverty. Penang remains the lowest every year. Surprisingly, while other states experienced increase in incidence of poverty from 1997 to 1999 due to financial crisis, the incidence of poverty in Penang decreased from 1.7 per cent to 0.7 per cent.

Table 3: Incidence of Poverty in the Northern States (%) according to ethnicity in year 1970-2012

Year	Bumiputera	Chinese	Indian	Others
1970	64.8	26.0	39.2	44.8
1979	49.2	16.5	19.8	28.9
1984	28.7	7.8	10.1	18.8
1989	23.0	5.4	7.6	22.8
1992	17.5	3.2	4.5	21.7
1995	12.2	2.1	2.6	22.5
1997	9.0	1.1	1.3	13.0
2009	5.3	0.6	2.5	6.7
2012	2.2	0.3	1.8	1.5

Source: Economic Planning Unit (n.d.c)

Table 4: The Gini coefficient development based on ethnicity

Year	Bumiputera	Chinese	Indian	Others
1970	0.47	0.47	0.47	0.67
1974	0.48	0.52	0.45	0.67
1979	0.47	0.47	0.46	0.60
1984	0.46	0.45	0.42	0.57
1989	0.43	0.42	0.39	0.40
1992	0.44	0.42	0.40	0.56
1995	0.44	0.43	0.40	0.41
1997	0.45	0.42	0.41	0.56
2009	0.44	0.43	0.42	0.50
2012	0.42	0.42	0.44	0.44

Source: Economic Planning Unit (n.d.b)

Based on Table 4, the Gini coefficient of the Bumiputeras stands at 0.42 in 2012, a drop of 0.02 from 1992. From Table 4, the pattern of the value of Gini coefficient for the three major ethnic group in Malaysia is almost the same for every years. Comparison between the Bumiputera and the Chinese shows that the Gini coefficient of the Chinese is lower than the Bumiputera for most of the year. However, in year 2002, the value of Gini coefficient of the Bumiputera is lower than the Chinese. There are also years where the value of the Gini coefficient for the Bumiputera and the Chinese are almost the same. In year 1999, 2007 and 2012, the value of Gini coefficient for the Bumiputera and the Chinese are almost the same. Comparison of Bumiputera with Indians also shows that the Gini coefficient for the Indians is lower than the Bumiputera. The patterns are the same for every year except for year 2012. This shows that the income are distributed more evenly between the Chinese and between the Indian compared to between the Bumiputera. However, if we compare the Indian and Chinese, the Gini coefficient for Indian is lower than Chinese. The patterns are the same except for year 2009 and 2012. This concludes that the income are distributed more evenly between the Indian compared to between Chinese.

## **METHODOLOGY**

The study uses Household Income Survey (HIS) data for the year 2009. The HIS is conducted every five (5) years by the Department of Statistics that cover information on income sources of households throughout Malaysia. The focus of this study concentrates on data collected for the Northern States (Perlis, Kedah, Penang and Perak) of Malaysia. 30 per cent observations of the Northern States data are used. There are a total of 53,199 households in Perlis, 435,504 households in Kedah, 374,601 households in Penang and 557,396 households in Perak. Since the survey reports total income level of household, analysis concentrates on head of households.

We use the 2009 national Poverty Line Income (PLI) to determine household's poverty level as shown in Table 5. During that year, the PLI for Peninsular Malaysia is RM 760. However, if according to strata, the PLI for urban and rural areas are RM 770 and RM 740 respectively.

We use Theil Index as shown below to calculate our inequality

$$T = \sum_{t=1}^n \ln (ny_t)$$

We calculate two groups of Theil Index: Theil Index by states, Theil Index among Bumiputera and Theil Index among Bumiputera in different states.

This study adopts logistic probability function that takes the value of 1 and 0 as the dependent variable. The dependent variable for this study is

$Y_i = 1$  if income of Bumiputera household falls below the PLI hence living in poverty  
 $= 0$  if income of Bumiputera household is above the PLI

The logistic regression model is defined as

$$L_i = \ln = Y_i + \alpha_0 + \alpha_1 X_i + \epsilon_i \quad (3.1)$$

Where,  $L_i$  is the log of the odds ratio and  $X_i$  is the set of independent variables.  $Y_i$  is the dependent variable taking the values of 1 and 0. If the Bumiputera household records an income above the poverty line income, it is assigned a value of 0. If the Bumiputera household records an income below the poverty line income, it is assigned a value of 1. In other words,  $Y_i = 1$  means the household is poor while  $Y_i = 0$  means that the household is not poor.

The independent variables investigated are natural logarithm of Theil index (ln THEIL), natural logarithm of household income (ln INC), gender of head of household (Gender with male as the reference category) and education (Secondary, Tertiary, Others and Primary as the reference category). There are limited variables included in the estimated model. Reasons being that inclusion of more variables result in an unstable estimation.

Three separate equations are estimated, one for the whole sample in Northern States, a separate estimation for households in urban areas and another separate estimation for households in rural areas. Separate estimation based on strata is to investigate the regional effects of poverty and inequality.

## RESULTS

Table 5 shows the Theil Index for Bumiputera of different socio demographic categories. The Theil index ranges from a low 0.20 to a high 0.33. In regard to strata, the Bumiputera residing in urban area has a higher inequality. Surprisingly, Perlis records the highest inequality with Theil index of 0.33. With regard to education, the Bumiputera receiving other types of education records a high inequality. When gender is compared, female has higher inequality.

Table 5: Theil Index for Bumiputera distribution in the Northern States

Strata	Bumiputera
Urban	0.28
Rural	0.26
<b>State</b>	
Kedah	0.27
Penang	0.28
Perak	0.26
Perlis	0.33
<b>Education</b>	
Primary	0.21
Secondary	0.20
Tertiary	0.24
Others	0.28
<b>Gender</b>	
Male	0.27
Female	0.33

Source: Authors own calculation based on HIS 2009 data

Table 6: Logistic probability function of the estimated equations

Variables	Model 1: Overall			Model 2: Urban			Model 3: Rural		
	Coefficient	Marginal effect	p-value	Coefficient	Marginal effect	p-value	Coefficient	Marginal effect	p-value
ln THEIL	-0.17	-0.003	0.227	-0.35	-0.004	0.214	-0.07	-0.002	0.611
ln INC	-2.16***	-0.41***	0.000	-2.38***	-0.03***	0.000	-2.11***	-0.07***	0.000
Gender	1.79***	0.034***	0.000	1.43***	0.01***	0.002	1.97***	0.07***	0.000
Education									
Secondary	-1.00***	-0.02***	0.000	-1.15***	-0.02***	0.009	-0.97***	-0.03***	0.000
Tertiary	-1.68	-0.03	0.107	0.000	-	-	-1.05	-0.03	0.338
Others	0.84***	0.04***	0.003	1.186	0.06	0.035	0.72***	0.05***	0.027
cons	9.85	0	0	11.03	0	0	9.74***	0	0

\*\*\* significance at 1%

\*\* significance at 5%

\* significance at 10%

Source: Authors own calculation based on HIS 2009 data

Table 6 shows the result of the of the estimated equations. logistic probability function For Model 1, income, gender, secondary education and other type of education are found to statistically significantly influence the state of poverty of Bumiputera household. A one-ringgit increase in the Bumiputera household income would reduce the probability of being poor by 41per cent. Household headed by female has a higher probability of living in poverty by 3 per cent as compared to household headed by male. Having received secondary education as compared to those with only primary education results in a lower probability of being poor by 2 per cent. Nevertheless, having other type of

education i.e. informal education, as compared to those with only primary education would result in a higher probability of living in poverty by 4 per cent.

For Model 2, income, gender and secondary education are found to be statistically significantly influence household poverty. If income increases by one-ringgit, the probability of being poor in urban areas reduces by 3 per cent. Household headed by female has a higher probability of living in poverty by 1 per cent as compared to household headed by male. Having at least a secondary education as compared to only primary education lead to a lower probability of being poor by 2 per cent.

For Model 3, income, gender, secondary education and other types of education are found to statistically significantly influences the state of poverty of Bumiputera household. A one-ringgit increase in Bumiputera household income would reduce the probability of being poor by 7 per cent. Household headed by female has a higher probability of living in poverty by 7 per cent as compared to household headed by male. Having received at least secondary education as compared to only received primary education has a lower probability of being poor by 3 per cent. Nevertheless, having received other types of education i.e. informal education, as compared to having received only primary education would result in a higher probability of living in poverty by 5 per cent.

In all three models, it was found that inequality is not statistically significant in influencing Bumiputera household poverty. There is not much difference on the variables affecting poverty between the rural and urban areas. The variables are income, gender and education attainment. Nevertheless the marginal effect is higher for the rural areas as compared to the urban areas.

## **DISCUSSION**

From the results presented in Table 6, it could be deduced that strata does not influence the poverty incidence of Bumiputera. Regardless of where the Bumiputera resides, the factors influencing their poverty are the same: income, gender and education level. It could be concluded that in order to reduce poverty, there is a need to ensure that the head of household receives at least secondary education and that household income is raised. Alam (2011) finds that education plays important role in determining poverty. He mentions that household which has high educational level is not susceptible to live in poverty. This statement is supported by Muleta and Deressa (2014) who mention that high literacy rates (high education) would lower the probability of poverty.

It has been proven by the literature that female constitutes as important factor in influencing poverty (Medeiros and Costa 2008). This is supported by the findings of this study. Given that female head of household would bring the household to higher poverty, it is important that female head is empowered and provided with various channels to increase their income and economic independence. There is a need to provide more assistance to female head of household who is living in poverty for the fact that female poverty is often more severe than male poverty. Often, in many developing countries, works by females are not counted as major income generation. As emphasised by Todaro and Smith (2011), female headed households have limited control over their spouses' income, have less education, involve in many informal-sector employment, lack of social security and are highly dependable on government employment program. As such, this worsens the income disparity between males and females, hence more reason to provide greater accessibility of employment, income and economic opportunities to female head of household to reduce poverty.

A household is said to be poor when the household's resources do not satisfy their needs and the most prevalent causes is related to money (UNESCAP, 2000). Given that income is the major consideration for poverty in this paper, income is a major determinant to come out of, poverty. In fact, income of the Bumiputera is known to be the lowest among all ethnic groups. The Chinese records the highest mean income with RM 5,011 while the Bumiputera and the Indian each records a mean income of RM 3,624 and RM 3,999, respectively. While it is easy to just say that income of the Bumiputera needs to be raised to ensure that they are out of poverty, raising income would either require intervention in the

labour market, regulation on wages as well as individuals suitability for certain kinds of jobs. To ease the burden of the poor, government aids are readily available but prolong dependence would create a bigger vicious cycle of poverty. Hence, there is a need to measure poverty in a larger dimension to include relative poverty or even multidimensional poverty. As such, data needs to be made readily available to measure the trends and changes in poverty incidence, not only among the Bumiputera but also across all ethnic groups.

## **CONCLUSION AND POLICY IMPLICATION**

This paper has provided a simple analysis of poverty incidence among the Bumiputera in the Northern States of Malaysia. Given that Bumiputera constitutes a large population but with low income, it is interesting to investigate factors such as income inequality, strata and other socio demographic factors that affect their poverty. While it is notionally thought that income disparity might influence poverty, especially income disparity between the urban and rural areas, inequality does not seem to statistically significantly influences poverty incidence of Bumiputera in the Northern States of Malaysia. This finding poses a serious policy consideration. All these while, beginning with the New Economic Policy in 1970, the policy target have always been to eradicate poverty and correct the economic imbalances among the ethnic groups. Perhaps, it is time to reconsider the policy and make poverty eradication a priority rather than trying to tackle all problems at once. Given that in mind, Malaysia has been successful in eradicating poverty from 50 per cent in the early 1970s to less than 10 per cent in 2014. Nevertheless, pockets of poverty remain especially among the Bumiputera in rural areas. When policy target focuses on just one issue i.e. poverty, a better policy measure could target appropriate group

Given that income is an important consideration, perhaps, it is time that government be stringent on the enforcement of minimum wage. Minimum wage should be fixed above the poverty line income. In fact, this is what the government has been struggling with, enforcing a minimum wage of RM900 and recently increasing to RM1,000 in the 2016 budget hearing. While this seems a good approach, businesses find alternative by employing more foreign workers to avoid such enforcement. Hence, better incentives for businesses to comply with the minimum wage policy is needed to create higher income and better job opportunities. Minimum wage policy needs to be strongly enforced and practised if Malaysia wants to pursue its aim to be a high-income nation by the year 2020 with a required per capita income of USD17,700. In doing so, the income of the bottom 40 (B40) need to be raised. It is known that 27.2 per cent of the B40 is Bumiputera and if the income of B40 is increased, indirectly, the income of the Bumiputera will also increase. Now that the poverty eradication programs are considered a success, it provides the government better focus on increasing the income of the unfortunate groups.

As mentioned, it is important that females are empowered to be more actively involved in the labour market either as employee or entrepreneur. Current agencies such as Amanah Ikhtiar Malaysia (AIM), Ministry of Women, Family and Community Development, Regional Development Authority (PERDA) and even Zakat institutions need to take more proactive measures to encourage women to partake in entrepreneurial activities. It is common knowledge that female is often paid lower than their counterparts. Reasons quoted for such discrimination are related to gender issues such as pregnancy, child rearing and limited labour ability. Hence, there is a need for a policy measure to be more gender sensitive in the labour market. Some developed countries have taken the initiative to accommodate female in part time work or flexible hours to allow them the opportunity for child rearing and time off from work during pregnancy.

Finally, it is important that the government continues its effort to provide education to all population, not limited to schooling but also higher education. It has been proven that having education would provide a higher chance of receiving high income and thus out of poverty. It has been reported that less than 20 per cent of Malaysian population receives tertiary education although schooling rate is almost 100 per cent. Often, the groups secluded from education are the ones living in the rural areas

due to limited facilities, incentives and moral support. Hence, there is a need to overcome all these challenges to ensure reduction in income disparity and also reduction in poverty.

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### **REFERENCES**

- Alam, A. (2011). Impact of gender discrimination on gender development and poverty alleviation. *Sarhad J. Agric*, 27(2), 330-331.
- Economic Planning Unit. (n.d.a) Mean Monthly Gross Household Income by Ethnic Group, Strata and State, Malaysia. available at: [www.epu.gov.my](http://www.epu.gov.my) (accessed 12 March 2014).
- Economic Planning Unit. (n.d.b) Incidence of Poverty by Ethnic Group, Strata and State, Malaysia, 1970-2014
- Economic Planning Unit. (n.d.c) Gini Coefficient by Ethnic Group, Strata and State, Malaysia, 1970-2014
- Taylor, R. J. (2008). Malaysia: from Kampung to Twin Towers, 50 years of economic and social development-by Richard Leete. *Asian-Pacific Economic Literature*, 22(2), 70-71.
- Medeiros, M., & Costa, J. (2008). *What Do We Mean by? Feminization of Poverty??* (No. 58).
- Muleta, A. N., & Deressa, D. F. (2014). Female Headed Households and Poverty in Rural Ethiopia. *Science, Technology and Arts Research Journal*, 3(1), 152-155.
- Population and Housing Census of Malaysia (2010). *Population Distribution and Basic Demographic Characteristics*. Kuala Lumpur: Department of Statistic Malaysia.
- Rowntree, B. S. (1941). Poverty and progress. A second social survey of York. *Poverty and progress. A second social survey of York*.
- Sen, A. (1983). Poor, relatively speaking. *Oxford economic papers*, 35(2), 153-169.
- Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth*. Reprint 2008. Charleston :BiblioBazaar.
- Todaro, M.P. & Smith, S.C. (2011). *Economic Development*, 11<sup>th</sup> Edition). Pearson: Singapore
- Townsend, P. (1980). Research on poverty. *Wealth, income and inequality*, 299-306.
- UNESCAP (2000). *Urban Poverty Alleviation*. Paper presented at the Regional High Level Meeting in Preparation for Istanbul+5 Asia and Pacific.
- World Bank (2000). *World Development Report 2000/2001 Attacking Poverty*. Oxford University Press: NY.

## **FEMALE POVERTY IN THE NORTHERN STATES OF MALAYSIA**

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**ABSTRACT:** The male population in Malaysia is higher compared to female, but there are more female in education in comparison with male. According to the Statistics of Higher Education of Malaysia Report 2010, more than 60 per cent of enrolments in Public Higher Education Institutions are female. Even though there are more female in tertiary education, but the wages for female employee are still lower compared to male employee. Somehow, this situation has contributed to female poverty. Among others, the factors known to influence female poverty are low education attainment, poor health, lack of gainful employment due to child rearing responsibility, involvement in low productivity jobs, divorce. While Malaysia has demonstrated successful reduction of poverty from more than 50 per cent in the 1970s to 0.6 per cent in 2014, there is no information on how female poverty has been affected over the years. The main objective of this study is to assess female poverty incidence in the Northern States of Malaysia. Specifically, the study aims to empirically determine the poverty incidences among female and the factors influencing the female poverty in the Northern States of Malaysia. The study found that 0.17 per cent of female in the Northern States are living in state of poverty. Female with lower education have higher incidence of poverty where 36 per cent and 21 per cent of them who have non-formal and primary education respectively are poor. Logistic probability function taking the value of 1 (female living in poverty) and 0 (female not living in poverty) is employed to determine factors influencing female poverty. The independent variables included are per capita income, income inequality by states and education attainment. All variables are found to be statistically significant in influencing female poverty.

*Keywords:* female poverty, Northern States of Malaysia, logistic probability function

## **INTRODUCTION**

In the past, many parents believed that education was unnecessary for girls (Kaur, 1988). This was because parents thought that a girl's place was at home in the kitchen. Girls were also not encouraged to go out to the public for the sake of modesty. When education was extended to the girls, separate schools were established as co-education was frowned upon.

According to Musa (2010), when the British ruled Tanah Melayu, they did not encourage females to pursue higher education. This was because they thought females receiving education would not contribute to economic growth. The highest education that female would get during that time was primary education to allow them to work as teacher's assistant after Standard Six. However, the situation was different when the Japanese ruled Tanah Melayu. During that time, the Japanese were viewed as more cruel than the British and parents were constantly living in fear of their daughters being harassed by the Japanese soldiers. However, despite the negative perception, the Japanese were actually the ones who encouraged females to receive education. In fact, the Japanese sent some females from Tanah Melayu abroad, to Japan to be exact, to obtain quality higher education. The females had to learn the Japanese language and culture. This marked the development of females in Tanah Melayu because upon receiving education, most of them became teachers and made huge contributions to the nation. They had encouraged other females to receive education and got involved in the process when Tanah Melayu sought for independence. However, Kaur (1988) mentioned that women were poorly represented at the tertiary education as there were no female taking engineering courses from 1959 until 1963 at the University of Malaya, the only university in Malaysia at that time. In 1970, only 0.4 per cent of female were eligible to enter university.

Even though there are more female in tertiary education, but the wages for female are still lower compared to male. Somehow, this situation has contributed to female poverty. Among others, the

factors known to influence female poverty are low education, poor health, lack of gainful employment due to child rearing responsibility, involvement in low productivity jobs, divorce. While Malaysia has successfully demonstrated reduction of poverty from more than 50 per cent in the 1970s to 3 per cent in 2012, there is no information on how female poverty has been affected over the years. The main objective of this study is to assess female poverty incidence in the Northern States of Malaysia.

## **BRIEF OVERVIEW OF FEMALE EDUCATION AND EMPLOYMENT IN MALAYSIA**

Nowadays, females in Malaysia have become more educated as most of them receive tertiary education. According to the Statistics of Higher Education of Malaysia (2011) as shown in Table 1, more than 60 per cent of the student enrolments in Educational Studies, Arts and Humanities, Social Sciences, Business and Law, Sciences, Mathematics and Computers and Health and Welfare in Public Higher Education Institutions are females. Meanwhile, in Agriculture and Veterinary and Services fields, 59 per cent of the students are female. However, the percentage of female students in engineering, Manufacturing and Construction field is still lower than male, which is 41.85 per cent.

Table 1: Enrolment of Students, Ratio and Percentage of Female Students in IPTA and Fields of Study, 2010

<b>Fields of Study</b>	<b>Ratio (M:F)</b>	<b>Percentage of Female (%)</b>
Education	1:2.26	69.36
Arts & Humanities	1:1.70	63.03
Social Sciences, Business and Law	1:2.05	67.24
Sciences, Mathematics & Computers	1:1.63	61.93
Engineering, Manufacturing & Construction	1:0.72	41.85
Agriculture & Veterinary	1:1.44	59.08
Health & Welfare	1:2.33	69.99
Services	1:1.46	59.29
Total	1:1.51	60.14

Source: Statistics of Higher Education of Malaysia Report (2011)

A high percentage of female enrolments within the field of education proves that females in Malaysia still prefer teaching as their job. Besides that, female also choose to study in health and welfare field, where it can be seen that most of the nurses are female. Table 1 also shows that there are fewer female in practical type of studies such as engineering, manufacturing and construction field perhaps due to the high risk involved, in which these fields had the least percentage of female.

Percentage of female in Malaysia who received tertiary education kept increasing throughout the years. Being well educated led females to participate in the labour force and thus decrease their unemployment rate. Nowadays, it can be seen that there are many females in the labour force unlike in the past where most of the females stayed at home and were merely in charge of house chores.

Table 2 shows the labour force participation and unemployment rate of females in Malaysia and the Northern States for the year 1990, 2000 and 2010. The labour force participation of females in Malaysia decreased from 47.8 per cent in 1990 to 47.2 per cent and 46.8 per cent in 2000 and 2010 respectively. However, Malaysian female unemployment rate fluctuated from 5.4 per cent in 1990, then decreased to 3.1 per cent in 2000 and increased to 3.6 per cent in 2010.

An increase of unemployment rate in 2010 may be due to the financial crisis in 2008, because the pattern of the unemployment rates of the females in Malaysia were also the same as the one observed in the Northern States of Malaysia. Penang has the lowest unemployment rate among all the Northern States, which was 3.4 per cent in 1990, 1.3 per cent in 2000 and 2.4 per cent in 2010. However, in 1990, females in Kedah has the highest unemployment rate, which was 6 per cent, followed by Perlis and Perak where the unemployment rate were 4.4 per cent and 4.3 per cent respectively. Females in Perak have the highest unemployment rate among the Northern States of Malaysia in 2000 and 2010, which were 4.2 per cent and 3.6 per cent respectively. The unemployment rates for the females in Kedah and Perlis during 2000 were 2.9 per cent and 3.5 per cent respectively, and 3.2 per cent and 2.9 per cent respectively in 2010.

Table 2: Labour force participation and unemployment rate of the females in Malaysia and the Northern States, in the year 1990, 2000 and 2010

State	1990		2000		2010	
	Labour force participation (%)	Unemployment rate (%)	Labour force participation (%)	Unemployment rate (%)	Labour force participation (%)	Unemployment rate (%)
Malaysia	47.8	5.4	47.2	3.1	46.8	3.6
Perlis	34.1	4.4	40.9	3.5	34.8	2.9
Kedah	40.7	6.0	43.2	2.9	41.3	3.2
Penang	49.2	3.4	58.9	1.3	56.2	2.4
Perak	45.8	4.3	42.8	4.2	40.2	3.6

Source: Department of Statistics, Malaysia (2011)

Usually, female employees are paid lower than their male counterparts (see Table 3) and their pays are used to meet the basic needs in the household. However, these pays are not sufficient to pull the households out of poverty. If poverty is analysed from a gender perspective, it is found that female is more vulnerable to poverty. This is because of the inequality in different socio-economic aspects and the culture. This was agreed by Alam (2011) who state that females share more burden of productive and household work, and if those burdens are shared equally, it could help in poverty alleviation. According to Table 3, in 2010, 2011 and 2012, the mean monthly wages for male are RM 1,862, RM 1,845 and RM 1,947 respectively while for female are RM 1,734, RM 1,752 and RM 1,861 respectively.

Table 3: Mean monthly wages (RM) by gender, Malaysia, 2010–2012

Year	Male	Female
2010	1,862	1,734
2011	1,845	1,752
2012	1,947	1,861

Source: Department of Statistics (2013)

## METHODOLOGY

This research project uses Household Income Survey (HIS) data in year 2009 and only covers Northern States of Malaysia which consist of Penang, Kedah, Perlis and Perak. From the HIS data, only data of female head of household will be used because this study only focus on female poverty. The information on income for members of household is based on the income of the head of household so that is why only data of female head of household will be used. The statistical package STATA 13 is used for the analysis.

Analysis on female in poverty in the Northern States of Malaysia has been divided into several categories which are:

- a) Strata: Urban and rural areas
- b) Ethnicity: Bumiputera, Chinese, Indian, Others
- c) Education: primary, secondary, tertiary, non-formal
- d) Marital status: never married, married, widowed, divorced, separated, no information
- e) Age Group: 15-25, 26-36, 37-47, 48-58, 59-69, 70-80, more than 80 years

The logistic regression model is defined as

$$L_i = \ln Y_i = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \epsilon_i \quad (1)$$

Where,  $L_i$  is the log of the odds ratio and  $Y_i$  is the income which is the dependent variable of this research.

$Y_i = 1$ , if income falls below PLI, which means that the female head of household is poor.

$Y_i = 0$ , if income is above PLI, which means that the female head of household is non-poor.

Explanation based on the marginal effect is given in order to determine how different values of an independent variable will impact a particular dependent variable. The independent variables are strata, ethnicity, education, marital status and age.

Sensitivity analysis is conducted to determine how different values of an independent variable will impact a particular dependent variable under a given set of assumption. The analysis conducted based on 2009 PLI, and when the PLI is being shift upward to 5, 10, 15, 20, 25 and 30 per cent.

## POVERTY INCIDENCE

The study conducted for this research project is to determine the poverty incidence among the females in the Northern States of Malaysia. Poverty incidence is the percentage of people living in poverty. The poverty incidence will be explained according to strata, ethnicity, education, marital status and age group in next sections. Table 4 summarise the poverty incidence of female head of household in the Northern States of Malaysia in 2009.

According to Table 4, it shows that all Northern States of Malaysia have higher poverty incidence of females in rural areas more than urban areas. In Perlis, the poverty incidence of the females in urban areas is 21 per cent compared to 32 per cent in rural areas, while in Kedah, the poverty incidence in urban and rural areas are 10 per cent and 33 per cent respectively. Poverty incidence in the rural areas in Penang is 16 per cent compared to urban areas, which is only 5 per cent, while in Perak, the poverty incidence in rural and urban areas are 29 per cent and 14 per cent respectively. Both Perlis and Kedah have higher poverty incidence in both urban and rural areas compared to Penang and Perak because they are less developed states. As we can see, Penang has the lowest poverty incidence of the females because it is a more developed state in comparison with the other states.

Table 4: Poverty Incidence of Female Head of Household in the Northern States of Malaysia in 2009

Percentage of poor population 2009 (%)		Perlis	Kedah	Penang	Perak
<b>Strata</b>	Urban	21	10	5	14
	Rural	32	33	16	29
<b>Ethnicity</b>	Bumiputera	30	26	8	25
	Chinese	0	5	5	12
	Indian	-	26	8	9
	Others	0	-	-	-
<b>Education</b>	Primary	35	21	11	23
	Secondary	15	12	6	9
	Tertiary	0	0	0	0
	Informal	43	60	6	34
<b>Marital Status</b>	Never married	15	7	7	0
	Married	20	4	1	3
	Widowed	31	29	6	28
	Divorced	30	34	9	8
	Separated	0	100	22	-
<b>Age Group</b>	15-25	0	20	0	0
	26-36	12	9	5	0
	37-47	10	15	15	7
	48-58	14	7	2	13
	59-69	36	35	2	18
	70-80	35	54	10	45
	>80	100	46	0	39

Source: Authors own calculation based on HIS 2009

Note: '0' means 0 per cent people who are poor, '-' indicates there is no population in that group

The result in Table 4 above shows that there are zero poverty incidences of female Chinese in the Northern States of Malaysia. In addition, there is also no poverty among other ethnic group female. In general, it can be seen that female Bumiputera has the highest poverty incidence for all Northern States of Malaysia. The poverty incidences of the female Bumiputera are 30 per cent, 26 per cent, 8 per cent and 25 per cent for Perlis, Kedah, Penang and Perak respectively. However, Kedah and Penang have the same poverty incidence for both female Bumiputera and Indian. Both states also have the same poverty incidence for female Chinese, which is 5 per cent. Besides that, in Perak, the poverty incidences of Chinese and Indian females are 12 per cent and 9 per cent respectively.

Females who received informal education have the highest poverty incidence in all Northern States, except in Penang. It is possible that those who received informal education are given low wages because they could not work as professionals. The poverty incidence for those who received informal education in Perlis, Kedah, Penang and Perak are 43 per cent, 60 per cent, 6 per cent and 34 per cent respectively. In addition, Penang has the same poverty incidence of 6 per cent for both informal and secondary education. The poverty incidence for females who received primary education in all Northern States is higher than those who received secondary education. In Perlis, the poverty incidence for females who received primary education is 35 per cent compared to 15 per cent for those who received secondary education, while in Kedah, the poverty incidence is 21 per cent for those with primary education compared to 12 per cent for those who received secondary education. Besides that, the poverty incidence for females in Perak who received primary education is 23 per cent compared to 9 per cent for those who received secondary education. In addition, the poverty incidence for female in Penang who received primary education is 11 per cent. There is zero poverty incidence for females in the Northern States of Malaysia who received tertiary education. This is clearly because people who received tertiary education will get a good job and wages so they will not be poor.

Poverty incidence for the females in Penang who are divorced is only 22 per cent, while in Kedah, all female divorcees are poor. However, in Perak, there is zero poverty incidence for the females who are never married. In general, widowed female has the highest poverty rate, except in Kedah and Penang. This is because the female depends on their husband for source of income. Therefore, when the husband died, the widows do not have any source of income and hence, face difficulties in starting a new life without a husband. If they want to get a job, it is impossible for them to get high wages. The poverty incidence among females who are widowed in Perlis, Kedah, Penang and Perak are 31 per cent, 29 per cent, 6 per cent and 28 per cent respectively. Besides that, females who are divorced also have almost the same poverty rate with those who are widowed, except in Perak due to the same reason. For females who are divorced, their poverty incidence in Perlis, Kedah, Penang and Perak are 30 per cent, 34 per cent, 9 per cent and 8 per cent respectively.

All females aged above 80 years old in Perlis are poor, while none of those who are in age group 15-25 are poor except for females in Kedah. Besides that, there is also zero poverty incidence for female in age group of 26-36 in Perak and above 80 years old in Penang. In Perlis, the highest poverty incidence of the females following those aged above 80 years old is those in age group 59-69, which is 36 per cent, followed by 35 per cent for those in age group 70-80. Female in younger age groups have almost the same poverty incidence. In Kedah, females in age group 70-80 have the highest poverty incidence which is 54 per cent, followed by those aged above 80 years old and age group 59-69. The lowest poverty incidence is female who is in age group 48-58, followed by those in age group 26-36. Female who are in age group 37-47 has the highest poverty incidence in Penang, which is 15 per cent, followed by those in age group 70-80 and 26-36. In Perak, the females have the same first three highest rank of poverty incidence as Kedah. This is followed closely by those in age group 48-58 and age group 37-47. Females who are in the range of age 26-58 years old usually have quite low poverty incidence because they are still young and able to work.

## **LOGISTIC PROBABILITY FUNCTION**

The logistic probability function for female head of household in the Northern States of Malaysia will be analysed based on marginal effect that was calculated. The analysis will be divided into when using normal Poverty Line Income (PLI) and also when PLI is being shifted upward by 5 per cent, 10 per cent, 15 per cent, 20 per cent, 25 per cent and 30 per cent respectively. From there, it can be seen if there are any changes on the inequality, income and education as the PLI has been shifted upwards.

For normal PLI, an increase in inequality reduces the probability of female head of household to be poor by 0.04, whereas if their income increases, the probability will reduce by 0.17. The probability of female head of household who received at least a secondary education to be living in poverty is 0.05 less than those who received primary education while for females who received informal education, the probability is 0.12 greater.

When the PLI is shifted upward by 5 per cent, an increase in inequality reduces the probability of female head of household to be poor by 0.05, whereas if their income increases, the probability will reduce by 0.18. The probability of female head of household who received at least a secondary education to be living in poverty is 0.07 less than those who received primary education while for females who received informal education, the probability is 0.14 greater.

However, when the PLI is shifted upward by 10 per cent, an increase in the inequality reduces the probability of female head of household to be poor by 0.04, whereas if their income increases, the probability will be reduced by 0.20. The probability of female head of household who received at least a secondary education to be living in poverty is 0.09 less than those who received primary education while for females who received informal education, the probability is 0.11 greater.

Besides that, when the PLI is shifted upward by 15 per cent an increase in the inequality reduces the probability of female head of household to be poor by 0.05, whereas if their income increases, the probability will reduce by 0.22. The probability of female head of household who received at least secondary education to be living in poverty is 0.12 less than those who received primary education while for females who received informal education, the probability is 0.11 greater.

When the PLI is shifted upward by 20 per cent, an increase in the inequality reduces the probability of female head of household to be poor by 0.05, whereas if their income increases, the probability will reduce by 0.24. The probability of female head of household who received at least secondary education to be living in poverty is 0.15 less than those who received primary education while for females who received informal education, the probability is 0.09 greater.

An increase in inequality when the PLI is shifted upward by 25 per cent reduces the probability of female head of household to be poor by 0.06, whereas if their income increases, the probability will reduce by 0.26. The probability of female head of household who receive at least a secondary education to be living in poverty is 0.16 less than those who received primary education while for females who received informal education, the probability is 0.08 greater.

When the PLI is shifted upward by 30 per cent, an increase in the inequality reduces the probability of female head of household to be poor by 0.07, whereas if their income increases, the probability will reduce by 0.28. The probability of female head of household who received at least a secondary education to be living in poverty is 0.13 less than those who received primary education while for females who received informal education, the probability is 0.10 greater.

## **CONCLUSION AND RECOMMENDATIONS**

Education plays an important role as determinant of female poverty in the Northern States of Malaysia. Secondary education has negative coefficient with normal PLI and even when PLI shift upwards. This means that the higher the level of education of a female head of household, the lower the chances for her to live in poverty. This contradicts with females who received non-formal

education where it has positive coefficient as they will be more prone to poverty. However, tertiary education has zero coefficient because there is no female who received tertiary education living in poverty.

Besides that, income also plays important role in determining whether a female head of household live in poverty or vice versa. Income has negative coefficient which means that the higher the income of the females, there is less chances for them to be poor. In conclusion, when female head of household in the Northern States of Malaysia receive high level education, they will get better job with higher income. Therefore, it will prevent them to live in poverty. Moreover, even if some of them are poor, they have skills and knowledge to use in order to get out of poverty.

The government has introduced Amanah Ikhtiar Malaysia (AIM) to provide micro credit scheme and 1Azam to provide the opportunities to generate higher income for the poor. However, based on the findings of this research, the following recommendations are proposed:

- i. Females should receive education regardless of their background or where they come from. This is because education plays an important role in affecting the poverty among the female in the Northern States of Malaysia. The education they receive must be of high quality so that they can improve their lives as well as getting jobs with good payments and no longer be in poverty. Therefore, government must take actions to make sure all females in Malaysia received high level of education and parents have to make sure that their daughters get tertiary education.
- ii. Females are in high position in workforce. Good educations will even the field for the females. It will make female's credibility equal to her male counterpart. Thus, they will be able compete fairly with each other in securing high positions in their workplace. This will in turn prevent females from depending on males and living in poverty. Therefore, government must enforce policies to make sure females get the same chance as males to climb up to higher position in the workforce.

### **Acknowledgement**

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### **REFERENCES**

- Alam, A. (2011). Impact of gender discrimination on gender development and poverty alleviation. *Sarhad J. Agric*, 27(2), 330-331.
- Department of Statistics Malaysia (2011). Labour force participation and unemployment rate of the females. Retrieved April 15, 2015 from [www.statistics.gov.my](http://www.statistics.gov.my)
- Department of Statistics (2013). Mean monthly wages (RM) by gender. Retrieved April 12, 2015 from [www.statistics.gov.my](http://www.statistics.gov.my)
- Kaur, A. (1988). An historical analysis of women's economic participation in development. In: Jamilah Ariffin, ed. 1994. *Readings on women and development in Malaysia*. Petaling Jaya: MPH Group Publishing. 3-22.
- Musa, M. (2010). Wanita Melayu, Kesedaran Pendidikan dan Pembentukan Masyarakat Malaysia Moden. *Malaysia Dari Segi Sejarah*, 38, 1-24.
- Statistics of Higher Education of Malaysia Report (2011). Enrolment of Students, Ratio and Percentage of Female Students in IPTA and Fields of Study. Retrieved May 10, 2015 from [www.mohe.gov.my](http://www.mohe.gov.my)

## **PATTERNS OF INCOME DISTRIBUTION IN THE NORTHERN STATES OF MALAYSIA: A LIFE CYCLE APPROACH**

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**ABSTRACT:** Income distribution can be defined as equality in which income is dealt out among members of a society. Income distribution is measured by how much income is earned by different segments of a population. In Malaysia, a common measure of income distribution is through calculating mean monthly income. The reported mean monthly income uses macroeconomic data segregated into ethnicity, states and urban-rural. At present, there is no income distribution measurement specifically for the Northern States of Malaysia. Therefore this study aims to estimate and identify the patterns of income distribution using different categories of income. The categories of income used are employment income, property income and gross income. This study uses 2009 Household Income Survey (HIS) data where 30 per cent of total observations are used. The findings confirm the LCH theory. There are different peak ages with different categories of income. However, the peak is not as high as proposed by Modigliani and Brumberg (1954). Calculation of mean income of different categories shows that the income from employment takes a large portion of total income.

*Keywords:* income distribution, Northern States of Malaysia, life cycle hypothesis

### **INTRODUCTION**

Income distribution can be defined as equality in which income is dealt out among members of a society (Anand, 1983). If everyone earns exactly the same amount of money, income distribution will be perfectly equal. If no one earns any money except for one person, who earns all the money, then the income distribution will be perfectly unequal. The income distribution is measured by how much income is earned by different segments of the population. The issue of income distribution in Malaysia was a concern during the racial riot on the 13<sup>th</sup> of May 1969. The May 13 Tragedy was the start of the realisation that racial disintegration is a serious problem in this country and measures taken in the past to deal with it have been proven inadequate (The National Operation Council, 1969). Although there are many speculations about the real reasons of the riot, it started mainly because of misunderstanding between the Bumiputeras; which are basically Malays and the Chinese. Report by The National Operation Council 1969 shows that the riot started because of the distribution of the income between the races are unevenly distributed. Even though the riot happened 46 years ago, the extent of chaos has proven that racial issue is highly sensitive in Malaysia. Therefore, this study aims to estimate and identify the patterns of income distribution using different categories of income.

### **LIFE CYCLE HYPOTHESIS**

Life Cycle Hypothesis (LCH) was first proposed by Modigliani and Brumberg (1954). Modigliani and Brumberg (1954) were concerned with the cross-section or the microeconomic implication of the theory, while Modigliani and Brumberg (1980) looked at the time-series and macroeconomic implications. For each individual, it is assumed that increase in life-time resources will lead to proportionate increase in consumption in all periods of life. As a result, consumption is proportional to average income over life span. Modigliani and Brumberg (1954), state that the share of consumption in income is lower for better-off households. In other words, the saving rate rises with income. Modigliani and Brumberg (1954) argue that the proportionality of consumption and income in the long-run is entirely consistent with the cross-sectional facts because, as we move up the income distribution, a higher and higher fraction of people are there on a temporary basis, with high transitory income, and thus a temporarily high saving ratio. The same argument explains why savings rates rises more rapidly with income among households who are farmers or small business proprietors, whose income tends to be relatively volatile. In the macroeconomic context, argued in Modigliani and Brumberg (1980), the same line of argument shows that, for the economy as a whole, the saving ratio

should be constant over the long-run, provided that the rate of growth of the economy doesn't change, but will vary pro-cyclically over the business cycle. Over the life-cycle, consumption is smoother than income. Modigliani (2001) shows the graphic of the Life Cycle Hypothesis. Data from Italy was used in his research. The Hump-shaped of the Life Cycle Hypothesis is shown below:

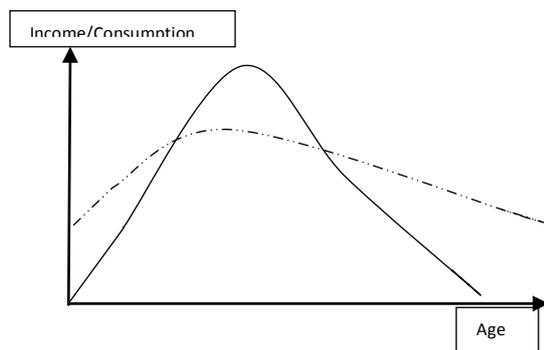


Figure 1: Hump-shaped of Life Cycle Hypothesis  
Source: Modigliani (2001)

The black line shows the pattern of income while the dotted line shows the pattern of consumption. The black line shows the trend of average income corresponding to the age of the household head. The income also shows differences in the years of working, experience, diligence and also education received. The dotted line shows the pattern of consumption which is obviously flatter than consumption. This trend produced a strong hump shaped for savings profiles.

There is vast literature, particularly in the US, which point to the fact that the youth are not saving enough for their retirement. For example, Bernheim, Skinner and Weinberg (2001) studied the behaviours of individuals belonging to the baby-boom generation and uses consumption as a measure of the current standard of living. In particular, Bernheim et al. (2001) found that younger workers are saving only about a third of what would be needed to maintain their standards of living unchanged after retirement.

Scholz, Seshadri and Khitatrakun (2006) match HRS families with Social Security records and observe the entire history of earnings. The key finding is that more than 80 per cent of households are accumulating adequate wealth to maintain pre-retirement consumption levels through retirement with home equity included in wealth. However, if only half of home equity is included, their conclusion would have to change to that about 60 per cent of households are accumulating sufficient wealth. If Social Security benefits are cut by 25 per cent in the future, only 64 per cent of households are accumulating enough wealth even with all the home equity included in the wealth.

As argued by Bernheim, Schleifer and Summers (1985), bequests could be a strategy where parents leave their property or money only in exchange to services provided to them by their children. One test for bequests was performed by Hurd (1987). His intuition is that a bequests motive should be important only for families with children. Hurd uses 10 years wealth changes from HRS for people aged between 58 to 73, with and without children, and finds little evidences which support a bequest motive. In particular, wealth declines 17 per cent among married couples with children, and only 2 per cent among married couples without children.

## **PERMANENT INCOME HYPOTHESIS**

The permanent income hypothesis (PIH) is an economic theory which attempts to describe how agents spread consumption over their lifetimes. First developed by Milton Friedman, it hypothesised that a person's consumption at a point in time is determined not just by their current income but also by their expected income in future years which is being said as their "permanent income". In its simplest form, the hypothesis states that changes in permanent income are what drive the changes in a

consumer's consumption patterns. Its predictions of consumption smoothing, where people spread out transitory changes in income over time, departs from the traditional Keynesian emphasis on the marginal propensity to consume. It has had a profound effect on the study of consumer behaviours, and provides an explanation for some of the failures of Keynesian demand management techniques.

Income consists of a permanent component and a transitory component. The permanent components are anticipated and planned income while transitory components are windfall gain or unexpected income. In the permanent income hypothesis model, the key determinant of consumption is an individual's lifetime income, not his current income. Permanent income is defined as expected long-term average income.

Assuming consumers experience diminishing marginal utility, they will want to smooth out consumption over time, e.g. take on debt as a student and also ensure savings for retirement. Coupled with the idea of average lifetime income, the consumption smoothing element of the PIH predicts that transitory changes in income will only have a small effect on consumption. Only longer lasting changes in income will have a large effect on spending.

A consumer's permanent income is determined by their assets, both physical and human assets. These influence the consumer's ability to earn income. The consumer can then make an estimation of anticipated lifetime income. A worker saves only if they expect their long-term average income, i.e. their permanent income, will be less than their current income.

## **METHODOLOGY**

The data used for this study is obtained from Household Income Survey. Only the data of the year 2009 were used in this study. Only 30 per cent of the observations were used. The data has 13,215 observations. The variables used in this study are age, ethnicity, strata, gender, education attainment and household size. The data only encompass Northern states which include Perlis, Kedah, Penang and Perak. The raw data were combined into some categories, but for ethnicity, strata and gender, the categories were directly taken from the Household Income Survey data 2009. The categories for age and education attainment were shown in Table 1. The variables were combined into some categories to make the observation easier.

Table 1: Categories of Variables

<b>Variables</b>	<b>Categories</b>
<b>Age</b>	
16 to 23 years old	Young group
24 to 54 years old	Working group
≥ 55 years old	Pensioners
<b>Education attainment</b>	
Year 1 to year 6	Primary
Form 1 to form 6	Secondary
Universities, colleges, institution and all above	Tertiary
Religious education or no formal education	No formal education

The young group categories are grouped between 16 to 23 years old. From the Household Income Survey data 2009, 16 is the youngest head of household age recorded. To explain the reason why 23 years old is chosen as the end limit of the young group, the Malaysia education system would need to be explained. In Malaysia, primary and secondary education is compulsory until the age of 17 years old. Then, students can choose to continue to either matriculation, Diploma or Form six which they would finish these studies at the age of about 20 years old. Only after that, they can continue to pursue their degree studies for the next three or four years, with a majority of the student finishing at the age

of 23 years old. The working group aged between 24 to 54 years old. Meanwhile, as stated by the law during 2009, a pensioner's age starts at 55 years old.

Different types of income source are used to confirm the pattern of Life Cycle Hypothesis. Modigliani and Brumberg (1954) assume that the individual receives utility only from present and perspective assets and from assets to be bequest. The employment income represents the present assets, the property income represents the bequeathed assets and the gross total income is the combination of both present and the bequeathed assets. Consistent with the study by Modigliani and Brumberg (1954), three income sources from the Household Income Surveys data 2009 were used. The three income sources are total paid employment income, total property income and gross total income. For this study, calculation of mean income is used to achieve the objectives. Mean income of total paid employment income, total from property income and the gross total income of different age categories is calculated. The mean income is calculated using the mean formula.

### **PATTERN OF INCOME DISTRIBUTION**

To observe the pattern of income distribution using the three income sources, a two-way graph is plotted. The graph is between income sources which are total paid employment income, total property income and gross total income and age. The incomes are the three income sources plotted in three different graphs. Once again, Stata is used to plot the graphs.

There are 417 head of households from the young group in Perlis, 5,975 in Kedah, 2,118 in Penang, and 4,783 in Perak. For head of households from working age group, there are 39,117 in Perlis, 343,287 in Kedah, 297,948 in Penang and 400,100 in Perak. While, there are 13,663, 86,240, 74,534 and 152,513 head of households from the pensioner group in Perlis, Kedah, Penang and Perak. 11,730 Bumiputera, 968 Chinese, 429 Indians and 166 of others ethnicity comprise the young group. There are about 633,777 Bumiputera, 320,670 Chinese, 120,446 Indians and 5,559 others than the three major ethnics of working group in the Northern State of Malaysia. While pensioners consist of 191,036 Bumiputera, 112, 206 Chinese, 21,981 Indians and 152,513 of other ethnicity.

The young group and the working age group mostly live in urban area rather than in rural area. There are 8,670 people belonging to the young group, 680,597 people of working age group and only 184,634 pensioners living in the urban area. While, there were only 4,624 people of young group, 399,856 people of working age group and 142,317 pensioners living in rural area.

Most of the head of household are male. For the head of household for young groups, 9,261 are male and 4,033 are female. 936,579 are male and 143,874 are female for head of households of the working age group. For the head of households of pensioners, 240,655 are male and 86,295 are female. 507 head of household within the young group have primary education as the highest educational attainment, 10,461 received up to secondary educations, 1,896 received tertiary education and 429 did not receive any formal education. For head of household of working age group, 221,600 have attended primary education, 675,916 have undergone secondary education, 153,537 have received tertiary education and 29,399 have not attained formal education. Meanwhile, for head of household of pensioners, 169,682 have primary education as their highest educational attainment, 76,917 have received secondary education, 152,260 have undergone tertiary education and 65,091 have no formal education.

Table 2 below shows the mean income of three different income sources which is income from employment, income from property and gross income. From Table 2, the mean income from employment is the lowest for pensioners age groups which is RM 11,951.09, young age group have mean income from employment of RM 19,011.90. Working age group has the highest mean income from employment which is RM 28,095.92. For the mean income from property, young age group have the lowest mean income with only RM 47.33, then followed by the pensioners with mean income of RM 405.63 and working age group has the highest mean income of RM 626.96. Mean gross income shows that young groups have the lowest mean gross income of RM 23,400.70, followed by the

pensioners of RM 28,484.58 and working age group have the highest mean gross income of RM 40,667.97. The pattern of income shows that working age groups always have the highest income regardless of income sources.

Table 2: Mean Income of different income source

Age	Mean income from employment (RM)	Mean income from property (RM)	Mean gross income (RM)
Young group	19,011.9	47.33	23,400.7
Working group	28,095.92	626.96	40,667.97
Pensioners	11,951.09	405.63	28,484.58

Sources: Authors own calculation based on HIS 2009

Table 3 shows the different mean income of different types of income sources by different social groups. As had been discussed before, income from employment contributes to the largest part of the total income. Table 6 shows that people with tertiary education have the highest income for all age categories. These two patterns point to the conclusion that tertiary education is important and one of the ways to increase income is by pursuing tertiary education.

Table 3: Mean income of different sources

		Income from employment			Income from property			Gross income		
		Youngsters	Working Age Group	Elderly	Youngsters	Working Age Group	Elderly	Youngsters	Working Age Group	Elderly
<b>States</b>	Perlis	14,685.49	24,033.69	12,434.83	32.71	189.42	245.48	20,070.38	33,401.8	27,722.51
	Kedah	31,444.01	39,516.84	34,782.35	206.10	1,719.06	1,609.47	34,522.17	50,506.09	50,539.61
	Penang	20,867.23	25,429.32	10,721.2	0	89.15	340.18	23,416.88	36,347.27	28,437.14
	Perak	7,424.23	26,096.43	11,039.1	0	141.38	166.36	15,546	36,656.37	27,236.35
<b>Ethnicity</b>	Bumiputera	19,129.63	27,078.17	12,032.38	44.72	334.67	331.21	22,305.62	35,525.99	27,196.15
	Chinese	26,239.48	34,075.65	23,330.09	22.17	1,093.26	969.99	40,842	54,052.41	46,561.24
	Indian	11,022	25,604.81	26,401.01	200	533.52	1,020.75	23,662	32,933.14	45,616.06
	Others	16,383	29,772.43	5,159.18	0	777.69	1,934.12	16,729	36,143.5	39,319.67
<b>Strata</b>	Urban	24,507.98	33,826.54	22,149.76	46.01	755.02	831.08	19,600.08	46,776.59	43,245.38
	Rural	9,682.55	20,520.8	9,724.26	50.38	268.54	307.07	21,055.69	31,602.26	25,187.29
<b>Gender</b>	Male	18,078.82	29,757.32	19,444.3	45	591.10	672.80	22,060.43	40,873.67	38,141.56
	Female	22,273.01	22,968.54	9,006.352	53.36	462.86	422.84	26,528	32,274.88	21,617.8
<b>Education</b>	Primary	6,744	16,256.01	12,459.64	0	377.22	442.87	6,844	27,491.09	26,988.75
	Secondary	18,618.01	24,787.78	22,550.27	50.46	481.53	775.56	23,358.55	3542.98	43,225.36
	Tertiary	31,155.37	62,182.04	47,975.34	54.90	1,242.12	1,920.1	29,248.17	73,538.9	94,580.31
	Others	0	14,823.94	8,693.34	0	188.05	341.92	5,800	20,107.88	19,506.22

Sources: Authors own calculation based on HIS 2009

### PATTERN OF LIFE CYCLE THEORY

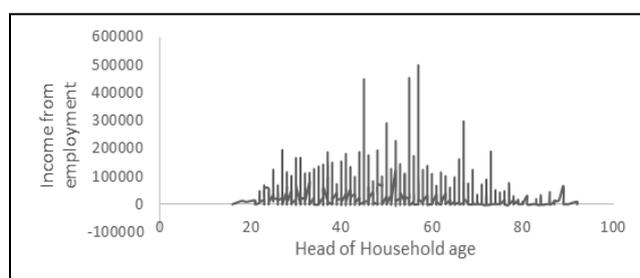


Figure 2: Relationship between Age and Income from Employment

Figure 2 shows the relationship between age and income from employment. From the graph, it is clearly shown that the Life Cycle Theory is proven. Even though, the hump shape is not clearly visible, but the shape is still there. The hump shape for the Northern states is not as high as proposed by Modigliani, 2001. For the Northern states, the hump shape is lower.

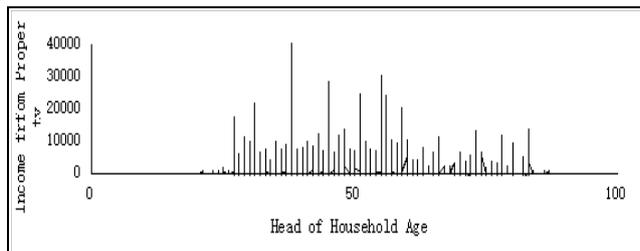


Figure 3: Relationship between Age and Income from Property

Figure 3 shows the relationship between age and income from property. The highest income is obtained by the people at the age of 38. However, no hump shape can be seen from Figure 3. The graph is skewed to the left. So, this does not follow the pattern of Life Cycle Hypothesis.



Figure 4: Relationship between Age and Gross Income

Figure 4 shows the relationship between age and gross income. The result shows almost the same pattern with the income from employment. Again, the hump-shape is not so clear, but it still showed some pattern of Life Cycle Hypothesis. The hump shape for the Northern states in Malaysia is lower and unclear compared to the hump shape proposed by Modigliani.

## **DISCUSSION**

The results of income distribution of the three sources show that the income from employment is the main source of income. The pensioners have the lowest income from employment compared to others because most of the pensioners do not work after their pension age which is 55 years old in Malaysia. Youngsters have the second lowest income because they are just starting to work. Since young workers are not as experienced and skilled, their salaries are relatively lower. While, working groups have the highest mean income from employment. This is normal because the working group are receiving their salary and are paid higher than the young group since they are more skilled and experienced.

For income from property, again, the working group has the highest mean income. The working group uses their money from the salary to invest in properties. If we use the argument that the working group, who are investing their money during the working age, the result of the mean income from property would have shown that the mean income from property for the pensioners is higher than the working group. However, in this study, the result shows that pensioners have a lower mean income from property than the working group. The reason for this result is that the pensioners are living in their own house that they had bought during their working age. Additionally, maybe because of decrease in income, pensioners start selling their property to generate income. Young group has the lowest mean income from property. Since these youngsters are receiving low salary, they are still unable to invest their money in property. Some youngsters from high-income family may receive some property from their parents.

Findings from this study show that the pattern of income distribution in Northern states of Malaysia does follow the Modigliani's pattern of Life Cycle Hypothesis (LCH). However, the hump shape is not as high as proposed by Modigliani. In Northern states of Malaysia, the pattern of income from employment shows that people at the age of twenties earns almost the same as the people at the age of fifties. This shows that wages in Malaysia do not increase in relation to age despite more experience and knowledge.

## **RECOMMENDATIONS**

Based on the findings above, several recommendations are provided: Youngsters in Penang should receive aids for basic needs. With the development in Penang, it is a state where more job opportunities are available. With the high living cost in Penang, and low income especially for the youngsters who have just started their career, the youngsters will face difficulties in adapting to the cost of living of this state. As one of the most important basic needs is accommodation, it is suggested that the State Government should provide accommodation for youngster who have just started their job with a low rental rate.

Wages in Malaysia should be revised every year. The almost same pattern of income from employment over the life time shows that wages in Malaysia do not increase much. The wages in Malaysia do not significantly increase with increase of experience and knowledge. This leads to migration of professional workers in Malaysia. The government should revise the wages of workers in Malaysia based on their experience and knowledge. Lastly, pensioners in Malaysia should be educated on how to manage their pensions after they have retired as mismanagement of financial resources after retirement will lead to financial problems.

## **Acknowledgement**

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## **REFERENCES**

- Anand, S. (1983). *Inequality and Poverty in Malaysia*. Washigton, D.C.: Oxford University Press.
- Bernheim, B. D., Shleifer, A., & Summers, L. H. (1985). The strategic bequest motive. *Journal of Political economy*, 93(6), 1045-1076.
- Bernheim, D. B., Skinner, J.& Weinberg, S. (2001). What Accounts for the Variation in Retirement Wealth among US Households? *American Economic Review*, 91, 832-857.
- Hurd, M. D. (1987). Savings of the Elderly and Desired Bequests. *American Economic Review*, 77, 298-312
- Modigliani, F. & Brumberg, R. H. (1954). Utility Analysis and the consumption function: an interpretation of cross-section data (p. 338-436). In K.K. Kurihara (Eds) *Post-Keynesian Economics*. New Brunswick: Rutgers University Press.
- Modigliani, F., & Brumberg, R. (1954). Utility analysis and the consumption function: An interpretation of cross-section data. *Franco Modigliani, I*.
- Modigliani, F. (2001). *Adventures of an Economist*. New York : TEXERE LLC.
- Scholtz, J.K., Seshadri, A.&Khitatrakun, S. (2006). Are Americans Saving "optimally" for Retirement? *Journal of Political Economy*, 114(4), 607-643.
- The National Operation Council, (1969). *The May 13 Tragedy*. Kuala Lumpur: The National Operation Council.

## **GIS IN STUDYING SLOPE FAILURE IN PENANG: CHALLENGES AND POTENTIAL**

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**ABSTRACT:** Geographic Information System (GIS) is an information system that is used to store, display, analyse and manipulate spatial data. Geographic information system (GIS) can help users to visualise, question, analyse, and interpret data to understand patterns, trends, and relationships. GIS-based maps and visualizations have greatly assisted understanding of situations. In recent years, slope failure hazard assessment has played an important role in developing land utilisation planning aimed at minimizing the loss of lives and damages to property. There are various GIS-based slope failure studies that involve many approaches. These approaches can be classified into qualitative factor overlay, geotechnical process models, and statistical models. At present, not many studies have satisfactorily studied the integration of these models with GIS to map slope failure. This paper deals with several aspects of landslide by presenting a focused review of GIS-based slope failure hazard zone. The paper starts with a framework for GIS-based study of slope failure, followed by a critical review of the state-of-the-art applications of GIS and digital elevation models (DEM) for mapping and modelling landslide hazards. The paper ends with a description of an integrated system for effective landslide hazard zonation. The adoption of a GIS-based framework for knowledge discovery allows designers to identify the suitability of development within certain areas. The usage of GIS can be beneficial in various fields, including the issue of slope failure. Moreover, GIS is also beneficial to organisations of all sizes and in virtually every industry. GIS is important in understanding what is happening and forecasting future trend in a geographic space.

*Keywords:* Geographic Information Systems (GIS), challenges, potential, slope failure

### **INTRODUCTION**

Increasing population has resulted in the opening and development of the areas for residential, industrial, agricultural and other infrastructure development to accommodate the needs and population growth. Physical developments on flat and lowland areas in Penang have now encroached into highland, and the encroachment is causing disruption to the stability of the slope. The phenomenon of slope failure will not only result in adverse impacts on the property, but would also caused fatalities such as the Highland Towers incident in 1993, Gunung Tempurung 1997 and 2004, Pos Dipang 1996, Sandakan 1996, Bukit Antarabangsa 2002 and Bukit Lanjan of New Klang Valley Expressway 2003 (Utusan Malaysia, 2011). The latest slope failure event in Madrasah Al-Taqwa, Hulu Langat has caused the death of 16 orphans and another 24 buried (Utusan Malaysia, 2011).

### **THE STUDY AREA**

Penang State is located at Straits of Malacca between the latitudes of 5° 8' N-5° 35'N and longitudes 100° 8'W-100° 32'W. The State's total land area is 1048 square kilometres, consisting of 121 square kilometre of Northeast district, 176 square kilometre Southwest, 269 square kilometre Northern Seberang Perai, 239 square kilometre Central Seberang Perai and 243 square kilometre Southern Seberang Perai. According to the Department of Statistics (2009), the total population in Penang is 1.6 million people which is 5.7 per cent of the estimated total population of Malaysia. Population density in Penang stands at 1,508 persons per square kilometre.

Penang Island as one of the nation's earliest urban areas is expanding rapidly. Growing population has increased the demand for developmental projects to meet the needs for settlements. With approximately 50 per cent of Penang land area identified as highland, Penang is experiencing population growth in the northern region that possesses hilly topography.

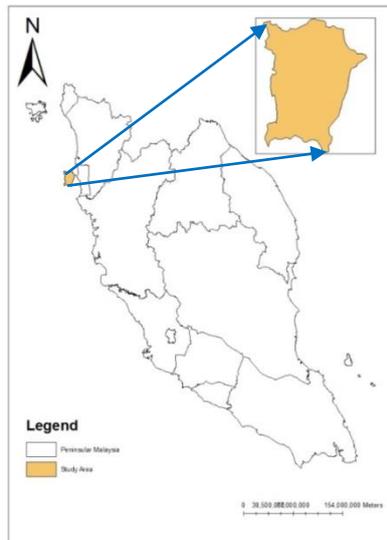


Figure 1: Location of study area  
Source: Malaysia Physical Map (2015)

## **SLOPE FAILURE**

Slope failure is a geomorphological process acting on the earth's surface (exogenous) resulting from the degradation of land depletion. Land depletion is a movement of large stones, soil mixed with stones or rocks due to the action of gravity (Tjia, 1987). According to Chung and Fabbri (1999) slope failure is due to spatial factors. Development slope can be a natural phenomenon or human induced (Komoo, 1995). Most of the ruins in Malaysia are classified as slope failure (Komoo, 1995).

The potential slope failure occurred in a certain time and certain areas are affected by the steepness of the slope and weathering processes (Varnes, 1984). According to Tjia (1987), terrain changes depend on the steepness of the slope weathering processes. Avalanche slope failures occurring in the hills and steep mountains will, under some circumstances, lead to mountain slopes into the ground (Ismail, 2001). Slope failure is the degradation of the earth's surface. It has caused significant damage in Malaysia (Wan Ibrahim, 2005). This process acts on earth, either naturally or through external forces, and the result of reaction generated in the depletion shore restore the stability of a slope. The World Landslide Inventory 1996 Commission defines slope failure as pulled by gravity with movement of rock debris down the slope (Sassa, Fukuoka, Wang and Wang, 2005).

According to Komoo (1995), landslide incidents in Malaysia are usually classified as slope failure. Slope failure occurring on the slopes are usually kind of weathered granite rock on the slope of > 20 degree involving small scale but there is no sign before the occurrence of slope failure (Public Works Research Institute (PWRI), 1981).

## **SLOPE FAILURE IN PENANG**

In landslide literature, there are many GIS-based studies on landslide susceptibility and hazard mapping. Different approaches have been employed to measure landslide hazard, including direct or indirect heuristic, deterministic, probabilistic, statistical and data mining. Examples of Penang slope failure studies are Ahmad et al. (2005) and Pradhan (2013).

Landslides remain a major threat in Penang, especially during raining seasons. Since September 1995, Penang has been shocked by 60 landslides incidents in the Penang Hill area following a freak storm that had damaged the pathway near the Penang Botanical Gardens. Landslides occurrences in Penang are mainly due to heavy tropical rainfall. Table 1 below shows record of slope failures in Penang between 1998 and 2015. According to local daily reports, slope failures in Penang Island tend to occur

at Paya Terubong, Balik Pulau and Bukit Bendera. Land clearing activities involving hill slopes in Penang State also require serious attention from the authorities as the land became more susceptible to erosion. The situation worsens during monsoon season as greater rainfall affects the movement of soil on the excavated hillsides.

Table 1: Record of slope failure in Penang between 1998 and 2015

<b>Date</b>	<b>Location</b>	<b>Occurrence</b>	<b>Causes</b>
28/11/1998	Paya Terubong	Ruin at Block 8, Sun Moon City	Heavy rain and slope $60^\circ > 60^\circ$
08/09/2008	Balik Pulau	Sedimentation and landslide occurred in Jalan Tun Sardon, Tanjung Bungah, Batu Feringghi	Heavy rain
06/09/2008	Bukit Bendera	Landslide	Heavy rain
09/09/2008	Balik Pulau	Landslide	Heavy rain
09/09/2008	Balik Pulau	Landslide from the slope of the hill country camp service centres (Sri Mutiara)	Heavy rain
22/10/2008	Paya Terubong	10 meter high hillside collapsed	Landslide, Soil erosion, soil instability and the impact of geological hazards
2 /10/2009	Solok Tan Jit Seng at Tanjung Bungah, Pulau Pinang	Landslide	Rain
2 /11/ 2009	War Museum in Batu Maung	Landslide	Construction of housing Project
23 /4/ 2009	30 landslide prone locations are tracked along a 5 km line of vehicles heading from Jalan Kebun Bunga to Bukit Bendera	Landslide	Heavy rain Erosion
14/9/2013	Bukit Bendera hit by 13 landslides, Tanjung Bungah	Landslide	Soil erosion and slope failure
23/9/2015	Paya Terubong	Landslide water gushed down from a hill slope near the Green Garden apartment in Paya Terubong	Water gushed down from a hill slope near the Green Garden apartment in Paya Terubong

Source: Utusan Malaysia (2015)

## **APPLICATION OF GIS IN THE SLOPE FAILURE**

GIS helps to predict the occurrence of slope failures by warning potential slope failures and providing a decision-making support system to evaluate the suitability of physical development in the area. GIS can predict the location of potential slope failure in the future. Information and knowledge of the area such as the degree of sensitivity and physical suitability for development are very important to enable more orderly planning and safer development (Harun, 2006). Simon et al. (2009) uses GIS and engineering factors of slope failure disaster assessment to map the zone of potential slope failure along the East Coast Expressway, between kilometre 160 and 190 in the State of Pahang.

This study uses six slope failure factors that are lithology, soil type, land use, topography, slope gradient and total annual rainfall. This study divides the study area into four zones of potential slope failure. The study found that rainfall is the dominant factor in causing slope failure. Other examples of GIS-based slope failure studies include, but is not limited to, Ahmad (2005), Crozier (2010), Alrowaimi (2006), Robin et al. (2008), Rahman et al. (2009), Mantovani et al. (2010), Pareek et al. (2010) and Das et al. (2010). This study maps areas with potential risk of slope failure. This map can help designers and planners to identify areas with potential slope failure and provide precautionary warning to any developmental plan involving these high risk areas.

## METHODOLOGY

### GIS and Database of the Landslide

In order to perform the landslide analysis, landslide characteristics need to be extracted from the raw data, and undergo pre-processing in order to be quantified.

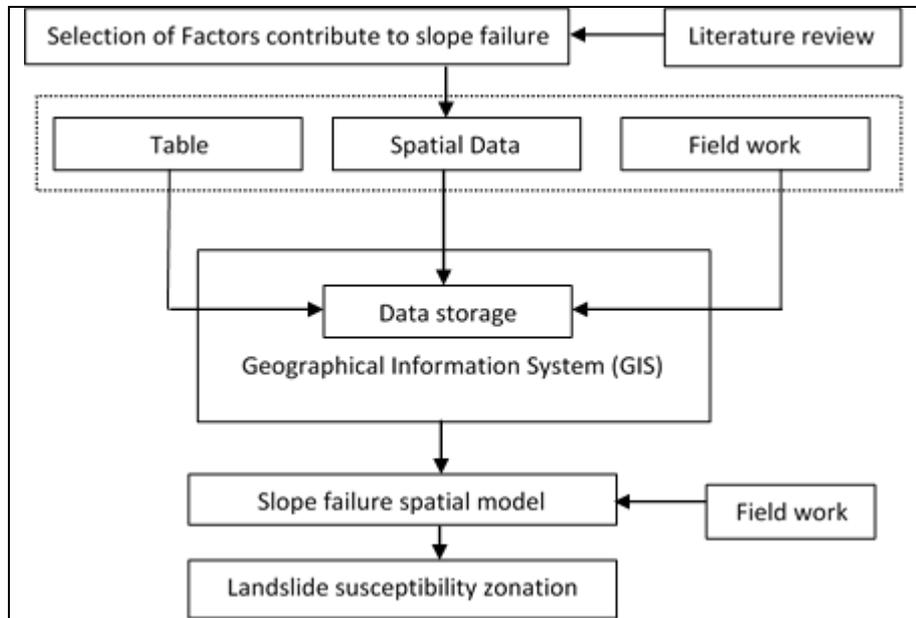


Figure 1: Framework for Landslide Analysis

Through density analysis, line density tool calculates the density of linear features in the neighbourhood of each output raster cell. Density is calculated in units of length per area unit. Conceptually, a circle is drawn around each raster cell centre using search radius. The length of the portion of each line that falls within the circle is multiplied by its landslide field value. These figures are summed, and the total is divided by the circle's area. Figure 2 below illustrates this concept.

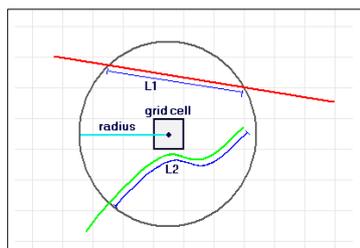


Figure 2: Determining line length using line density tool

Source: ArcGIS Pro, 2015

A raster cell is shown with its circular neighbourhood in Figure 2. Lines L1 and L2 represent the length of the portion of each line that falls within the circle. The corresponding population field values are V1 and V2 respectively. Thus:

$$\text{Density} = ((L1 * V1) + (L2 * V2)) / (\text{area of circle})$$

The density of point features around each output raster cell. Conceptually, a neighbourhood is defined around each raster cell centre, and the number of points that fall within the neighbourhood is summed and divided by the area of the neighbourhood. Increasing the radius will not greatly change the calculated density values. Although more points will fall inside the larger neighbourhood, this number will be divided by a larger area when calculating density. The main effect of a larger radius is that

density is calculated considering a larger number of points, which can be farther from the raster cell. This results in a more generalised output raster.

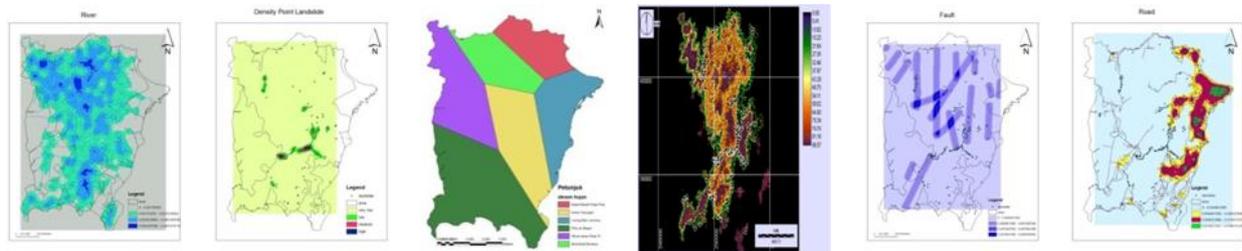


Figure 3: Maps of causal factors in slope failure

Clearly, a useful hazard zonation map should also depend on other factors that affect the mechanism of landslide occurrence such as river, road, fault and rainfall. Therefore, the next step is to incorporate these factors and other relevant parameters in hazard analysis. In order to analyse hazard systematically and efficiently, the use of GIS is essential (Van Westen and Lulie Getahun, 2003).

### DISCUSSION AND CONCLUSION

A framework for analysing slope failure based on landslide records through the use of GIS technology is proposed for Penang State. A landslide hazard zonation map is also proposed based on data collected. GIS enables incorporation of various layers in the framework of landslide hazard analysis in Penang. The incorporation of dynamic slope failure analysis with GIS will produce a more reliable landslide hazard map for city planning and potential planning error can be minimised. Table 2 shows the derivation of layers and their respective weight value. Table 3 shows susceptibility map zone analysis of slope failure and Figure 3 displays susceptibility map zone analysis of slope failure.

Table 2: Derivation of the layers and influence assigned to each Weighted Overlay operation

Data source	Geoprocessing Tool	Process Output	Raster Classification Tool	Weight
Drainage	Line Density	Drainage Density	Drainage Reclassify	0.033
Lineament	Line Density	Lineament Density	Lineament Reclassify	0.040
Topography	Feature to Raster	Karst Raster	Karst Reclassify	0.200
Geological	Feature to Raster	Lithology	Reclassify	0.050
Rainfall	Point	Rainfall Thiessen	Reclassify	0.070
Road	Line Density	Road Density	Reclassify	0.640

Table 3: Susceptibility Map Zone Analysis of Slope Failure

Zone	Value P	Category	% Width	% SF	Total SF
1	0-0.3	Very low	48.13	0	0
2	0.03-0.6	Low	33.90	0.95	2
3	0.6-0.75	Moderate	12.54	3.81	8
4	0.75-0.95	High	4.07	9.52	20
5	0.95-1.00	Very High	1.36	85.71	180
Total			100	100	210

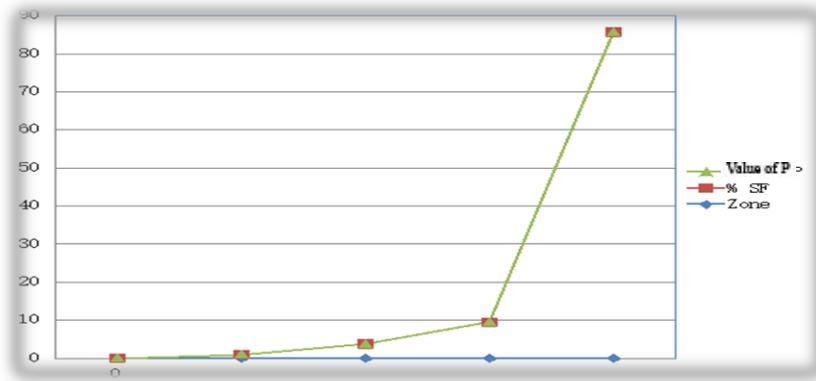


Figure 4: Susceptibility Map Zone Analysis of Slope Failure

Table 4: Analysis of slope failure susceptibility zone map based on field data

Zone	P-value	Category	% Width	% SF	Total SF
1	0-0.3	Very low	48.13	0	0
2	0.3-0.6	Low	33.90	2.63	1
3	0.6-0.75	Moderate	12.54	10.53	4
4	0.75-0.95	High	4.07	13.15	5
5	0.95-1.00	Very High	1.36	73.69	28
Total			100	100	38

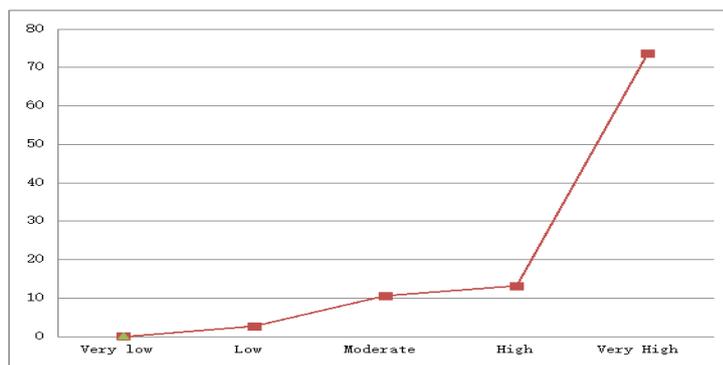


Figure 5: Slope Failure susceptibility zone map based on field data

Nominal data serves as quantitative representation that excludes the minimum and maximum values of the actual data. Chapin and Kaiser (1979) states that data must be divided into two parts for model development and model testing, but they did not specify the breakup of percentage among the parts. Although landslides can destroy human infrastructure and be potentially deadly, with the exception for a few incidents, their impact is generally localised and predictable. Slope failure in Penang is a challenging environmental problem that threatens the well-being of the population. Potential slope failures mapping illustrates the importance of slope failure disaster zone mapping by documenting the most dangerous zones for human settlement. In conclusion, the formation of the space model using GIS can successfully produce models that are capable of categorising zones according to the level of hazard.

The study found the model's accuracy satisfactory. From the field trials, 73.69 per cent of the slope failure occurred in Zone 4, making it the most dangerous zone. 10.56 per cent of the failure are to be found in the moderate Zone 3, and 5.26 per cent in Zone 2. No slope failure was detected in Zone 1. These results indicate well-classified slope failure occurrences. In this study, five classification systems were considered: very high at 85.71 per cent, high zone 9.52 per cent, moderate 3.81 per cent and low 0.95 per cent. Again, no slope failure occurred in Zone 1. This indicates well-classified results.

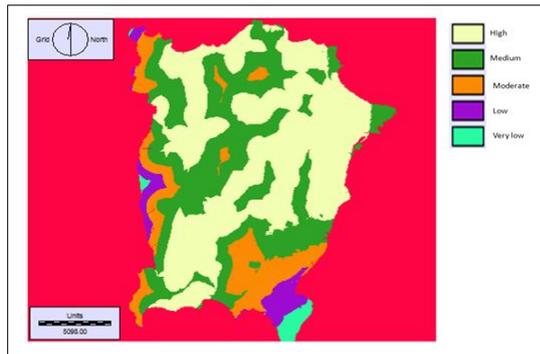


Figure 6: Slope Failure Susceptibility Zonation Map

This paper has described the methodology to generate a landslide susceptibility map using the following factors: drainage, lineament, topography, geological, rainfall and road. Landslide susceptibility map are of great help to planners and engineers for choosing suitable locations to implement developments. These results demonstrate how susceptible map can assist in slope management and future land planning. The models used in this study are valid for generalised planning and assessment purposes. They may be less useful at site-specific scale where local geological and geographic heterogeneities may prevail.

## REFERENCES

- Ahmad, F. S. (2005). *Penggunaan Sistem Maklumat Geografi Untuk Meramal Keruntuhan Cerun Di Pulau Pinang*. Ijazah Sarjana Kejuruteraan (Geoteknik) Fakulti Kejuruteraan Awam Universiti Teknologi Malaysia
- Ahmad, F., Yahaya, A. S., & Farooqi, M. A. (2006). Characterization and Geotechnical Properties of Penang residual Soil with Emphasis on landslides. *American Journal of Environmental Science*, 2(4), 121-128.
- Alrowaimi, R. M. M. (2006). *The Compressibility of Fill Subjected to Applied Stress and Inundation*. Faculty of Civil Engineering. Universiti Teknologi Malaysia. Tesis Sarjana. [online]. Available: [http://eprints.utm.my/2194/1/Mohamed MuftahRArowaimi](http://eprints.utm.my/2194/1/Mohamed%20MuftahRArowaimi) [17.07.2010]
- ArcGIS (2015). *How Line Density Works*. Retrieved from <http://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/how-line-density-works.htm>
- Chapin, F.S. & Kaiser, E.J. (1979). *Urban Landuse Planning*. Urbana: University of Illinois Press.
- Crozier, M.J. (2010). Deciphering the effect of climate change on landslide activity: A review. [doi: DOI: 10.1016/j.geomorph.2010.04.009]. *Geomorphology*, 124(3-4), 260-267.
- Chung, C.F. & Fabbri, A.G. (1999). Probabilistic Prediction Models for Landslide Hazard Mapping. *Photogrammetric Engineering and Remote Sensing*, 65(12): 1389–1399.
- Das, I., Sahoo, S., van Westen, C., Stein, A., & Hack, R. (2010). Landslide Susceptibility Assessment Using Logistic Regression and its Comparison with a Rock Mass Classification System, Along a Road Section in the Northern Himalayas (India). *Geomorphology*, 114(4): 627-637.
- Department of Statistics, Malaysia (2009). *Demografi dan Penduduk*. Jabatan Perangkaan Malaysia.
- Harun, N. H. (2006). *Kajian Penentuan Kawasan Bukit Berisiko Menggunakan Sistem Maklumat Geografi (GIS)*. Universiti Teknologi Malaysia. (Tesis Sarjana). Tidak diterbitkan
- Ismail, N. H. (2001). *Tanah Runtuh Dan Masalah Alam Sekitar Yang Terpinggir*. (Tesis Sarjana). Universiti Sains Malaysia. Tidak diterbitkan
- Komoo, Ibrahim. (1995). *Geologi Kejuruteraan Perspektif Rantau Tropika*. Bangi: Penerbit Universiti Kebangsaan Malaysia. Syarahan Perdana Jawatan Profesor.
- Malaysia Physical Map. (2015). Retrieved from <http://malaysiamap.facts.co/malaysiamapof/malaysiamap.php>
- Mantovani, F., Gracia, F.J., Cosmo, P.D. & Suma, A. (2010). A New Approach to Landslide Geomorphological Mapping Using the Open Source Software in the Olvera Area (Cadiz, Spain). *Landslides*, 7(1): 69-74.

- Pareek, N., Sharma, M.L., & Arora, M.K. (2010). Impact of Seismic Factors on Landslide Susceptibility Zonation: A Case Study in Part of Indian Himalayas. *Landslide*, 7: 191–201.
- Pradhan, Biswajeet. (2013). A comparative study on the predictive ability of the decision tree, support vector machine and neuro-fuzzy model in landslide susceptibility mapping using GIS. *Computer & Geosciences*, 51, 350-365.
- Public Works Research Institute (PWRI) (1981). *Slope Failure in Japan*. Japan: Slope Failure Division, Public Works Research Institute.
- Rahman, Zulfahmi Ali, Abd. Rahim, Sahibin, Yaakob, Jasni and Idris, Wan Muhd Razi (2007). Tinjauan Awal Potensi Ketidakstabilan Cerun dan Cirian Fiziko-Kimia Tanah di Cameron Highland, Pahang. *Sains Malaysiana*, 36(2): 105-116.
- Robin, F., Corominas, J., Bonnard, C., Cascini, L., Leroi, E., & Savage, W. Z. (2008). Guidelines for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning. *Engineering Geology*, 102: 85–98.
- Sassa, K. Fukuoka, H., Wang, F., & Wang, G. (2005). *Landslides Risk Analysis and Sustainable Disaster Management*. New York: Springer Berlin Heidelberg.
- Simon N, Mat Akhbir, J., Napiah, Azlikamil & Tan, Han Kee. (2009). Pemetaan Potensi Bencana Tanah Runtuh Menggunakan Faktor Penilaian Bencana Tanah Runtuh Dengan Pendekatan GIS. *Geological Society of Malaysia*, 55, 47–53.
- Tjia, H.D. (1987). *Geomorfologi*: Dewan Bahasa Dan Pustaka Kementerian Pendidikan Malaysia Kuala Lumpur.
- Utusan Malaysia (2015). Trageditanahruntuh[online], Available: [http://ww1.utusan.com.my/utusan/info.a.sp?y=2011&dt=0808&sec=Muka\\_Hadapan&pg=mh\\_01.htm](http://ww1.utusan.com.my/utusan/info.a.sp?y=2011&dt=0808&sec=Muka_Hadapan&pg=mh_01.htm) [online] 26.08.2015
- Varnes, C.J. (1984). Landslide Hazard Zonation: A Review of Principal and Practice Commission on Landslide of the IAEG, UNESCO. *Natural Hazards*, 3:61.
- Van Westen, C. J., & Lulie Getahun, F. (2003). *Analyzing the evolution of the Tessina landslide using aerial photographs and digital elevation models*. *Geomorphology*, 54(1-2), 77-89. DOI: 10.1016/S0169-555X(03)00057-6
- Wan Ibrahim, Wan Mohd Muhiyuddin (2005). *Pembentukan Model Ruangan Kegagalan Cerun Bagi Sub Lembangan Hulu Sungai Langat*. (Tesis PhD). Universiti Sains Malaysia. Tidak diterbitkan.

## **AN ESTIMATION OF SEDIMENT YIELD USING UNIVERSAL SOIL LOSS (USLE) AND RATING CURVE IN BARAT DAYA DISTRICT OF PENANG, MALAYSIA**

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**ABSTRACT:** Sediment yield estimation in rivers at the regional or local scale is very important especially in term of managing the water resources in the catchment area. The sediment yield usually calculated either from direct measurement of sediment concentration in rivers or from sediment transport equation at a particular outlet point in the catchment. A total of 19 rivers were selected as sampling sites located at the Barat Daya District of Penang. The Universal Soil Loss Equation (USLE) was used to estimate the sediment yield in the study area by integrating with the Geographic Information System (GIS) to generate maps of the USLE factors, which are rainfall erosivity (R), soil erodibility (K), slope length and steepness (LS), crop management (C), and conservation practice (P) factors. A sediment rating curves of the study area was developed to verify the accuracy as well as comparison to the sediment yield estimated by USLE. The results show good correlation between the sediment yield estimated by USLE and observed data ( $r^2$  is 0.62). The sediment yield estimated in the year 1974 was 1300 ton/km<sup>2</sup>/year, 1984 was 1921 ton/km<sup>2</sup>/year, 2004 was 1919 ton/km<sup>2</sup>/year and 2012 was 2336 ton/km<sup>2</sup>/year. Based on the land use analysis, agricultural activity was dominant in the Barat Daya area and contributes much of the sediment into the river system.

*Keywords:* estimation sediment yield, USLE, Barat Daya District of Penang, Malaysia

### **INTRODUCTION**

Soil erosion is a worldwide problem because of its economic and environmental impacts. Many human-induced activities, such as mining, construction, and agricultural activities disturb land surface, resulting in accelerated erosion (Lim et al., 2005). Over the past 40 years, 30 per cent of the world's arable land has become unproductive. Erosion also reduces the ability of the soil to store water and support plant growth, thereby reducing its ability to support biodiversity (Lal, 1990). Sediment yield is the amount of sediment load passing the outlet of a catchment and is the net result of erosion and deposition processes within a basin. It can be expressed in absolute terms ( $t\ yr^{-1}$ ) or per unit area ( $t\ km^{-2}\ yr^{-1}$ ) (Jain et al., 2010). The amount of sediment yield generated within a catchment is a function of a number of anthropogenic and physical factors including farming, mining, construction, slope, basin area and rainfall intensity. Information on sediment yield of a river basin is an important requirement for water resources development and management (Akrasi, 2011), because high sediment loads affect water quality, water supply, flood control, reservoir lifespan, irrigation, navigation, fishing, tourism, hydro-power generation, river channel morphology and stability (Schwartz and Greenbaum, 2009). During the last decades, many different models have been proposed to describe and predict soil erosion by water and associated sediment yield, varying considerably in their objectives, time and spatial scale involved, as well as in their conceptual basis (De Vente and Poesen, 2005). Hence, the main objective of this study is to estimate sediment yield using Universal Soil Loss Equation (USLE) and Rating Curve Method and to estimate past sediment yield for the year of 1974, 1984, 2004 and 2012, for 19 catchments in the Barat Daya District of Penang, Malaysia.

### **MATERIALS AND METHODOLOGY**

#### **Study area**

Barat Daya District of Penang was selected as the study area, consists of 19 river catchments. Figure 1 and Figure 2 show the location and land uses of each catchment, and the morphological characteristic of the respective catchment is shown in Table 1. The list of the selected rivers are the Upstream and Downstream of Relau River, Upstream and Downstream of Ara River, Bayan Lepas River, Teluk

Kumbar River, Pulau Betong River, Nipah River, Burung River, Kuala Jalan Baru River, Buaya River, Titi Teras River, Pak Long River, Ayer Puteh River, Rusa River, Pinang River, Titi Kerawang River, and Teluk Bahang Upstream and Downstream River. Barat Daya District was selected as research area due to the lack of data in terms of sediment and discharge, and also the diversity of land uses compared to the Timur Laut District which is dominated by build-up land use. In addition, there is no comprehensive sediment study of the Barat Daya District. According to the Malaysian Meteorological Department data, the temperature of the northern part of Penang ranges between 29°C and 32°C and the mean relative humidity between 65 per cent and 70 per cent. The highest temperature is during April to June while the relative humidity is lowest in June, July and September. Rainfall on Penang Island averages between 2,000 and 3,000 mm per annum respectively. Figure 3 shows the rain gauged data for the stations of Bayan Lepas and School of Physics, USM for 2012. The highest 376.9 mm annual rainfall was recorded in September; which is 384.66 mm (School of Physics) and Bayan Lepas.

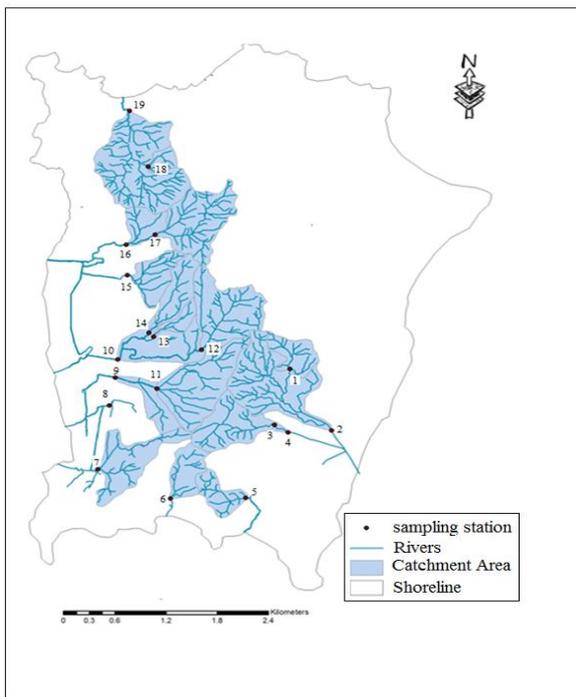


Figure 1: Location of sampling stations

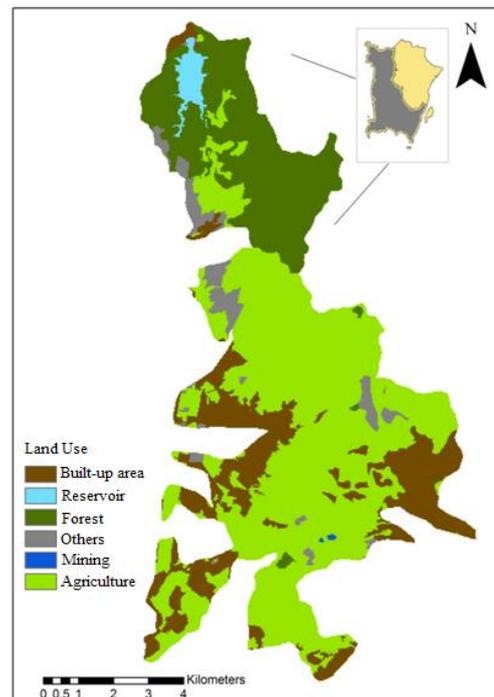


Figure 2: Land use for 2012

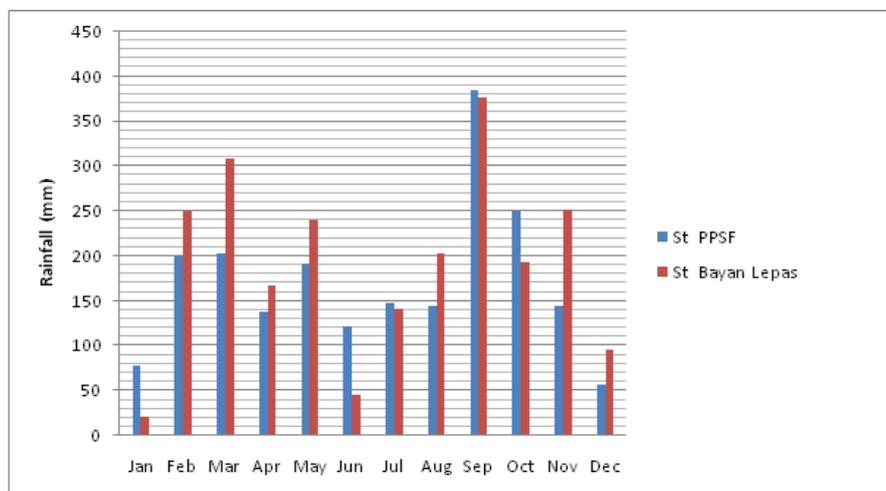


Figure 3: Monthly Rainfall data for 2012

Table 1: Location and morphological characteristic of catchments in the study area

Rivers/ Sampling location	River Length (km)	Catchment area (km <sup>2</sup> )	Drainage density (km/km <sup>2</sup> )	River Order	Latitude	Longitude
1. Relau River Upstream(RU)	10.05	2.53	3.97	3	N 5° 20.94''	E° 100 16.32''
2. Relau River Downstream (RH)	46.24	11.55	4	5	N 5° 19.27''	E° 100 16.88''
3. Ara River Upstream (AU)	15.25	4.93	3.09	3	N 5° 19.48''	E° 100 15.86''
4. Ara River Downstream (AM)	17	5.1	3.33	3	N 5° 19.34''	E° 100 16.33''
5. Bayan Lepas River (BL)	9	2.35	3.83	3	N 5° 17.8''	E° 100 15.6''
6. Teluk Kumbar River (TK)	7.92	2.72	2.91	3	N 5° 17.5''	E° 100 13.8''
7. Pulau Betong River (PB)	15.39	5.36	2.87	4	N 5° 18.42''	E° 100 12.17''
8. Nipah River (SN)	3.07	0.92	3.34	2	N 5° 19.9''	E° 100 12.38''
9. Burung River (BR)	30.54	10	3.05	4	N 5° 20.68''	E° 100 12.49''
10. Kuala JalanBaru River (KJB)	63.21	16.14	3.92	5	N 5° 21.12''	E° 100 12.55''
11. Buaya River (BY)	22.78	7.65	2.98	3	N 5° 20.23''	E° 100 13.24''
12. TitiTeras River (TT)	26.78	7.12	3.76	4	N 5° 21.21''	E° 100 13.77''
13. Pak Long River (PL)	4.55	1.1	4.14	3	N 5° 21.63''	E° 100 13.32''
14. Air Puteh River (AP)	10.98	3.05	3.6	3	N 5° 21.75''	E° 100 13.22''
15. Rusa River (RS)	12.29	2.98	4.12	3	N 5° 23.18''	E° 100 12.75''
16. Pinang River (SP)	43.37	8.84	4.91	4	N 5° 23.94''	E° 100 12.7''
17. TitiKerawang River (TTK)	28.79	6.71	4.29	4	N 5° 24.2''	E° 100 13.35''
18. Teluk Bahang River (TBU)	4.37	0.98	4.46	2	N 5° 25.43''	E° 100 13.21''
19. Teluk Bahang River (TBD)	50.19	11.96	4.20	4	N 5° 27.25''	E° 100 12.81''

### Sediment rating curves

The framework for the estimation of sediment yield is shown in Figure 4. The samplings were carried out every fortnight to develop the sediment rating curves for the river catchments. The rating curve will then be used to estimate the sediment yield during the ungauged period. The sediment rating curves were developed based on Ismail (1995). It was based on the relationship between the rainfall and sediment loading. Two rating curves were developed, one for rainfall amount that is less than 20mm, and the other is for rainfall of more than 20mm. The sediment rating curve equation as shown in Table 2 were used to obtain the sediment yield for each river catchment. Based on the estimation of sediment yield from the sediment rating curve, the relationship of the obtained sediment yield are used to verify the accuracy of sediment yield estimated from the USLE.

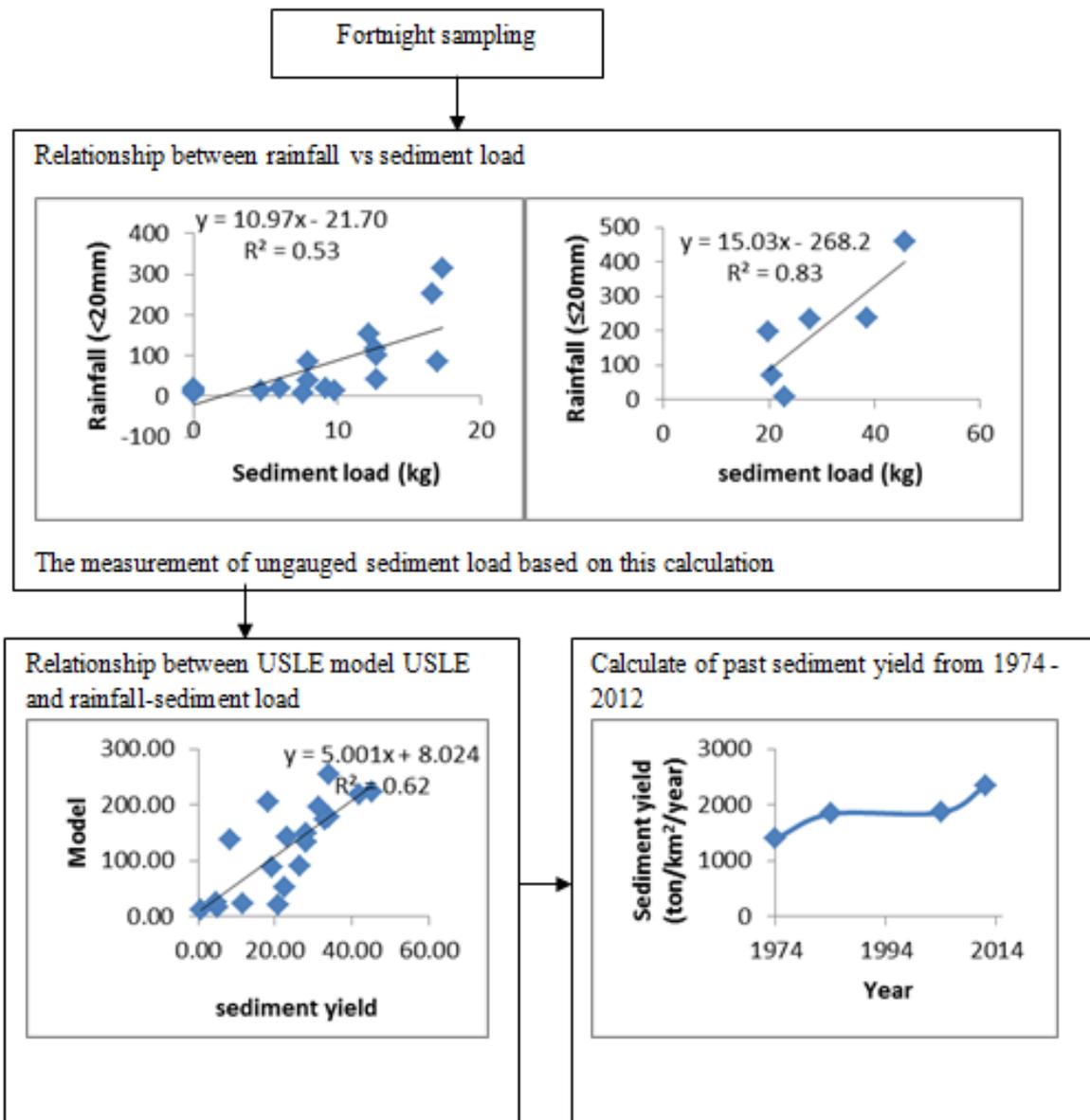


Figure 4: The framework for the estimation of sediment yield

### The sediment yields estimation from Universal Soil Loss Equation (USLE)

For estimation of sediment yield, USLE method is also used to compare the gauging data. GIS is an efficient tool to integrate various datasets and assess any dynamic system such as soil loss/ soil erosion and there have been many studies of soil loss by various methods (Adinarayana et al.,1999; Lee, 2004; Millward and Mersey, 2001). The USLE model integrated with GIS could be used to calculate soil erosion at any point in catchment experiencing net erosion. It is an easy and simple approach, efficient method of soil loss assessment and universally accepted method for monitoring soil loss. The USLE is an empirical model developed by Wischmeir and Smith (1978) to estimate soil erosion. Figure 5 and Figure 6 show the steps for obtaining the soil loss map from USLE. Mathematically, the equation is denoted as:

$$A \text{ (tons/ha/year)} = R \times K \times LS \times C \times P \quad (1)$$

Where, A denotes the average annual soil loss caused by sheet and rill erosion ( $t \text{ ha}^{-1} \text{ yr}^{-1}$ ); R is the rainfall erosivity factor; K is the soil erodibility; LS is the slope length and steepness factor (dimensionless); C is the land cover and management factor (dimensionless, ranging between 0 and

1); P is the support conservation practice factor (dimensionless, ranging between 0 and 1) (Chander and Zullyadini, 2014).

Table 2: The calculation of Rating Curve

Rivers catchment	Rainfall relation < 20 mm		Rainfall relation ≥ 20 mm	
	R <sup>2</sup>	Regression	R <sup>2</sup>	Regression
Relau River Upstream(RU)	0.53	y = 15.03x-268.2	0.83	y = 10.97x-21.7
Relau River Downstream (RH)	0.72	y = 288.2x-7745	0.87	y = 27.18x+54.48
Ara River Upstream (AU)	0.86	y = 18.25x-390.3	0.76	y = 22.39x+ 50.68
Ara River Downstream (AM)	0.83	y = 257.2x-6017	0.98	y = 11.20x+37.18
Bayan Lepas River (BL)	0.52	y = 23.5x-126.6	0.56	y = 33.49x+ 78.69
Teluk Kumbar River (TK)	0.58	y = 121.8x-3774	0.70	y = 10.01x+98.62
Pulau Betong River (PB)	0.75	y = 5.26x-47.83	0.85	y = 5.38x+30.85
Nipah River (SN)	0.80	y = 0.73x-15.56	0.80	y = 78.97x-130.7
Burung River (BR)	0.97	y = 42.07x-1170	0.78	y = 40.81x+50.12
Kuala JalanBaru River (KJB)	0.93	y = 236.6x-6046	0.78	y = 59.05x+293.3
Buaya River (BY)	0.86	y = 49.92x-1076	0.88	y = 63.61x+54.72
TitiTeras River (TT)	0.57	y = 117.3x-3152	0.95	y = 7.46x+23.12
Pak Long River (PL)	0.93	y = 7.14x-173.9	0.78	y = 33.1x+29.31
Air Puteh River (AP)	0.7	y = 4.33x-14.96	0.59	y = 4.35x+22.35
Rusa River (RS)	0.78	y = 44.18x-876.2	0.99	y = 3.5x+19.67
Pinang River (SP)	0.77	y = 0.43x+77.82	0.89	y = 41.22x+129
TitiKerawang River (TTK)	0.77	y = 8.35x-114	0.69	y = 31.66x+29.47
Teluk Bahang River (TBU)	0.5	y = 20.33x-432.7	0.98	y = 18.72x+23.70
Teluk Bahang River (TBD)	0.64	y = 23.20x-480.3	0.98	y = 10.57x+42.95

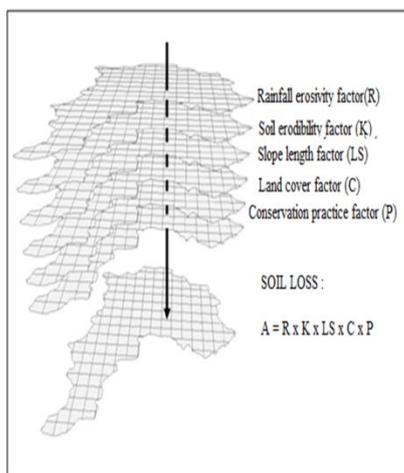


Figure 5: The layering of USLE factor

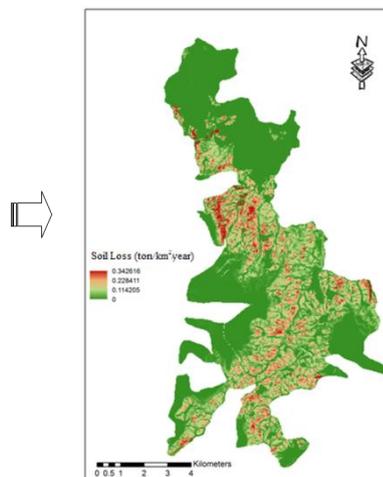


Figure 6: Soil erosion map (2012)

## RESULTS AND DISCUSSIONS

The most common way of combining intermittent concentration data with continuous discharge data uses a rating curve to predict unmeasured concentrations from the discharge at the time (Ndomba et al., 2008). A suspended sediment rating curve or transport curve is usually presented in one of two basic forms, either as a suspended sediment concentration/streamflow or as a suspended sediment discharge/streamflow relationship (Walling, 1977). In most cases, rating curves are constructed from instantaneous observations of discharge and either sediment concentration or load, but several specific variants have been proposed (Walling, 1977). Colby (1956) has classified rating relationships, according to temporal resolution of the data, into instantaneous, daily, monthly, annual and flood period curves and, according to particle size criteria, into clay-silt ratings and sand-sized ratings.

Other researchers have subdivided instantaneous data according to stage and season, constructing separate rating relationships for rising and falling stages (Loughran, 1976) and for various times of the year (Hall, 1967) as reported in Walling (1977). From this rating curve method, an estimation of sediment yield was obtained.

Table 3 and Figure 7 shows the result between the sediment yield estimated by USLE and observed data ( $r^2$  is 0.62) and the equations were used to estimate past sediment yield. The estimated sediment yield from 1974-2012 shows an increasing trend (Figure 8). The highest sediment yields for gauging data was 221.94 ton/km<sup>2</sup>/year recorded at Sungai Rusa catchment while the lowest sediment yields was 10.99 recorded at Sg. Nipah. The average amount of sediment yields for all 19 catchments were estimated at 163.72 ton/km<sup>2</sup>/year and 195.28 ton/km<sup>2</sup>/year (19.3 per cent) for 1974 and 1984, respectively. Then it increased slightly (0.5 per cent) to an average of 196.18 ton/km<sup>2</sup>/year in 2004 and a larger increase was noticeable (10.8 per cent) to 217.43 ton/km<sup>2</sup>/year in 2012. USLE estimated the soil loss at 110.18 ton/km<sup>2</sup>/year and 116.89 ton/km<sup>2</sup>/year for 1974 and 1984 respectively, then also increase slightly to 117.87 ton/km<sup>2</sup>/year in 2004 then 122.44 ton/km<sup>2</sup>/year in 2012.

Sediment availability in the study area is related to the land use and agriculture was the most dominant activities. In Penang Island, natural elements particularly weather elements are highly erosive (Goh and Hui, 2006). Geomorphological processes such as rain splash erosion and surface runoff erosion have been shown to be extremely high in wet equatorial areas (Pradhan et al, 2012; Ismail, 1995).

Table 3 : Estimated sediment yield from gauging data and USLE method 2012

Rivers catchment	Gauging 2012 (ton/km <sup>2</sup> /year)	USLE (ton/km <sup>2</sup> /year)
Relau River Upstream(RU)	178.55	178.48
Relau River Downstream (RH)	87.10	103.75
Ara River Upstream (AU)	173.38	173.33
Ara River Downstream (AM)	196.00	165.18
Bayan Lepas River (BL)	205.53	99.73
Teluk Kumbang River (TK)	254.07	178.67
Pulau Betong River (PB)	21.86	111.81
Nipah River (SN)	10.99	11.49
Burung River (BR)	52.80	119.84
Kuala JalanBaru River (KJB)	141.33	123.43
Buaya River (BY)	89.33	140.91
TitiTeras River (TT)	149.82	148.27
Pak Long River (PL)	132.77	149.30
Air Puteh River (AP)	217.82	217.62
Rusa River (RS)	221.94	234.06
Pinang River (SP)	23.96	66.14
Titi Kerawang River (TTK)	16.94	33.90
Teluk Bahang River (TBU)	138.00	49.33
Teluk Bahang River (TBD)	24.76	31.62

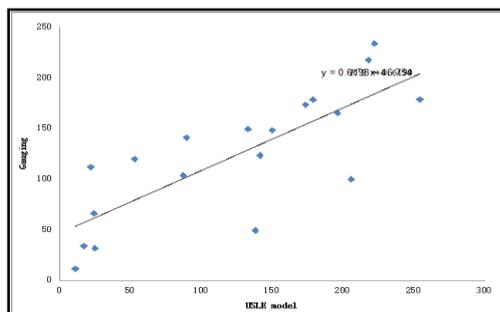


Figure 7: Verify Gauging and USLE

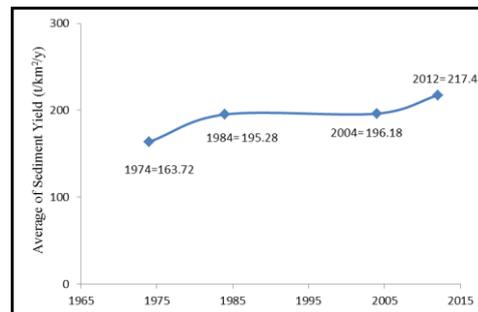


Figure 8: The trend of past sediment yield from 1974-2012

## CONCLUSION

The rating curve method was used because of insufficient hydrological and sediment data in Barat Daya District. This study has successfully estimated the past sediment yield for 19 ungauged catchment in the Barat Daya District of Penang, using existing conceptual methods and GIS. This method can be used for the identification of sediment source areas and the prediction of sediment yield from an ungauged catchments.

## Acknowledgement

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## REFERENCES

- Adinarayana, J., Rao, K.G., Krishna, N.R., Venkatachalam, P., & Suri, J.K. (1999). A rule-based soil erosion model for a hilly catchment. *Catena*, 37(3–4), 309–318.
- Akrasi, S.A. (2011). Sediment discharges from Ghanaian Rivers into the sea. *West African Journal of Applied Ecology* 18, 1–13.
- Chander, S.P. & Zullyadini, A.R. (2014). GIS-based Assessment of Soil Erosion at the Timah Tasoh Reservoir Catchment for Sustainable Catchment Management. *International Journal of Environment, Society and Space*, 2(2), 60-74.
- Colby, B.R. (1956). Relationship of sediment discharge to streamflow. *US Geological Survey Open File Report*.
- De Vente, J. & Poesen, J. (2005). Predicting soil erosion and sediment yield at the basin scale: Scale issues and semi-quantitative models. *Earth Science Review*, 71, 95-125.
- Goh, E., & Hui, T.K. (2006). *Soil Erosion Engineering*. Penerbit USM.
- Hall, D.G. (1967). The pattern of sediment movement in the River Tyne. In: *River Morphology* (Proc. Bern General Assembly of IUGG, vol.1, 117-140. *IAHS Publ.* 75. Wallingford, UK: IAHS Press.
- Ismail, Wan Ruslan (1995). *Impact of Hill Land Clearance and Urbanisation on Hydrology and Geomorphology of Rivers in Penang, Malaysia*. (PhD Thesis). University of Manchester, United Kingdom. 348.
- Jain, M.K., Mishra, S.K., & Shah, R.B. (2010). Estimation of sediment yield and areas vulnerable to soil erosion and deposition in a Himalayan watershed using GIS. *Current Science* 98(2), 213–222.
- Lal, R. (1990). *Soil Erosion in the Tropics. Principles and Management*. New York: McGraw-Hill. 580.
- Lee, S. (2004). Soil erosion assessment and its verification using the universal soil loss equation and geographic information system: A case study at Boun, Korea. *Environmental Geology*, 45, 457–465.
- Lim, K.J., Sagong, M., Engel, B.A., Tang, Z., Choi, J. & Kim, K. (2005). GIS-based Sediment Assessment tool. *Catena*, 64. 61-80
- Loughran, R.J. (1976). The calculation of suspended sediment transport from concentration vs discharge curves: Chandler River, NSW. *Catena* 3, 45–61.
- Millward, A.A. & Mersey, J.E. (2001). Conservation strategies for effective land management of protected areas using an erosion prediction information system (EPIS). *Environmental Management*, 61(4), 329–343.
- Ndomba, P.M., Mtaló, F.W. & Killingtveit, A. (2008). Developing an excellent sediment rating curve from one hydrological year sampling programme data: Approach. *Journal of Urban and Environmental Engineering*, 2(1), 21-27. doi: 10.4090/juee.2008.v2n1.021027
- Pradhan B, Chaudari, A, Adinarayana J, & Buchroithner, M.F. (2012). Soil erosion assessment and its correlation with landslide events using remote sensing data and GIS: a case study at Penang Island, Malaysia. *Environmental Monitoring and Assessment*, 184(2), 715-727
- Schwartz, U. and Greenbaum, N. (2009). Extremely high sediment yield from a small arid catchment—Giv'at Hayil, northwestern Negev, Israel. *Israel Journal of Earth Sciences*, 57, 167–175.

- Walling, D.E. (1977). Limitation of the rating curve technique for estimating suspended sediment loads, with particular reference to British rivers. In: *Erosion and Solid Matter Transport in Inland Waters* (Proc. Paris Symposium, July 1977), 34–48. IAHS Pub. 122. Wallingford, UK: IAHS Press.
- Wischmeier, W.H., & Smith, D.D. (1978). Predicting rainfall erosion losses: A guide to conservation planning. *Agriculture Handbook*, 537, Washington, D.C.

## ANALYSIS OF COST-EFFECTIVENESS OF AGRICULTURAL YIELD FROM VEGETABLE FARMING

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**ABSTRACT:** Most developed countries in the world depend heavily on agriculture but scarce attention has been paid to studies on the cost-effectiveness of agricultural yield from vegetable farming, especially by the relevant authority. While the total agricultural yields obtained are high in terms of economic perspective, however the cost of fertilizers and soil loss in agricultural areas are not taken into account. The loss of nutrients from fertilizers and soil in agricultural activities need to be stressed because it can cause significant losses to agricultural producers in term of soil fertility. As such, the objectives of this study were to investigate the agricultural gross revenue earned by the type of crop and current crop price, to estimate the amount of nutrient loss from fertiliser and soil loss by crop type and to analyse the cost-effectiveness of agricultural yield. Four types of vegetables were selected for this study, namely Spinach (*Amaranthus oleraceus L.*), Red Chili and *Chili Padi* (*Capsicum frutescens L.*) and Cucumber (*Cucumis sativus L.*) planted in an open slope of 5° at a plot size of 1.5m x 2.0m. The rainfall in this study was produced by a rainfall simulator at a pressure of 7 psi that can produce rainfall intensity of 67 mm/hr. From this study, the total amount of vegetables harvested from each plot was 2.96 kg for Spinach, 2.67 kg (Red Chili), 0.51 kg (*Chili Padi*) and 4.52 kg for Cucumber. In terms of current market value, Spinach yielded RM 10.03, Red Chili RM 53.37, *Chili Padi* RM 10.20 and Cucumber RM 12.90. The amount of soil loss is 9.43 kg for Spinach, 7.6 kg for Red Chili, 3.94 kg for *Chili Padi* and 9.86 kg for Cucumber. For the nutrient loss, Spinach yielded 12.58 g, Red Chili (11.51 g), *Chili Padi* (8.04g) and Cucumber (11.51g). The total cost of nutrient and soil loss is RM 6.33 for Spinach, Red Chili RM 5.12, *Chili Padi* RM 2.67 and Cucumber RM 9.96 respectively. Hence, the net profit of each vegetable during the study period is RM 3.70 for Spinach, RM 48.25 Red Chili, RM 7.53 *Chili Padi* and RM 2.94 Cucumber. This study suggested that the cost of nutrient loss from fertilizer and the soil loss should be considered in the determination of current market price of vegetables. In agricultural practice, the farmers should consider the amount of nutrient and soil loss in order to sustain the fertility of the soil from the agricultural activities.

*Keywords:* cost-effective, soil and nutrient loss, vegetable farming

### INTRODUCTION

Most developed countries in the world depend heavily on agriculture. Efforts to sustain and improve the sector's productivity are therefore crucial to the region's economic development. Land degradation is thought to pose a severe threat to the sustainability of agricultural production due to prevalent environmental damage. The idea of agricultural sustainability centres on the need to develop technologies and conservation management practices that do not have adverse effects on environment, good and service, while improving food productivity (Crosson and Anderson, 2002).

As the world's population soared, there has been great challenge to reconcile food production and natural conservation in modern agriculture, which embodies a human-controlled agro-ecosystem dependent on inputs from the outer environment, such as sunlight, wind, water, and soil. The ecosystem also includes purchased inputs, such as fertilizers, pesticides, fuels, electricity, mechanical equipment and other industrial products. Systems ecological evaluation and assessment would be essential to build the resource relocation and sustainable development of the agricultural industry (Rudel, 2013).

The agricultural sector in Malaysia has been growing rapidly over the years. Due to the excellent natural conditions in Malaysia such as the level of humidity, tropical weather and fertile soil, the

current production of the agricultural industries in Malaysia is considered as one of the largest amongst the Asia region (Quah, 1999). In agricultural activities, fertilizer application is the main source of phosphorus and nitrogen, with both most likely ending up in streams. Other potential sources of phosphorus and nitrogen include urban and industrial run-off, pesticides, effluent from feedlots of livestock and wastewater treatment plants, and weathering of rock material; nitrogen may also be augmented by fixation from the atmosphere. The amount of nutrient released depend on factors such as the type, amount, method and timing of nutrient application, the susceptibility of the soil to erosion and the rates of chemical and biological transformation (Turner and Rabalais, 2003). Large scale agricultural activity often requires land clearance. As such, forest area will be logged to make ways for agriculture. Land clearing process affects the natural environment (Guillaume Damris and Kuzyakov, 2015; Midmore Jansen and Dumsday, 1996; Malmer, 1990), hence good management practices are needed, especially with regards to sloping areas. Slope run-off processes can be divided into two phases: the operations on the slope and material handling operations. Operating on slopes is further divided into two, namely the process of surface run-off and groundwater run-off. Surface run-off occurs under two circumstances, namely when the soil is already saturated and unable to absorb water infiltrate into the soil (Shaw, Beven, Chappell and Lamb, 2011; Morvan et al., 2014). Material handling operations also coincide with operations on the surface. This operation refers to the process of transporting materials and minerals down the slope.

The cost-effectiveness of agricultural cultivation area of vegetables is an issue that should be given serious attention. The agricultural activity can be beneficial or detrimental. Commercial agriculture use fertilizer in order to increase the agricultural yield. Less attention has been paid to the study on the cost effectiveness of agricultural yield for vegetable farming especially from the relevant authority. While the total agricultural yields obtained are high in terms of economic perspective, the cost of fertilizers and soil loss in agricultural areas are neglected. The loss of nutrients from fertilizers and soil in agricultural activities need to be stressed, because it can cause significant losses to farmers in term of soil fertility. As such, the objectives of this study were to investigate the agricultural gross revenue earned by the type of crop and current crop price, to estimate the amount of nutrient loss from fertilizer and soil loss by crop type and to analyse the cost-effectiveness of agricultural yield.

## **RESEARCH AREA AND METHODOLOGY**

Five plots located in Universiti Sains Malaysia main campus with a dimension of 2m x 1.5m are chosen for vegetable cultivation. The soil series according to the Department of Agriculture (1970) is Red-Yellow Podzolic soil with Reddish-Brown Lateritic soils and Lithosols. Four types of vegetable are cultivated, namely Spinach, Chili (Red Chili and *Chili Padi*) and Cucumber and another plot had been preserved in its natural state as a control plot. The run-off water was collected in a trough and vacuumed continuously in a 28 litre container for analysis which involved parameters like total suspended solids, nitrite-nitrogen (NO<sub>2</sub>-N), nitrate-nitrogen (NO<sub>3</sub>-N), ammonia-nitrogen (NH<sub>3</sub>-N) and phosphate (PO<sub>4</sub>). These parameters were determined by the American Public Health Association standard method (APHA, 1999) and the brief standard procedure by Adam (1990). The parameter for total suspended solids is based on the filtration method (Gordon, McMahon and Finlayson, 1992). The fertilizers used consist of N15, P15 and K15 (Nitrogen, Phosphorus and Potassium).

Rainfall simulator is an approach to produce controllable rainfall, in the context of time and space, and it allows the repetition and simulation of many years of rainfall events. As such, this study uses a pressurised type rainfall simulator that satisfied specific criteria such as run-off sample collection efficiency, rainfall intensity and event duration for run-off and erosion experiment purposes (Erpul, Gabriels and Janssens, 1998). The rainfall simulator has been calibrated in order to produce simulations that have similar characteristics to natural rainfall.

The simulator device used in this study consists of a triangular frame mast with a height of three metres, a three-metre length arm mounted at the top of the mast, and three nozzles spaced 1.1 metre apart installed at the nozzle boom, such that the nozzle's height is 2.4 m (see Figure 1). According to Duncan (1972), this height is adequate for creating terminal velocities similar to natural rainfall for all

drop sizes. The Fulljet type nozzles with wide angle square spraying, model 1/2HH-50WSQ (Spraying Systems Co. USA) were chosen for their wide spraying angle, the square wetted zone and the high uniformity of the spray. Water under an adequate pressure was supplied to the nozzles by a 13 horse power water pressure pump, thus enabling the simulator to produce a rainfall intensity of 67 mm/hr that is within the range of two years Average Recurrent Interval (ARI) for natural rainfall in Penang (Department of Irrigation and Drainage, 2012).

## CHARACTERISTICS OF CROPS

Vegetable is an important resource providing mineral, vitamin, protein and carbohydrate in human nutrition (Fadelah, Harun, Mooi, Hawa and Noor Rawi, 1990). The selected vegetables are some of the most common vegetables produced in Malaysia (see Table 1).

Table 1: Description of vegetables produced in Malaysia

Name	Description/Characteristics
<b>Spinach</b>	Spinach (locally known as <i>Bayam</i> ) with the scientific name <i>Amaranthus oleraceus L.</i> included in <i>Amaranthaceae</i> family is less than one metre high. Spinach is a leafy vegetable that contains vitamin A, B, C and minerals such as calcium and iron. The tree has small flowers and tiny black seeds. Harvesting takes place after about a month by removing the entire tree (HalimathulSaadiah, 1998). Cultivation of Spinach on plot studies requires deep plough soil friable about 15-20 cm. Spinach adapts to a range of soil types, especially light clay loam and sandy clay. Soil rich in organic matter, with good drainage and soil pH around 5.5 to 6.5 provide the most conducive environment. Spinach leaves are lanceolate and the life expectancy is three months. Spinach needs a substantial amount of water to grow (Department of Agriculture, 1996).
<b>Chili</b>	The scientific name is <i>Capsicum frutescens L</i> and belongs to the family of <i>Solanaceae</i> also known as the Bird Chili ( <i>Chili Burung</i> ) and <i>Chili Melaka</i> . Chilies are lowland vegetables and originated from South America and are currently widely grown in tropical climates. There are some flowers on stems and branches. Two types of chilies are cultivated in this study, which are Red Chili and <i>Chili Padi</i> .
<b>Cucumber</b>	Cucumber (locally known as <i>Timun</i> ) is known by its scientific name as <i>Cucumissativus L.</i> and belongs to the family of <i>Cucurbitaceae</i> . Cucumber is a creeping vine that roots in the ground and trellis along other supporting frames, wrapping around supports with thin, spiralling tendrils. The plant has large leaves that form a canopy over the fruit. It can be harvested approximately eight weeks after planting and the life expectancy is 70 days. Young fruit is eaten raw as a salad or used to decorate dishes (Halimathul Saadiah, 1998).

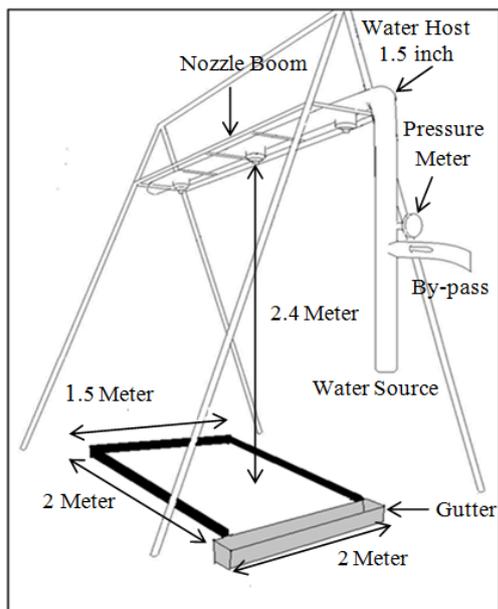


Figure 1: Rainfall simulator and plot design

## RESULTS AND DISCUSSIONS

The total agricultural yield from each vegetable plot during the study period is shown in Table 2. The highest vegetable yield is Red Chili, producing a total weight of 2.67 kg and based on the current market price of RM19.99 per kg, the total yield is RM53.37. The lowest vegetable yield is Spinach, although producing the total weight of 2.67 kg but due to its current market price at RM3.39 per kg, the total yield is only RM10.03. Total yield for *Chili Padi* and Cucumber are RM19.99 and RM12.90 respectively. *Chili Padi* only produces a total weight of 0.51 kg and 4.52 kg for Cucumber during the study period.

Table 2: The total yield for each vegetable during the study period

Vegetable	Weight (kg)	Current Value (RM/kg)	Total Yield (RM)
Spinach	2.96	3.39	10.03
Red Chili	2.67	19.99	53.37
<i>Chili Padi</i>	0.51	19.99	10.20
Cucumber	4.52	2.85	12.90

Table 3 shows the agricultural cost and net yield for each vegetable during the study period. In formulating the agricultural cost, the price of fertilizer (multiply with nutrient loss) and soil price (multiply with total soil loss) were determined. The total agriculture cost for each vegetable will then be deducted from the total agricultural yield to obtain the net agriculture yield. The highest total nutrient loss (from fertilizer) is Spinach (12.58 g) followed by Red Chili and Cucumber (11.51 g respectively) and *Chili Padi* (8.04 g). The highest total soil loss is Cucumber (14.94 kg), followed by Spinach (9.43 kg), Red Chili (7.60 kg) and *Chili Padi* (3.94 kg). The highest cost for agriculture activity during the study period is Cucumber, resulting in total of RM9.96 per kg and the lowest is *Chili Padi* (RM2.67 per kg). Taking into account these values, net agriculture yield for each vegetable is obtained. The net agricultural yield provides a clear picture of the actual cost involved in vegetable production. Agricultural activities must take into account the loss of soil and nutrients to determine the actual price of each type of vegetable. According to Spencer (2004), major drivers of prices and costs are farm production factors, value chain integration, marketing approach, regulation and compliance, trade impacts, technology and innovation, consumer and retail market dynamics. None of these factors considered environmental variable as one of the market price determination.

Table 3: Agriculture cost and net yields for each vegetable during the study period

Vegetable	Fertilizer Price (RM/kg)	Total Nutrient Loss (g)	Fertilizer Cost (RM/kg)	Soil Price (RM/kg)	Total Soil Loss (kg)	Soil Loss Cost (RM/kg)	Total Cost (Fertilizer + Soil Loss) (RM/kg)	Net Agriculture Yield (RM)
Spinach	8.75	12.58	0.11	0.66	9.43	6.22	6.33	3.70
Red Chili	8.75	11.51	0.10	0.66	7.60	5.02	5.12	48.25
<i>Chili Padi</i>	8.75	8.04	0.07	0.66	3.94	2.60	2.67	7.53
Cucumber	8.75	11.51	0.10	0.66	14.94	9.86	9.96	2.94

The total soil and nutrient loss cause a substantial loss to the agricultural sector. Soil loss will affect soil productivity as it removes the top layer of soil at the land (McCormack, Young and Kimberlin, 1981; USDA, 1998). When nutrient resources are so depleted by erosion, plant growth is stunted and overall productivity declines (Lal and Stewart, 1990; Pimentel et al., 1995). To offset the nutrient losses erosion inflicts on crop production, large quantities of fertilizers are often applied. The replacement strategy with the application of commercial fertilizers is expensive for the farmer and nation. Current market price of fertilizer is RM8.75 per kg while market price for pot soil is RM0.66 per kg. Therefore, although Spinach and Cucumber can contribute to the higher yield in terms of amount harvested, but the total cost of fertilizer and soil loss is amongst the highest (RM6.33 per kg and RM9.96 per kg respectively). Hence, the net agricultural yields from these vegetables are lower than Red Chili and *Chili Padi* (Table 3). The total yield for Spinach and Cucumber are RM10.03 and RM12.90 respectively (see Table 2) but taking into account the total cost as a result of loss from soil and fertilizer, the net agricultural yield are only RM3.70 (Spinach) and RM2.94 for Cucumber.

When referring to the total soil loss for each vegetable (Spinach, Cucumber, Red Chili and Chili Padi) during the study period, it should be noted that Spinach plot is contributing much more soil loss than other vegetables. Pimentel et al. (1995) estimated the average rate of soil loss due to erosion of soil in agricultural areas around the world is around 0.13-0.40 tons/km<sup>2</sup>/year. Morgan (1974) estimated that the rate of soil loss for a vegetable farm in Peninsular Malaysia is 1,009 tons/km<sup>2</sup>/year. Intensive soil erosion will attenuate layer of fertile soil and reduce soil productivity. Weibe (2003) estimated that the worldwide shortage of agricultural produce as a result of soil erosion is 0.6 per cent per year for potato, 0.48 per cent a year for millet crops and 0.42 per cent a year for corn. Lack of agricultural products is due to the low productivity of the land resulted by soil erosion which fails to support the growth of plants.

Run-off also plays an important role in agricultural activities resulting in the loss of nutrients from agricultural areas into water bodies. According to Cole (1993), the major nutrients required for plant growth are nitrogen and phosphorus. Slow growth and stunted crops in agricultural areas will cause losses to agricultural producers or farmers. This is because plants grown will take longer time to produce yield and thereby increase the cost of agricultural capital. Aminudin et al. (2001) describes the rate of erosion at vegetable farms in Cameron Highland as very high (82 tons/ha). Soil erosion is one of the physical processes that contribute to the soil degradation and generate environmental problems, such as landslide. In addition, (FAO, 1990) reported that one-third of the world's agricultural land planted with crops are easily eroded by erosional agents. Shortages of cropland are already having negative impact on world food production (Brown, 1997). Another impact of soil erosion is the export of surface sediment from farms into a nearby river system that degrade water quality (Jaafar, 2012). Total losses from soil and nutrient loss due to the erosion process in agricultural areas can be reduced by implementing contour planting to reduce the velocity of surface run-off (Brye, Norman, Bundy and Gower, 2000). Vegetation canopy can also play an important role in reducing the raindrops impact. Their main role is to reduce the kinetic energy by intercepting the rainfall to avoid direct impacts to the soil surface (Morgan, 1979), thus reducing the run-off and nutrients transported.

## CONCLUSION

This study focused on analysing the cost-effectiveness of agricultural yield based on plot scale using rainfall simulator. Rainfall simulator is able to simulate rainfall intensity similar to natural rainfall events. Soil erosion can have a significant negative impact on crop yields because as soil erosion continues, the soil is further degraded. Poor soil quality is reflected in the decrease of organic matter, aggregate stability, phosphorus levels, and potential plant-available water. The net result is a decrease in soil productivity. This study suggested that the cost of nutrient loss from fertilizer and the soil loss should be considered in the determination of current market price of vegetables. Therefore, when selling agricultural produce, farmers should take into account the loss of soil and nutrients in determining the actual price of each type of vegetable.

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## REFERENCES

- Adam, A.D. (1990). *Water & Wastewater Examination Manual*. Lewis Publishers Inc. Michigan.
- Aminuddin, B.Y., Wan Abdullah, W.Y., Cheah, U.B., Ghulam, M.H., Zulkefli, M., & Salama, R.B. (2001). Kesan pertanian intensif di kawasan tanah tinggi terhadap ekosistem. *Journal Tropical Agriculture and Federal Science*, 1, 69-76.
- APHA (1999). *Standard Methods for the Examination of Water and Wastewater*, 19<sup>th</sup> Edition. Port City Press. Baltimore.
- Brown, L. R., & Mitchell, J. D. (1997). *The agricultural link: How environmental deterioration could disrupt economic progress* (p. 73). Washington, DC: Worldwatch Institute.
- Brye, K.R., Norman, J.M., Bundy, L.G. & Gower, S. T. (2000). Water-Budget Evaluation of Prairie and Ecosystems. *America Society of Agronomy*, 64 (2), 715-724.
- Cole, G.A., (1993). *Text Book of Limnology 3<sup>rd</sup> Ed.* Waveland Press Inc. Illinois, USA Company.
- Crosson, P. R., & Anderson, J. R. (2002). *Technologies for meeting future global demands for food*. Resources for the Future.
- Department of Agriculture (1996). *Ciri-ciri Pengenalan Varieti : Bayam, Bendi, Petola, dan Timun*. Jabatan Pertanian Malaysia, Putrajaya.
- Department of Agriculture (1970). *Generalized Soil Map Peninsular Malaysia*. Department of Mapping, Malaysia.
- Department of Irrigation & Drainage (2012). *Urban Stormwater Management Manual for Malaysia*. Kuala Lumpur.
- Duncan, M.J. (1972). *Performance of a rainfall simulator and an investigation of plot hydrology*. Unpublished MSc thesis. Lincoln University, New Zealand.
- Erpul, G., Gabriels, D. & Janssens, D. (1998) *Assessing the drop size distribution of simulated rainfall in a wind tunnel*. *Soil and Tillage Research*, 45(3-4), 455-463.
- FAO (1990). *Report on the 1990 world census of agriculture*. Food & Agriculture Organization. Rome.
- Fadelah, A.A., Harun, A., Mooi, K., Hawa, J. & Noor Rawi, A.B. (1990). Varieti kubis yang berpotensi untuk dataran rendah. *Buletin Teknologi Sayur-sayuran* 6, 15–21.
- Guillaume, T., Damris, M., & Kuzyakov, Y. (2015). Losses of soil carbon by converting tropical forest to plantations: erosion and decomposition estimated by  $\delta^{13}C$ . *Global change biology*, 21(9), 3548–3560.
- Gordon, N.D., Mc Mahon, T. A. & Finlayson, B.L. (1992). *Stream Hydrology: An Introduction for Ecologists*. John Wiley & Sons. Chichester.
- HalimathulSaadiah A. Shafiei (1998). *Sayur-sayuran Semenanjung Malaysia*. Dewan Bahasa dan Pustaka, Kuala Lumpur.

- Jaafar, Mokhtar (2012). *Pengurusan ladang mesra alam sekitar bagi mengatasi masalah hakisan tanah: Pengalaman England*, 7(1), 228-242.
- Lal, R. & Stewart, B.A. (1990). *Soil Degradation*. Springer-Verlag, New York.
- McCormack, D. E., K. K. Young, & L. W. Kimberlin. 1981. *Technical and societal implications of soil loss tolerance*. In R.P.C. Morgan [ed.] *Soil Conservation, Problems and Prospects*. John Wiley & Sons. New York.
- Midmore, D. J., Jansen, H. G., & Dumsday, R. G. (1996). Soil erosion and environmental impact of vegetable production in the Cameron Highlands. *Malaysia. Agriculture, ecosystems & environment*, 60(1), 29-46.
- Malmer, A. (1990). Stream suspended sediment load after clear-felling and different forestry treatments in tropical rainforest, Sabah, Malaysia. *International Association of Hydrological Sciences Publications*, 192, 62-71.
- Morgan, R. P. C. (1974). Estimating regional variations in soil erosion in Peninsular Malaysia. *Malaysia Nature Journal*, 5(28), 94-106.
- Morgan, R. P. C. (1979). *Topics in applied geography: soil erosion*. Longman, London. 113 pp.
- Morvan, X., Naisse, C., Malam Issa, O., Desprats, J. F., Combaud, A., & Cerdan, O. (2014). Effect of ground-cover type on surface runoff and subsequent soil erosion in Champagne vineyards in France. *Soil Use and Management*, 30(3), 372-381.
- Pimentel, D., Harvey, C., Resosudarmo, P., Sinclair, K., Kurz, D., McNair, M., Crist, S., Shpritz, L., Fitton, L., Saffouri, R. & Blair, R. (1995). Environmental and economic costs of soil erosion and conservation benefits. *Science, New Series*, 267(5201), 1117-1123.
- Quah, S.H.(1999). *Sustainable Food Production, Income Generation and Consumer Protection in Malaysia*. Agro-chemical News in Brief Special Issue.
- Rudel, T.K. (2013). *Tropical Deforestation: Small Farmers and Land Clearing in The Ecuadorian Amazon*. Columbia University Press, New York.
- Shaw, E. M., Beven, K. J., Chappell, N. A., & Lamb, R. (2011). *Hydrology in practice*. Spon Press, New York.
- Spencer, S. (2004). *Price Determination in the Australian Food Industry, A report*. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.
- Turner, R. E. & Rabalais, N. N. (2003) Predicting the response of Gulf of Mexico hypoxia to Variations in Mississippi River nitrogen load. *Limnology and Oceanography*, 48(3), 951-956.
- United States Department of Agriculture (USDA) (1998). *Effects of Soil Erosion on Soil Productivity and Soil Quality*. Soil Quality-Agronomy Technical Note No. 7.

## **DRIVING FORCES IN MODELLING DYNAMIC URBAN SPATIAL GROWTH FOR THE GEORGE TOWN CONURBATION (GTC)**

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**ABSTRACT:** Urban growth and transformation of spatial land use and land cover have affected various important physical environments, social, and economic activities. Researchers throughout the world have implemented diverse approaches in understanding the dynamic process of urban spatial growth where models have been developed to predict and simulate future urban growth and development. Model were developed based on the driving forces or factors that stimulate urban development. Therefore, the driving forces must be identified and analysed, especially for those that can be applied to forecast future changes and their potential environmental effects. The objective of this paper is to identify and analyse possible driving forces that promote urban spatial growth using the George Town Conurbation as a case study. The driving force were identity by reviewing recent research journals and articles regarding modelling urban growth. In addition, on-line survey was also generated and distributed to planners, academicians, researchers, and urban modellers to assess their perception on urban land use transformations and also measure the weight of potential drivers or factors that stimulate urban spatial growth. The findings indicated that distance to public amenities, cheap housing price, distance to workplace, and proximity to area that support new and growing businesses are among factors that are important determinants of urban development. The results provide valuable insights in modelling the dynamic urban spatial growth in future research.

*Keywords:* urban growth, land use and cover, driving force, George Town Conurbation

### **INTRODUCTION**

Urbanisation is among the most significant process that has shaped land use and land cover drawing a great deal of attention throughout the world. It is estimated that urban's population will rise from 3.57 billion in 2010 to 6.34 billion in 2050 where almost 70 percent of the world's population are expected to live in the cities (United Nations, 2014). This immense figure is mainly due to migration from rural areas to city in search of better quality of life generated by rapid urbanisation (Tan et al., 2015; Deng et al., 2009). Lu et al. (2013) and Liu et al. (2008) stress that urban population growth is beneficial to urban development and economic development, especially in promoting business and industry. Consequently, urban regions are more developed, for instance, more infrastructure and pleasant environment as a result of rapid urbanisation (Su et al., 2011).

However, overpopulation in urban areas contributes to a number of social, economic and environmental problems such as pollution, traffic congestion, rise of housing prices, and loss of natural areas (Tan and Li, 2013). Increased urban population has forced cities to expand vertically or horizontally, encroaching into agricultural land and natural boundaries, and changing land use and land cover without us realizing it (Kumar et al., 2011; Su et al., 2011). The George Town Conurbation is no exception as exemplified by the two revision made by Town and Country Planning Department (Town and Regional Planning Department, 2015a) on George Town Conurbation's boundaries due to rapid urbanisation caused by George Town city. Deeper understanding of the concepts or mechanisms underlying the urban growth can diminish the negative impacts of urbanisation while maximising the positive impacts (Aguayo et al., 2007).

Urban spatial growth models have been extensively applied to project the future growth of a city where one can clearly understand the process of urbanisation (Verburg et al., 2004). These models have the ability to simulate the spatial changes of land use and land cover of a city and forecast the possible urban development according to data received (Wahyudi and Liu, 2014). The basic concepts underlying urban spatial growth models were initiated in the North America five decades ago (Batty, 1971) and have been adopted in Europe, East Asia and West Asia countries. Models are crucial in forecasting urban growth when various factors or driving forces that stimulate urban change in a

highly complex manner are involved (Entwisle et al., 2007). Therefore, modelling and simulation techniques are believed to be essential approaches to understand the mechanisms underlying urban systems and contribute toward planning and managing urban growth (Tayyebi et al., 2011; Entwisle et al., 2007, Al-Shalabi et al., 2013; Wahyudi and Liu, 2014).

Determining and studying the factors or driving forces that stimulates urban growth is the fundamental step in modelling the dynamic urban spatial growth. Aguayo et al. (2007) emphasises that the factors that stimulate urban development, especially those factors that can be used to predict future changes and their potential environmental effects must be identified and analysed in order to understand the spatial and temporal dynamics of these processes. Therefore, the objective of this paper is to identify and analyse possible driving forces that promote urban spatial growth in the context of urban growth in Malaysia, which will then be included in modelling the George Town Conurbation.

## **LITERATURE REVIEW**

To date, various studies that identify and implement driving forces urban growth model have been done by many researchers and academicians throughout the world (Lo and Yang, 2002; Aguayo et al., 2007; Goetzke et al., 2007; Lu et al., 2013). For example, Aguayo et al. (2007) revealed that urban growth areas are stimulated by distance and density of specific elements which implies proximity and neighbourhood are two important driving forces to urban development. It is difficult to develop an area if the road network is not well constructed because it is the key to open many opportunities, especially for business by attracting higher population migration. The demand for high quality house has promoted urban growth such as construction of shopping malls, nodes and highway (Lo and Yang, 2002). Residents' desire to live at location with easy access to other destinations helps to explain the construction of nodes and highway in many urban areas. Supporting that factor, Li et al. (2013) also indicate that the road network plays the most important role in developing the new urban landscape. Road network not only facilitate residents' daily lives but also reduce the cost of construction of amenities like shopping malls and hospitals and so forth (Li et al., 2013). However, it is undeniable that the physical landscape and neighbourhood influence also contribute to stimulate urban development which influences decisions regarding road network development (Li et al., 2013). Proximity and accessibility to markets or social services which are considered cost-weighted distances were used as socio-economic variables that stimulate urban growth (Goetzke et al., 2007).

Industrialisation or commercialisation which implies economic factor is also one of the important determinants in promoting urban development (Lu et al., 2013; Liu et al., 2008; Lo and Yang, 2002). It offers many job opportunities which attract employees to stay at the vicinity and also influence road network development to stimulate economic factor in regional trade (Lu et al., 2013). Lo and Yang (2002) found that industrial and commercial activities are located at high-density urban area which proved that these two activities are also important forces in developing an area. Increase of investment to secondary and tertiary industries has boosted land for residency and become the direct factors of land conversion for development (Liu et al., 2008). Liu et al. (2008) also suggest that urban growth is more likely to be expanded if the location is closer to urban centres. This may be due to the many economic resources in urban areas offered by industrial and commercial activities.

Briassoulis (2008) proposed that urban model should consider bio-physical driving forces which consist of characteristics and processes of the natural environment. Suitability of a location to develop can be impacted by bio-physical factors, for instance, slope layer need to be taken into consideration in urban expansion model (Verburg et al., 2004). Hu and Lo (2007) proposed that steep and elevated areas are less likely to be developed due to the cost of construction and higher risk of land instability. Bio-physical factors may partially constrain urban development. Factors like economic gains and insufficiency of land availability might lead developer to consider developing despite the high cost and risk of slope and elevation. Apart from that, zoning status or legally protected areas has produced best result in sensitivity analysis of developed urban model which signify it as an important factor of urban expansion (Poelmans and van Rompaey, 2010).

Kuang, et al. (2014) realised that urban planning, management strategies and policies have become major driving forces that need to be considered in modelling urban growth as they can affect other drivers. China experiences unprecedented speed of urbanisation rate since the Chinese government set up the Special Economic Zone which has emerged as China's commercial and industrial hub while USA remained and maintained relatively stable urbanisation rate due to introduction to a variation of distinct zone to manage rural and urban areas (Kuang et al., 2014). Their research has proven that political factor is capable of either changing or expanding dramatically or managing an urban development which can be crucial in modelling. Instead of exercising land use policy to direct physical development, it can also serve as a platform to promote economic, social, environment and other goals which indirectly stimulate urban development (Briassoulis, 2008). Lu et al. (2013) identify that implementing policy for boosting economy, developing a potential location and enhancing living environment have maximised the effect of urban growth at high rate of land use transformation. Private property developers will take opportunity to develop nearby location as proposed by urban planning and management policies from the government as they foresee potential of development driven by political factors.

Due to the fact that Malaysia is facing rapid urbanisation similar to other countries, four major conurbations: Kuala Lumpur, George Town, Johor Bharu and Kuantan have been identified in National Physical Plan 2 in order to facilitate urban planning process (Hashim, 2011). All of the above-mentioned conurbations were named after the major cities that trigger rapid urbanisation to its surroundings. George Town city has developed rapidly and caused the George Town Conurbation to expand its boundary to Southern Kedah and Northern Perak (Town and Regional Planning Department, 2015b). The existence of North-South Expressway and good road network are factors that drive urban development in George Town Conurbation. The industrial and commercial areas located in Penang, especially in Bayan Lepas and Juru are also key factors that stimulate urban development. However, researchers found that negative impacts from urban development will worsen in Seberang Perai region in Penang State and encroach into agricultural and natural areas if proper urban planning is not in place to contain its expansion (Samat et al., 2014).

## **METHODOLOGY**

The primary objective of this paper is to identify and analyse possible driving forces that promote urban spatial growth, especially those that can be employed to predict future changes and their potential environmental effects. The identified driving forces will then be adapted in the Malaysian context to model urban growth of George Town Conurbation. In order to achieve the objective, recent research journals and articles regarding modelling urban growth were reviewed. Potential significant factors were identified by reviewing studies by previous researchers and academicians. In addition, on-line survey was conducted. The survey consists of 5 items to gather information about respondents' demographic backgrounds and another 6 items to assess their knowledges of urban development. The survey contains open-ended and closed-ended questions using Likert scale. Through purposive sampling, the surveys were distributed to planners from Town and Regional Planning Department (JPBD), academicians and researchers of public universities in Malaysia, private urban modellers and developers. This survey aims to assess their perception on urban land use transformation and also to measure the weight of potential drivers or factors that stimulate urban spatial growth in Malaysia. The study obtained 39 respondents from various professional backgrounds with 27 respondents' (69.2 per cent) aged more than 40 years old. This implies that this group of respondents have witnessed and experienced urban growth and development since year 1990. Apart from that, 84.6 per cent of the respondents (33 respondents) are directly involved or are well aware of urban development. 24 respondents (61.5 per cent) are academicians in urban studies and 9 respondents (23.1 per cent) are urban planners. The reliability of the on-line survey has been tested, especially for questions to determine the importance of a driving force in urban growth. The result, Cronbach's Alpha value of  $\alpha=0.789$ , indicates that the instrument is reliable. Quantitative data is analysed using Microsoft Excel 2010 and qualitative data, in the form of direct quotations, are used to supplement the findings.

## Study Area

The study was carried out in the George Town Conurbation which involves Penang State and parts of neighbouring states of Kedah and Perak as proposed by Penang Town and Country Planning Department (Town and Regional Planning Department, 2015c) that is in compliant with National Physical Plan 2(NPP2) of Peninsular Malaysia. It is located in the northwest coast of Peninsular Malaysia between latitude  $4^{\circ} 50' N$  and  $5^{\circ} 52' N$  and longitude  $100^{\circ} 10' E$  and  $100^{\circ} 51' E$ , with an area about 3,938 square kilometres (See Figure 1). George Town Conurbation is a metropolitan area with a total population over 2.5 million people and it is estimated to exceed more than 3 million residents by 2020 (Department of Statistics, 2010). According to the Town and Country Planning Department (Town and Regional Planning Department, 2015c), the proposal to determine the limit of George Town Conurbation boundaries was supported by economic criteria, distance travelled and mega projects on George Town's neighbouring districts.

The reason for selecting George Town Conurbation as the study area is due to the fact that rapid development in Penang especially in George Town has contributed to the rapid economic development, especially in the industrial manufacturing, trade, commerce and services sectors. In addition, its strategic location in establishing relationships and cooperation with regional countries and bordering regions are also one of the reasons for selecting this conurbation as the study area. This strategic location will intensify the northern territory's role in contributing to major economic development of the country (Majeed, 2011). Furthermore, George Town Conurbation is one of the four major conurbations that has been highlighted in NPP2 which implies that the study area is very significant in developing Malaysia (Hashim, 2011).

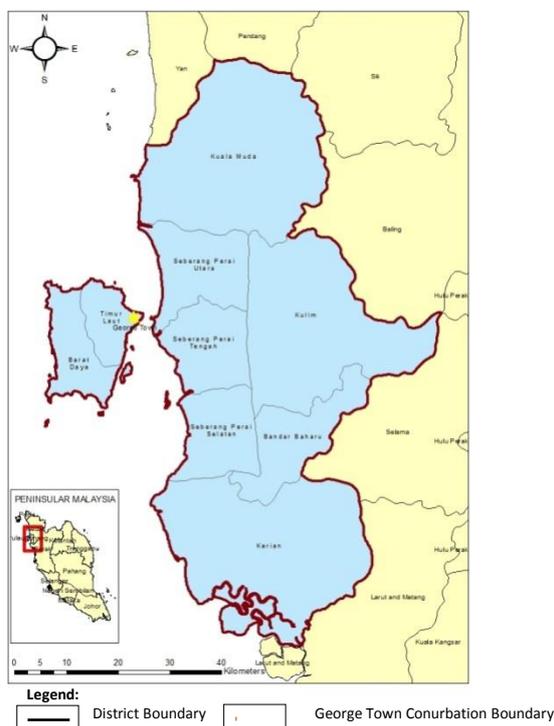


Figure 1: The Study Area (George Town Conurbation)

## RESULTS AND DISCUSSIONS

Based on the driving forces studied by previous researchers and academicians, an on-line survey was generated to determine the weight of each factor asked in the survey which will then be used in modelling the dynamic urban spatial growth of the study area. The selected driving forces was considered for their availability of data since data input and database creation is time consuming and

costly (de Bruijn, 1991). A Likert scale was used to understand the respondents' perception on intensity of importance for factors in stimulating urban development using the scale shown in Table 1.

Table 1: Scale of relative importance

<b>Intensity of Importance</b>	<b>Definition</b>
1	Equal Importance
2	Weak
3	Moderate Importance
4	Moderate Plus
5	Strong Importance
6	Strong Plus
7	Very Strong or Demonstrated Importance
8	Very, Very Strong
9	Extreme Importance

Data obtained from the questionnaire was then processed and analysed using Analytic Hierarchy Process (AHP) (Beynon, 2002; Hossain et al., 2014). Table 2 showed weightings for each factor as indicated by the data gather from the survey.

Table 2: Factors with respective weighting value

<b>Factors</b>	<b>Weight</b>	<b>Factors</b>	<b>Weight</b>
Distance to public amenities e.g. school, university, etc.	0.1122	Distance to public amenities e.g. school, university, etc.	0.1589
Distance to workplace	0.1141	Distance to workplace	0.1457
Proximity to area that support new and growing business	0.0977	Proximity to area that support new and growing business	0.1393
Distance to health centre e.g. public hospital, public clinic, etc.	0.0950	Distance to health centre e.g. public hospital, public clinic, etc.	0.1333
Distance to main road or highway	0.0906	Distance to main road or highway	0.1276
Distance to commercial or industrial area	0.0977	Distance to commercial or industrial area	-
Proximity to parks and natural features	0.0977	Proximity to parks and natural features	-
Distance to city centre	0.0879	Distance to city centre	-
Cheap housing price	0.1123	Cheap housing price	0.1589
Population density or neighbourhood	0.0948	Population density or neighbourhood	0.1362
<i>Consistency Ratio</i>	<i>0.004</i>	<i>Consistency Ratio</i>	<i>0.001</i>

(a)

(b)

Table 2(a) are weighting values for all factors rated by the respondents whilst Table 2(b) are weighting values after removing three factors with lowest mean rated by the respondents. The respondents have rated distance to commercial or industrial area, proximity to parks and natural features and distance to city centre as less important in stimulating urban development. This may be due to not wanting to spend most of their time and financial resources travelling to the workplace and buy an overpriced house, which is typically the case in city region. On top of that, it would be better to live in an environment free from commercial or industrial waste which can affect the health of nearby communities. Another reason that may have contributed to the finding is that more efficient road network will shorten travelling time, thus, distance to city centre become less important in promoting urban development.

Respondents were also required to list all possible factors that might stimulate urban growth to support their perception in rating the importance of each factor. 10 respondents (25.6 per cent) responded that population growth and migration to urban areas are factors that stimulate urban development. Efficiency of public transportation, good road network and amenities like private hospital and public school were also mentioned by 7 respondents (17.9 per cent) as factors that

promotes urban development. Some of the respondents also indicated land availability and demand for affordable housing as factors that stimulate urban growth. In addition, respondents also mentioned that business and employment opportunities together with lifestyle and entertainment offered by urban area can contribute to urban development. One of the respondents emphasised that “*Urban manager should know very well that urban development is about integration and interrelatedness of all stakeholders in urban community*”, which implies that cooperation from all stakeholders is necessary in planning and managing urban development.

## **CONCLUSION**

The study showed that quite a number of journals and articles have revealed three major driving forces which stimulate urban development namely: physical landscape, socio-economic and environment. In fact, National Physical Plan 2 also has given a great deal of attention to these driving forces in planning the four major conurbations in Malaysia. Although the plan contributes to boosting national and public economy, rigorous policy regulations are needed to avoid unnecessary expansions especially to agricultural and natural resources. A good dynamic urban model should be able to utilise land within a boundary optimally. From responses provided, some participating researchers proposed that political factor should be considered in predicting urban growth. It has been proven that political factor does have a significant impact to urban growth but it is very difficult to quantify. Therefore, future research could investigate political factors which influence urban growth using qualitative approach.

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## **REFERENCES**

- Aguayo, M. I., Wiegand, T., Azócar, G. D., Wiegand, K. & Vega, C. E. (2007). Revealing the driving forces of mid-cities urban growth patterns using spatial modeling: a case study of Los Angeles, Chile. *Ecology and Society*, 12(1), 13.
- Al-Shalabi, M., Billa, L., Pradhan, B., Mansor, S. & Al-Sharif, A. A. A. (2013). Modelling urban growth evolution and land-use changes using GIS based cellular automata and SLEUTH models: the case of Sana'a metropolitan city, Yemen. *Environment Earth Sciences*, 70, 425–437
- Batty, M. (1971). Modelling cities as dynamic systems. *Nature*, 231, 425-428.
- Beynon, M. (2002). DS/AHP method: a mathematical analysis, including an understanding of uncertainty. *European Journal of Operational Research*, 140, 148-164.
- Briassoulis, H. (2008). Land-use policy and planning, theorizing, and modeling: Lost in translation, found in complexity? *Environmental and Planning B*, 35, 16-33.
- de Bruijn, C.A. (1991). Spatial factors in urban growth: towards GIS models for cities in developing countries. *ITC Journal*, 4, 221-231.
- Deng, J.S., Wang, K., Hong, Y. & Qi, J.G. (2009). Spatio-temporal dynamics and evolution of land use change and landscape pattern in response to rapid urbanization. *Landscape and Urban Planning*, 92, 187-198.
- Department of Statistics (2010). *Population distribution and basic demographic characteristics*. Department of Statistics, Malaysia.
- Entwisle, B., Rindfuss, R. R., Walsh, S. J. & Page, P. H. (2007). Population growth and its spatial distribution as factors in the deforestation of Nang Rong, Thailand. *Geoforum*, 39, 879-897.
- Goetzke, R., Judex, M., Braun, M. & Menz, G. (2007). Evaluation of driving forces of land-use change and urban growth in North Rhine-Westphalia (Germany). *Center for Remote Sensing of Land Surfaces*, 1, 3425-3428.
- Hashim, N. (2011). *The planning & implementation of urban agglomeration*. Malaysia: Malaysian Institute of Planners.

- Hossain, M. F., Adnan, Z. H. & Hasin, M. A. A. (2014). Improvement in weighting assignment process in Analytic Hierarchy Process by introducing suggestion matrix and Likert scale. *International Journal of Supply Chain Management*, 3(4), 91-95
- Hu, Z., & Lo, C. P. (2007) Modeling urban growth in Atlanta using logistic regression. *Computers, Environment and Urban Systems*, 31(6), 667-688.
- Kuang, W., Chia, W., Lu, D., & Dou, Y. (2014). Comparative analysis of megacity expansions in China and the U.S. patterns, rates and driving forces. *Landscape and Urban Planning*, 132,121-135.
- Kumar, D.S., Arya, D.S. & Vojinovic, Z. (2013). Modelling of urban growth dynamics and its impact on surface runoff. *Computers, Environment and Urban Systems*, 41, 124-135.
- Li, X., Zhou, W., & Ouyang, Z. (2013). Forty years of urban expansion in Beijing: What is the relative importance of physical, socioeconomic, and neighborhood factors? *Applied Geography*, 38, 1-10.
- Liu, Y. S., Wang, L. J., & Long, H. L. (2008). Spatio-temporal analysis of land-use conversion in the eastern coastal China during 1996-2005. *Journal of Geographical Sciences*, 18(3), 274-282.
- Lo, C. P. & Yang, X. (2002). Drivers of land-use/land-cover changes and dynamic modeling for the Atlanta, Georgia Metropolitan Area. *Photogrammetric Engineering & Remote Sensing*, 68(10), 1073-1082.
- Lu, C., Wu, Y., Shen, Q. & Wang, H. (2013). Driving force of urban growth and regional planning: A case study of China's Guangdong Province. *Habitat International*, 40, 35-41.
- Majeed, H. A. (2011). *The George Town conurbation plan*. Malaysia: Khazanah Nasional.
- Poelmans, L. & van Rompaey, A. (2010). Complexity and performance of urban expansion models. *Computers, Environment and Urban Systems*, 34, 17-27.
- Samat, N., Ghazali, S., Hasni, R. & Elhadary, Y (2014). Urban expansion and its impact on local communities: A case study of Seberang Perai, Penang, Malaysia. *Pertanika J. Soc. Sci. & Hum.*, 22(2), 349-367.
- Su, S., Jiang, Z., Zhang, Q. & Zhang, Y. (2011). Transformation of agricultural landscapes under rapid urbanization: a threat to sustainability in Hang-Jia-Hu region, China. *Applied Geography*, 31, 439-449.
- Tan, M. & Li, X. (2013). The changing settlements in rural areas under urban pressure in China: Patterns, driving forces and policy implications. *Landscape and Urban Planning*, 120, 170-177.
- Tan, R., Liu, Y., Zhou, K, Jiao, L. & Tang, W. (2015). A game-theory based agent-cellular model for use in urban growth simulation: A case study of the rapidly urbanizing Wuhan area of central China. *Computers, Environment and Urban Systems*, 49, 15-29.
- Tayyebi, A., Pijanowskia, B. C. & Tayyebi, A. H. (2011). An urban growth boundary model using neural networks, GIS and radial parameterization: An application to Tehran, Iran. *Landscape and Urban Planning*, 100, 35-44.
- Town and Regional Planning Department (2015a). *Georgetown – Sungai Petani – Kulim growth management plan*, retrieved on 5 June 2015, from [http://www.townplan.gov.my/download/Banner%20Page/Georgetown\\_english.pdf](http://www.townplan.gov.my/download/Banner%20Page/Georgetown_english.pdf)
- Town and Regional Planning Department (2015b). *Rangka kerja penyelarasan pengurusan pertumbuhan Georgetown Conurbation*, retrieved on 5 June 2015, from <http://www.townplan.gov.my/download/GTCRIN~2.PDF>
- Town and Regional Planning Department (2015c). *Pernyataan dasar-dasar dan cadangan umum RSNPP 2020*, retrieved on 5 June 2015, from [http://jpbdgeoportal.penang.gov.my/jpbd/RSN/Topik\\_4.0.html](http://jpbdgeoportal.penang.gov.my/jpbd/RSN/Topik_4.0.html) [In Bahasa]
- United Nations, Department of Economic and Social Affairs, Population Division (2014). *World Urbanization Prospects: The 2014 Revision, CD-ROM Edition*.
- Verburg, P. H., Schot, P. P., Dijst, M. J. & Veldkamp, A. (2004) Land use change modelling: Current practice and research priorities. *GeoJournal*, 61(4), 309-324.
- Wahyudi, A. & Liu, Y (2014). Spatial dynamic models for inclusive cities: A brief concept of cellular automata (CA) and agent-based model (ABM). *Jurnal Perencanaan Wilayah dan Kota*, 26(1), 54-70.

## **INFRASTRUCTURE ACCESSIBILITY IN NIGERIAN CAMPUSES: EVIDENCE FOR POLICY AND PRACTICE**

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**ABSTRACT:** Mobility barriers in Nigerian campuses are unmistakable and continued to affect the accessibility experience of persons with disabilities (PWD). Yet, an examination of disabling barriers for inclusive mobility of (PWD) has been largely absent. Previous studies of disablement processes have been infused with diverse socio-spatial overtones and undertones, but focused on medical rehabilitation rather than environmental modifications. This study sought to identify and examine the adequacy and usability of accessibility infrastructure in tertiary institutions offering special education in North West Nigeria, with a view to making recommendations to reduce if not overcome the identified problems at the policy and implementation levels. Participatory physical accessibility auditing conducted revealed a number of disabling barriers to PWD inclusive mobility. Findings highlight areas of concentrated disadvantages to include lack of adequate, accessible and usable infrastructure as guaranteed by the laws. Suggestions were drawn from the best practices for improving access and accessibility. Thus, the recommendations made have the potential of mitigating problems associated with inequality and disability in developing countries and widening participation in the global drive to achieve “*education for all*”.

*Keywords:* accessibility, infrastructure, disability, inclusive mobility, widening participation

### **INTRODUCTION**

In an effort to make education accessible to all, there is a rising concern that disability is ignored in the United Nations Millennium Development Goal (Albert et al., 2005; Croft, 2010). Many disabled persons are excluded from the mainstream educational opportunities, or segregated even in the 21<sup>st</sup> century (Garuba, 2003). This trend is required to be reversed (Shakespeare & Officer, 2011; UN CRPD, 2006; UN Enable, 2011). Persons with disabilities (PWD) are facing multiple disadvantages, particularly with regards to mobility as a result of architectural neglect (Goldsmith, 2000; Imrie, 1997, 2000; Waller, Bradley, Hosking, & Clarkson, 2015). In a word, public buildings are so often conceived without the provisions for disabled people in the building (Imrie, 2003). When public buildings are conceived without PWD accessibility requirements, mobility restriction results and modification cost arises, but not otherwise (Holmes-Siedle, 1996). Architectural disability in architectural scholastic term is the lack of access to the built environment as orchestrated by the designers (Goldsmith, 2000) and is tantamount to access restriction and exclusion in higher educational settings (Barnes, 2007).

Accessibility is an essential element in the inclusive mobility and participation of PWD in higher education (Sachs & Schreuer, 2011). According to Holmes-Siedle (1996), integration of PWD into the mainstream setting is allowed in as much as the body can adjust and become suited to live within what is considered a “normal society”. Given equal opportunity, potentialities of non-disabled persons are no different from those of the so-called PWD. It is in this sense that PWD made impressive records of achievements and performance across ages and milieu (Wilkinson, 2009). The burgeoning literature on how a growing enrolment rate in education contributes to socioeconomic development and reduce poverty (Morley & Croft, 2011; Yusuf et al., 2009) attested to the importance of widening participation in education. Thus, there is a general clamour on the need to embark on widening participation and inclusion of PWD in developmental activities, particularly in developing countries.

Despite the importance of widening participation, it seems much needs to be done to ensure that the claims on the widening participation are not just a question of what Yusuf et al. (2009) called registration of students into the increasingly dysfunctional institutions. Just as access to education is important in order to increase participation, so is physical accessibility to guarantee equality in participation of the PWD on equal merit. Accessibility provision is an antithesis of poor pedagogical

practices of discrimination, whether physical (Curl et al., 2011) or otherwise. When public built environment is not furnished with the requisite infrastructure for PWD inclusive mobility, socio-spatial discrimination results. In a word, inclusive mobility is obtained with the provision of accessibility infrastructure. However, inaccessibility of education built environment will continue if inclusive policies do not receive the consideration they deserved (Sachs & Schreuer, 2011). An environment designed to meet the need of PWD is expected to have the accessibility infrastructure adequate to accommodate their accessibility needs.

While discourse exists in the implementation of disability policies (Wendelborg & Tøssebro, 2010), in several sub-Saharan African countries it does not attract significant research attention (Croft, 2010). Nigeria, however, recognised the need to integrate the teeming population of her citizens and visitors with disabilities. Accordingly, Nigeria is in the forefront of signing and ratifying a number of international treaties, including the United Nation (UN) Convention on the Rights of Persons with Disabilities (CRPD), in addition to international treaties, Nigeria promulgated a decree christened "Nigeria with disability decree 1993". By implication, Nigeria has agreed to abide by the agreement to the inclusion of PWD, example, in the educational sector, providing access and accessibility to public buildings, anti-discriminatory mechanisms and host of other inclusive measures. Nigeria has a decade's old and comprehensive disability policy. The policy, like every other decree is meant to safeguard the rights and dignity of PWD to pursue education on equal merit. Nonetheless, several authors including (Abang, 2007; Aluko, 2006; Eleweke, 1999) posit their sentiments, expressing concern that the law does not apply in practice in the Nigerian context.

However, none of such claims regarding lack of policy implementation advanced a verifiable fact or statistics to prove that the policy is not being implemented. What needs to be done to overcome the dearth in the implementation of the policy is not only important, but a starting point of a corrective measure. These views are in agreement with Yusuf et al. (2009) concern that disability as a structure of inequality has not received significant attention it merited in relation to higher education in the sub-Saharan Africa. Very few studies examine the built environment in the Nigerian context (Ahmed et al., 2014; Hamzat & Dada, 2005). However, the major limitations of the previous studies are that, these studies mainly focus on public spaces not specifically designated to serve the need of PWD. Also, medical practitioners often conducted these previous studies with a focus on medical rehabilitation rather than environmental modification. This is reinforcing a medical model of disability, which regards "... *the human being is flexible and "alterable" whilst the society as fixed and unalterable, leaving disabled people to a hostile environment*" (Holmes-Siedle, 1996). This research is not medically, but socio-spatially inclined.

Documents review of policy decree that has been in existence for upwards two decades (1993-date) is intended to provide a basis for the study, and serve as a basis for the physical accessibility audit checklist (PAAC). The access audit is tailored towards improving accessibility provision in line with the main research focus. PAAC examines existing accessibility infrastructures and services against predetermined criteria designed to assess the availability, enumerate the adequacy and measure usability of an existing infrastructures accessibility and services offered to PWD for an overall improvement (Holmes-Siedle, 1996; Kamarudin et al., 2012).

In this paper, we address key issues related to inclusive mobility of PWD in educational settings. Our study is motivated by the limitations associated with the previous studies as earlier discussed. The study is structured in two parts: Part 1 deals with policy accorded rights to inclusive mobility in selected campuses in Nigeria. Secondly, it concerns infrastructure, accessibility. The focus is to locate evidence of mobility disability amidst inclusive policy in order to propose a way forward in both physical and policy levels.

## **METHODOLOGY**

Nigeria, the most populous country in Africa covered an area of 932, 768 km<sup>2</sup> with a population that surpasses the 15 other West African countries combine (Eleweke, 1999). Constitutionally, it is split

into six geopolitical zones. North West Nigeria is the most populous region in the country, according to the National Population Commission (2010) and holds the highest illiteracy rate in the English language as contained in the National Literacy Survey (National Literacy Survey, 2010). The only two higher institutions offering “*special education*” at departmental level and with a considerable number of PWD on records were selected for the case study from Kano State (the most populous state in the region in particular and the country in general). The institutions selected for the study involved Bayero University Kano (BUK) represented as case study-1 and Sa’adatu Rimi College of Education Kumbotso (SRCOE) represented as a case study-2.

The methods consist of two parts: qualitative content analysis of policy documents and physical observations that involved PAAC. The selected documents to review is the “Nigeria with disability decree 1993” being the so-called current version to date. The analysis follows a qualitative content analysis procedure to emphasise the relevant areas. The focus was placed on accessibility provisions for hearing, visual, and walking impaired staff and students. The facilities examined are entrance ramp, washrooms, automatic doors, curving, seating for PWD, designated parking space for PWD, amplification system, telecommunication devices for the deaf (TDD), and door Markings/Sign in braille. Areas identified with barrier-ridden features were photographed as sources of multiple evidences. Data collections follow a participatory approach carried out with participation of disabled staff and students with mobility impairments. People that are considered mobility impaired are the visually, hearing and walking impaired to a large extent (Baris & Uslu, 2009), because the environment seldom favours their mobility requirements. The main criteria for the selection of the case study area followed the availability and presence of PWD in a given institution. The selection of the cases within the institutions focused on mobility impairment.

## RESULTS AND DISCUSSION

Table 1: The rights of PWD in the Nigerian context as contained in the “National Disability Decree 1993”

KEY EMPHASIS
Section 1: General Principles- Clear and comprehensive legal security.... Standards for enforcement.... applicable to disabled in Nigeria
Section 2: Declaration of policy- Disabled are ...guaranteed equal treatment ...for all purpose... All authorities to adopt policies and ensure full integration and the mainstreaming of PWD
Section 3: Interpretation- Meaning of disability and commission in national context
Section 5: Education- 5.1- free education at all levels 5.3.2- structural adaptation of all educational institutions at all levels 5.4.2.1- provision of special needs of the disabled 5.4.2.2- establish a national institute of special education to facilitate needs of the disabled 5.4.2.5 improve university education facilities to ensure maximum benefit for the disabled- “Government shall ensure that no less than 10% of all educational expenditures are committed to the educational needs of the disabled at all levels”
Section 6: Employment and vocation- Without discrimination
Section 7: Housing- Access and accessibility
Section 8: Accessibility- 8.1- “accessibility to public institutions and facilities are hereby guaranteed to the disabled” 8.2- governments shall provide (a) adequate mobility within its facilities (b) suitable exits for the disabled
Section 9: Transportation- 9.1 Free transportation by bus, rail or any other than air 9.2 Adjustment of the transport system to PWD's needs 9.3 Priority shall be accorded to PWD by reserving reasonable number of seats to PWD
Section 12: Telecommunication- Facilities are guaranteed under this act (a) ...Sign language in programs with national significance (b) provide at reasonable price devices for hearing impaired (c) free postal services to PWD

*Source: author’s compilation and emphasis from “the Nigerian with disability decree 1993”  
Presentation of findings for PAAC*

Table 2: Matrix of accessibility infrastructure in BUK and SRCOE

Study area	Facilities/ Buildings	Entrance Ramps	Automatic doors	Curving	Modified washroom	Seating for Disabled	Designated Parking	(TDD)	Amplification Systems	Sign/Door Markings
Case study site-1	Admin/ Chancellery	1	0	1	0	0	0	1	0	0
	Library	0	0	0	0	0	0	0	0	0
	Central Bus stop	0	0	0	0	0	0	0	0	0
	DSE	1	0	1	0	0	0	0	0	0
	Restaurant/ Cafeteria	0	0	1	0	0	0	0	0	0
	Theatre	0	0	1	0	0	0	1	0	0
	<i>Total in Case study site-1</i>		11%	0%	22%		0%		11%	
Case study site-2	Admin/ Chancellery	1	0	0	0	0	0	0	0	0
	Library	1	0	0	0	0	0	0	0	0
	Central Bus stop	0	0	0	0	0	0	0	0	0
	DSE	2	0	2	0	0	0	0	0	0
	Restaurant/ Cafeteria	0	0	1	0	0	0	0	0	0
	Theatre	1	0	0	0	0	0	0	0	0
	<i>Total in Case study site-2</i>		28%	0%	17%			0%		

Assessment of accessibility of campus infrastructure using PAAC is presented in matrix form in Table 2. The values of 3, 2, 1, and 0 to represent 100% facilities, 50% or more facilities, less than 50% of facilities, and 0% facilities are provided. Enumerated facilities include 12 buildings, six from each campus comprising of chancellery/Senate or administrative block, the main campus library, Department of Special Education (DSE), cafeteria, main campus theatre, and central bus stop as depicted in Figure 1. The red and blue bars represent campus site 1 (SA) and site 2 (SB) respectively. Curving recorded the highest value in case study 1 as shown in Table 2, followed by the entrance ramp and TDD. Automatic doors, modified washroom, seating for disabled, amplification system and sign/ door markings have the least value in case study site 1. In case study site 2, entrance ramp recorded highest, followed by curving. Automatic doors, modified washroom, seating for the disabled. TDD, amplification system and sign/ door markings have the least value in the case study site 2 as shown in Table 2. The result implies that physical beauty of campus is prioritized over accessibility by paying more attention to the curve than any other accessibility infrastructure, in case study site 1. Ramp appeared more adequate than other infrastructures. In a separate interview conducted, the TDD is available to satisfy the Nigerian University Commission (NUC) requirements as argued by one of the respondents. For other infrastructure automatic doors, modified washroom seating for the disabled, amplification system and sign/ door markings for disabled, however, none is available in the so-called disability friendly campuses. The PAAC results of the case study site 2 again show replication logic to campus site 1. Here, entrance ramp is prioritized followed by curving. Other accessibility infrastructures, however, are either consciously or unconsciously omitted in case study site 2 as shown in Table 2.

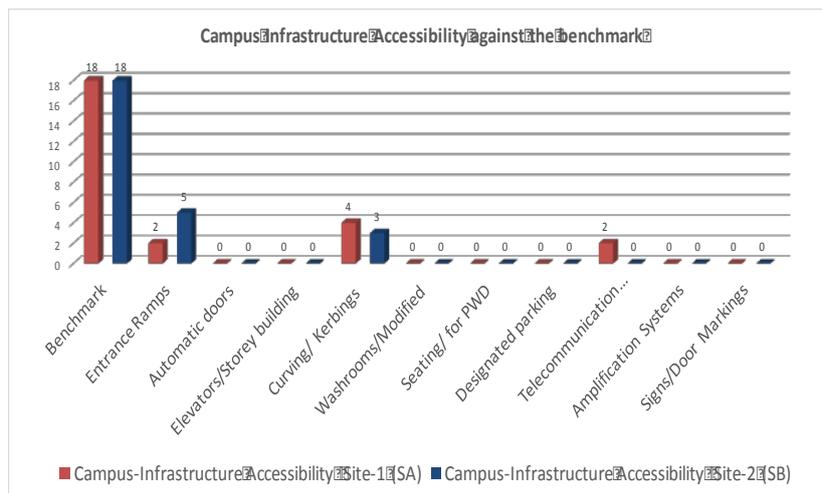


Figure 1: Accessibility infrastructures provided in two study areas, Source: Author's Survey

From the PAAC results, overall, the department of special education (DSE) scored poorly but relatively better than other buildings. The PWD, like everyone needs access to the chancellery or the administrative block if they have the right to be employed as contain in the policy documents. Rights to inclusive mobility also covered the main campus library, DSE, cafeteria, lecture theatre, and central bus stop as in Figure 1.

### Walking impaired

Entrance ramps: SRCOE recorded a better, but poor result of 28%. A Critical look at the celebrated record of 28% entrance ramp in SRCOE shows that 40% of the entrance ramps are located in a single building. The newly constructed department of special education, as if PWD are expected to limit their mobility around and within such building; they should have nothing to do with the cafeteria or any other building. The modification must be wholly for inclusive participation (Holmes-Siedle, 1996). For example, the absence of connection between entrance gates and central bus stop and the DSE puts PWD to an extra stress. Nearly 100% facility provisions are expected to be available in the only tertiary institutions catering for the educational needs of PWD in a state with the highest number of PWD, and located within the geopolitical region with the highest illiteracy rate in the country. However, entrance ramps are recorded only in the DSE and lecture theater. The implication of that is that PWD are expected to study special education in Nigerian psyche and nothing more. Contrarily, lives and legacies of disabled people defied socio-spatially constructed disability (Wilkinson, 2009). The PWD livelihood should not be confined to “learn and teach special education”.

Medical approach leads to the segregation of PWD (Shakespeare & Officer, 2011). Similarly, for Cut kerbs: SRCOE record a relatively better, but still a poor record of 17%, which are similar to what is obtained in BUK with 22% and perhaps for the same reason; beautification. Architects were often blamed for an obsession with embodying harmonic order to the detriment of body and physiological diversity (Imrie, 2003). Upgrading the curving and cut kerbs to have an adequate turning radius may benefit all. Modified washrooms, seating for the disabled and designated parking collectively have 0%, which indicated that the importance of modified washrooms; seating for the disabled and designated parking has been underestimated in both campuses. No toilet facility was designated to cater for wheelchair user's needs.

### Visually impaired

Automatic doors and lifts in multi-storey buildings 0% record for both BUK and SRCOE is expected, considering the unstable electricity that lingers in the country for several decades. Curving recorded a relatively better score in BUK than any other accessibility infrastructure in the beautifully landscaped campus. Sign door markings have been completely overlooked. Should PWD feel excluded, will it be

appropriate to dismiss them as asking for too much? There is a need to hear their own side of the story (Moswela & Mukhopadhyay, 2011). Visually impaired more than other study participants, experienced environmental alienation attributed to the absence of basic provisions such as signs in braille, tactile, door markings, lack of central islands and clear, unobstructed pathway from one building to another within either of the two “disability friendly campuses”.

### **Hearing impaired**

Most of the facilities enumerated have across impairment advantage, but there are facilities that are impairment specific. Telecommunication device for the deaf (TDD) is one of them. A Telecommunication TDD for text communication via a telephone line is essential for hearing impaired especially in an emergency situation. Case study-SA, has a record of 11% because they constitute setting up a department of special education in line with the NUC guidelines. Amplification system is important in an often-overcrowded lecture halls/theaters, but here again 0% was recorded from both campuses. The consequence of such architectural oversight may translate into the campus livelihood of PWD.

### **Policy implications**

Factors influencing the design process and product of a given environment are many including climatic, topographical or location, User’s and legal requirement, as well as design concept e.g. top-down or bottom-up approach, and of course costs. Steady indications abound that many architects feel that designing with the disabled user requirement is not necessary, as it constitutes a cost and aesthetic implication that is difficult to justify when compared with the number of disabled in the society (Holmes-Siedle, 1996). This notion is particularly proven untrue in a number of studies.

Design practice in Nigeria is implicated in this study as disability unfriendly. Why else is the environment like the department of “special education” not specifically designed to cater for the mobility needs of PWD amidst inclusive policies? The “on paper promise” include free education at all levels, structural adaptation of all educational institutions at all levels, provision of special needs of disabled, institute of special education to facilitate the needs of disabled people, improve university education facilities to ensure maximum benefit for the disabled. The conclusion of the policy decree clearly stated: *“Government shall ensure that no less than 10% of all educational expenditure are committed to the educational needs of the disabled at all levels”*. Now that the policy has been more than two decades old, such policy needs to be implemented or reviewed or else PWD will have the right to demand *“when is the policy going to see the light of the day?”*

To make public facilities on the campuses of higher education accessible to PWD, the “on paper promises” need to be practically concretized. It has been stated that *“accessibility to public buildings and facilities are hereby guaranteed to the disabled”* as contained in Table 1, in practice, public built environment, including those meant to accommodate a number of disabled staff and students has neither been conceived with nor modified for disable user requirement. Similarly, the promise of making telecommunication facilities accessible to PWD as contained in Table 1, ought to be fulfilled. Disability policy implementation guarantees access and accessibility for disabled users and everyone else. Ultimately, it has the potential to mitigate problems associated with employment and social security suffered especially by PWD if *“Government shall ensure that no less than 10% of all educational expenditure are committed to the educational needs of the disabled at all levels”* in the oil rich country, Nigeria.

### **CONCLUSION**

Overall, the evidences of mobility disability in educational settings designed to accommodate PWD are examined against national inclusive policy in the study. A widening gap is established between “the on paper policy” and its translation into reality for disabled people integration in the Nigerian educational settings. Qualitative content analysis of policy documents and physical accessibility audit

checklist of infrastructure is used. In order to exercise a positive influence on the architect to create an accessible built environment for all, three things are recommended: first, Architects should consider accessibility for the disabled as a positive selling point of the design concept, secondly, Accessibility for PWD be made a requirement in obtaining approval from regulatory bodies or most importantly, The architect and environmentalists understand that users may include persons with temporary or permanent disabilities. Disability friendly built environment does not necessarily represent a place designated for PWD's use. It is a place accessible and usable by disabled persons, whether officially designated or not. Thus, it includes not only the buildings that are designated to serve the educational needs of PWD but other interior or exterior spaces of common patronage to all people irrespective of impairment or so-called disability. Therefore, PWD need is to have access not only to the department of special education, but also access to public washrooms, restaurants, university libraries, administrative building, and lecture theaters and halls, as well as central bus stop and parking space with requisite infrastructures. The study findings show that the disability friendly campuses with the largest number of PWD in the most populous state in Nigeria are in need of urgent attention for the inclusion of disabled people and everybody.

Though accessibility auditing is participatory conducted with disabled people, it is nonetheless an interpretation of the subjective understanding of the researchers rather than the disabled persons themselves. In the future, the study will include the perception of the PWD.

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### **REFERENCES**

- Abang, T. B. (2007). Disablement, Disability and the Nigerian Society. *Disability, Handicap & Society*, 3(1), 71-77.
- Ahmed, A., Awad, Z. A. C. M., & Yaacob, N. M. (2014). The Response of Accessibility Infrastructures for PWD to National Disability Policies in Higher Institutions of Developing Countries: Case Study of Ahmadu Bello University, Zaria and University of Malaya, Kuala Lumpur. *Journal of Surveying, Construction and Property*, 5(1).
- Albert, B., Dube, A. K., & Riis-Hansen, T. C. (2005). Has disability been mainstreamed into development cooperation. *UK: Disability KaR programme*.
- Aluko, Y. A. (2006). Women in higher education in Nigeria: progress and constraints. *Gender and behaviour*, 4(1), 550-567.
- Baris, M. E., & Uslu, A. (2009). The accessibility of disabled people to the built environment in Ankara, Turkey. *African Journal of Agricultural Research*, 4(9), 801-804.
- Barnes, C. (2007). Disability, higher education and the inclusive society. *British Journal of Sociology of Education*, 28(1), 135-145.
- Croft, A. (2010). *Including Disabled Children in Learning: Challenges in Developing Countries. CREATE Pathways to Access. Research Monograph No. 36*: ERIC.
- Curl, A., Nelson, J. D., & Anable, J. (2011). Does Accessibility Planning address what matters? A review of current practice and practitioner perspectives. *Research in Transportation Business & Management*, 2, 3-11.
- Eleweke, C. J. (1999). The need for mandatory legislations to enhance services to people with disabilities in Nigeria. *Disability & Society*, 14(2), 227-237.
- Garuba, A. (2003). Inclusive education in the 21st century: challenges and opportunities for Nigeria. *Asia Pacific Disability Rehabilitation Journal*, 14(2), 191-200.
- Goldsmith, S. (2000). *Universal design: a manual of practical guidance for architects*: Routledge.
- Hamzat, T., & Dada, O. (2005). Wheelchair accessibility of public buildings in Ibadan, Nigeria. *Asia Pacific Disability Rehabilitation Journal*, 16(2), 115-124.

- Holmes-Siedle, J. (1996). *Barrier-free design: a manual for building designers and managers*: Routledge.
- Imrie, R. (1997). Challenging disabled access in the built environment: an evaluation of evidence from the United Kingdom. *Town Planning Review*, 68(4), 423.
- Imrie, R. (2000). Disability and discourses of mobility and movement. *Environment and Planning A*, 32(9), 1641-1656.
- Imrie, R. (2003). Architects' conceptions of the human body. *Environment and Planning D*, 21(1), 47-66.
- Kamarudin, H., Hashim, A. E., Mahmood, M., Ariff, N. R. M., & Ismail, W. Z. W. (2012). The implementation of the Malaysian standard code of practice on access for disabled persons by local authority. *Procedia-Social and Behavioral Sciences*, 50, 442-451.
- Morley, L., & Croft, A. (2011). Agency and advocacy: Disabled students in higher education in Ghana and Tanzania. *Research in Comparative and International Education*, 6(4), 383-399.
- Moswela, E., & Mukhopadhyay, S. (2011). Asking for too much? The voices of students with disabilities in Botswana. *Disability & Society*, 26(3), 307-319.
- National Literacy Survey. (2010). Report of the National Literacy Survey June, 2010. *Media & Marketing Communications Company Group National Commission for Mass Literacy, Adult and non formal education National Bureau of Statistics*. Retrieved from <http://www.nigeriastat.gov.ng>.
- National Population Commission. (2010). Federal Republic of Nigeria, 2006 population and housing census priority table volume III; population distribution by sex, state, LGA and senatorial district. *Abuja, Nigeria, National Population Commission*.
- Sachs, D., & Schreuer, N. (2011). Inclusion of Students with Disabilities in Higher Education: Performance and participation in student's experiences. *Disability Studies Quarterly*, 31(2).
- Shakespeare, T., & Officer, A. (2011). World report on disability. *Disabil Rehabil*, 33(17-18), 1491.
- UN CRPD. (2006). Convention on the rights of persons with disabilities and optional protocol. New York: United Nations.
- UN Enable. (2011). Convention and optional protocol signatures and ratifications.
- Waller, S., Bradley, M., Hosking, I., & Clarkson, P. J. (2015). Making the case for inclusive design. *Applied Ergonomics*, 46, 297-303.
- Wendelborg, C., & Tøssebro, J. (2010). Marginalisation processes in inclusive education in Norway: a longitudinal study of classroom participation. *Disability & Society*, 25(6), 701-714.
- Wilkinson, M. (2009). *Defying disability: The lives and legacies of nine disabled leaders*: Jessica Kingsley Publishers.
- Yusuf, S., Saint, W., & Nabeshima, K. (2009). Accelerating catch-up tertiary education for growth in Sub-Saharan Africa. World Bank.

## **IDENTIFYING SHRINES AREA USING RADARSAT LEMBAH BUJANG, KEDAH, MALAYSIA**

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**ABSTRACT:** Lembah Bujang was an international cultural and commercial crossroad 2000 years age. Its history, economic potential and a unique socio – cultural, art and architecture and diplomatic relationship offer fertile ground for scholar investigation. However, the issue on the pre-historic ruins as archaeological sites in Lembah Bujang were secretly demolished by modern development brings a further analysis. The aim for this research is to identify potential shrines area in two study areas consisting of Lembah Bujang and Kompleks Sungai Batu using RADARSAT images. Local Adaptive Filtering and Feature Extraction were applied to multi-temporal images of RADARSAT for years 2003 and 2014 to identify potential shrines. Two study areas were selected using ENVI 4.8. The findings show that The Local Adaptive Filtering on GAMMA Map filter is one of the best techniques in identifying potential shrines areas. This technique proves to be a reliable guide in historical sites detection in Malaysia which will also contribute to the chronological literature of the land use development planning in Lembah Bujang. Additionally, this technique will also aid in making recommendations for land use planning guidelines in preservation and conservation of heritage sites.

*Keywords:* remote sensing, RADARSAT, land use planning, historical sites

### **INTRODUCTION**

Lembah Bujang, a place located in northern Malaysia (Kuala Muda, Kedah) is one of the most remarkable archaeological sites. It was an international cultural and commercial crossroad 2000 years age. Its history, economic potential and a unique socio – cultural, art and architecture and diplomatic relationship offer fertile ground for scholar investigation. Over 50 shrines and hundreds of relics are on displayed in the nearby Lembah Bujang archaeological museum. Recently, many of these prehistoric sites are being rapidly destroyed due to modern land use practices such as infrastructure development and industrialization together with development of townships are major destructive factors and require urgent conservation by the authority.

Lembah Bujang Archaeological sites are threatened by rapid development. Developers might have demolished excavation sites near Sungai Batu that contain hidden shrines during land clearing works. Simultaneously, the other perimeter areas which also have in term of significant heritage value are not protected under any policies and law which caused vulnerability upon future development. At present, most of cultural heritage legislation and management is based on old-fashioned methods of field survey which underpin regional and national registers of cultural heritage sites. This old method had been influenced realistic forecasting and lack of reliable data and causes costly and time consuming due to their application over large areas and introduces unnecessary conflicts. (Grøn and Loska, 2002).

Renowned because of that, the capability of remote sensing techniques offer the advantage of providing a synoptic view, covering large areas, and demonstrating the capability to detect features not easily visible on the ground that may be important for archaeological applications (Brivio et al., 2000). Nevertheless, the availability of multi-spectral data proved to be an effective data source for paleo-geographic environment studies (Brivio et al., 2000; Parry, 1992). The used of remote sensing techniques in both historic and prehistoric site discrimination are well documented (Lyons and Hitchcock, 1977). RADARSAT-1 provides horizontal transmit and horizontal receiver (HH) data (793-821 km altitude), RADARSAT-2 launched in 2008, provides VV polarization, cross polarization (HV or VH), dual polarization (HH+HV@VV+VH) and quad-polarization (HH+VV+HV+VH). This makes RADARSAT an incredibly versatile imagery type (798km altitude). The application of radar

to a later phase of development because the multispectral technique seems to be the most promising in terms of cultural heritage site localization and monitoring, and has already shown its usefulness (Shennan and Donoghue, 1991). SAR system (Synthetic Aperture Radar) is one of the recent active sensors used for archaeological investigation which can be operated from satellites to facilitate registration of small-scale topographical features (penetrating vegetation), variation in ground moisture, and the occurrence of stones.

SAR datasets, with the ability to record data beneath the earth's surface have been applied to a number of archaeological investigations. In the central Iberian Peninsula of Spain, SAR data (with a 2.4-13.7m resolution) found potentially buried architecture (Ayuga et al., 2006). SAR data has also been used to detect archaeological sites not discovered during foot survey (Sarah, 2009). In examining structural patterns at Petra, Jordan, SAR detected previously unknown linear features. The data also showed ancient pathways, open subterranean chambers, and natural landforms related to known archaeological sites. This study continued at Beidha, Jordan through a cultural sites analysis initiative, which identified the general landscape condition of the area (Comer, 2003). AirSAR has been used extensively at Angkor Wat to understand more complicated human-environment interactions (Evan et al., 2007). Work done at early Bronze Age site in Israel, Leviah Enclosure (not seen in the ground or in aerial photographs) was detected with ATR and later confirmed with excavation (Ben-Dor et al., 1999). Therefore, the objective of this study is to identify potential shrines area in the two study areas consisting of Lembah Bujang and Kompleks Sungai Batu using RADARSAT to conserve the historical sites for efficient land use planning.

## STUDY AREA

Lembah Bujang is located in Sungai Petani, Kedah (northern Malaysia), and specifically in Merbok, Kuala Muda district. It is one of the most significant findings of evidences proving the earliest civilizations of Malay Peninsula. Lembah Bujang holds a significant value as a physical prove of the earliest civilization in the Southeast Asia region. The specific study areas are divided into two main areas consist of Lembah Bujang and Kompleks Sungai Batu (see Figure 1).

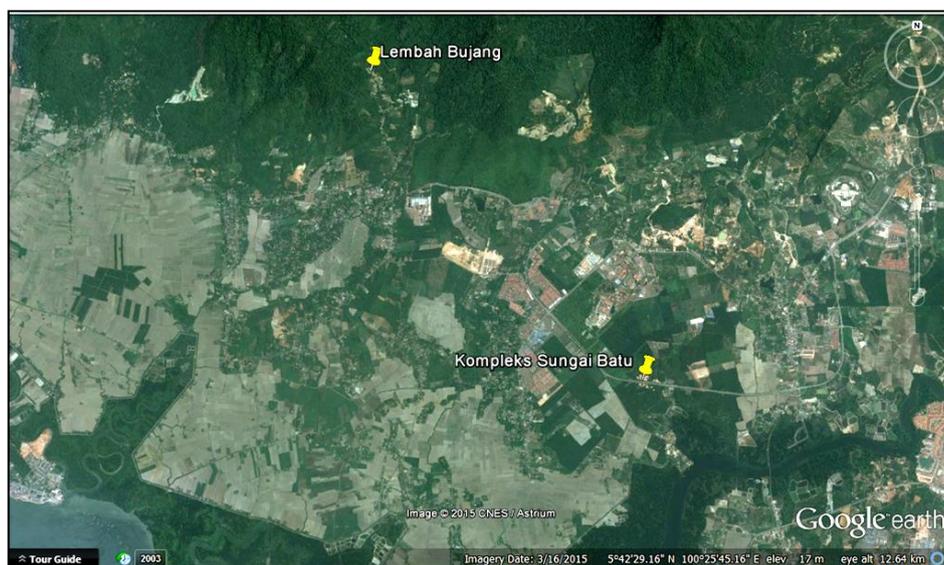


Figure 1: Location of Study Areas  
Source: Google Earth, 2015

## METHODOLOGY

### Material and Software

The data was been collected from primary and secondary data sources. The data collected from the primary sources include topographic maps of the area, land use map, and imageries used in this study are RADARSAT for years of 2003 and 2014. Table 1 shows the detail specification for imageries used in this study.

Table 3: Detail specification of RADAR imageries used in this study

SPECIFICATIONS	IMAGE 1	IMAGE 3
Radarsat	RADARSAT1	RADARSAT2
Acquisition Date	Year 2003	Year 2014
Modes	Standard	Standard
Swath width	Standard	Standard
Band	C-Band	C-Band
Polarisation	HH	
Nominal resolution	Standard: 25m	Standard : 30m
Areas	Lembah Bujang and Sungai Batu	

### Methodologies

In this study, we conducted a data collection in two different sites consist of Lembah Bujang and Kompleks Sungai Batu. The specific inventory on material of shrines was identified to be used in image processing. The complete methodology is shown in Figure 2.

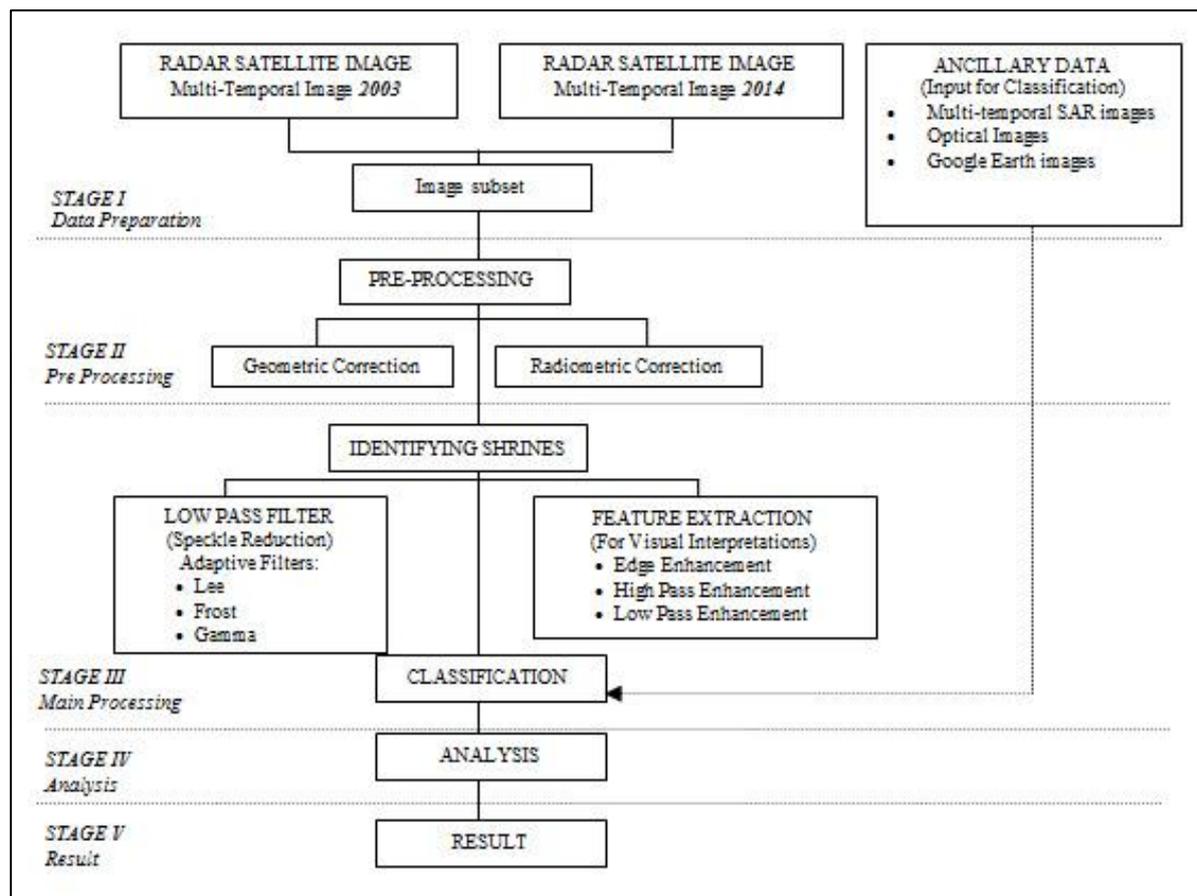
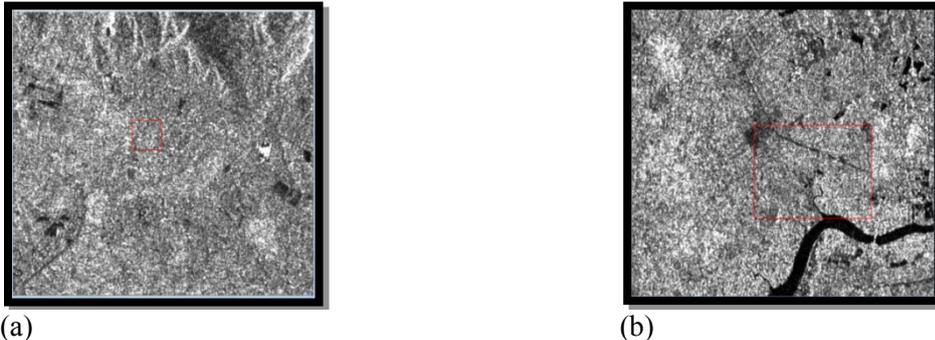


Figure 2: A Detail of RADAR Processing Images

## **Pre-Processing**

The image pre-processing and data preparation techniques are the first to be carried out; these include image rectification and subset. The image-to-map procedures have been applied to the Radar image using a set of ground control points area appeared in the same place both in the imagery and known locations in corresponding maps and urban plans used as ancillary information in the rectification process. The rectified data sets are then subset producing the two sets of specific study areas. The Radar satellite imagery shows the subset of study area with main shrine area located at Lembah Bujang and Kompleks Sungai Batu, Malaysia in multi temporal images: 2003 and 2014. The process was carried out via ENVI 4.8. The results of subset for three areas of study are shown in Figure 3:



(a) (b)  
Figures 3: Subset of study area for three study area of (a) Lembah Bujang; and (b) Kompleks Sungai Batu

## **ANALYSIS OF SHRINES IDENTIFICATION**

Local adaptive filter or smoothing techniques have been applied to radar imagery such as Lee, Frost and Gamma MAP filter. The advantage of adaptive filtering is its accuracy in estimating the backscattering coefficient inside homogenous (stationary) area while preserving edge and texture structure in non-stationary scenes. The performance of this proposed filter is evaluated and compared with the pixel intensity values such as enhancement of the images by using Research System tool; ENVI 4.8 as a method in RADARSAT digital images processing. Various window sizes and six of iterations  $3 \times 3$ ,  $5 \times 5$ ,  $7 \times 7$  and  $15 \times 15$  window sizes in order to fully understand the effects imposed by various window sizes and different number of iterations of each filter. Results below are the findings and details of the images after going through the filtering process.

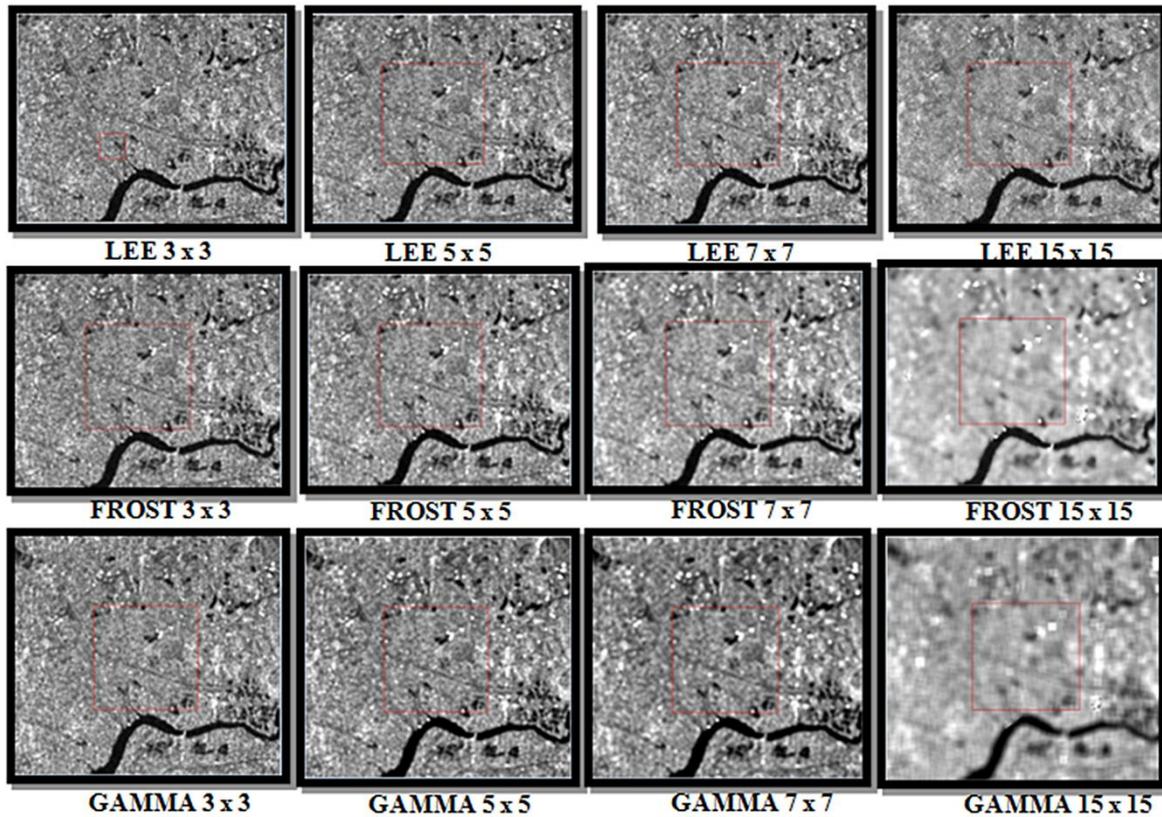


Figure 4: Result of Low pass filter image for different windows are tested for Lembah Bujang

The term ‘enhancement’ is used here to refer to the alteration of the appearances of an image in such a way that the information contained in the images become more readily interpretable by the viewer according of his/her needs. Four type of enhancement have been tested to compare the images appearances in the studies area. The result of Edge Enhancement in Lembah Bujang; and Sungai Batu imageries shows the equation with Kernel Size at Field to 5 and Applied Images Add Back Field to 90% per 100% with techniques Laplacian on convolution method. Same goes to high pass and low pass enhancement techniques, the value of kernel size is 5 and images add back field to 90% per 100%. This convergent study has provided refinements to the problem-solving process part of the detection of shrine area by using geospatial application technique in the heritage site. The increasing values of the window is related to the increasing brightness of the images. However, further studies in other filtering techniques can improve the radar images to minimise the speckle texture.

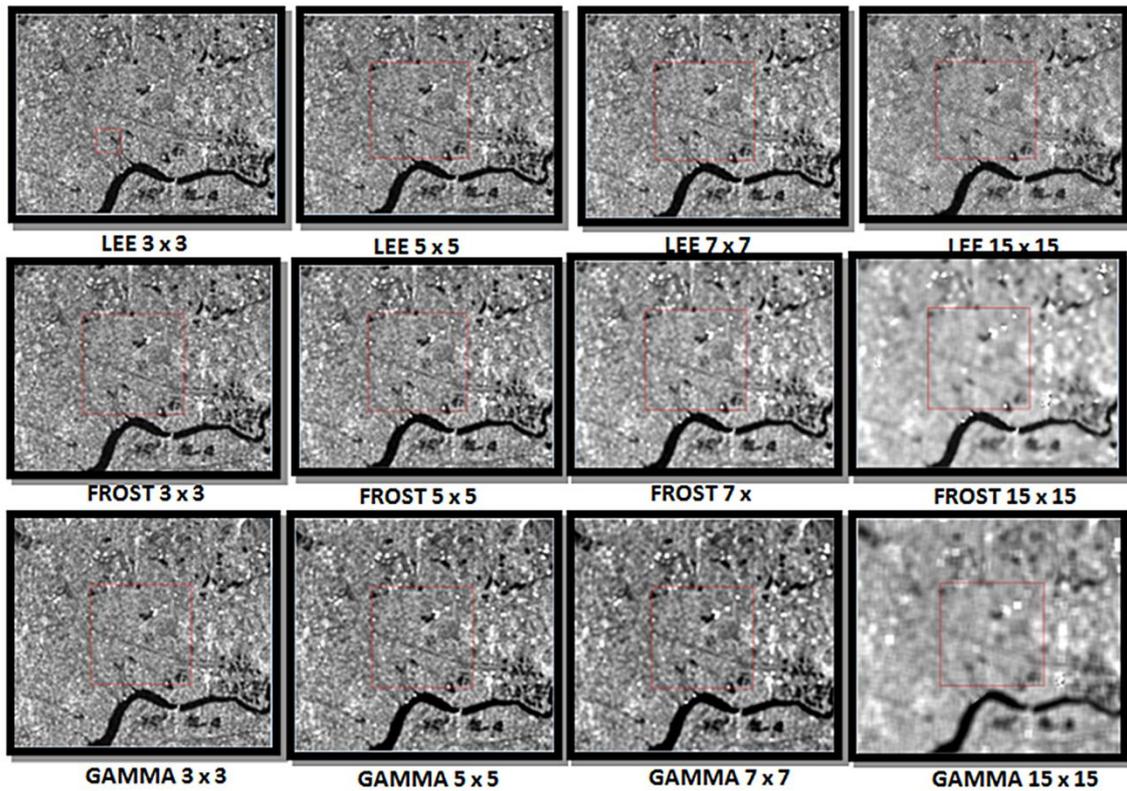


Figure 5: Result of Low pass filter image for different windows are tested for Kompleks Sungai Batu

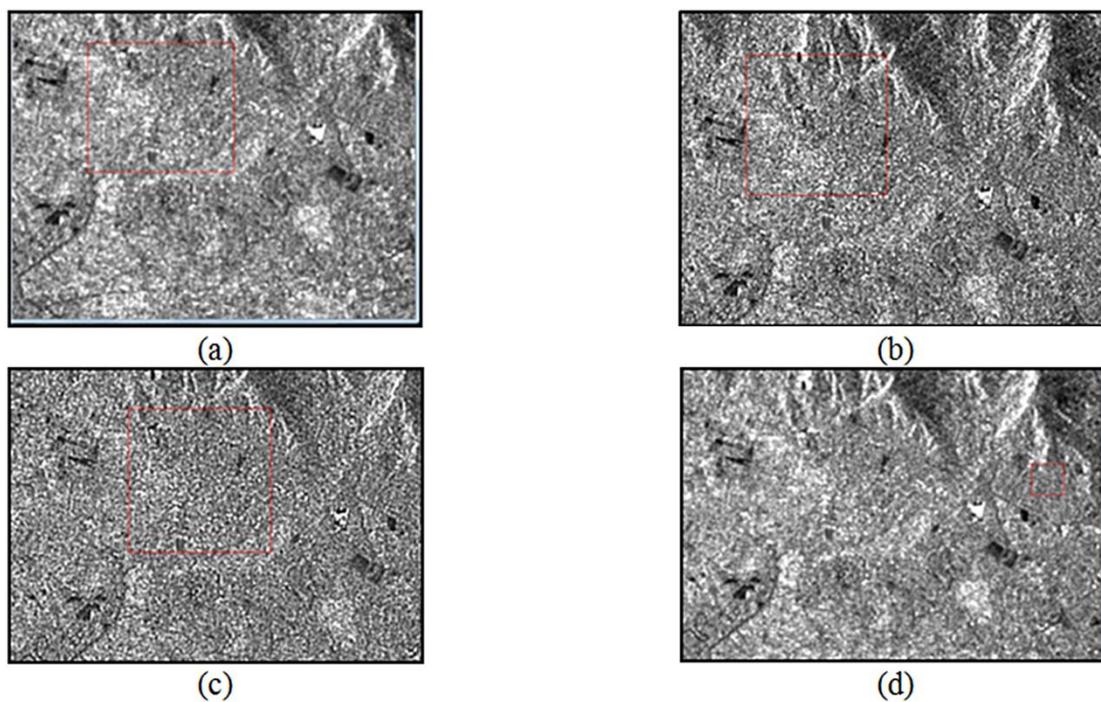


Figure 6: Result of Image Enhancement for different techniques are tested for Lembah Bujang a) Gamma Filtering 3x3, b) Edge Enhancement, c) High Pass Enhancement, d) Low Pass Enhancement

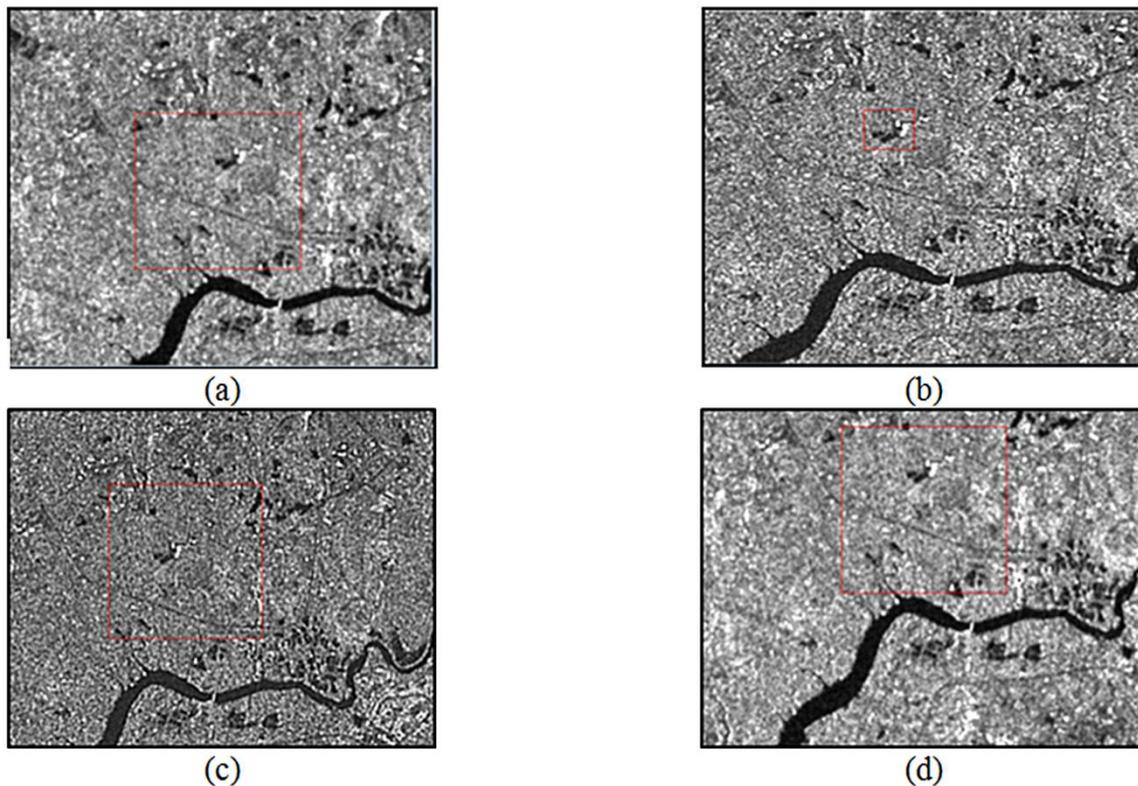


Figure 7: Result of Image Enhancement for different techniques are tested for Kompleks Sungai Batu a) Gamma Filtering 3 x 3, b) Edge Enhancement, c) High Pass Enhancement, d) Low Pass Enhancement

## CONCLUSION

The goal of our research is to demonstrate the multi techniques of image processing in attempt to identify shrine areas in heritage sites at Lembah Bujang at once to improve the existing tool of urban planning in preserving the historical sites. It shows that a radar image is one of significant tools as a support system and very competent in identifying a potential shrines areas. The future studies suggested here will provide a means for land use planning development by using the remote sensing technology in the significant site area especially on historical site.

## Acknowledgement

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## REFERENCES

- Ayuga, J.G.R., Mozota, F.B., Lopez, R. and Abadia, M.F. (2006). Application of Hyperspectral Remote Sensing To The Celtiberian City Of Segeda, in S. Campana and M. Forte (eds) *From Space to Place: 2nd International Conference on Remote Sensing in Archaeology*. Oxford: British Archaeology.
- Ben-Dor, Eyal, Portugali, Juval, Kochavi, Moshi, Shimoni, Michal and Vinitzky, Lipaz (1999). Airborne Thermal Video Radiometry and Excavation Planning at Tel Leviah, Golan Heights, Israel. *Journal of Field Archaeology*, 26(2), 117-127.

- Brivio, P.A., Pepe, M. & Tomasoni, R. (2000), Multispectral and multi-scale remote sensing data for archaeological prospecting in an alpine alluvial plain. *Journal of Cultural Heritage*, 1, 155–164
- Comer, D.C. (2003). Environmental History at an Early Prehistoric Village. An Application of Cultural site Analysis at Beidha, Southern Jordan, *Journal of GIS in Archeology*, 1,103-115.
- Evans, D., Pottier, C., Fletcher, R., Hensley, S., Tapley, I., Milne, A., Barbetti, M., (2007). A comprehensive archaeological map of the world's largest pre-industrial settlement complex at Angkor, Cambodia. *Proceedings of the National Academy of Sciences of the United States of America*, 104 (36), 14277–14282
- Grøn, O., & Loska, A. (2002). *Development of methods for satellite monitoring of cultural heritage sites*. Technical report, The Norwegian Directorate for Cultural Heritage, The Norwegian Space centre, NIKU. Oslo.
- Lyons, T.R. & Hitchcock, R.K. (1977). *Aerial Remote Sensing Techniques in Archaeology*. Reports of the Chaco Centre, No 2, US Department of the Interior, National Park Service, Cult Res Mgt Dew, Washington, D. C.
- Parry, J.T. (1992). The investigative role of Landsat TM in the examination of pre-proto-historic water management sites in northeast Thailand. *Geocarto Int.*, 4, 5–24.
- Sarah H.P. (2009). *Satellite Remote sensing for Archaeology*. Routledge, USA, Canada.
- Shennan, I., and Donoghue, D. (1991). Remote Sensing in Archaeological Research. *Proceedings of the British Academy*. 77, 223-232.

## **ENERGY EFFICIENT LIGHTING FOR BETTER ENVIRONMENT**

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**ABSTRACT:** Global overall energy consumption is rising. Along with it, a relative contribution is lighting energy. While existing light sources are reaching their limit of performance, LED-based light sources are however offering the potential to meet energy saving targets with their improving performance. In most buildings, the dominant light source is the fluorescent lamp. Although it is energy efficient, the total energy consumed is still significant, especially more so for public institutional buildings in Malaysia. This research studied the application of linear LED replacement tubes as the alternative retrofitting energy efficient solution to the existing fluorescent tubes in the International Islamic University Malaysia Main Library. The study assessed the potential to reduce energy consumption and consequently, the electricity bill but without reducing the performance. The methodology adopted the data collection technique through physical walk-through audit and an observational survey of the existing lighting situation. Using the Lighting Power Density (LPD) calculation methods from ASHRAE and IESNA, a recommended light level and cost analysis were undertaken. With the LED retrofit, the recommended lighting levels were established, and an annual savings of 33% was predicted in one academic building, with a return on investment period of less than two years.

*Keywords:* energy efficient, LED lighting, light retrofitting

### **INTRODUCTION**

Global lighting energy consumption is enormous, and the demand is rapidly increasing. Currently, more than 33 billion lamps operate worldwide, translating into 19% of the world's electricity consumption (de Almeida, et.al., 2013). With the skyrocketing electricity prices and mounting concerns about climate change have forced governments, policy makers and the global lighting markets to start to migrate and encourage consumers to energy efficient light sources, like LEDs. Historically, electrical light sources evolved from Edison's incandescent bulb to mercury vapor fluorescent lamp, metal halide up to high-pressure sodium lamps (Cole and Driscoll, 2014) and the latest addition are the light emitting diodes (LED). LED entered the market as a light source for general illumination in the early 2000s, but by 2006 it had improved and became competitive and popular in both residential and commercial applications. They are projected to dominate the light sources, thus rendering the traditional ones obsolete. Energy efficient LEDs are revolutionizing the energy sector of lighting with their extreme reliability and a much longer lifetime than all other light sources. As existing light sources approached their limit of performance, LEDs are offering the potential to meet energy saving targets with their rapidly improving performance. Upon this context, this article studied the applications of LEDs as a retrofitting solution to the existing fluorescent lighting system and assesses their potentials to reduce energy consumption and electricity cost with no adverse effects on performance. The study used the IIUM Main library as a case study.

### **AN OVERVIEW OF GLOBAL LIGHTING ENERGY CONSUMPTION**

Lighting accounts for more than 19% (or almost one-fifth) of the overall world electricity production where artificial lighting ranks at the top among the end-uses dominating global electric utilities. This phenomena entails greenhouse gas (GHG) emissions of an equally vast scale of 1,900 million tons of CO<sub>2</sub> annually, equivalent to 70% of the emissions of the world's lighter passenger vehicles (OECD/IEA, 2006 & IEA, 2010). The amount of electricity used for lighting in buildings differs according to the type of buildings. In some buildings, it is the largest single category of energy consumption. In the US, for instance, lighting in commercial buildings is the leading energy consumer with 25%, ahead of space cooling (13%) (U.S DoE, 2011).

## **LIGHTING ENERGY of UNIVERSITY BUILDINGS**

Globally, almost half of the global lighting electricity is consumed by the commercial sector/tertiary sector, where universities belong. This is estimated at 1,133TWh representing 43% of lighting consumption (DoE, 2011). The rest is distributed amongst the residential sector (with 811TWh or 31%); the industrial sector (with 490TWh or 18%,) and the outdoor stationary sector (with 218TWh or 8%). In institutional buildings, lighting energy consumption has an enormous impact on both financial and environmental interests. In the United States, the Department of Energy (DoE, 2011) notes that in a classic college or university, lighting represents 31% of the total energy use, making it the best targets for energy savings (E-Source Companies LLC, 2003). In another study by Mahlia, et.al (2011) it was observed that the lighting energy could consume up to 42% of the total energy supplied. However, as much as 30 to 50% of light energy plus 10 to 20% of cooling load can be saved after lighting retrofits. The increasing energy bills, environmental responsibility, financial constraints, aging infrastructures are all forcing institutions to re-examine and re-evaluate their energy consumption and other conservation demands. A recent study by (SchoolDude, 2013) shows that energy inefficient universities use up to three times more energy than energy efficient ones. Thus, as universities search for new financing mechanism, the next constant issue is adopting new energy efficient technologies that will save enormous amounts of money that could go toward improving educational programs and meeting other university needs.

### **Lighting Technologies**

The three landmarks in lighting technology are the Incandescent lamps (ILs); the Fluorescent lamps (FLs); and the Solid State Lighting (SSL). They all experienced various improvements over 120 years, but LED-based light products, which began few decades ago as just indicators, are now poised to become the most efficient light source ever created. LED is a Solid State Lighting (SSL) that is lighting that uses semiconductors to convert electricity into light (de Almeida et.al, 2014). LED consists of a number of layered semiconductor materials where electricity is directly converted into light particles called Photons. This requires less energy input, leading to its efficacy gains. There are two main types of SSL technology: the inorganic semiconductor-based LED and the polymeric-based organic LED (OLED). Both technologies are currently the subject of active research worldwide (The National Academy of Sciences, 2013).

Haitz and Tsao (2011) predicted that the exponential development of cost per lumen (i.e. unit of useful light emitted) and the amount of light per package of LED lamps could reach 200 lm/W in 2020, overtaking the 100 lm/W in 2010 (de Almeida et.al., 2014). de Almeida et.al. further maintained that this would be the case if enough industrial and government commitment were utilized for research on LED-based lighting products. The mounting evolution due to LED's development is attributed to the successful production of white light-emitting diode (WLED). This shifted the bulk adoption of LED lighting from the niche markets of traffic lights, signage, and displays to architectural lighting (which has the highest global revenue of 45% in the light industry) and automotive industry.

LED-based lighting products for the building industry are available in two forms. The first, called LED linear replacement, consist of light bulbs or lamps that can replace, one-for-one, an existing lamp without modification to the original luminaire or fixture. Thus, they are shaped like a fluorescent lamp. The second is an integrated style LED retrofit kit that is not shaped like a fluorescent lamp. It is a purpose-built luminaire, which has either an integral LED light source or a LED module that can be removed. To be retrofit, these would require complete removal and replacement of the luminaire (The National Academy of Sciences, 2013)

### **Retrofitting Fluorescent lamps with LED Tubes**

Lighting retrofit for an existing building is considered one of the most effective measures to reduce building energy consumption (Li, 2013). In the context of lighting products, Baynham and Stevens

(2014) explained that a retrofit is a product that is compatible with an existing system and which has an offering above and beyond what it replaces. Retrofitting presents an opportunity to take advantage of new technologies without incurring the need for full fitting replacement. In most cases, it involves a direct lamp replacement, requiring no rewiring or modification to the existing circuit. Through LED retrofitting projects, the US Department of Energy expected a potential energy savings of national electricity use by nearly half of its current total energy consumption by 2030 (U.S DoE, 2014). de Almeida et.al (2014) reported that the European Unions estimated 50% energy savings with progressive replacement of lamps with efficient LEDs in all sectors equating to a saving potential of 209TWh of energy, which translates into 77 million tons of CO<sub>2</sub>.

Positively, as a result of various geographical, political, and cultural factors, LEDs made even more substantial progress in Asian countries. McKinsey & Company (2012) reports that with Japan and China recording the highest penetrations, the value-based LED share in the regions' lighting market was over 10% in 2011. In Japan, for instance, lighting systems consumed 16% (the equivalent of 150.6TWh) of the total energy consumption. It is forecasted that if all incandescent and fluorescent lamps in Japan are to be replaced with LEDs, the overall energy consumption will be reduced by 9%, representing over 90TWh or 61% of the annual lighting electricity consumption. A simulation conducted by the Japan Electric Lamp Manufacturers Association found that the effect of this transition would be a reduction of 27 million tons of CO<sub>2</sub> annually (Center for Clean Air Policy, 2013; The Institute of Energy Economics Japan, 2011).

### **Previous Studies on Lighting Retrofitting**

Many studies have been conducted regarding retrofitting conventional light sources with the rapidly progressive LED technology (Uddin, et.al, 2011; Chen & Chung, 2011 & Ryckaert, et.al, 2012). In Finland, Sarvaranta (2011) analyzed the impact of using total LED lighting on energy savings and CO<sub>2</sub> reduction between 2020 and 2050. The author estimated that household lighting energy consumption could be reduced by 80% (from 2.4 to 1.9TW/a) in 20 years and with the corresponding decrease in electricity cost. The Institute of Energy Economics Japan (2011) conducted a field trial in 2008 to examine the feasibility of installing LED lighting into communal areas of social housing (i.e. stairwells, corridors, and common rooms usually illuminated 24 hours a day). They measured the performance, energy saving potentials, and maintenance of light levels of over 4,250 LED lamps across 35 different sites. It was found that LED lightings can significantly reduce energy consumption, lower cost of maintenance, and improved lighting in social housing. In another study by Edirisinghe (2012) the power consumption of T8 LED lamp with a FL is compared to a unit area of a building space, the result indicated a reduction of 40% when LED lighting was used. The LED technology is witnessing a swift development as compared to other traditional light sources starting from the 1879 Edison's first incandescent bulb. It clearly portrayed LEDs as having the highest potential. LEDs as the current lighting 'breakthrough' are set to help considerably to reduce consumption of energy compared to existing conventional light sources. They are also predicted to improve light quality and reduce maintenance costs. With the evidences on the energy savings potential with LED retrofitting, this study undertook to retrofit a library building in a university. A library building is the most lit and with the longest duration of lighting in any institution.

### **The Case Study: International Islamic University Malaysia (IIUM) Main Library**

The case study for this study is the IIUM Library at Gombak Campus, Kuala Lumpur. It was first established in 1983 with a small seating capacity. After three years, the library was added to five stories with the fifth level serving as a storage facility and not accessible to all. The library has a floor area of approximately 25,000 sqm, consisting of conducive environment with a seating capacity of over 2,000 users, 73 carrel rooms, 10 research rooms, 8 discussion rooms, 4 computer labs, 4 audio-visual viewing rooms, an auditorium and a multi-purpose room. The majority of the lighting technology employed at the IIUM Library building is fluorescent-based 36W T8 technology lamps with electronic ballast (93%). The lamps specifications are shown in Table 1.

**Table 4: Specifications of the existing lamps in IIUM & the proposed LED lamps**

Brand	Existing T8 FLs		Proposed T8 LED	
	Philips Lifemax		Philips InstantFit	
Type/color	T8 Linear bulb/Cool Daylight	Fluorescent	Linear LED (replacement)	T8
Product Title	TL-D Standard ISL	36W/54-765	14.5T8/48-4000IF 10/1	
Lamp wattage	36W		14.5W	
Lamp efficacy	72 lm/W		103lm/W	
Lumen output	2600lm		1,500lm	
Color temperature	6200K cool daylight		3000K - 5000K	
Lifespan	13,000 hours		50,000 hours	
Ballast Loss/Wattage	Electronic/8W		-	
Hours of use per day	14 hours		14 hours	
Days of use per week	7 days in a week		7 days in a week	

**Analyzing the Efficiency of the Existing Light**

To appraise the energy efficiency of the existing lighting system, the Illuminating Engineering Society of North America (IESNA) Handbook, American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) Standard 90.1 and Malaysian Standard (MS 1525:2014) will be used as reference guide. They provide the codes and legislation used for designing and installing lighting systems in building. They also set the maximum allowable Lighting Power Density (LPD) in W per m<sup>2</sup> (or W/ft<sup>2</sup>) and the average maximum illumination levels in Lux (lx) required. The energy used per square meter, called Lighting Power Density (LPD) is first calculated. It is a screening measure that indicates whether a space offers the opportunity for energy savings or not. LPD is found by dividing the total wattage (W) of the fluorescent tubes in a particular area by the floor area (m<sup>2</sup>/ft<sup>2</sup>). Next is to note the average illumination levels at task point of the different locations of the selected spaces using a handheld Lux Meter. Comparing the calculated and recommended LPD for the selected spaces (Table 2), it is clear that the existing lighting is not effective in terms of energy efficiency. It is so because, while most of the measured average illumination levels fall below or within the range of the recommended lux levels, the LPDs did not conform to the approved standards. In all spaces, it is higher than the recommended intensities. This confirmed the basis for the integration of the latest energy efficient lighting technology that will have effective LPDs, thereby reduce energy consumption, save energy and provide optimum performance.

**Table 5: Comparing Measured & Recommended Lux Levels and LPD**

Floor	Space	Measured Lux (lx)	Recommended Lux (lx)	Calculated LPD (W/m <sup>2</sup> )	Recommended LPD (W/m <sup>2</sup> )
1 <sup>st</sup> Floor	Reading & Bookshelves	403	300 – 500	17.8	13
	Photocopy	182	100	12.5	5
2 <sup>nd</sup> Floor	OPAC	412	300 – 500	22.5	13
	Leisure study	403	150	17.1	6
	CS Division	309	300	26.8	11
3 <sup>rd</sup> Floor	Reading & Bookshelves	490	300 – 500	21.1	13
	Thesis collection	321	300 – 500	18.0	13
4 <sup>th</sup> Floor	Reading & Bookshelves	401	300 – 500	47.4	13
	Meeting room	215	300	23.3	14

### Lighting Energy Audit

To conduct an extensive lighting energy audit, the first step is to assess the existing lighting setting in terms of energy consumption by the type of light bulbs. The calculation of the energy consumption is based on the real measurement of the wattage input consumed by all existing fluorescent tubes in the library. Thus, the lighting system total power, overall energy consumption, and total energy cost of existing fluorescent lamps were found using the procedures employed in U.S. Department of Energy, (2010) and are tabulated in Table 3.

Equation 1: Total power (kW) consumed for lighting in the library;

$$\text{Existing lamp wattage } (W) \times \text{Number of lamps}$$

Equation 2: Total energy (kWh/year) consumed by existing lighting annually:

$$\text{Total power consumed by luminaire } (W) \times \text{Hrs of use per day} \\ \times \text{Day of use per week} \times \text{Weeks of use per year}$$

Equation 3: Total energy cost (RM) annually for operation of the existing light in the library:

$$\text{Total energy consumed } (kW \text{ per yr}) \times \text{energy cost } (\text{sen per kWh})$$

Equation 4: Total energy savings: The energy saving (ES) will be the difference between the energy consumption (EC) of existing fluorescent lighting ( $EC_{existing}$ ) and that of the retrofitting linear LED lighting ( $EC_{retrofitting}$ ) system. The following relation will be employ:

$$ES = EC_{existing} - EC_{retrofitting}$$

**Table 6: Number of FLs and Overall Lighting Power Consumption in the Library**

Floor/Space	Fluorescent type	
	36W 4ft	18W 2ft
1 <sup>st</sup> Floor	2,018	265
2 <sup>nd</sup> Floor	1,283	102
3 <sup>rd</sup> Floor	1,899	104
4 <sup>th</sup> Floor	2,361	133
<b>Total No.</b>	<b>7,561</b>	<b>604</b>
	<b>272,196</b>	<b>10,872</b>
Total Power Consumed (kW)	<b>283.07</b>	
Total power plus Ballast power (kW)	<b>348.388</b>	
Total energy consumption (kWh)	<b>1,775,385.248 per year</b>	
Total energy cost (RM)	<b>RM 648,015.616 per year</b>	

The preceding calculations indicate the cost spent on lighting energy consumption for the overall 8,165 fluorescent tubes currently used at the IIUM Library building which is approximately RM650,000 annually. Recent electricity bill obtained from Development Division shows that the entire university (Gombak Campus only) is paying RM26,820,000 on electricity per year.

### Comparing the Existing FL with the Proposed LED Lighting Systems

According to Owano (2014), Philips is one of the world's largest manufacturers of light bulbs and innovators in LED lighting and the InstantFit LED T8 is the world's first LED replacement tube that requires no rewiring. Hence, for this study, the LED T8 lamp model was chosen, as the proposed retrofit option is the Philips InstantFit LED Lamp. It is considered to have an ideal energy saving choice for existing linear fluorescent fixtures. Table 4 shows that retrofitting existing fluorescent tubes with InstantFit linear LED tube will actually reduce energy consumption and subsequent electricity bill of IIUM.

**Table 7: Cost Comparison between Existing FLs & Proposed LED Light**

	<b>Existing Light: FL tube</b>	<b>Proposed alternative: LED tube</b>
No. of Lamps required	7,561	7,561
Price (RM) per unit	4.5	88.00
Lifespan (hours)	13,000	50,000
Power Consumed per fixture (W)	44	14.5
Total Power Consumed (kW)	332.684	109.64
Total Energy Consumption (kWh) per annum	1,695,174.21	558,697.41
Energy Cost (RM)	618,738.59	203,924.56
<b>Energy Savings (RM) annually</b>	<b>414,814.03</b>	

For this particular study, 14.5W Philips InstantFit Linear LED tube was chosen as the proposed candidate. Although the cost is 17 times higher than existing FLs, it consumes three times less wattage and has almost four times longer lifespan. Thus, with the current electric utility rate of RM 0.365, if the existing fluorescent lamps at the IIUM Library are replaced with the proposed LED light, 1.14 million kWh of energy will be saved annually. This translates to an approximate sum of RM 415,000 saved, annually. The energy consumption for lighting is only 0.76% of the total energy cost of the campus, as against 2.5% of the current consumption for lighting.

#### **Simple Payback Period (spp)**

The simple payback period (SPP) was determined using the following relations (Zakaria, 2014), as follows:  $SPP = CI / (AEC_{old} - AEC_{new})$ ; where CI (Cost of Investment, including installation cost) is RM778,783.00, assuming installation cost is RM10 per lamp. The difference in AEC (annual energy consumption) value is RM414, 814.03.

Thus,  $SPP = 778,783 / (414,814.03)$

$SPP = 1.88$  years

#### **CONCLUSION**

The calculation of the lighting energy for the existing and the proposed InstantFit LED tube was undertaken based on the 14 hours per day and seven days per week operation usage. Table 4, shown previously, summarizes the calculated amount and value of energy savings to be generated when the existing lights are retrofitted with energy efficient InstantFit LED lights. The return on investment period, was found to be less than 2 years (22 months) when calculated in simple terms of comparing the total cost of the InstantFit LED fittings against the energy they save. This illustrates that the LED lighting will return its original investment cost in less than two years, far less than the approximate lifetime of the InstantFit LED retrofit. The financial value of these savings is approximately RM415, 000 annually, with an energy savings of 1.14 million kWh per annum by the new LED lighting. This result illustrates the efficiency and effectiveness of LED lighting as an energy saving measure.

With anticipated falling prices of LEDs, the technology will soon save billions in energy and maintenance cost across the globe. LED-based lights are thus, the answer to producing real and significant energy savings and actually reduce electricity bill at IIUM. Implementing this study will provide tremendous financial benefits that will quickly affect the lighting energy efficiency value of IIUM, in particular, and confirm its commitment towards becoming a more sustainable university worldwide.

## REFERENCES

- Baynham, M., & Stevens, M. (2014). Are we planning effectively for climate change? An evaluation of official community plans in British Columbia. *Journal of Environmental Planning and Management*, 57(4), 557-587.
- Center for Clean Air policy (2013). *Encouraging Demand-Side Energy Efficiency through the Eco-Point Program*.
- Chen, N. & Chung, H.S. (2011). A Driving Technology for Retrofit LED Lamp for Fluorescent Lighting Fixtures with Electronic Ballasts. *IEEE Transactions on Power Electronics*, 26(2), 588–601.
- Cole, M. & Driscoll, T., 2014. The Lighting Revolution : If We Were Experts Before, We're Novices Now. *IEEE Trans. Ind. Appl.*, 50(2), 1509–1520.
- de Almeida, A., Santos, B., Paolo, B. & Quicheron, M., (2014). Solid state lighting review - Potential and challenges in Europe. *Renewable & Sustainable Energy Reviews*, 34, 30–48.
- de Almeida, A., Zissis G., Quicheron M., & Bertoldi P., (2013). *Accelerating the deployment of Solid State Lighting (SSL) in Europe*. European Union, Italy.
- E-Source Companies LLC (2003). *Managing Energy Costs in Colleges and Universities*.
- Edirisinghe, U. A. (2012). *Study to evaluate the effectiveness of lighting system by using LED technology in Commercial buildings*. University of Vocational Technology, Sri Lanka.
- Haitz, R., & Tsao, J. Y. (2011). Solid-state lighting: 'The case' 10 years after and future prospects. *physica status solidi (a)*, 208(1), 17-29.
- IEA (2010). *Guide Book on Energy Efficient Electric Lighting for Buildings: Summary Report*. Finland.
- Li, K., (2013). *Integration of HVAC System and LED Based Luminaires*. Eindhoven University of Technology.
- Mahlia, T. M. I., Razak, H. A. & Nursahida, M. A. (2011). Life cycle cost analysis and payback period of lighting retrofit at the University of Malaya. *Renewable & Sustainable Energy Reviews*, 15(2), 1125–1132.
- Mckinsey & Company (2012). *Lighting the Way: Perspectives on the Global Lighting Market*.
- OECD/IEA (2006). *Light's Labour's Lost: Policies for Energy-efficient Lighting*. France: IEA Publications.
- Owano, N., (2014). *Philips eases switching fluorescent tubes with LED replacements*.
- Ryckaert, W. R., Smet, K. A. G., Roelandts, I. A. A., Van Gils, M. & Hanselaer, P., (2012). Linear LED tubes versus fluorescent lamps: An evaluation. *Energy and Buildings*, 49, 429–436.
- Sarvaranta, A. (2011). *Impacts of new lighting technologies on reducing energy use and CO<sub>2</sub> emissions in Finland during 2020-2050*, Aalto University.
- SchoolDude (2013). *SMART THINKING: 12 Steps Forward to Reducing Energy Consumption at Colleges and Universities*.
- The Institute of Energy Economics Japan (2011). Electricity Saving Potential of LED Lighting, *IEEJ*, June 2011, 1–4.
- The National Academy of Sciences, (2013). *Assessment of Advanced Solid State Lighting*.
- Uddin, S., Shareef, H., Mohamed, A., Hannan, M. A. & Mohamed, K. (2011). LEDs as Energy Efficient Lighting Systems : A Detail Review. *IEEE Student Conference on Research and Development*.
- US, Department of Energy (2010). *Exterior Lighting Guide for Federal Agencies*. California.
- US, Department of the Environment (DoE) (2011). *Linear Fluorescent Replacement Lamps*.
- US, Department of the Environment (DoE) (2014). *DOE Solid-State Lighting: Modern Investments, Extraordinary Impacts*.
- Zakaria, M. H. (2014). *Energy and Economical Impact Analysis of Low Energy Lighting of Cameron Smail Building In Heriot Watt University*. Heriot-Watt University, Edinburgh, UK.

## **TREEMAP ALGORITHM FOR DYNAMIC STORMWATER INFILTRATION MOVEMENT INTO SOIL SURFACE**

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**ABSTRACT:** Plenty of researches have been carried out focusing on the real time movement of objects such as the movement of animals, humans, vehicle, clouds and water. However, real time movement of water in soil particles that leads to other natural processes (landslides and soil erosion) should be emphasized and given adequate attention through 3 Dimensional (3D) modelling of this event to provide prediction and analysis. To date, 3D research has focused on city models and Building Information Modeling (BIM) but studies that involve 3D modelling of natural processes (movement of air and fluid) is rare. Water flows in many directions and it is most suitably represented in form of 3D. Applying 2 Dimensional (2D) tools to 3D situation limits the scientist works in many ways in terms of understanding, viewing and analysing. 2D model focuses solely on x axis (horizontal) and y axis (vertical). This research applies tree algorithm to model a dynamic stormwater infiltration movement spatially that flow through the soil by additional z axis which represents the depth of the soil. Tree algorithm is used to re-class and provides hierarchical depth of the soil where the depth are divided into five hierarchies (40cm, 80cm, 120cm, 160cm and 20cm) based on subsurface flow wetting range. Required information concerning rainfall and soil types were translated into a model based on the infiltration process occurred at the study area. Although most of the previous studies use Tree algorithm for 2D analysis, this study highlights the capability of the algorithm in 3D analysis by producing hierarchy for soil depth.

*Keywords:* 3 dimensional, indeterminate spatial extend, fluid flow, Tree algorithm

### **INTRODUCTION**

Briefly, landslide in Malaysia usually occurs on the cut slopes or embankments along the highways or road in hilly area and in residential area and high-rise apartment that cause death (Pradhan and Lee, 2009). Field investigation by Matori et al. (2012) has proven that most of landslide occurred in Cameron Highlands happened along the road where surrounding slopes are cut or modified. Flash floods and tropical rainfall are the main trigger of landslide in Malaysia where they trigger failure of the rock surface along joint, fracture and cleavage planes (Pradhan and Lee, 2009). The research on new model development done by Chan (1998) suggest the need to obtain the most accurate result in landslide hazard analysis. Accurate results are needed in landslide hazard analysis to attain the best prediction models essential for evacuation and warning system since landslide that occurs along the highways, residential and developed areas can leads to life threatening situations and fatality. Malaysian Government is paying serious attention on this matter by launching a program - National Slope Master Plan in 2009. However, there are still on-going development that leads to environmental destruction and hillslope instability. The crucial landslide triggering factor is the movement of water in the soil due to rain. As the water that move through the soil effect the soil surface changes, this study focuses on representing the process in 3D by maintaining the interest of spatial GIS. GIS's strengths have made it an almost compulsory tool in assessing landslide hazard and risk (Westen, 2004). During National Geospatial Information Symposium 6 (NGIS6), Mamit (2014) mentions that GIS technique is vital for sustainable management of natural resources for expedient and accurate decision-making. Tree algorithm technique adopted to divide the depth of the soil allows the modelling of fluid spread gravitationally deeper into the ground. The idea was translated into a model by using 3D GIS technique where the locations of the flow become a concern. This paper highlights two main objectives which are to identify the algorithm that best represent fluid flow movement in soil due to stormwater and to design the flow movement pattern of fluid that distribute deeper into the ground in the form of 3D model.

## **TREEMAP ALGORITHM FOR STORMWATER MODELLING**

Precipitation is the main source that triggers stormwater that flow as surface runoff, retain in the soil, infiltrate in the soil as subsurface flow or flow down to the groundwater. The infiltration of stormwater into the soil involves fluid movement in the porous media of soil. Pores in the soil allow water infiltration into deeper layer of soil. On high rate of precipitation, the infiltration rate becomes higher and cause excessive movement of water in soil that lead to changes happen on the surface terrain such as road crumbling, soil erosion, flood and landslide. The movement of stormwater that infiltrate the soil is due to gravitational and capillary forces. However, this study only focus on gravitational force and concentrate on the movement of water infiltration downward which produces subsurface flow.

Treemap was previously used to divide the region to visualize and navigate hierarchy on map (Auber et al., 2013). However the division of hierarchy is based on the representation of repartition of tax money in the US over time shown in ordinary map. This study adopted the same tool but Treemap is instead used to distinguish hierarchy for specific group of data to segregate the soil layer depth. The soil layer depth segregation is required to show the flow water movement of infiltration process where the water move from soil surface to deeper layers. Treemap in this study is modified to represent the hierarchical information of soil that is divided into six ranges of 0 cm, 40 cm, 80 cm, 120 cm, 160 and 200 cm according to the wetting range of subsurface soil.

Space Filling-curve (SFC) is used to store and retrieve multidimensional data in a spatial database. A few changes on Gosper's curve is required (including the flow pattern and Voronoy shaped volumetric polygon) to present a dynamic flow of stormwater infiltration in this study. Gosper's curve provides a pattern of soil water movement in the soil. GIS software is able to represent 2D spatial features. However, it cannot support dynamic and probabilistic model. Data represented visually enable readers to comprehend the content faster than those represented in the form of text (Kamada and Kawai, 1991). Moving from 2D to 3D landscape is suggested by Raper (2000) that provide valuable step to the end users. Precipitation and infiltration are real time data that require integration of GIS and 3D model to show the actual model based on temporal data. The best way to represent the indeterminate spatial extend of stormwater infiltration is through 3D modelling.

## **STUDY AREA**

The study area for this research is located at N 5° 35' 24.27'' and E 101° 20' 34.25'' at East West Gerik-Jeli Highway heading to Kelantan. The slope circled in Figure 1 show the exact location of the research. On last December 2014, there was an incident where the road slide down due to heavy rainfall. Ongoing monitoring is conducted to detect any changes on the surface of the terrain due to high rate of precipitation. The soil type of this area is clayed and located at the area of high risk soil erosion as reported by the Department of Agriculture Malaysia.

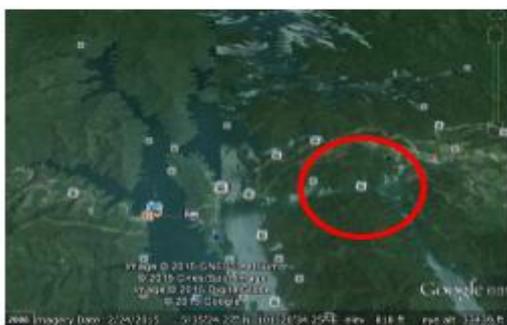
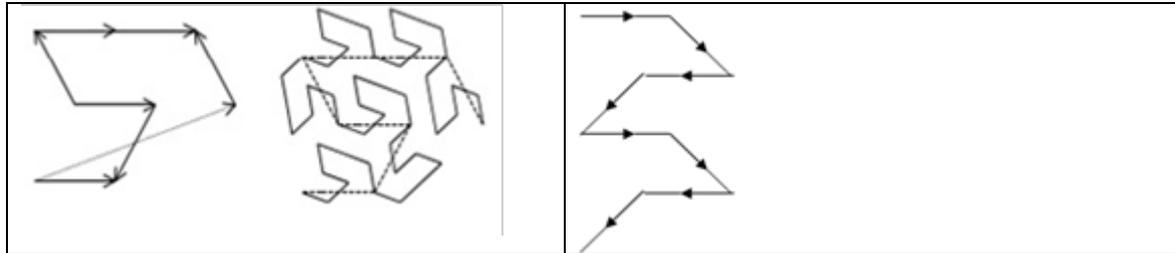


Figure 1: The study area located at East-West, Gerik-Jeli Highway  
Source: Google Earth, 2015



angle and axiom with 3D SWI Curve but with different shape and replacement rule. The shape of 3D SWI curve will never repeat upward as it follows the rules of soil water gravitational force. Thus the curve and flow of water will flow deeper into the ground until it reaches the level of soil wetting point.



Angle: 60°

Axiom : AB

Replacement Rule:

$$\begin{aligned} A &\mapsto A - B - -B + A + +AA + B - \\ B &\mapsto +A - BB - -B - A + +A + B \end{aligned}$$

Gosper curve

Angle: 60°

Axiom : AB

Replacement rule:

$$A \mapsto A + B - A - B + A + B - A - B$$

3D Soil Water Infiltration Curve (3D SWI Curve)

Figure 4: Comparison of Gosper curve with 3D Soil water Infiltration Curve

## RESULTS

This study applies Treemap algorithm that is usually used to explain 2D analysis is able to represent the fluid movement in form of 3D. By using the pattern of 3D SWI Curve, this model provides flow path with nine nodes where every node comprises 12 non-overlapping Tetrahedral Network (TEN) (see Figure 5). This non-overlapping TEN acts as a smaller volume of soil in the nodes that gives a more realistic soil water flow direction path where the TEN has specific volume of water that can be occupied. The water flow from node 1 to node 9 but the location of water stop flowing depending on the rate of rainfall. All data stored in the database and the fluid movement depends on the changes of the real time data.

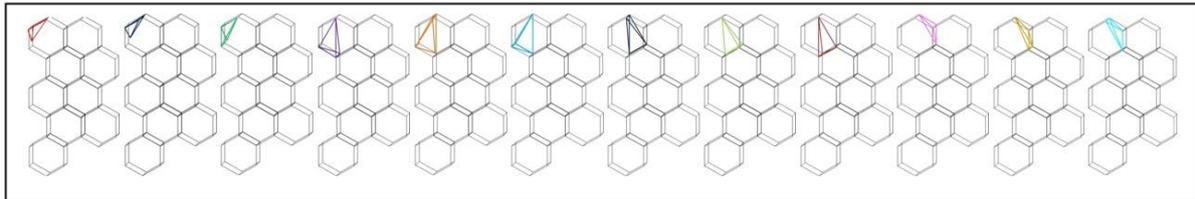


Figure 5: Node that comprising of 12 non-overlapping Tetrahedral Network (TEN)

The water that infiltrate the soil will partially remain in the soil and the rate depends on soil type. The water that infiltrate and remain in the soil is measured to calculate the volume of water that accumulate as subsurface flow that later will flow out towards downhill. The remaining water that successfully flows down until node 9 is collected to calculate the overall volume of subsurface flow. The rate of infiltration of water in porous media of soil is calculated using Horton equation (Horton, 1933):

$$f_t = f_c + (f_0 - f_c)e^{-kt}$$

Where:

$f_t$  infiltration rate at time  $t$

$f_0$  initial infiltration rate or maximum infiltration rate

$f_c$  constant or equilibrium infiltration rate after the soil has been saturated or minimum infiltration rate

$k$  decay constant specific to the soil

The final output of the research is shown in Figure 6. The yellow and brown nodes represent one of the flow paths underneath the surface terrain. Three different colours indicate the different soil depth

of nodes. Black rectangle represents surface terrain. This model is created based on soil water infiltration due to gravitational forces. Capillary forces are not included in this study.

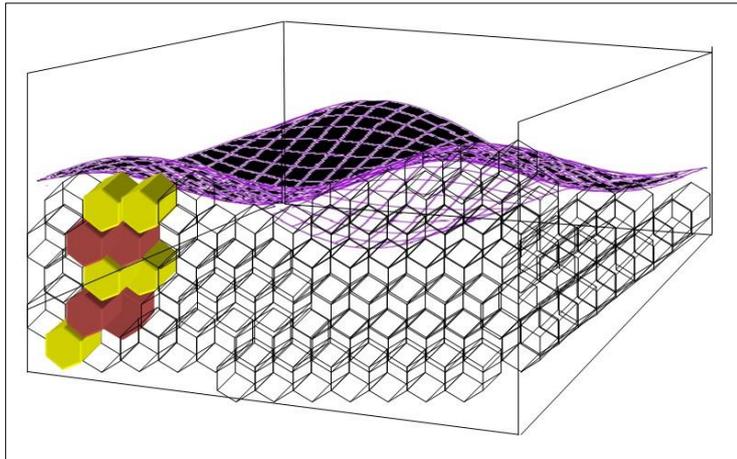


Figure 6: The final output of soil water infiltration movement model

## CONCLUSION

In conclusion, indeterminate spatial extent (stormwater infiltration movement) is appropriate and suitable to be represented in form of 3D models because this process occurs underneath the earth surface and requires better understanding and representation. The current available patterns can help in representing any other type of movement. However, the stormwater infiltration movement that flow downwards needs a pattern that can represent the movement according to its nature that flow down due to gravitational force. By applying Tree algorithm and 3D SWI Curve, it will ease future analysis and prediction on stormwater infiltration process.

## Acknowledgement

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## REFERENCES

- Asano, T., Ranjan, D., Roos, T., Welzl, E. & Widmayer, P. (1997). Space-filling curves and their use in the design of geometric data structures. *LATIN '95 Proceedings of the Second Latin American Symposium on Theoretical Informatics*. 36-48.
- Auber, D., Huet, C., Lambert, A., Renoust, B., Sallaberry, A. & Saulnier, A. (2013). GosperMap: using a Gosper Curve for laying out hierarchical data. *IEEE Transactions on Visualization and Computer Graphics*. 19(11), 1820–32.
- Chan, N. W. (1998). Responding to landslide hazards in rapidly developing Malaysia: a case of economics versus environmental protection. *Disaster Prevention and Management*. 7(1), 14-27.
- Horton, R.E. (1933). The role of infiltration in the hydrologic cycle. *Transactions. American Geophysical Union*. 14, 446–460.
- Kamada, T., & Kawai, S. (1991). A general framework for visualizing abstract objects and relations. *ACM Transactions on Graphics*, 10(1), 1–39.
- Mamit, J.D. (2014) . Application of Geospatial Technologies for Natural Resources and Environmental Management in Malaysia. *6th National Geospatial Information Symposium (NGIS)*, Putra Jaya.
- Matori, A. N., Basith, A., & Harahap, I. S. H. (2012). Study of regional monsoonal effects on landslide hazard zonation in Cameron Highlands, Malaysia. *Arabian Journal of Geosciences*, 5, 1069–1084.

- Pradhan, B., & Lee, S. (2009). Regional landslide susceptibility analysis using back-propagation neural network model at Cameron Highland, Malaysia. *Landslides*, 7, 13–30.
- Raper, J. (2000). *2.5-and 3-D GIS for coastal geomorphology*. Marine and Coastal Geographical Information Systems.
- Westen, C. J. Van. (2004). Geo-Information tools for Landslide Risk Assessment . An overview of recent developments. *Proceedings of the 9th International Symposium on Landslides*, 39–56.

## **THE INFLUENCE OF SURFACE RUN-OFF TO 3D SLOPE STABILITY ANALYSIS FOR RAINFALL INDUCED LANDSLIDE**

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**ABSTRACT:** Expansion of urban and recreational developments in hilly areas has resulted in increasing number of residential, commercial properties and infrastructure that is threatened by landslides. A three dimensional (3D) slope stability analysis has emerged recently due to its capability of capturing complex terrain shape in more realistic manners, rather than two-dimensional (2D) approach. The Hovland method is one of the 3D slope stability analysis widely used due to its simple algorithm and practical engineering application. Previous studies have proposed modifying Hovland's method and integrating it with Geographic Information System (GIS) software to make it practical to be used in a real environment. However, scarce attention has been paid to improve 3D slope stability analysis and to take into account the influence of rainfall induced landslide. This is due to the dynamic behaviour and complex parameters involved. For regions with tropical climate like Malaysia, the study of rainfall induced landslide is crucial due to the many landslide incidents triggered by heavy rainfall. This paper seeks to address this problem by adding the rainfall factor as input to Hovland 3D slope stability analysis in the form of pore water pressure. Rainfall volume can be transformed into infiltration and surface runoff, such as the Infiltrated Excess Overland Flow (IEOF) and Saturated Excess Overland Flow (SEOF). This study only focuses on SEOF as a dynamic variable by using the Topographic Wetness Index (TWI) and Green-Ampt as input for SEOF equation and SEOF later used in pore water pressure computational replacing static water table level. The result of this research is an improved Hovland 3D slope stability analysis method by integrating SEOF factor in the calculation.

*Keywords:* rainfall, landslide, slope stability

### **INTRODUCTION**

In recent years, there have been rapid growth of world's population living in urban areas. According to World Urbanization Prospect 2014 by the United Nations (2014), 3.9 billion people of the world population resides in urban areas in 2014 and the percentage is increasing over the time, especially in developing countries (Eltayeb Elhadary and Samat, 2012) including Asia (Department of Economic and Social Affairs, 2014). Malaysia is one of the developing countries has similarly achieved a high level of urbanisation (Mazlan, 2014). The United Nations estimated that nearly 86 per cent of Malaysians will live in cities by 2050 (United Nations, 2014). However, the major problem that comes with rapid growth is serious consequences to human lives and environmental degradation. The high development density in the urban area has created pressure to expand development to the hillside or hilly area to satisfy demands of urban inhabitants such as residential, commercial properties and infrastructure (Anderson et al., 2014; Di Martire et al., 2012). The major implications arising from the exploration on the hillside is weakening slope, and the high intensity and extreme of rainfall events can cause excessive environmental problems, such as landslides (Di Martire et al., 2012; Saadatkah et al., 2014).

Landslides were ranked third among natural hazards that threaten human lives all over the world (EM - DAT, 2011) and in Malaysia. This hazard is the second most destructive disaster after flood and it directly affects the environment and infrastructure, and causes economic losses and a large number of casualties. Malaysia has a hot and humid tropical climate with high humidity and copious rainfall, particularly during the two monsoon seasons, first monsoon between November to January and second monsoon between April to May and dry season between June to September (Matori et al., 2012). Based on the Public Work Department of Malaysia data (2009), between 1973 and 2007, 440 landslide events occurred and caused a total of 31 fatalities in Malaysia. The total economic loss was about RM 3 billion. Heavy rainfall plays a key role as the hydrological triggering mechanism on man-

made slopes in most of the landslide incidents (Othman et al., 2012). Recent developments in the field of the landslide have led to a renewed interest in enhancing slope stability analysis. Several studies have improved the practicality of slope stability analysis by taking advantage of the modern Geographical Information System (GIS) software, as implemented by Mergili et al. (2014), Shen et al. (2012), Thiebes et al. (2013), and Zheng and Yang (2011). However, the implementation of slope stability analysis currently fall short in the dynamic aspects where dynamic factors such as surface run-off are not considered in the safety factor computation (Luo et al., 2015). The aim of this study is to propose a spatio-temporal approach to analyse the influence of surface run-off to the slope stability and the integration of the surface run-off model and 3D slope stability (Hovland method) within the GIS environment.

## **METHODOLOGY**

### **2D Slope Stability vs 3D Slope Stability**

During heavy rainfall events, water infiltration into the soil will increase the pore water pressure, thus diminishing the ratio of porosity and permeability. The shear strength of the slope reduces when the pore water pressure reaches a critical point, causing slope instabilities and lead to landslides (Hamdhan and Schweiger, 2011). This mechanism plays a key role in slope stability. Initially, slope stability was performed using two-dimensional (2D) approach. Although the actual topography is three-dimensional (3D), the slope stability analysis usually have to be performed using 2D structural model due to its simplicity (Spencer, 1967). This method assumes the slopes to be symmetric and infinitely long in the third dimension. This oversimplification of methods resulted in inaccurate results which failed to represent the reality. Various optimisations of the structural model had been developed to overcome this deficiency, but improvements are still to be seen.

Evolution towards 3D slope stability has emerged in recent literature due to its capacity to handle complex terrain shape in a more realistic manner, as compared to 2D slope stability approach as shown in Figure 1. Past researches indicate that 3D analysis of slope stability generally provide more accurate result than 2D analysis (Hicks et al., 2014). Hovland (1977) appears to be the first to analyse a 3D slope stability using the column method which is the most popular method. Lam and Fredlund (1993) and Ahmed et al. (2012) state that the reasons for its popularity is due to its ability and high feasibility for practical engineering applications.

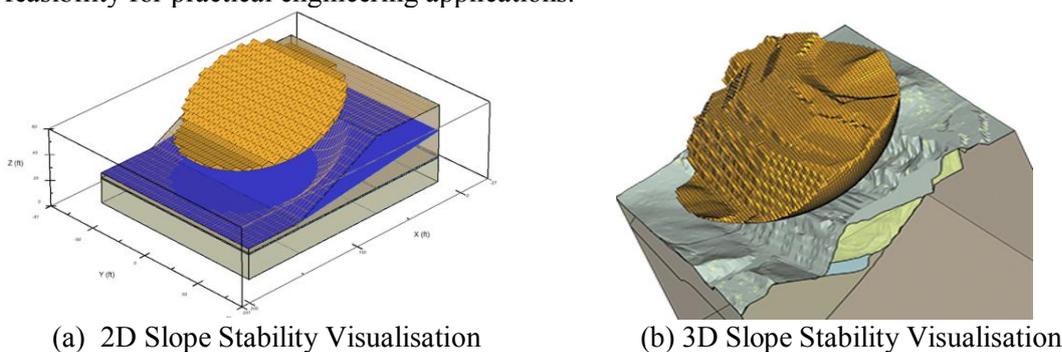


Figure 1: Visualisation between 2D and 3D Slope Stability  
Source: SoilVision.com, 2015

### **Hovland 3D Slope Stability**

Hovland is a 3D slope stability method based on an extension of Fellenius 2D slope stability. Instead of using slices as in the 2D slope stability, Hovland uses columns. The normal and shear force components in Hovland are derived from column weight and simplify external and internal forces of the standard column model by ignoring all inter-column forces on the sides of the columns as well as pore-water pressure (Kalatehjari and Ali, 2013) as shown in Figure 2.

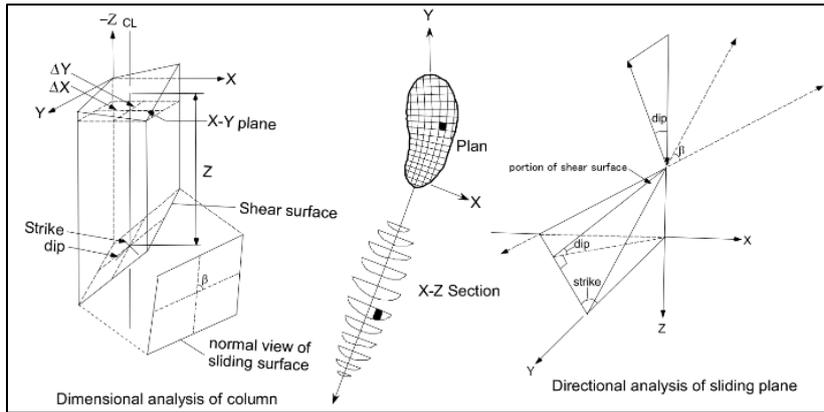


Figure 2: Hovland Column Model  
Source: Tiwari and Douglas (2012)

Hovland method can be expressed by equation (1) (Tiwari and Douglas, 2012)

$$SF = \frac{\sum_X \sum_Y \left( \frac{c \cdot \Delta X \cdot \Delta Y \cdot \sin \theta}{\cos \alpha_{xz} \cdot \cos \alpha_{yz}} \right) + \sum_X \sum_Y (\gamma \cdot Z \cdot \Delta X \cdot \Delta Y \cdot \cos(\text{dip}) \cdot \tan \phi)}{\sum_X \sum_Y \gamma \cdot Z \cdot \Delta X \cdot \Delta Y \cdot \sin \alpha_{yz}} \quad (1)$$

where SF is the slope safety factor. Safety factor is the ratio of resisting force and driving force as shown in Figure 3. Resisting force is the force resisting downward movement by soil cohesion and internal friction. Conversely, the driving force is the force moving soil downward, mostly comes from gravitational force. Safety factor above 1 signifies that the slope is safe and safety factor below 1 signifies unstable slope and high probability for landslide to occur.

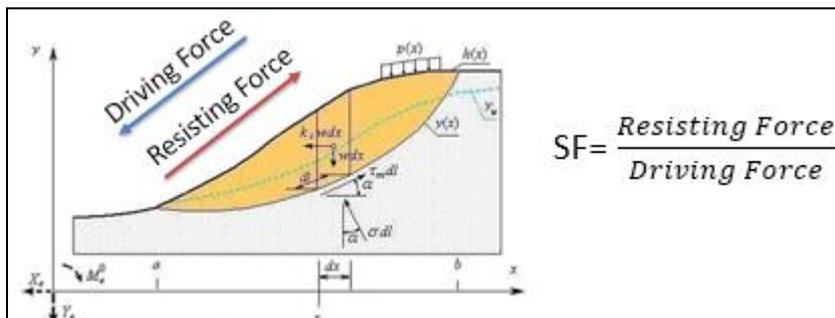


Figure 3: Safety Factor Ratio  
Source: Adapted from Montenasoft.com

### Pore Pressure Integration into Hovland

Pore pressure ( $P_s$ ) is another source of driving force due to hydrostatic pressure, which can directly impact the safety factor. Pore pressure can be expressed as equation:

$$P_s = \gamma_w \cdot hw \quad (2)$$

where  $\gamma_w$  is the water weight (9.81 kN/m) and  $hw$  is the water height. Figures 4, 5 and 6 show different scenarios for water table, saturated soil and surface water.

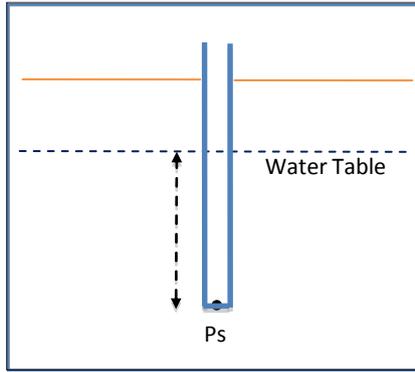


Figure 4: Pore pressure measurement with the water table

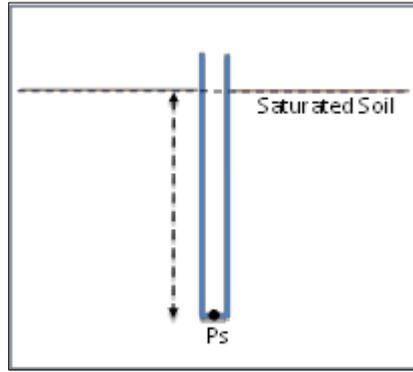


Figure 5: Pore pressure measurement with saturated soil

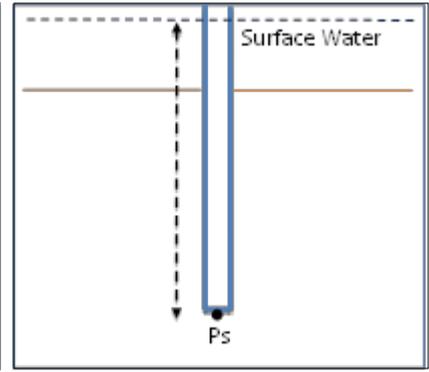


Figure 6: Pore pressure measurement with surface water

Hovland formula can be expanded to cover pore water pressure by adding an equation into the equation (1), as shown in equation:

$$SF = \frac{\sum_X \sum_Y \left( \frac{c \cdot \Delta X \cdot \Delta Y \cdot \sin \theta}{\cos \alpha_{xz} \cdot \cos \alpha_{yz}} \right) + \sum_X \sum_Y (\gamma \cdot Z \cdot \Delta X \cdot \Delta Y \cdot \cos(\text{dip}) - \gamma_w \cdot w \cdot \frac{\Delta X \cdot \Delta Y \cdot \sin \theta}{\cos \alpha_{xz} \cos \alpha_{yz}}) \tan \phi}{\sum_X \sum_Y \gamma \cdot Z \cdot \Delta X \cdot \Delta Y \cdot \sin \alpha_{yz}} \quad (3)$$

In ArcMap, Slope ( $\beta$ ) is equivalent to dip value in Hovland formula (Tiwari and Douglas, 2012), so the equation can be expressed as:

$$SF = \frac{\sum_X \sum_Y \left( \frac{c \cdot \Delta X \cdot \Delta Y \cdot \sin \theta}{\cos \alpha_{xz} \cdot \cos \alpha_{yz}} \right) + \sum_X \sum_Y (\gamma \cdot Z \cdot \Delta X \cdot \Delta Y \cdot \cos(\beta) - \gamma_w \cdot h_w \cdot \frac{\Delta X \cdot \Delta Y \cdot \sin \theta}{\cos \alpha_{xz} \cos \alpha_{yz}}) \tan \phi}{\sum_X \sum_Y \gamma \cdot Z \cdot \Delta X \cdot \Delta Y \cdot \sin \alpha_{yz}} \quad (4)$$

### Pore Pressure Effect to Slope Stability and Surface Runoff Integration

Conventional method to add pore pressure into Hovland uses fixed water table level, which is obtained from pore hole survey as visualised in Figure 7. This is the approach taken by Jia et al., (2012) and Tiwari and Douglas (2012). However, this approach is only suitable to predict landslides in dry situation and less accurate to predict a landslide caused by rainfall. This is because in heavy rain, soil will be saturated and water ponding may occur, and this will cause the pore water pressure to change drastically, hence impacting the slope safety factor directly.

Rainfall has two effects on earth. Part of the water will infiltrate deep into the ground and the excess will flow through the surface. Jia et al., (2015) further expanded Hovland's model to improve accuracy in predicting the rainfall induced landslide by using infiltration model to include soil saturation into calculation as visualised in Figure 8. According to Luo et al. (2015), surface run-off is a hydrological process, which can directly affect 3D slope stability when the water is flowing or accumulated on top of the slope as visualise in Figure 9. Jia et al., (2015) approach however, did not take into account the run-off effect to the slope stability in Hovland method.

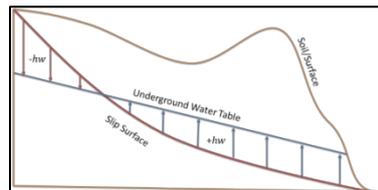


Figure 7: Pore pressure height from the slip surface to the water table

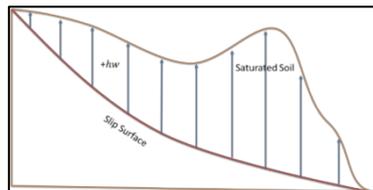


Figure 8: Pore pressure height from the slip surface to the saturated soil

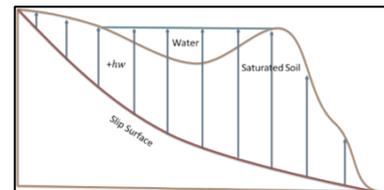


Figure 9: Pore pressure height from the slip surface to the saturated soil and water surface

There are two methods to calculate and predict surface run-off, which are Infiltration Excess Overland Flow (IEOF) and Saturation Excess Overland Flow (SEOF). IEOF occurs when the soil is not fully saturated and the rainfall rate is higher than the soil absorption rate. IEOF usually occurs in arid areas while SEOF occurs when the soil is fully saturated and remaining rainfall become surface run-off. This paper will focus on SEOF because the monsoon climate in Malaysia consists of long and heavy rainfall which result in saturated soil. SEOF's location and volume are determined by six factors which are rainfall, land use, slope angle, soil type, IEOF exclusion area and Topographic Wet Index (TWI) as shown in Figure 10.

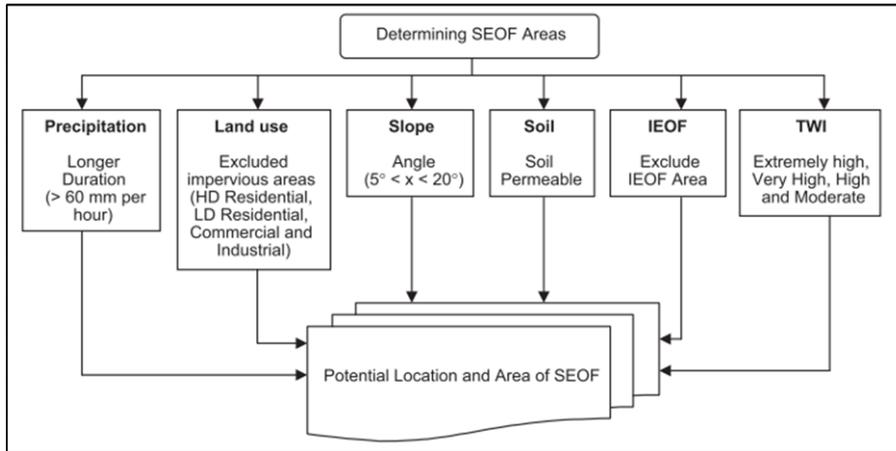


Figure 10: SEOF determination

Source: Izham et al., (2011)

## RESULTS

The key to improve Hovland's 3D slope stability analysis in predicting rainfall induced landslide is by expanding pore water pressure computation in Hovland's method by taking into account SEOF factor. This approach has the advantages of simplicity, as no modification is required to the Hovland's formula itself and the adaptation is based solely on water table level input, which now needs to be fed from SEOF instead of using fixed data as shown in Figure 11.

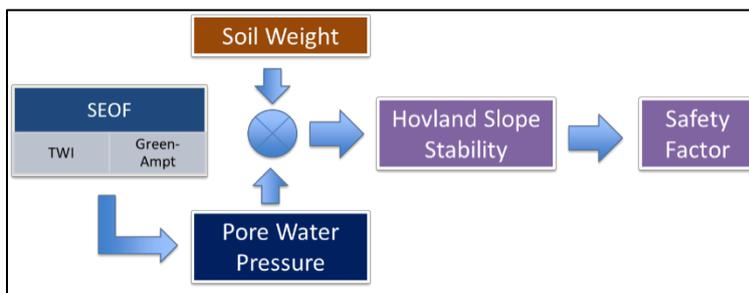


Figure 11: 3D Slope Stability Block Diagram

The first step to integrate SEOF into Hovland slope stability method is to determine the slip surface. Slip surface is defined as a slope cut out, which gives minimum safety factor for the respective slope. For Hovland, the slip surface shape is half ellipsoid. The parameters for slip surface ellipsoid are optimised using the Monte Carlo analysis. The minimum safety factor of this process is considered as a base safety factor. The next step is to integrate SEOF into the flow. SEOF will provide two additional piece of information into the equation, soil saturation and also water ponding. The existence of soil saturation and water ponding will directly impact the safety factor. Soil saturation and water ponding will determine how pore pressure is calculated, either as Figures 7, 8 or 9. If the soil is not yet saturated, the pore pressure is calculated from the water table from bore hole survey data as shown in Figure 7. Once the soil is saturated, but no water ponding is formed on top of slip

surface, the pore pressure is calculated from saturated soil as shown in Figure 8. However, if there is water ponding, the pore pressure is calculated as shown in Figure 9. This process is repeated using rainfall data in order to give real time and dynamic safety factor analysis for the study area. The whole process can be summed up in Figure 12.

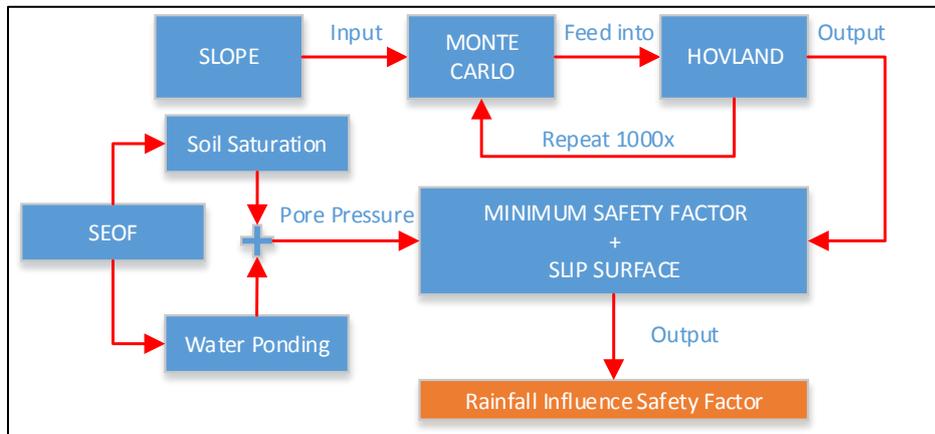


Figure 12: SEOF Integration Flow Chart

## SUMMARY

Conventional Hovland slope safety factor analysis approach only takes into account the fixed water table from borehole survey, therefore it could not reflect the actual safety factor in the heavy rainfall situation. Continuous rainfall will cause soil to be saturated and will render the slope safety factor to deteriorate due to increase of the pore pressure. Depending on topography, water ponding may occur near the slope and will compromise the slope safety factor even further. The results of this research address these issues by improving Hovland 3D slope safety factor analysis method by taking SEOF factor into consideration and produce better rainfall induced landslide prediction. The practical application of this solution is clear. Policymakers and all stakeholders can utilise this solution to predict and simulate the worst case scenario in the monsoon season to determine the slope stability. With such insights, they can then take pre-emptive actions to tackle the slope stability problem before landslide occurs.

## Acknowledgements

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## REFERENCES

- Ahmed, A., Ugai, K., & Yang, Q. Q. (2012). Assessment of 3D Slope Stability Analysis Methods Based on 3D Simplified Janbu and Hovland Methods. *International Journal of Geomechanics*, 12(2), 81–89.
- Anderson, M. G., Holcombe, E., Holm-nielsen, N., & Della Monica, R. (2014). What Are the Emerging Challenges for Community-Based Landslide Risk Reduction in Developing Countries? *Natural Hazards Review*, 15(2), 128–139.
- Department of Economic and Social Affairs. (2014). Our urbanizing world. *Department of Economic and Social Affairs*, 4. Retrieved from [www.unpopulation.org](http://www.unpopulation.org)
- Di Martire, D., De Rosa, M., Pesce, V., Santangelo, M. a., & Calcaterra, D. (2012). Landslide hazard and land management in high-density urban areas of Campania region, Italy. *Natural Hazards and Earth System Science*, 12, 905–926.

- Elhadary, Y. A. E., & Samat, N. (2012). Political Economy and Urban Poverty in the Developing Countries: Lessons Learned from Sudan and Malaysia. *Journal of Geography and Geology*, 4(1), 212–223.
- EM - DAT. (2011). The International Disasters Database. Retrieved from <http://www.emdat.be>
- Hamdhan, I. N., & Schweiger, H. F. (2011). Slope Stability Analysis of Unsaturated Soil with Fully Coupled Flow-Deformation Analysis. *Iamg 2011*, 1–18. Retrieved from [http://www.cogeo.at/publications/iamg2011/IAMG2011\\_Salzburg\\_063.pdf](http://www.cogeo.at/publications/iamg2011/IAMG2011_Salzburg_063.pdf)
- Hicks, M. a., Nuttall, J. D., & Chen, J. (2014). Influence of heterogeneity on 3D slope reliability and failure consequence. *Computers and Geotechnics*, 61, 198–208.
- Hovland, H. J. (1977). Three-Dimensional Slope Stability Analysis Method. *Journal of the Geotechnical Engineering Division*, 103(9), 971–986.
- Jia, N., Mitani, Y., Xie, M., & Djamaluddin, I. (2012). Shallow landslide hazard assessment using a three-dimensional deterministic model in a mountainous area. *Computers and Geotechnics*, 45, 1–10. Retrieved from <http://linkinghub.elsevier.com/retrieve/pii/S0266352X12000638>
- Jia, N., Yang, Z., Xie, M., Mitani, Y., & Tong, J. (2015). GIS-based three-dimensional slope stability analysis considering rainfall infiltration. *Bulletin of Engineering Geology and the Environment*, 74(3), 919–931. Retrieved from <http://link.springer.com/10.1007/s10064-014-0661-1>
- Kalatehjari, R., & Ali, N. (2013). A Review of Three-Dimensional Slope Stability Analyses based on Limit Equilibrium Method. *Electronic Journal of Geotechnical Engineering*, Vol. 18(1977), 119–134.
- Lam, L., & Fredlund, D. (1993). A general limit equilibrium model for three-dimensional slope stability analysis. *Canadian Geotechnical Journal*, 2(1982).
- Luo, Y., He, S., Chen, F., Li, X., & He, J. (2015). A physical model considered the effect of overland water flow on rainfall-induced shallow landslides. *Geoenvironmental Disasters*, 2(1), 8. Retrieved from <http://www.geoenvironmental-disasters.com/content/2/1/8>
- Matori, A. N., Basith, A., & Harahap, I. S. H. (2012). Study of regional monsoonal effects on landslide hazard zonation in Cameron Highlands, Malaysia. *Arabian Journal of Geosciences*, 5(5), 1069–1084.
- Mazlan, M. (2014). ISIS Focus : Malaysia's New Wave of Urbanisation. *Institute of Strategic And International Studies (ISIS) Malaysia*, (8 (August 2014)).
- Mergili, M., Marchesini, I., Rossi, M., Guzzetti, F., & Fellin, W. (2014). Spatially distributed three-dimensional slope stability modelling in a raster GIS. *Geomorphology*, 206, 178–195.
- Montenasoft.com. (n.d.). No Title. Retrieved from <http://www.montenasoft.com>
- Othman, A. N., Naim, W. M., M., W., & S., N. (2012). GIS Based Multi-Criteria Decision Making for Landslide Hazard Zonation. *Procedia - Social and Behavioral Sciences*, 35(December 2011), 595–602. Retrieved from <http://linkinghub.elsevier.com/retrieve/pii/S1877042812004387>
- Public Work Department of Malaysia. (2009). Malaysia: National slope master plan 2009-2023, 2 (1–10). Retrieved from <http://slopes.jkr.gov.my/Documentation/NSMP/English Version/NSMPSec2.pdf>
- Saadatkah, N., Kassim, A., & Lee, L. M. (2014). Hulu Kelang, Malaysia regional mapping of rainfall-induced landslides using TRIGRS model. *Arabian Journal of Geosciences*. Retrieved from <http://link.springer.com/10.1007/s12517-014-1410-2>
- Shen, H., Klapperich, H., Abbas, S. M., & Ibrahim, A. (2012). Slope stability analysis based on the integration of GIS and numerical simulation. *Automation in Construction*, 26, 46–53.
- Spencer, E. (1967). A Method of analysis of the Stability of Embankments Assuming Parallel Inter-Slice Forces. *Geotechnique*, 17(1), 11–26.
- Thiebes, B., Bell, R., Glade, T., Jäger, S., Anderson, M., & Holcombe, L. (2013). A WebGIS decision-support system for slope stability based on limit-equilibrium modelling. *Engineering Geology*, 158, 109–118.
- Tiwari, B., & Douglas, R. (2012). Application of GIS Tools for Three-Dimensional Slope Stability Analysis of Pre-Existing Landslides. In *GeoCongress 2012: State of the Art and Practice in Geotechnical Engineering* (pp. 479–488). ASCE.
- United Nations, D. of E. and S. A. (2014). *World Urbanization Prospects, the 2014 Revision*. New York: World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).

Zheng, K., & Yang, Y. (2011). The intelligent space-time prediction and analysis of the 3D loess slope geological disaster based on GIS. *2011 International Conference on Computer Science and Service System (CSSS)*, 857–859.

## **A COMPARATIVE STUDY OF SPATIAL VARIATION BETWEEN THE STATES OF PENINSULAR MALAYSIA IN TERMS OF WATER SUPPLY CHARACTERISTICS AND CONSUMER'S PERCEPTION**

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**ABSTRACT:** Peninsular Malaysia is made up of 11 states with different landforms, natural resources, population patterns and lifestyle patterns. This paper aims to compare the spatial variations between water supply characteristics in terms of price, non-revenue water (NRW) and domestic water consumption by states and domestic water consumers' perception in terms of their satisfaction of their water service suppliers. The methodology is based on both primary and secondary data. Primary data is derived from a questionnaire survey on 400 domestic water consumers and secondary data obtained through a survey of books, articles, journals, annual reports and official websites that are related to water issues. The results conclude that different states show different levels of performance by various water service suppliers and different perception amongst consumers which is caused by spatial variation.

*Keywords:* spatial variation, water service provider, water supply, consumers perception, non-revenue water

### **INTRODUCTION**

Malaysia is a country located in the equatorial region with rainfall throughout the year and an average of 3000mm of rain per year. The country is rich in water resources such as rainwater, rivers, lakes and underground water and has 189 river basins that contribute to water resources 900billion cubic meters of annual budget (Sulaiman, 2014). Malaysia consists of thirteen states separated by South China Sea into Peninsular Malaysia and East Malaysia. Peninsular Malaysia also known as West Malaysia consists of 11 states that are divided into four regions: Northern Region, East Coast Region, Central Region and Southern Region. Peninsular Malaysia population is roughly 23.5 million on year 2010 (Department of Statistics, 2010), average rainfall of 2500mm per year (Department of Irrigation and Drainage Malaysia, 2011). Though Malaysia experiences abundance of rainfall annually, however rainfall are seasonal and unevenly distributed (Chan, 2007).

### **HISTORY OF WATER SUPPLY IN PENINSULAR MALAYSIA**

According to Malaysia Water Industry Report (1996/1997), first water supply system began in Pulau Pinang in 1804 when the population then was about 10,000 people where clean stream water from hill was brought along brickwork channel to town and tin pipes conducted to house, and in 1930's, modern rapid gravity filtration plants just only introduced to the country. Due to the pristine raw water quality or by gravity slow sand or rapid sand filtration, water treatment was either not necessary. Disinfection technology using hypochlorite and later gaseous chlorine made its first appearance in 1915 (Chan, 2007). Before Second World War, all the major towns had treated water supplies and there were 100 water treatment plants in the country.

According to Chan (2007), after independence, major development in water supply took place and continued. The launching of the National Five Year Development Plans commencing in 1966 play a vital role in accelerating the development of water supply in the country. Legislations were introduced to identify jurisdiction on control of raw water sources and assurance of raw and treated water quality. To ensure effective development and operation of water supply in the country, a new known as the Ministry of Energy, Water and Communications was created on March 2004 and National Water Services Commission was established under Act 2005 under the Ministry.

## **WATER SUPPLY AT PENINSULAR MALAYSIA**

According to the Department of Water Supply, Ministry of Energy, Green Technology and Water Malaysia, in mid-2005, Malaysia Parliament passed amendments to the Ninth Schedule of Federal Constitution which move matters related to water supply and services from State List to the Concurrent List. With the amendment, the Federal Government will regulate water services industry in terms of licensing and regulatory services operation. State Government is to maintain its power over water resources, watersheds and river basin. Treatment and distribution of water in every state in Malaysia is carried out by government agencies of each state. For each state, these agencies are different, either by Public Works Department (JKR), Department of Water (JBA) or the State Water Supply Authority (Kamarudin et al., 2014). This has led to 11 states in Peninsular Malaysia to having different water supplier and different water prices. And due to the difference in terms of space and physical factors: the amount of rainfall, the number of rivers and water quality also varies. In addition, the use of water also difference from state to state in term of domestic use, industrial and irrigation. Figure 1 shown the difference of water supplier of every state in Peninsular Malaysia.

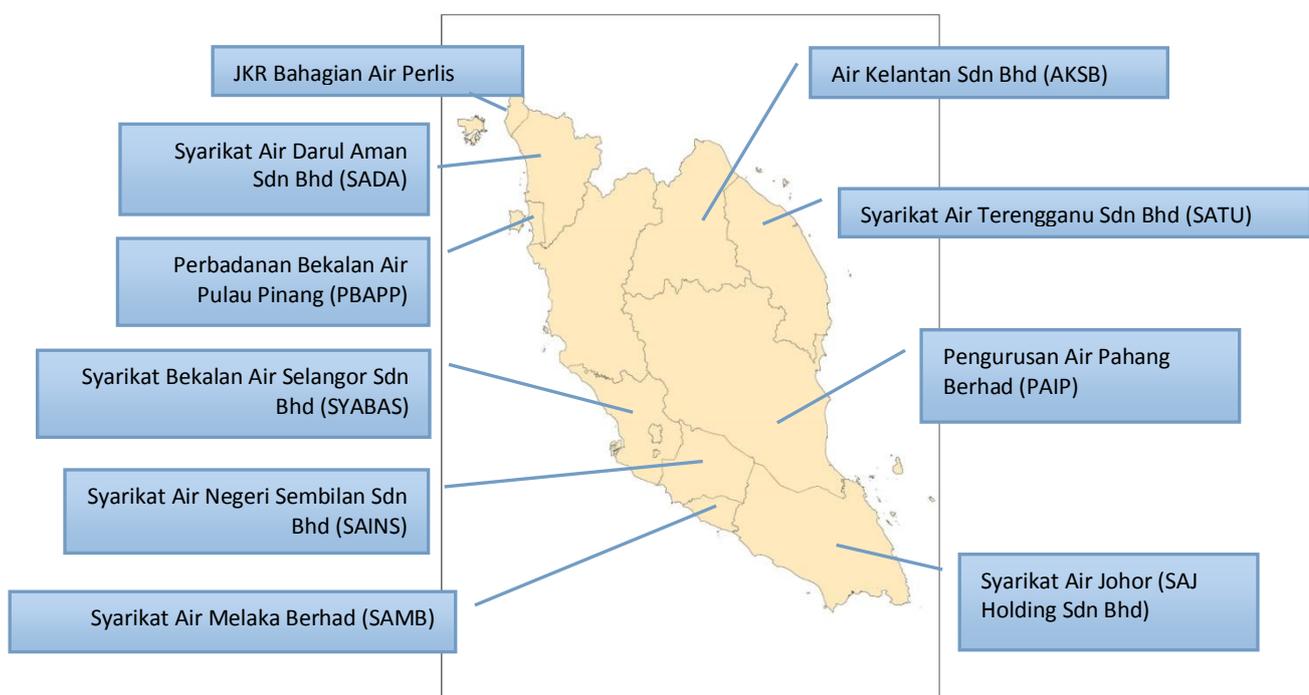


Figure 1: List of Water Supply for every state in Peninsular Malaysia

**Source:** Name list of water Supply by state: Department of Water Supply  
<http://h2o.water.gov.my/v2/fail/locrfe/peninsula.html>

This paper aims to compare water suppliers among the states of Peninsular Malaysia in term of price, NRW and domestic water use by states. The study also examines the satisfaction of domestic water users to their water suppliers.

## **METHODOLOGY**

This paper is based on both primary and secondary data. A total of 400 domestic water consumers from every state of Peninsular Malaysia were invited to fill in a questionnaire regarding their daily water consumption and SPSS was used for data analysis. Respondents were chosen by random sampling method from urban and rural area of every state and sample stratification was based on racial composition of Malaysia, composition of urban- rural, sex, age group and level education. Secondary data were obtained through a survey of book, articles, journals, annual report and official website that related to water issues, water data like price, consumption and NRW rate. Based on

primary and secondary data collected, comparison of price, water consumption, NRW rate and level of satisfaction from domestic water consumers was used to form the basis of discussion of the paper.

## **RESULTS AND DISCUSSION**

Peninsular Malaysia consists of 11 states and there are 11 companies / different water suppliers as shown in Figure 1. Water consumption can be divided into two, namely domestic consumption and non-domestic consumption. Domestic consumption is the water used by households for drinking, cooking, washing, watering plants, and use in the toilet. Non domestic water consumption is water that is used in agriculture/irrigation, industrial and commercial (Abrashinsky, 2004) Figure 2 shows the use of domestic and non-domestic water by states in Peninsular Malaysia. Domestic water consumption rate is found to be highest in the Kedah state (81.5 per cent) and lowest in the Malacca state. In average, 61.5 per cent of water used by domestic and 38.5 per cent water use on non-domestic purpose (SPAN, 2012-2013). This figure shows that most water (more than 50 per cent) is used for domestic purposes. From Figure 2, the highest non-domestic water consumption is Malacca (48.6 per cent) and the lowest is Perlis (18.5). Average for non-domestic water consumption is 38.5 per cent.

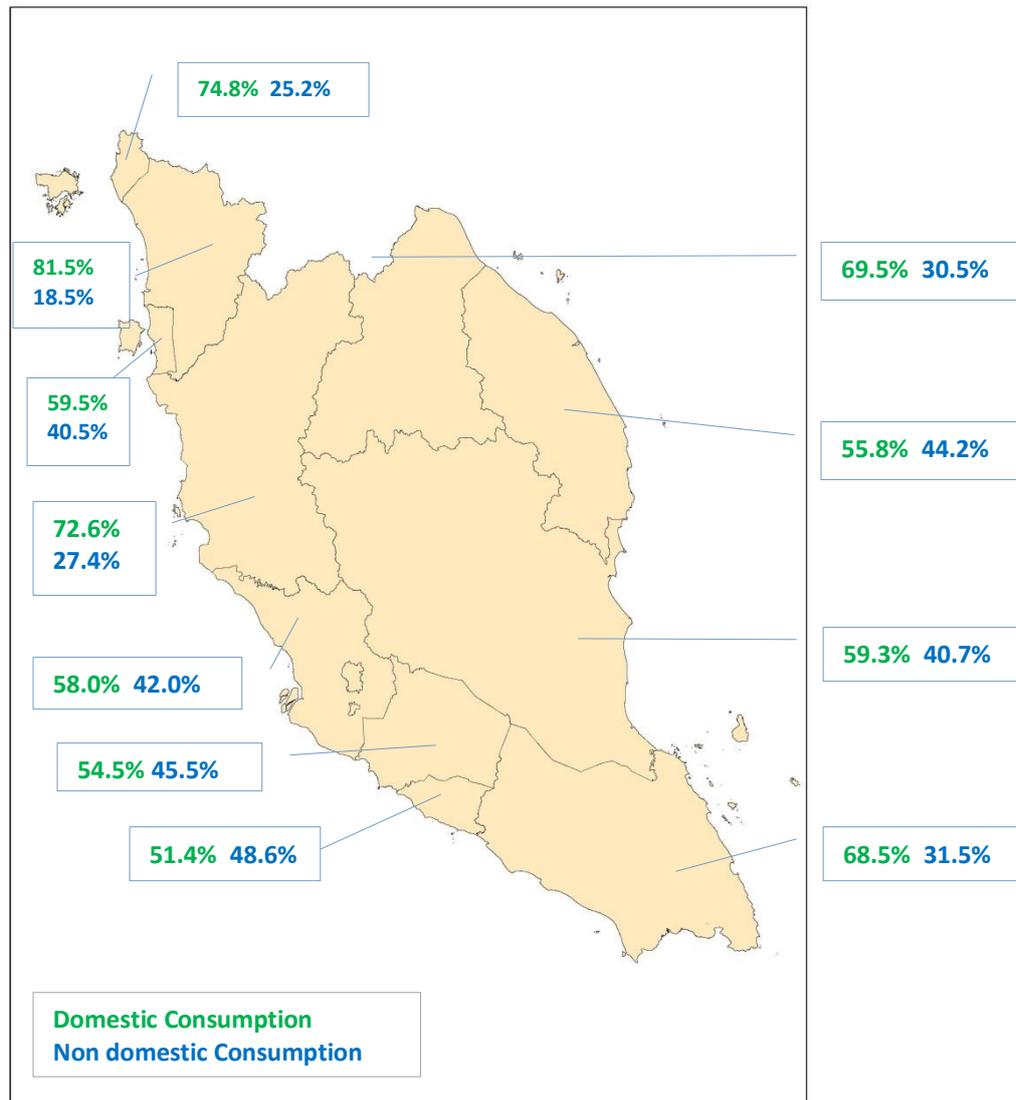


Figure 2: Comparing the domestic and non-domestic water use by state in year 2013  
 Source: SPAN Water Consumption (2012-2013)

Figure 3 shows the water supply coverage by state for urban and rural area. Penang, Perak, Perlis, Selangor, Negeri Sembilan, Malacca, Johor and Pahang had 100 per cent water supply coverage at urban area and only Kelantan and Terengganu state does not achieve 100 per cent water supply coverage at urban area. For rural area, there are only Melaka state achieve 100 per cent water supply coverage at rural area.

Non-revenue water (NRW) represents water lost in the water supply value chain. For year 2014 national average NRW is 36.6 per cent (PBAPP). Figure 3 shows that 4 states NRW rate are above the average. The state are Perlis, Kelantan, Pahang and Kedah. However, 7 states NRW rates are below the average. The states are Penang, Johor, Terengganu, Melaka, Negeri Sembilan, Perak and Selangor. The highest NRW state is Perlis (62.4 per cent) and the lowest is Penang (18.3 per cent).

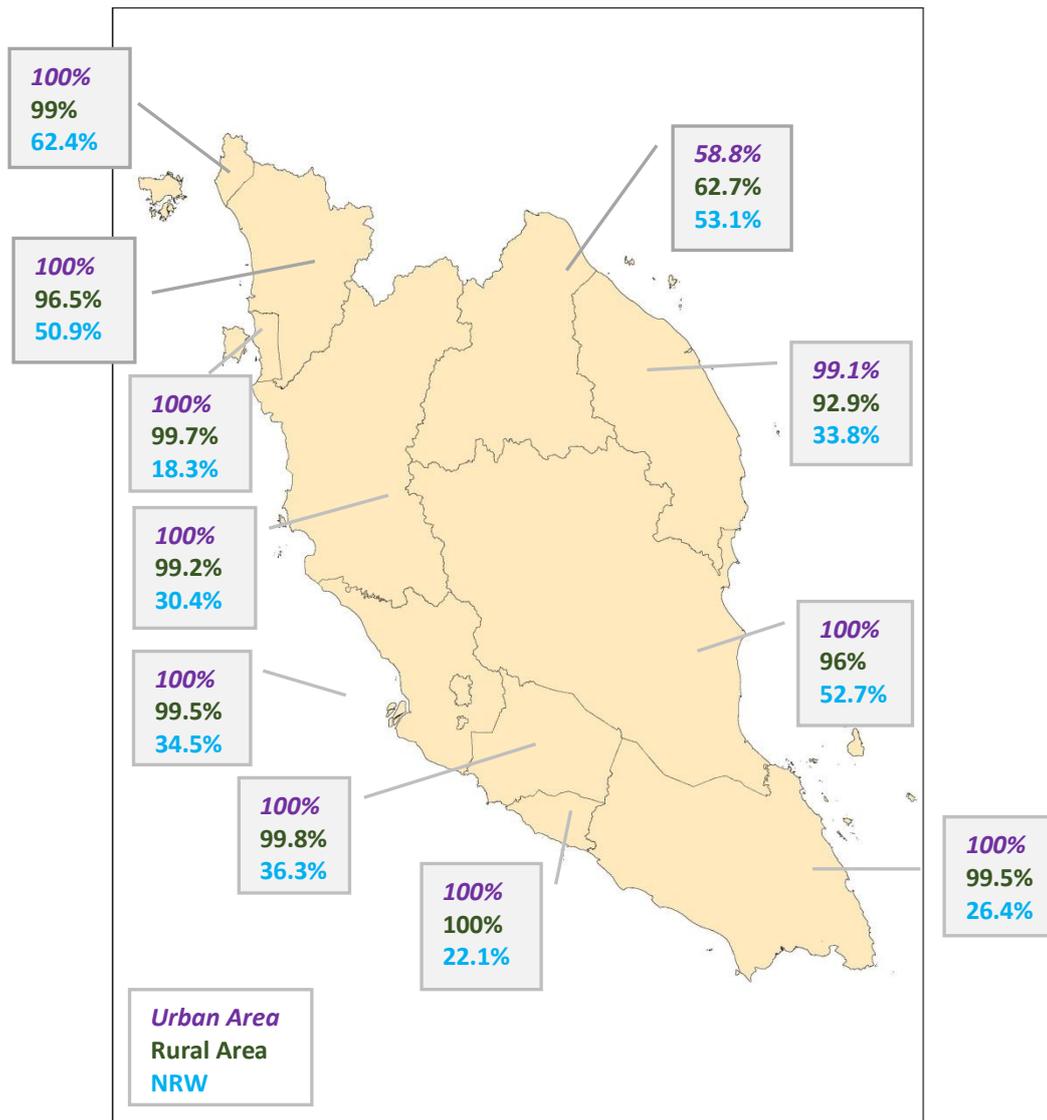


Figure 3: Coverage of Water Supply and NRW by State  
 Source: KeTTHA Annual Report 2013 and PBAPP)

Figure 4 shows domestic water tariff at Peninsular Malaysia. Due to different water suppliers for every state, there are different domestic water tariff by state. Average domestic water tariff at Malaysia is RM 0.66 per 1,000 L for the 1<sup>st</sup> 35,000L. Penang, Terengganu, Perlis, Kelantan and Pahang domestic water tariff is below the average domestic water tariff. Water tariff for Kedah, Negeri Sembilan, Johor, Melaka, Perak and Selangor domestic water tariff is above the average. Penang has the lowest domestic water tariff of RM0.32 per 1,000 L for the 1<sup>st</sup> 35,000L and Johor has the highest domestic water tariff (RM1.05 per 1,000 L for the 1<sup>st</sup> 35,000L).

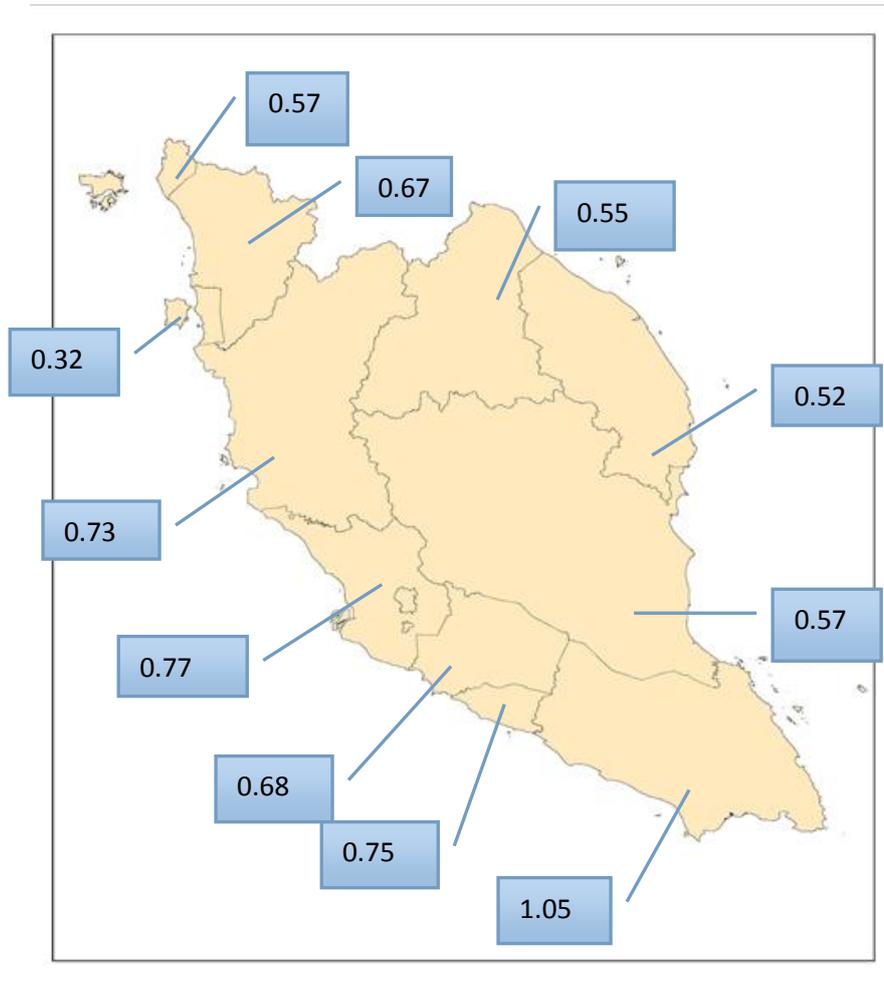


Figure 4: Domestic Water Tariffs (RM per 1,000 L for 1<sup>st</sup> 35,000L)

Source: PBAPP [http://www.pba.com.my/?page\\_id=603](http://www.pba.com.my/?page_id=603))

From Figures 3 and 4, the research found that Penang water supplier (Perbadanan Bekalan Air Pulau Pinang) performed well where there are 100 per cent water coverage at urban area, with the lowest NRW rate and water tariff and so on the consumer perception where 51.3 per cent of consumer rank PBAPP is good and 10.3 per cent rank as very good (Table 1). From Table 1, the research found that a majority of Perlis consumers rank their water supplier as average (47.7 per cent) and poor (41.5 per cent).

Table 1: Consumers Ranking of their Water Supplier by State

State	Consumer rank their water provider				
	Very poor	Poor	Average	Good	Very good
<b>Kelantan</b>	1.5	7.7	31.5	48.4	10.9
<b>Terengganu</b>	0.3	1.8	16.3	63.9	17.7
<b>Pahang</b>	0	1.8	34.2	54	9.9
<b>Johor</b>	2.6	1.3	29.5	56.4	10.3
<b>Melaka</b>	2.8	8.3	33.3	47.2	8.3
<b>Negeri Sembilan</b>	0.7	4.6	28.3	50.2	16.1
<b>Selangor</b>	0.9	3.3	30.5	52.1	13.1
<b>Perak</b>	2.8	4	39	42.7	11.4
<b>Penang</b>	2.2	3.6	32.7	51.3	10.3
<b>Kedah</b>	2.3	2.3	32	54	9.3
<b>Perlis</b>	0	41.5	47.7	8.3	2.5

Source: Questionnaire survey

From Figure 4, the research found that Penang has the lowest water tariff in Peninsular Malaysia where there are only RM0.32 per 1,000 L for the 1<sup>st</sup> 35,000L. However, there are only 27.4 per cent of Penang domestic water consumer think the tariff is low/ cheap and 15 per cent of consumer think the tariff still high / expensive. For Johor state which has the highest domestic water tariff in Peninsular Malaysia where is RM1.05 per 1,000 L for the 1<sup>st</sup> 35,000L, 20.4 per cent of their water consumer said that the water tariff was high/ expensive and only 11.3 per cent of consumer said the tariff was low/ cheap.

Table 2: Consumer's Perception on Water Tariff

State	Consumer Perception on water tariff (%)		
	High (Expensive)	Moderate	Low (Cheap)
<b>Kelantan</b>	12.2	71	16.8
<b>Terengganu</b>	19.1	71.5	9.4
<b>Pahang</b>	13.6	72.8	13.6
<b>Johor</b>	20.4	68.3	11.3
<b>Melaka</b>	10.3	82.7	6.8
<b>Negeri Sembilan</b>	18.9	67	14.1
<b>Selangor</b>	14.6	69.3	16
<b>Perak</b>	21	65.3	13.7
<b>Penang</b>	15	57.6	27.4
<b>Kedah</b>	16.2	70.7	13.1
<b>Perlis</b>	2.1	33.2	64.7

Source: Questionnaire survey

## CONCLUSION

Spatial variations certainly affect water issues, water supply and consumers' characteristics. Different areas create a difference in performance, demand, and perception. This paper conclude that Perbadanan Air Pulau Pinang (PBAPP) demonstrate good performance as they supply the cheapest water to consumers with the lowest NRW rates and 100 per cent coverage water supply for urban area compared to all other states. However, satisfaction and perceptions of the population varies greatly

between states. Many factors cause these differences and further study is needed to identify these factors so that they can be addressed towards sustainable water resources management.

### **Acknowledgements**

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### **REFERENCES**

- Abrashinsky, N. (2004). *Domestic Use of Water*. University of Wisconsin-Ean Chaire, USA.  
Retrieved from: <http://academic.evergreen.edu/g/grossmaz/abrashnm/>
- Chan, C. H. (2007). Water Supply Historical Development – Evolution of Water Supply in Malaysia 50 Years of Progress (1957-2007). *Malaysia Water Industry Guide 2007*. 39-46. retrieved from: [http://www.jba.gov.my/images/Historical%20Development/Historical%20Development/WSupply%20Historical%20Development\\_50%20years%20Progress.pdf](http://www.jba.gov.my/images/Historical%20Development/Historical%20Development/WSupply%20Historical%20Development_50%20years%20Progress.pdf)
- Department of Statistic (2010). Retrieved from <https://www.statistics.gov.my/>
- Department of Water Supply- Ministry of Energy, Green Technology and Water Malaysia. Retrieved from: <http://www.jba.gov.my/>
- Department of Irrigation and Drainage Malaysia (2011). *Review of The National Water Resources Study (2000-2050) and Formulation of National Resources Policy Final Report (Volume 2)*. Retrieved from: <http://www.water.gov.my/images/Hidrologi/NationalWaterResourcesStudy/Vol2WaterGovernance.pdf>
- Kamarudin, N., Ismail, W.R. & Abd Kader, N.H. (2014). Assessing Efficiency and Effectiveness of Malaysian Water Supply Services: A Data Envelopment Analysis Approach. *Journal of Quality Measurement and Analysis*, 10(2), 1-13.
- KeTTHA Annual Report 2013 (pg 64-83). Retrieved from: <http://www.greentechmalaysia.my/file/download/GTM-%20Annual%20Report%202013.pdf>
- Malaysia Water Industry Report (1996/1997). Retrieved from: <http://www.jba.gov.my/>
- National Water Services Commission (SPAN). Retrieved from: <http://www.span.gov.my>
- Perbadanan Bekalan Air Pulau Pinang. <http://www.pba.com.my/>
- Sulaiman, A.H. (2014). *A Comprehensive Urban Stormwater Management Approach in Combating Flood in Malaysia: An Indispensable Link for Safer, Greener and More Livable Urban Environment*. Keynote Paper presented at the 13<sup>th</sup> international conference on urban drainage, 2014, 7<sup>th</sup> – 12<sup>th</sup> September, Borneo Convention Center Kuching, Sarawak, Malaysia.

## **SPATIAL INEQUALITIES IN MALAYSIA'S NON-REVENUE WATER RATES ISSUES, CHALLENGES AND MANAGEMENT STRATEGIES**

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**ABSTRACT:** In Malaysia, high non-revenue water (NRW) rate is amongst the country's top water issues. NRW rates of all states in the country vary greatly, with the rates ranging from 18.2 to 62.4 per cent. This huge spatial variation is due to variations in management efficiency of the water operator, amount of funding for NRW reduction programme and level of public awareness. This paper aims to examine the effect of the spatial inequality on NRW management in Malaysia's states by comparing NRW rates between states with different area sizes. The study is mainly based on literature review and secondary data. The results show that states with smaller surface areas recorded lower NRW rates but the smallest state was found to record the highest NRW rate. Factors such as service's coverage area, population density, water supply network density, dispersal of the city area, and location of the water users, and type of water users also have significant impacts on NRW management. For example, high water supply network density, poor water resources availability and high demand in Penang have forced the state's water operator to increase its efficiency in NRW management. In contrast, low water demand, low population density, and less commercial area in Perlis are found to be the reasons of high NRW rate in the state. In conclusion, spatial factors can impact NRW as smaller states can better manage NRW due to the smaller water service areas covered. However, states cannot use size of service area and spatial variations as excuses for high NRW as the study found that adequate funding, proper planning, effective management, efficient service, and proactive strategies of water operator are more important factors that can have significant impacts on the NRW rates.

*Keywords:* non-revenue water (NRW), water loss, surface area, spatial variation, water service

### **INTRODUCTION**

Non-Revenue Water (NRW) refers Table 1 to treated water lost from a water supply network before it passes through consumers' water metres. Generally, NRW is defined as the sum of water loss and unbilled authorised consumption. Causes of NRW are divided into three different categories, with the first and most common cause of NRW being water lost from pipe leakage, pipe burst, overflow of water utility's storage tanks, and other forms of water lost physically, this type of NRW is defined as real loss. The second type of NRW is water lost commercially from metre inaccuracy and unauthorised consumption (e.g. water theft, illegal pipe connection, etc.). Third is, unbilled authorised consumption referring to the water provided free by the water utility, for example water used for firefighting (Lambert and Hirner, 2000). In many developing countries, high NRW rate is one of the water issues threatening the countries' water security and large amount of clean water "disappeared" from its water supply network causing huge losses to the economy, societal, and environmental aspects (Frauendorfer and Liemberger, 2010). In Malaysia, high NRW rates are hindering the country's effort to sustain its water supply. Many of the state's water service providers (WSPs) have been struggling to reduce its NRW rates despite huge amount of investment (Lai et al., 2013). Referring to Figure 1, in 2013, Malaysia's NRW hovers at an average rate of 36.6 per cent, with the states' NRW rates ranging from 18.2 per cent to as high as 62.4 per cent (MWA, 2014). Reducing NRW effectively is a complicated task which requires technical and non-technical strategy. Lack of funding, poor public participation, lack of competent staffs, and lack of management unit's interest in reducing NRW have been reported as the most common challenges faced by Malaysia's WSPs in reducing NRW rate (Lai et al., 2013).

Table 1: International Water Association (IWA) Standard International Water Balance and Terminology

System Input Volume	Authorized Consumption m <sup>3</sup> / year	Billed Authorized Consumption m <sup>3</sup> / year	Billed Metered Consumption (including water exported)	Revenue Water m <sup>3</sup> / year	
		Unbilled Authorized Consumption m <sup>3</sup> / year	Billed Unmetered Consumption		
	Water Losses m <sup>3</sup> / year	Apparent Losses m <sup>3</sup> / year	Real Losses m <sup>3</sup> / year	Unbilled Metered Consumption	Non-Revenue Water m <sup>3</sup> / year
			Real Losses m <sup>3</sup> / year	Unauthorized Consumption	
				Leakage on Transmission and/ or Distribution Mains	
				Leakage on Service Connections up to the point of Customer Metering	
			Metered Inaccuracies		
			Leakage and Overflow at Utility's Storage Tanks		

Figure 1 Source: Lambert and Hirner (2000)

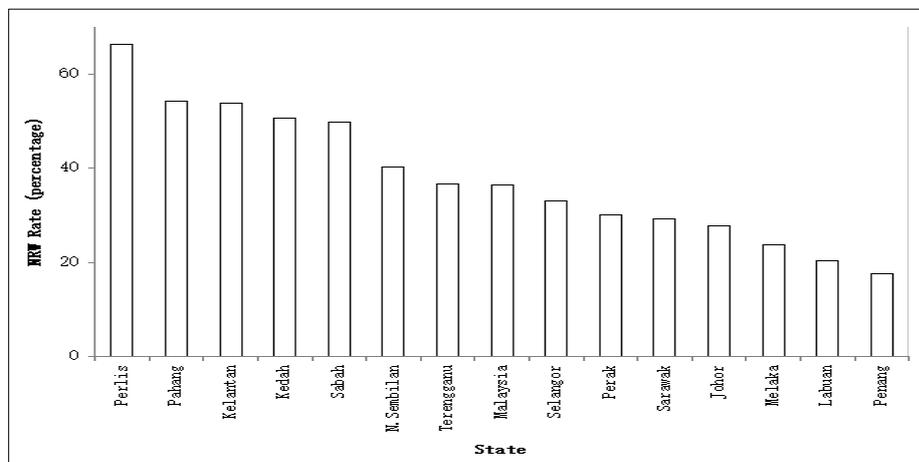


Figure 1: NRW Rates of All States in Malaysia in 2013

Source: MWA, 2014

### SPATIAL FACTORS INFLUENCING NRW MANAGEMENT

Spatial and geographical factors are major considerations of water utility in managing water supply and demand in a city (Amarasinghe et al., 2005). For example, spatial variation between two cities can cause big differences in population, urbanisation, income, domestic residential areas and industrialisations in the cities which can cause big differences in water demand. Moreover, the location of a city or a residential area can affect the water supply strategies as the flowing pattern of rivers and location of water infrastructures (e.g. dams, reservoir, water piping and water treatment plants) need to be taken into account in planning water supply strategies (Amarasinghe et al., 2005; Wells et al., 2014). In the aspect of NRW management, population density and population growth in different space is suspected to be the factors influencing water utility in managing NRW (Gonzalez et al., 2012). The study conducted by Gonzalez et al. (2012) suspects that water management in a city with higher population density and population growth is more complex because of the complexity of its water supply networks. And the findings also points out that several dispersed population centres could result in worse management of the supply infrastructure in the outlying areas. Thus, if the points from Gonzalez et al., (2012) study is correct, spatial inequality could be a factor influencing Malaysia's water service providers (WSPs) progress in reducing NRW rate. To date, there are only limited studies on how spatial factors influence NRW rates in Malaysian states. Therefore, this paper aims to discuss the effect of spatial inequality on NRW management in Malaysia's states. Specifically, this paper first compares the NRW rates in between the states that have big surface area with the states that have small surface area. Second, this study examines the issues and challenges

faced by the water operators in managing NRW in different states, namely the relationship of surface area, population density and geographic variations.

## METHODOLOGY AND RESEARCH MATERIALS

The study employed qualitative interview, literature review and secondary NRW data in Malaysia. Secondary data such as journal article, research report, government documents, and other reports were also used to support the study findings. In particular, this research studied water statistics published by *Suruhanjaya Perkhidmatan Air Negara* (SPAN) and Malaysian Water Association (MWA) in recent years. Moreover, qualitative interviews were also carried out with key informants (representatives of state's WSPs and SPAN) to obtain their opinions on the challenges confronting the states in reducing NRW.

## RESULTS AND DISCUSSIONS

In order to know how spatial factors influence the states' NRW rates, data concerning surface areas, urban population, population density, and water network density of all the states were analysed as they determine spatial variation. The results are presented in Figure 2, Figure 3, Figure 4, and Figure 5. First, the study investigates the differences of NRW rates with different states' surface areas. Referring to Figure 2, the three states which recorded lowest NRW rates in 2013 were the three smallest states in Malaysia. With the exception of Perlis state, the other three small states (Penang, Melaka, and Labuan) in Malaysia recorded NRW rates below 25 percent in 2013. According to Figure 3 which shows the NRW rates and urban populations in all states in Malaysia, it was found that states with higher urban population recorded lower NRW rates. In contrast, states with lower urban population recorded higher NRW rates in 2013. For example, three (Penang, Melaka, and Labuan) out of four states with urban population equal or more than 50 per cent recorded NRW rates below than 25 percent in 2013.

Referring to Figure 4 for the states' NRW rates with population densities, the three states that has lowest NRW rates in the country have higher population density if compared with the other states in Malaysia. Generally, except Selangor, the states which have population density with more than 400 people/ km<sup>2</sup> recorded lower NRW rates in 2013. In contrast, states with lower population densities recorded higher NRW rate in 2013. In addition, this study also examines the states NRW rates with network density, the results are presented in Figure 5. Referring to Figure 5, the states with higher network density recorded lower NRW rates in 2013. Penang, Melaka, and Labuan were three out of five states that had network density with more than 3 km length of pipe/ km<sup>2</sup> of surface area, and the results show the NRW rates of these three states were below 25 per cent in 2013. Again, Selangor State and Perlis State are the two exceptions with high network density but high in NRW rates. Overall, it seems the small states in Malaysia with high network density, high population density, and high urban population tends to have low NRW rates.

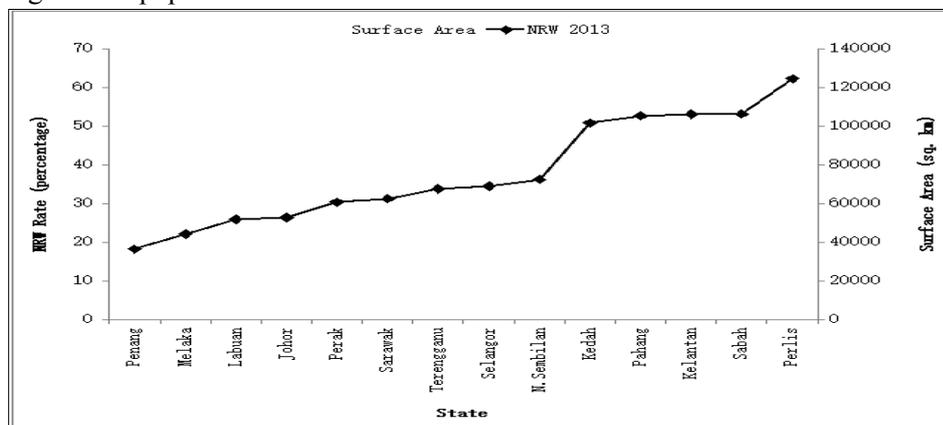


Figure 2: States' NRW Rates in 2013 and States' Surface Areas  
Source: MWA (2014); Department of Statistic Malaysia (2010)

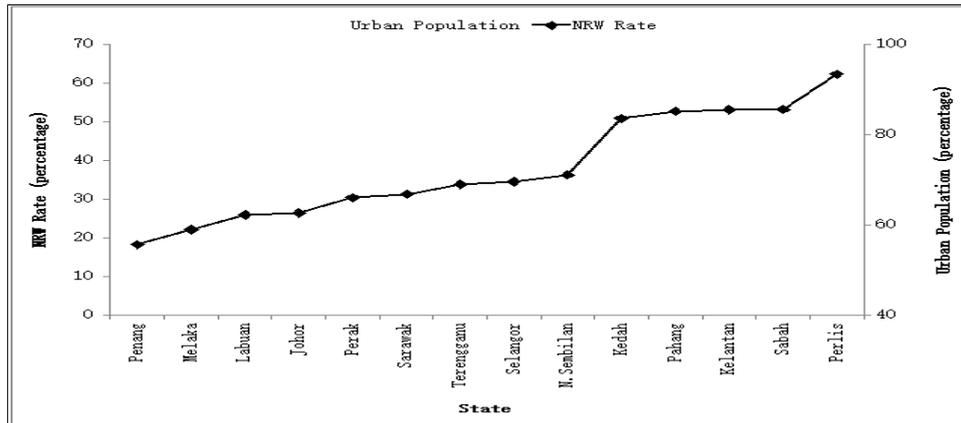


Figure 3: States' NRW Rates in 2013 and Urban Population (based on the data in 2010)  
Source: MWA (2014); Department of Statistic Malaysia (2010)

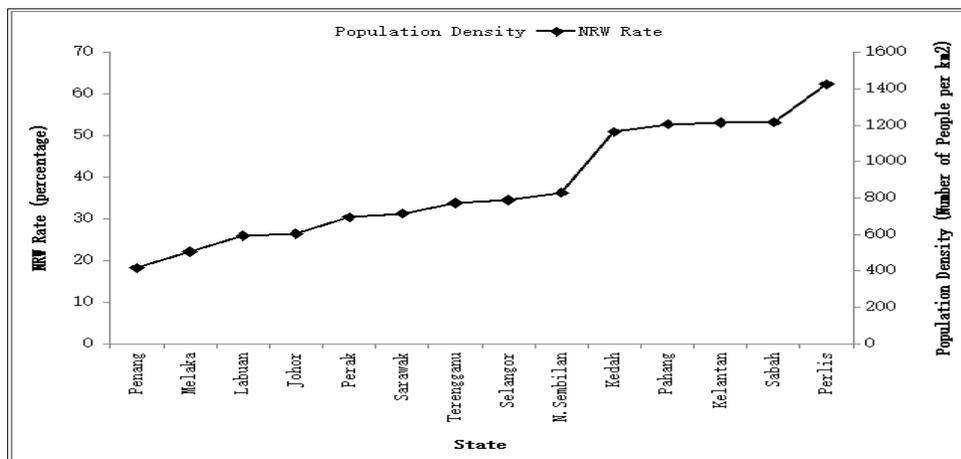


Figure 4: States' NRW Rates in 2013 and Population Densities (based on the data in 2010)  
Source: MWA (2014); Department of Statistic Malaysia (2010)

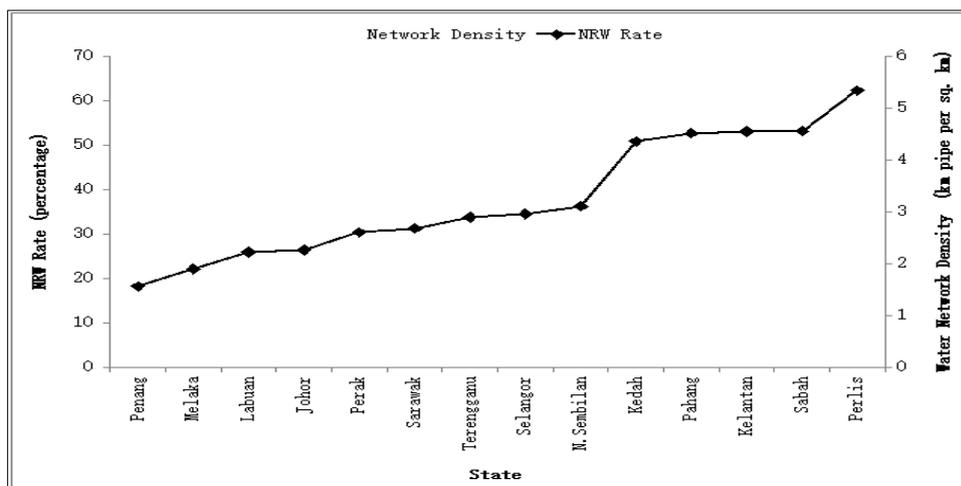


Figure 5: States' NRW Rates and Network Density in 2013  
Source: MWA (2014)

A qualitative interview was done with a representative from Johor's WSP to discuss its WSP challenges in reducing NRW. The interviewee from Johor mentioned that Johor's WSP is actually facing bigger challenges in reducing NRW rate in the rural areas. Compared with solving a NRW-

related issue in rural area, a NRW-related issue in urban area usually can be solved in a shorter time. For example, repairing a leaking pipe in urban area is quicker than repairing a leaking pipe in rural area. The rationale behind is that a leaking pipe along the roadside in urban area can be more easily discovered compared to a leaking pipe along the roadside in rural area, as there are more road users passing by the road in urban area and thus the chance of the leaking pipe seen and reported is higher. Besides, the interviewee from Johor also mentioned that more resources have to be allocated in urban areas to build comprehensive NRW management system as the water demand in urban area is higher, and water security in urban areas are more vulnerable than in rural area. For example, a pipe burst issue happened in the city centre can cause thousands of people staying in a few 30-floor condominiums to face water supply issue because the population density is much higher. In contrast, a pipe burst issue happened in the rural area may only cause water supply interruption to a village which has only about 200 to 500 people.

A qualitative interview was also carried out with a representative from Penang's WSP to discuss NRW management in Penang State. The Penang's interviewee mentioned that one of the reasons forcing the state's WSP to invest more resources in reducing NRW rate was high water demand and low water availability of Penang State. The Penang's interviewee said that the primary reason Penang state had to maintain its NRW rate at a low rate is because the state has to ensure that the water supply is not disrupted 24 hours a day especially to the industries in industrial areas where many factories are located. Some of these factories need water for commercial purpose, for example, to produce goods. Moreover, due to the high population density and low water availability in Penang, the management unit of the WSP understood that NRW rate has to be kept at a low rate in order to sustain the state's water supply. Penang State cannot depend solely on extracting the water resources from the Sungai Muda River, which is a river located at Kedah State for sustaining the water supply, reducing NRW and water wastage is a must-do task for the Penang WSP.

The above discussion has explained why a state with smaller surface area, higher urban population, higher network density, and higher network density would have lower NRW rate. This is because spatial and geographical factors can influence WSP's efficiencies and strategies in reducing NRW rate. Penang's case indicates that the Penang's WSP has to maintain its NRW rate at a low rate to sustain water supply because of low water availability in the state due to the location of the rivers. The Johor's case explains that resources invested in rural and urban areas for NRW reduction could differ because of the differences of population density. In Malaysia, Penang and Melaka are among the most developed states with more urbanised areas, industrial areas, and higher population density in its residential areas. All these factors influence their WSPs to reduce its NRW rates for sustaining water supply of the states. Besides, high population density and high network density of Melaka and Penang probably caused the NRW issues to be easily discovered by the people compared to other states. This can influence a WSP's efficiency in solving NRW issues.

## **CONCLUSION**

In conclusion, spatial and geographical factors could influence WSP in carrying out NRW reduction activities by influencing the WSP's strategies, policies, and decision in dealing with NRW-related issues. However, it does not mean that a NRW rate in a big state cannot be reduced to a lower rate, because reducing NRW effectively requires management of other factors, for example, funding, human capacity of WSP, technical capacity of WSP, and the level of public involvement in NRW reduction activities. The spatial and geographical factors must be taken into account when WSP plans its NRW reduction strategies. For a WSP based in a state having smaller surface areas, spatial and geographical factors do not seem to be the major factors hindering WSP's progress in reducing NRW, but other factors stated above have to be well managed in order to improve WSP's performance in reducing NRW. For WSP with broader service coverage area, it is advisable for the WSP to have service centres and teams located at both rural and urban areas in order to increase the efficiency of its staffs in solving NRW-related issue. Rather than depending solely on staffs who works in the states' headquarter of WSP, the responsibility of carrying out NRW reduction activities have to be delegated to the service centres or teams who are based in a particular service areas. If spatial factors can be

better managed, the WSP will be able to achieve lower NRW rate by increasing its efficiency in solving NRW-related issue.

## REFERENCES

- Amarasinghe, U.A., Sharma, B.R., Aloysius, N., Scott, C., Smakhtin, V., & Fraiture, C. (2005). Spatial Variation in Water Supply and Demand Across River Basins of India. Colombo, Sri Lanka.: International Water Management Institute.
- Department of Statistics. (2010). *Population Distribution and Basic Demographic Characteristics, 2010*. Available at: <https://www.statistics.gov.my/> (Accessed on 19 March 2013).
- Frauendorfer, R., & Liemberger, R. (2010). The Issues and Challenges of Reducing Non- Revenue Water. Philippines.
- González, F., Martínez-Espiñeira, Roberto, García-Valiñas, María A., & García-Rubio, Miguel A. (2012). Explanatory factors of urban water leakage rates in Southern Spain. *Utilities Policy*, 22(0), 22-30. doi: <http://dx.doi.org/10.1016/j.jup.2012.02.002>
- Lai, C.H., Chan, N.W., Suhaimi, A.T., & Jamaluddin, M.J. (2013). *Ke Arah Pengurusan Air Mampan: Kajian Awal Terhadap Cabaran untuk Mengurangkan Air Tidak Berhasil di Malaysia*. Paper presented at the Seminar Serantau Ke-2: Pengurusan Persekitaran di Alam Melayu, Pekanbaru, Provinsi Riau.
- Lai, C.H., Chan, N.W., & Zakaria, N.A. (2013). Non-Revenue Water Management in Malaysia: A Review of Selected Water Service Providers in Malaysia. *Geografi*, 1(2), 7-16.
- Lambert, A., & Hirner, W. (2000). Losses from Water Supply System: Standard Terminology and Recommended Performance Measures. *The Blue Page: The IWA Information Sources on Drinking Water Issues*.
- MWA (Malaysian Water Association). (2014). *Malaysia Water Industry Guide 2014*. Kuala Lumpur, Malaysia.
- Wells, E.C., Davis-Salazar, K.L., & Moreno-Cortes, J.E. (2014). Scale as a Key Factor for Sustainable Water Management in Northwest Honduras. *Journal of Ecological Anthropology*, 17(1), 1-22. doi: <http://dx.doi.org/10.5038/2162-4593.17.1.6>

## **PREDICTING SEBERANG PERAI HOUSING LAND PATTERN IN 2017**

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**ABSTRACT:** Land use decision making is a complex process involving trade-offs among various land stakeholders due to the resource's scarcity. Pulau Pinang is the second most densely populated and also the fourth most urbanised state in Malaysia. Urbanisation in Penang state is partially translated as escalating housing land demand that poses threats to agricultural land especially around the peri urban areas. At present, Malaysia is still lacking in scientific tools to assist planners simulate current and future land use developmental patterns. Existing planning guidelines could not anticipate future development scenarios. Hence the need for a scientific tool based on dynamic spatial model to simulate development pattern using scenario approach. This study aims to develop a GIS-based, CA Markov Model that predicts housing land development in Seberang Perai region of Penang State up to 2017 using 2005 and 2011 land use data. The study first demarcated Seberang Perai based on the degree of suitability to accommodate all land use classifications. The degree of suitability is ranked according to development criteria scores, weightings and constraints, with the latter two quantified using Analytical Hierarchy Process (AHP) technique. CA Markov Model then simulates the dynamic interactions between cells under specific transition rules to predict land pattern in 2017. The study provides information on the potential locations and direction/pattern of growth in 2017. The simulation outcomes show that new or expanded housing lands are located in close proximity with the predicted growth centres and settlements identified in the Penang Structure Plan 2020 hence endorses compact urban development pattern. The CA Markov Model can assist relevant authorities in allocating suitable housing land sites sustainably.

*Keywords:* housing land pattern, geographical information system (GIS), multi criteria decision analysis (MCDA), analytical hierarchy process (AHP), CA Markov

### **INTRODUCTION**

Depleting natural resources and population growth represent two of land use planning's supply and demand parameters that are to be balanced by resource allocation. Penang State is the third smallest state, constituting merely 0.3 per cent of Malaysia's total land area (Department of Survey and Mapping, 2005), and also second most densely populated and fourth most urbanised. These settings lead to immense pressure for new development land. Land allocation considers the suitability of current and potential new land use on the area of interest and its adjacent neighbours. Each land use has its own group of stakeholders that possess specific needs and preferences. Conflicting interests among stakeholders becomes more complex as sustainable land allocation needs to consider the impacts of various development scenarios. Therefore, trade-offs among development criteria become inevitable to accommodate the stakeholders' needs and preferences.

Population growth will both intensify the needs and varying demands for housing land. Physical land planning traditionally subscribes to top-down planning approach that is mainly influenced by generalised supply-side stakeholders' interests and priorities (der Merwe, 1997). According to Smit et al. (1987, as cited in der Merwe, 1997), the one-dimensional nature of land use decision focuses on the suitability of a particular land use rather than selecting the most suitable out of all land use options. The outcome of such planning nature merely provides short-term solution to the conflict. Challenges in current housing land planning include providing satisfactory and affordable sites, and establishing a more liveable environment to the population with various socio-economic backgrounds. Geographical Information System (GIS) is widely recognised as a powerful tool to manage conflicting interests in sustainable land management practices by providing scientific argument to support decision making recommendations. Wang et al. (2004) simulates various planning scenarios involving GIS-based analysis of temporal land use pattern and site suitability in the environmental planning of the Lake Erhai basin in China. Local authorities such as the Suffolk Coastal District Council launched

a web-based GIS service (Suffolk Coastal District Council, 2015) to identify potential housing land supply through their Strategic Housing Land Availability Assessment.

Land suitability and site selection differ in term of their analysis output; the former ranks the suitability of the entire study while the latter identifies only selected sites Al-Shalabi et al. (2006). Anderson (1987) characterised seven land suitability analysis methods (pass/fall screening, graduated screening, weighted factors, penalty point assignment, composite rating, weighted composite rating, and direct assignment) that Banai-Kashani (1989) found to be lacking verification of expert judgement consistency, and are also influenced by the economic, demographic and political uncertainties. Banai-Kashani (1989) proposes Analytical Hierarchy Process (AHP) by Saaty (1980) due to the technique's capability to analyse both qualitative and quantitative development criteria through Multi Criteria Evaluation (MCE) analysis, and also capability to evaluate and rectify the consistency of expert judgements.

Projection of Penang state housing needs (PDTCP, 2007) did not specify the actual housing sites (Samat et al., 2011). During site selection process, housing developers generally prioritise topographical-related guidelines (Federal Department of Town and Country Planning, 2011a, 2009, 2011b) over actual needs and preferences of house buyers. Mismatched housing supply and demand will lead to property overhang, for instance unsold high-rise dwelling units in Southern Seberang Perai was attributed to buyer's preference for landed property (PSDTCP, 2007).

## STUDY AREA AND DATA

Seberang Perai, formerly known as Province Wellesley, is a region of Penang State that is located at the mainland of Peninsular Malaysia (see Figure 1). Hosting three of the five state districts, namely Northern, Central and Southern, Seberang Perai constitutes 72 per cent of total state land with population density of 1,083 persons/km<sup>2</sup>, as compared to Penang Island's 28 per cent and 2,485 persons/km<sup>2</sup> respectively (Department of Statistics, 2011).

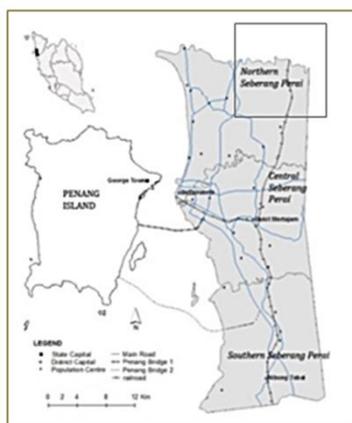


Figure 1: The study area

Land scarcity and socio-economic growth are two major influences that have pushed the island region's house pricing to more than 3.5 folds higher than Seberang Perai, therefore categorised as "severely unaffordable" by Khazanah Research Institute (2015). Penang state has very limited land stock due to its unique pattern of land ownership (MacDonald, 2011), forcing the state to rely heavily on private developers for housing supply and this causes the pricing to be dictated by the property market mechanism in spite of various governmental efforts to secure more affordable units (Quah, 2010).

Going by the House Buyers' Association's affordability threshold value of house-price-to-income-ratio of at most 3.0 (as cited in Khazanah Research Institute, 2015), and Penang State median monthly income of RM4,702 (Department of Statistics, 2015), the affordability threshold is at approximately

RM170,000. When the cheapest new landed housing unit on Penang Island costs RM550,000 (Valuation and Property Services Department, 2014), it forces the middle-income earners to either purchase subpar housing unit, reside on rented property or reside further away from the population centres (Quah, 2010).

Penang State Department of Town and Country Planning (PSDTCP) have adopted various measures to reduce the imbalanced population distribution and property pricing between the two regions (PSDTCP, 2007). Among others, the state is targeting for population distribution ratio of 60:40 for Seberang Perai and Penang Island respectively by 2020. Also by assigning sectoral development by district, the more balanced distribution of development is expected to support various state development corridors. PSDTCP also encourages landed housing development in Seberang Perai to accommodate the development spill over from Penang Island and also its endogenous demands.

The study relies on datasets obtained from PSDTCP, Northern Zone Project Office of DTCP, and DTCP Geoportal. They include land use data for 2005 and 2011, proposed land use for 2020, road network, administrative boundary, slope gradient, elevation, prime agricultural areas, development corridors, and flood-prone areas. Various topographical information were derived from Department of Survey and Mapping topographical maps (1987). Soil classification was derived from Penang State Hydrological Soil Group Map (at 1:75,000) (Department of Agriculture, n.d.). Housing site selection criteria were gathered via a series of interview with housing stakeholders in 2014 and literature review.

## METHODOLOGY

To predict the region's land use pattern, CA Markov Model relies on a two-part independent analysis: namely Multi Criteria Decision Analysis (MCDA) and Markov Chain Analysis (see Figure 2 below).

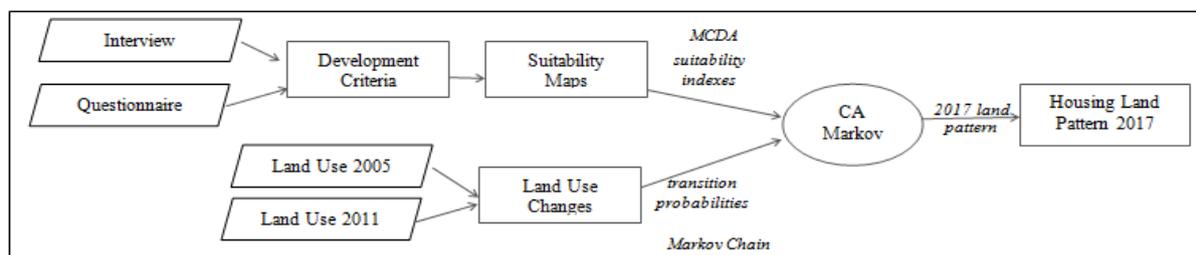


Figure 2: The Proposed Model

The first step in MCDA is to identify housing stakeholders who represent conclusive perspective of interests in housing land. Stakeholders here are defined as Buyers, Developers and Decision Makers. Site selection criteria, consisting of factors and constraints, were derived from a series of semi-structured interviews with house buyers and housing developer officers conducted in 2014. Decision maker's criteria were derived from various planning guidelines and policies (Federal Department of Town and Country Planning, 2011a, 2009, 2011b) to demonstrate the roles of developmental control. The study classifies land use activities into four categories: Housing, Other Built-Up Area, Agriculture and Other Non Built-Up Area. Weighting for each development factor per land use category (excluding Other Non Built-Up Area) is quantified using AHP technique. Other Non Built-Up Area is considered as developmental constraint. GIS is used to incorporate spatial dimension to the criteria weightings in order to derive site suitability indexes.

Cellular Automata-based Markov Chain Analysis utilises GIS to map the distribution of land use activities and monitor changes in activities' land use pattern. Seberang Perai is represented as a lattice of two-dimensional rectangular grid of square cells with 30 meter resolution. By assigning a landed

property plot size of 125 square meter<sup>4</sup>, two adjacent 30x30 meter cells are estimated to cater for ten terrace housing units and land loss for the provision of facilities and utilities.

Markov Chain analyses the successive changes of cell states,  $S = (s_1, s_2, \dots, s_r)$  within a specific time-frame (step) with a certain probability (Grinstead and Snell, 1997). *Cell state* depicts the land use activity at a specific location and particular time-step.  $P_{ab}$  or *transition probabilities* (see Equation 1) is derived from the initial state value of all cells.  $P_{ab}$  value at  $s_b$  is not influenced by  $s_a$ . The array of transition probability values, known as transition matrix, contains either changed or unchanged stochastic value of the  $(s_a, s_b)$  pairing.

$${}^tP_{a,b,i,j} = P\{X_t=s_b|X_{t-1}=s_a\} \quad [1]$$

where

${}^tP_{a,b,i,j}$  represents the probability of a cell state at location  $i,j$  and step  $t-1$ , transforming from the current state  $s_a$  into  $s_b$  at the following time-step.

Cellular Automata (CA) contains four basic elements that are lattice, cell state, neighbourhood, and transition rules (Batty, 1997). Here, *lattice* represents Seberang Perai region; *cell state* land use activity at a location  $i,j$  and at step  $t$  (see Equation 2); *neighbourhood* radius of land use activities that influences the centre cell; and *transition rule* dictates the temporal behaviour of central cells based on their reaction to the respective neighbourhood cells. Extended Moore Neighbourhood (5x5 cell) is selected as a two-dimensional lattice is the most relevant dimension to depict urbanisation (Batty, 1997).

$$u_{i,j}^t = \begin{cases} 1 = \text{Housing} \\ 2 = \text{Other Built - Up} \\ 3 = \text{Agricultural} \\ 4 = \text{Other Non Built - Up} \end{cases} \quad [2]$$

The transition rule is made up of criteria suitability indexes (see Equation 3), transition probabilities (see Equation 1) and neighbourhood indexes. Criteria suitability scores are standardised using Fuzzy Classification to rank the degree of membership of each factor cell to each land use activity, with value 225 reflecting most likely suitability. The scores are next multiplied with the corresponding weightings that had been derived using AHP technique shown in Equation 3. AHP Consistency Ratio at or less than 0.10 is deemed a reasonable level of consistency (Malczewski, 1999). The classification methods and approaches used in this study are available in IDRISI GIS software (Eastman, 2003). From here, the transition rule is defined (see Equation 4). Assessment is next carried out to verify the accuracy of the model prediction.

$${}^tS_{i,j} = \sum_{m=1}^M {}^t x_{i,j} \cdot w_m \cdot c_m \quad [3]$$

where

${}^tS_{i,j}$  = suitability index for cell  $i,j$  at time  $t$   
 ${}^t x_{i,j}$  = score of criterion  $m$  at cell  $i,j$  at time  $t$   
 $w_m$  = weight for criterion  $m$   
 $c_m$  = Boolean value for constraint

$${}^{t+1}u_{i,j} = f(({}^t u_{i,j}) \cdot ({}^t S_{i,j}) \cdot ({}^t P_{a,b,i,j}) \cdot ({}^t N_{i,j})) \quad [4]$$

where

${}^{t+1}u_{i,j}$  = the potential of cell  $i,j$  to change at time  $t+1$   
 ${}^t u_{i,j}$  = cell state at time  $t$   
 ${}^t S_{i,j}$  = suitability index for cell  $i,j$  at time  $t$   
 ${}^t P_{a,b,i,j}$  = probability of cell  $i,j$  to change from state  $a$  to  $b$  at time  $t$   
 ${}^t N_{i,j}$  = neighbourhood index of cell  $i,j$

<sup>4</sup> Average plot size for various types of landed properties priced RM150,000 and below in all three different districts sold under private housing projects within the first half of 2012-2014 (Valuation and Property Services Department 2012, 2013 and 2014).

## RESULTS AND DISCUSSIONS

Land use activities in 2005 and 2011 are shown in Figure 3a below. Housing includes both housing schemes and village dwellings. Other built-up covers commercial, services, transportation, utilities and industrial areas. Agriculture represents crop cultivation and farming of livestock and aquaculture. Other non built-up contains environmentally sensitive areas and vacant land.

The observed and predicted probabilities of changes in land use activity are shown in Figure 3b. The accuracy of land use transition evaluated using Kappa Index of Agreement (KIA) is at 83.75 per cent, reflecting approximately 84 per cent of the classified sites are of the same activity between the two years, and therefore reducing the probability of random classification (Malczewski, 1999).

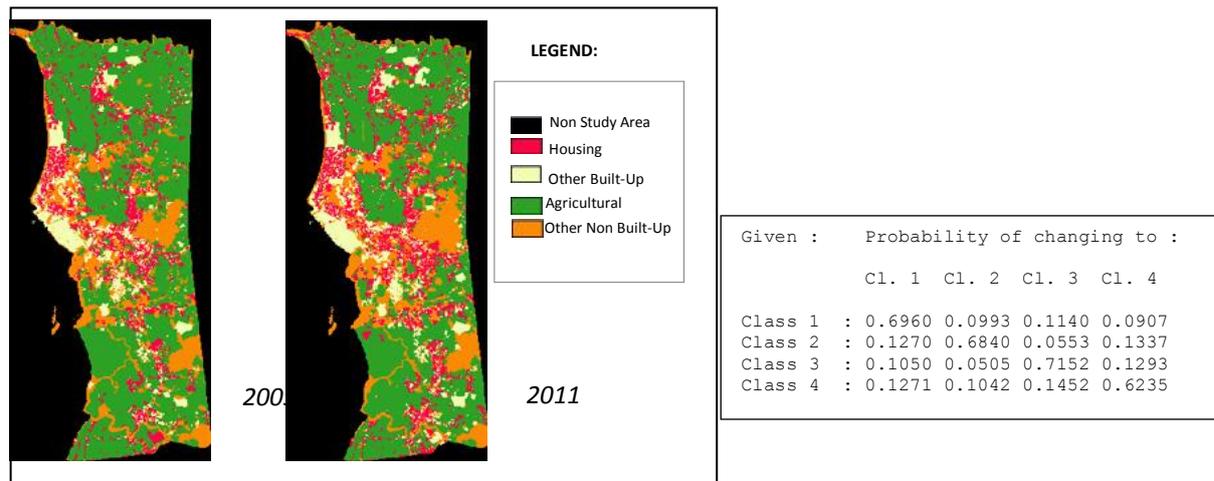


Figure 3: Land Use Patterns for 2005 and 2011 (left) and Land Use Activities Transition Matrix (right)

Development criteria and their respective weightings for Housing, Other Built-Up and Agriculture derived using AHP technique are shown in the following Table 1. Suitability map for all land uses are shown in the following Figure 5 based on AHP weightings (a = Housing, b = Other Built-Up and c = Agriculture) and Boolean Logic (d = Other Non Built-Up).

Table 1: Development Factors and Weightings per land use category

Factor	Housing	Other Built-Up	Agriculture
Proximity to CBD/Workplace	0.2293	0.2337	
Proximity to public health facilities	0.1589		
Proximity to school	0.1129		
Proximity to flood-prone areas	0.2038	0.0718	0.1884
Proximity to road network	0.0674	0.5785	0.0810
Proximity to sensitive areas	0.0375		
Proximity to other facilities	0.1216		
Proximity to existing housing	0.0685	0.1161	
Soil Classification			0.7306
<i>Consistency Ratio</i>	<i>0.08</i>	<i>0.09</i>	<i>0.06</i>

From these four outputs (see Figure 4), prediction for land use pattern in the year 2017 is simulated (see Figure 5.a), and specifically housing land distribution is shown in Figure 5.b. KIA is at 88.92 per cent.

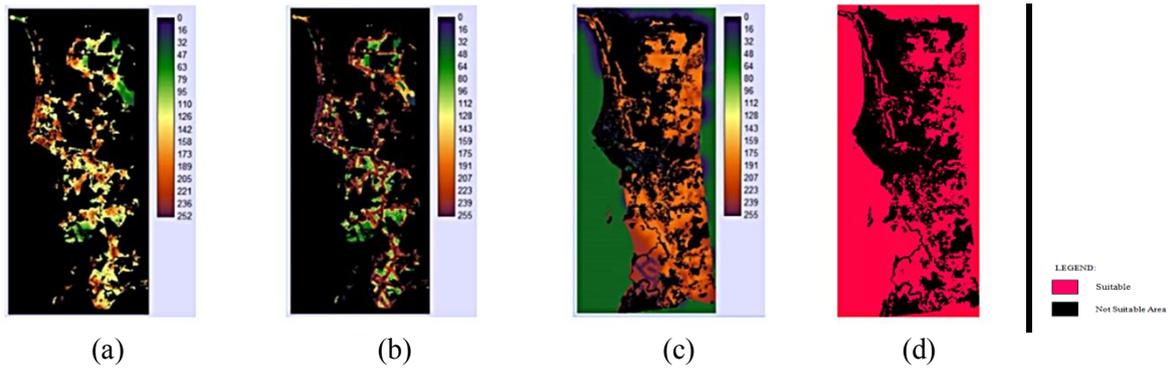


Figure 4: MCE-based Suitability Maps

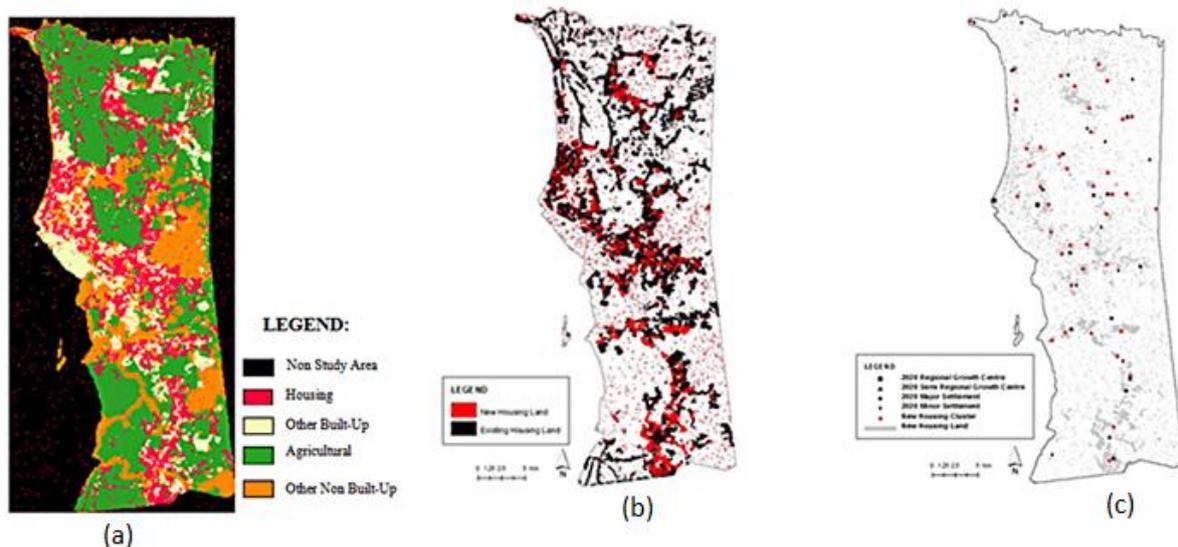


Figure 5: (a) Prediction of land use pattern 2017, (b) prediction of housing land pattern, and (c) prediction of new housing clusters 2017.

Housing land clusters (see Figure 5.c) are found to be located within close proximity to the predicted growth centres and settlements identified by PDTCP (2007), and in line with the compact city growth concept (Federal Department of Town and Country Planning, 2006) to maximise the usage of existing urban space and control the land encroachment at peri-urban areas. As PDTCP (2007) stipulated that commuting time between the dwelling unit and workplace within a major conurbation is within 45 minutes, and Seberang Perai is located within George Town Conurbation, it is assumed that any dwelling location in the region is suitable for current or potential Seberang Perai residents who are working in Penang Island. Also, fragments of new housing land are likely to be of new village dwellings as the lands are formerly agricultural plots.

## CONCLUSION

Simulation of future housing land pattern using CA Markov Model can assist housing decision makers and developers to identify more suitable housing sites that are able to cater for evolving needs of various levels of household incomes. As Penang State is striving to become a developed state, the expected higher income can be translated into higher demand for affordable housing. This study has demonstrated the capability of CA Markov model to predict housing land pattern that takes into account preferences of house buyers, and sustainable land usage and management practices by the developers and decision makers. While this neighbourhood effects-based prediction is unable to anticipate new leapfrog-form development, an alternative sprawl pattern influenced by land value, this alternative tool for housing site selection can still assist various initiatives to provide affordable and liveable housing for middle income-earners. Availability of more affordable housing options in

Seberang Perai will provide a win-win situation for Penang State by boosting socio-economic development in Seberang Perai and at the same time liberates Penang Island from various problems associated with very high population density.

### **Acknowledgement**

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### **REFERENCES**

- Anderson, L. T. (1987). Seven methods for calculating land capability/suitability. *Planning Advisory Service (PAS) Report No. 402*. Chicago: American Planning Association.
- Al-Shalabi, M. A., Mansor, S., Ahmed, N. & Shiriff, R. (2006). GIS based Multicriteria Approaches to Housing Site Suitability Assessment. *Shaping the Change: XXIII FIG Congress, October 8-13, 2006*. Munich, Germany.
- Banai-Kashani, R. (1989). A New Method for Site Suitability Analysis: The Analytic Hierarchy Process. *Environmental Management*, 13(6), 685-693. New York: Springer-Verlag.
- Batty, M. (1997). Cellular automata and urban form: a primer. *Journal of the American Planning Association*, 63(2). pp 266-274.
- Department of Agriculture (n.d.). *Peninsular Malaysia Penang State Hydrological Soil Group Map* (at 1:75,000).
- Department of Statistics, Malaysia. (2011). Population Distribution and Basic Demographic Characteristics 2010. Retrieved from [http://www.statistics.gov.my/portal/download\\_Population/files/census2010/Taburan\\_Penduduk\\_dan\\_Ciri-ciri\\_Asas\\_Demografi.pdf](http://www.statistics.gov.my/portal/download_Population/files/census2010/Taburan_Penduduk_dan_Ciri-ciri_Asas_Demografi.pdf)
- Department of Statistics (2015). *Household Income and Basic Amenities Survey 2014*. Department of Statistics, Malaysia.
- Department of Survey and Mapping, Malaysia (1987). *Topographic Map*. Kuala Lumpur: Department of Survey and Mapping.
- Department of Survey and Mapping, Malaysia (2005). *Maklumat Keluasan dan Perimeter Negeri-Negeri, Daerah-Daerah dan Pulau-Pulau di Malaysia*. Kuala Lumpur: Department of Survey and Mapping.
- der Merwe, J.H. (1997). GIS-aided land evaluation and decision-making for regulating urban expansion. A South African case study. *GeoJournal*, 43. pp. 135–151. The Netherlands: Kluwer Academic Publishers.
- Eastman, J.R. (2003). *IDRISI Kilimanjaro: Guide to GIS and Image Processing, Manual Version 14.00*. Worcester, USA: Clark Labs, Clark University.
- Federal Department of Town and Country Planning of Peninsular Malaysia (FDTCP), (2006). *National Urbanisation Policy*. Kuala Lumpur: FDTCP.
- Federal Department of Town and Country Planning (FDTCP). (2009). *Hill and Highland Planning Guidelines*. Ministry of Housing and Local Government, Malaysia.
- Federal Department of Town and Country Planning (FDTCP). (2011a). *Housing Planning Guidelines, Second Draft (17/6/2011)*. Ministry of Housing and Local Government, Malaysia.
- Federal Department of Town and Country Planning (FDTCP). (2011b). *Planning Guidelines for Environmentally Sensitive Areas, Draft*. Ministry of Housing and Local Government, Malaysia.
- Grinstead, C.M. & Snell, J.L. (1997). *Introduction to Probability*. American Mathematical Society.
- Khazanah Research Institute (2015). *Making Housing Affordable*. Kuala Lumpur: Khazanah Research Institute. License: Creative Commons Attribution CC BY 3.0.
- MacDonald, S. (2011). Drivers of house price inflation in Penang, Malaysia: Planning a more sustainable future. *Penang Institute Research Paper*. Retrieved from [http://penanginstitute.org/v3/files/research\\_papers/Drivers\\_of\\_house\\_price\\_inflation.pdf](http://penanginstitute.org/v3/files/research_papers/Drivers_of_house_price_inflation.pdf)
- Malczewski, J. (1999). *GIS and Multicriteria Decision Analysis*. Canada: John Wiley & Sons.

- Penang State Department of Town and Country Planning (PDTCP). (2007). *Penang State Structure Plan 2020*. Government Gazette 51, 13(1) Penang: PDTCP.
- Quah, J.H. (2010, September). Priced off Penang: Who can afford an island home? *Penang Economic Monthly*.
- Saaty, T.L. (1980). *The Analytic Hierarchy Process*. New York: McGraw-Hill.
- Samat, N., Hasni, R. & Elhadary, Y.A.E (2011). Modelling Land Use Changes at the Peri-Urban Areas Using Geographic Information Systems and Cellular Automata Model. *Journal of Sustainable Development*, 4(6), 72-84. doi: dx.doi.org/10.5539/jsd.v4n6p72
- Smit, B. Ludlow, L. Johnston, T. and Flaherty, M.S. (1987). Identifying important agricultural lands: A critique. *Canadian Geographer* 31(4): 356-365
- Suffolk Coastal District Council (2015). *Using the GIS to view the 2014 strategic housing land availability assessment*. Retrieved from <http://www.suffolkcoastal.gov.uk/yourdistrict/planning/devcontrol/gis/shlaaguide/>
- Valuation and Property Services Department (2012). *Property Market Report, First Half 2012*. Ministry of Finance Malaysia
- Valuation and Property Services Department (2013). *Property Market Report, First Half 2013*. Ministry of Finance Malaysia
- Valuation and Property Services Department (2014). *Property Market Report, First Half 2014*. Ministry of Finance Malaysia
- Wang, X., Yu, Sheng & Huang, G.H. (2004). Land allocation based on integrated GIS-optimization modeling at a watershed level. *Landscape and Urban Planning*, 66(2), 61–74.

#### **Interview**

- J. Panil, personal interview, October 9, 2014
- H. Saad, personal interview, October 10, 2014
- N. Ideris, personal interview, October 10, 2014
- N. Mohd Basar, personal interview, October 10, 2014

## **DEVELOPMENTAL PRESSURE AND NUTRIENT CONCENTRATIONS OF SUNGAI PETANI CATCHMENT, KEDAH**

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**ABSTRACT:** Developmental pressure is encroaching many small towns and cities in Malaysia. The wave of development has caused small towns like Sungai Petani Town and its surrounding catchment area to be affected by the changing land uses due to developmental pressure in the catchment area. This paper examined the temporal patterns of nutrient concentrations longitudinally along the Sungai Petani River from March 2012 to December 2013 due to the unequal distribution of 'green' areas with respect to the 'grey' areas. Four stations were chosen longitudinally from upper Sungai Petani River downstream towards Sungai Petani Town and were monitored from upstream part of Sungai Petani Town which is the least affected station, through Sungai Petani Town and towards the downstream station below the Sungai Petani Town. Water sampling at all stations were performed through grab sampling technique at depths of about 0.5 m. Water samples were analysed only for dissolved forms of nitrate (NO<sub>3</sub>), ammoniacal nitrogen (NH<sub>4</sub>), total nitrogen (TN), phosphate (PO<sub>4</sub>) and total phosphorus (TP). The samples were analysed using standard procedure by Adams (1989) and APHA (1998). Most of the nutrient concentrations increased from upper station to the second station situated in the Sungai Petani Town. Nitrate increases by 6 per cent and 15 per cent in 2012 and 2013 respectively, ammonia increases by 11 per cent and 35 per cent respectively, TN by 16 per cent and 22 per cent respectively, TP by 45 per cent and 44 per cent respectively, and PO<sub>4</sub> by 13 per cent and 90 per cent respectively. On the other hand, the concentration decreases from second to the last station at the outlet downstream of the town. Nitrate decreases by 16 per cent and 27 per cent in 2012 and 2013 respectively, ammonia increases by 28 per cent and 44 per cent respectively. TN by 34 per cent and 41 per cent respectively, TP 16 per cent and 28 per cent respectively, and PO<sub>4</sub> increases another 2.4 per cent in 2012 but decline by 42 per cent in 2013. The effect of urbanisation and development is clearly the main cause of the deteriorating water environment as shown by the increasing nutrient concentration along the Sungai Petani River where most of the parameters are above the permissible threshold limit.

*Keywords:* urbanisation, development, nutrient concentrations, Sungai Petani River

### **INTRODUCTION**

Today, like many other towns in Malaysia where developmental pressure encroaches many small towns and cities, development has cause small towns like Sungai Petani Town and its surrounding catchment areas to be affected by the changing land uses due to the developmental pressure in the catchment area. As such, inequality refers to the lack of 'green' areas versus urban concrete areas causing water quality to deteriorate.

Historically, from the 1920's to the 1960's, Sungai Petani Town was the backdrop of the rubber industry. With the fall of rubber prices in the 1980's, the State set up an industrial hub in Sungai Petani. Economic growth of Sungai Petani today is centred around the diverse industries established - from electronics to wood-based products. The population of Sungai Petani has increased from about 36,000 in 1970 to 456, 605 in 2010 (Malaysiabooks.com, 2015). Figure 1 shows the land uses in the Sungai Petani which is heavily urbanised with much more acreage of 'grey' infrastructure as compared to the 'green' infrastructure.

In terms of spatial inequality, one of the inequalities observed in developing urban areas is related to the 'green' area versus 'grey' areas. 'Grey' areas are related to areas of impervious surfaces such as roofs and tarmac i.e. buildings and streets found in most of the urban areas, while the 'green' areas are areas of the green forest land, vegetated land, parks and lawns in the urban areas (Svendsen et al., 2012) and aquatic ecosystems are also often included (Francis and Chadwick, 2013). Green area is an

indicator of both ecological health and quality of life in urban areas (Ginn and Francis, 2014). Lack of green areas in urban areas is due to lack of planning of the cities.

The effect of unequal mass of 'green' versus 'grey' areas has led to differential effect on water quality of the urban areas. The expanding urbanisation as observed elsewhere in other developing countries, dramatically affects water resources in terms of quality (physical, chemical, biological pollution, etc.) and quantity (Ducrot et al., 2004). This will also leads to competition for water, associated with a competition for access to land, exacerbated in peri-urban areas.

This paper highlight the consequences of the unequal distribution of green versus grey areas in an urbanising catchment area of Sungai Petani Town, depicting some results of the temporal patterns of nutrient concentrations longitudinally along the Sungai Petani River for 2012 and 2013. Furthermore, this paper enables transition from general water quality assessment to specific experiment by describing the inadequacy in previous research that motivates the present study.

## STUDY AREA

Sungai Petani River is a major river flowing through the city centre of Sungai Petani, Kedah with a length of 12.5 km and catchment area of 3500 hectares. Sungai Petani experiences equatorial climate, characterised by hot and humid climate as well as high temperature and rain evenly throughout the year. This area also receives convection and precipitation hill rainfall of southwest monsoon winds from the Straits of Malacca. In 2006, Sungai Petani river catchment consists of urban, residential and related (3.22 km<sup>2</sup>), swamp forest/mangrove forest (2.14 km<sup>2</sup>), open area (0.3 km<sup>2</sup>), roads, highways and utilities (0.06 km<sup>2</sup>), mix horticulture (0.19 km<sup>2</sup>), rubber (0.03 km<sup>2</sup>), paddy (0.47 km<sup>2</sup>), forest, secondary forest and bush (0.03 km<sup>2</sup>) (see Figure 1) (DOE, 2010).

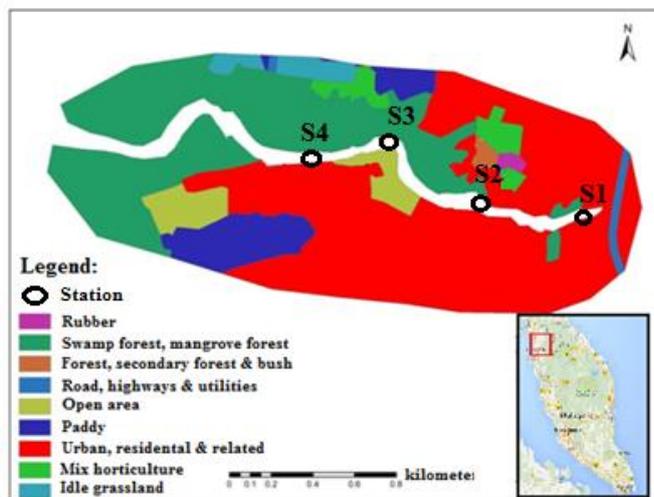


Figure 1: Sungai Petani River catchment showing the encroachment of urban areas in the catchment area  
Source: DOE (2010)

## DATA AND METHODOLOGY

Four stations were chosen longitudinally along Sungai Petani River from upper section of Sungai Petani River downstream towards Sungai Petani Town. Water sampling program were carried from March 2012 to December 2013 to capture both *in-situ* and *ex-situ* parameters. The sampling program is part of a wider study of the Merbok Catchment areas that include the Sungai Petani catchment (Ismail and Ibrahim, 2015).

Water sampling at all stations were performed using the grab sampling technique. Surface water samples for nitrogen (N) and phosphorus (P) were collected twice per month at depths of about 0.5 m

from water surface and directly stored into clean 1 litre polyethylene bottles. Water samples were analysed only for dissolved forms of nitrate ( $\text{NO}_3$ ), ammoniacal nitrogen ( $\text{NH}_4$ ), total nitrogen (TN), phosphate ( $\text{PO}_4$ ) and total phosphorus (TP). For nitrate, sample was analysed based on reaction of sulfanil amide in an acid solution. Then, the nitrate in the sample is reduced through a column containing cadmium copper (Adams, 1989). For ammonia, solution of boric acid and sulfuric acid are used based on phenol-hypochlorite method. For phosphate, reactive phosphate in the sample was determined using ascorbic acid and antimony to a blue-colour molybdate complex (Adams, 1989). For TN, the total N in the sample was determined using potassium persulfate and heat oxidizes method. The oxidizing nitrogen is then reduced in a cadmium copper reduction column. For TP, the total P in the sample was determined by digestion of organically bound using an alkaline persulphate mixture based on alkaline persulphate oxidation method (APHA, 1989).

## RESULTS AND DISCUSSIONS

Several nutrients concentrations especially N and P were chosen for discussion. This is because urban activities are amongst major sources of N and P to aquatic ecosystems (Carpenter et al., 1998). Most of the nutrient concentrations increased from upper station to the second station situated in the Sungai Petani Town.

As a result, all of the stations recorded higher average nitrate level during 2013 (ranging from 2.82 mg/l to 4.07 mg/l) compared to 2012 (ranging from 2.68 mg/l to 3.19 mg/l) (see Figure 2). In comparison, average of ammoniacal nitrogen ranged from 1.75 mg/l to 3.12 mg/l in 2013 but produced slightly lower concentration in 2012 (ranging from 1.16 mg/l to 1.63 mg/l) (see Figure 3). Moreover, the average TN concentration were higher in 2013 (ranging from 2.34 mg/l to 3.92 mg/l) compared to the year before (ranging from 2.25 mg/l to 3.41 mg/l) (see Figure 4). On the other hand, phosphate concentration is higher in 2012, compared with 2013. The average concentrations of phosphate in 2013 ranged from 0.45 mg/l to 0.95 mg/l. Compared to the average phosphate concentrations in 2012 which ranged from 1.47 mg/l to 1.71 mg/l (see Figure 6).

The nutrient concentrations in the Sungai Petani River were investigated longitudinally and we found that concentration increases from Station 1 (peri-urban area) to Station 2 (urban area). Nitrate concentrations increases by 6 per cent and 15 per cent in 2012 and 2013, respectively (Figure 2); ammonia increases by 11 per cent and 35 per cent, respectively (Figure 3); TN by 16 per cent and 22 per cent, respectively (Figure 4); TP by 45 per cent and 44 per cent, respectively (see Figure 5); and  $\text{PO}_4$  by 13 per cent and 90 per cent respectively (see Figure 6).

The results also showed that all nutrient concentration increases from Station 1 (peri-urban) to Station 2 (urban) and show continued decline when compared to station 3 and station 4. The nutrient concentration decreases from Station 2 to the last station at the outlet downstream of the town. Nitrate decreases by 16 per cent and 27 per cent in 2012 and 2013 respectively (see Figure 2), ammonia increases by 28 per cent and 44 per cent respectively (see Figure 3). TN by 34 per cent and 41 per cent respectively (see Figure 4), TP 16 per cent and 28 per cent respectively (see Figure 5), and  $\text{PO}_4$  increases another 2.4 per cent in 2012 but decline by 42 per cent in 2013 (see Figure 6).

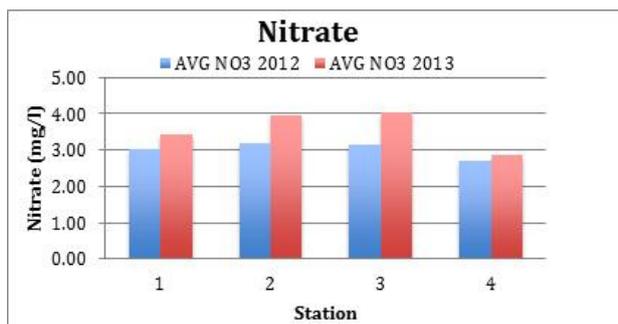


Figure 2: The average nitrate concentrations during 2012 and 2013

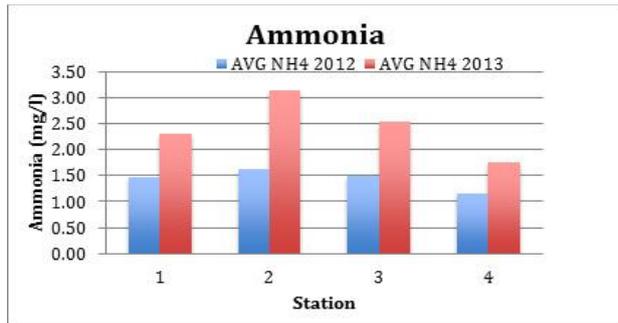


Figure 3: The average ammonia concentrations during 2012 and 2013

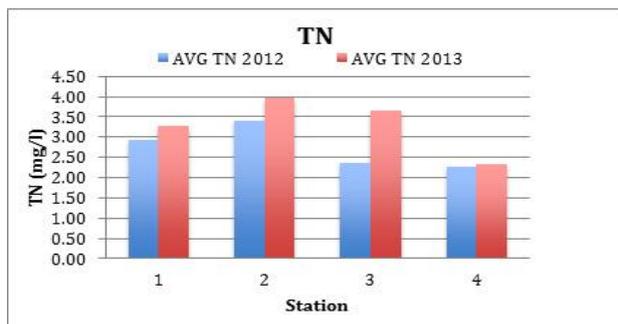


Figure 4: The average TN concentrations during 2012 and 2013

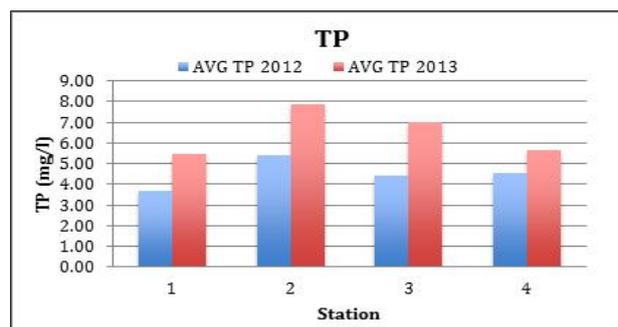


Figure 5: The average TP concentrations during 2012 and 2013

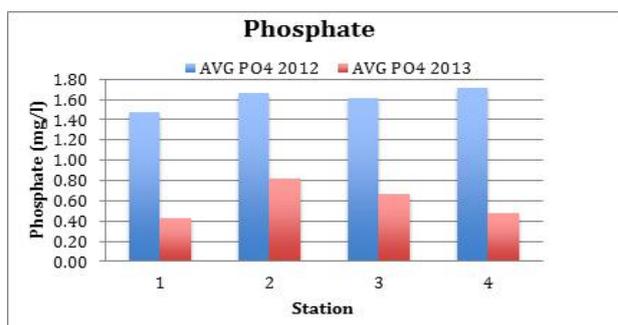


Figure 6: The average phosphate concentrations during 2012 and 2013

All stations, however, exceed the permissible limit of water quality standard. The ammoniacal Nitrogen for example was in Class IV and in Class V due to concentrations higher than limit of 1.75 mg/l at Station 2 (Interim National Water Quality Standards–Malaysia)(WEPA, n.d.). The water quality classification based on ammonia and nitrate concentrations (LAWA, 1998) showed that the water quality ranging from moderately polluted (Class III) to ‘excessively contaminated’ in Class IV (see Table 1) when ammoniacal nitrogen concentration is greater than 2.4 mg/l. The level of concentrations of nitrate in 2012 was in moderately polluted Class II-III (see Table 1), but ammoniat

is classified as heavily polluted (Class III-IV) (Figure 3). In 2013 however, the nitrate concentrations increases in range from 2.88 mg/l to 4.07 mg/l (Class III – critically polluted water), while ammonia between 1.75 mg/l to 3.12 mg/l (Class III-IV and IV– very heavily polluted and excessively polluted water).

Table 1: Water quality classes for surface water bodies according to LAWA (1998) and their thresholds for NH<sub>4</sub>-N, NO<sub>3</sub>-N, PO<sub>4</sub>-P and TP.

<b>Water Quality Class</b>	<b>Degree of Pollution</b>	<b>NH<sub>4</sub>-N</b>	<b>NO<sub>3</sub>-N</b>	<b>PO<sub>4</sub>-P</b>	<b>TP</b>
I	Unpolluted or very lightly polluted	<0.04	<1	<0.02	<1
I-II	Lightly polluted	<0.1	<1.5	<0.04	<1.5
II	Moderately polluted	<0.3	<2.5	<0.1	<3
II-III	Critically polluted	<0.6	<5	<0.2	<6
III	Heavily polluted	<1.2	<10	<0.4	<12
III-IV	Very heavily polluted	<2.4	<20	<0.8	<24
IV	Excessively polluted	>2.4	>20	>0.8	>24

Generally, phosphorus is the limiting nutrient in freshwater aquatic systems. That is, if all phosphorus is used, plant growth will cease, no matter how much nitrogen is available. The natural background levels of total phosphorus are generally less than 0.03 mg/l. The natural levels of phosphate usually range from 0.005 to 0.05 mg/l (Kotoski, 1997). The level of phosphate in Sungai Petani compared to the natural background were in the range from 8 folds at Station 1 in 2013 to 34 folds at Station 4 in 2012 (see Figure 6); and they are classified as excessively polluted in 2012.

According to Wetzel (2001), most uncontaminated freshwaters contain between 0.01 and 0.05mg/l of TP. Thus, the level of TP is far higher in the Sungai Petani Catchment and found to be critically polluted river (Class II-III in Table 1). The level of TP were in the range from 70 folds at Station 1 in 2012 to 160 folds at Station 2 in 2013 (see Figure 5).

The study of the relationship between water quality and urbanisation is not new. Specific emphasis has been placed on how urbanisation influenced the chemistry of spring water (Al-Kharabsheh, 1999), the temperature of urban streams (LeBlanc et al., 1997), and the reduction of urban groundwater supplies (Gupta, 2002). Other research has examined how the form and rate of urbanisation influence water quality. Goda (1991) examined the effects of density and industrial activities on a range of water quality classifications. Wang (2001) provides a comprehensive examination of the spatial variation to water quality across an entire watershed. His findings reveal a strong relationship between the degradation of urban water quality and urban land use (Ren et al., 2003).

The data collected for the longitudinal profile by sampling transects of the main river and the numerous tributaries. There is great spatial difference in the level of urbanisation among the four sampling station in this study. Station 2 and 3 are located at the centre of Sungai Petani Town with highly urbanised and mainly covered by commercial, residential and manufacturing lands. These factors have caused the water pollution of Sungai Petani River to become increasingly serious. Meanwhile, station 1 belongs to a less urbanised area which is at the period of transition from a rural urban landscape to an urban landscape. Which means the water quality problem is relatively because of less nutrient contamination.

The results of this study show that the effect of differing land use and unequal distribution of green area against grey areas has caused water quality deterioration. One possible solution to reduce pollution in urban areas like Sungai Petani Town is by tackling the source of urban pollution, and to have more green spaces or buffer zones which act as filter preventing direct entry of pollutant into water course and river channels. Buffer zone is a vegetated strip of land separating runoff and pollutants contributing areas from surface waters. It is one of the most effective tools in coping up with non-point sources pollution (Philips, 1989) and it was an urgent and effective way for filtering runoff and land based pollutants before reaching surface waters (Shen et al., 2015).

## CONCLUSION

As Malaysia heads towards urbanisation and industrialisation, it is very important to assess and tackle the issues of land use patterns and trends of water quality degradation during rapid urbanisation process. Our rivers, especially at the urban stretches, are being stressed due to urbanisation and these results in heavy pollution, decreased assimilative capacity and environment deterioration, which are the barriers of city development. The effect of urbanisation and development pressure is clearly the main cause of the deteriorating water environment as shown by the increasing nutrient concentrations longitudinally along the Sungai Petani River. Most of the parameters are above the permissible threshold limit. Both nitrate and ammonia which are indicators of pollution were higher than the permitted level. Implementing river improvement programs and creating green area in Sungai Petani Town are necessary for medium to long-term goal. More green areas as buffer zones is suggested as a remedial measure to combat further water quality deterioration and should be incorporated in future planning of the urban township. It is recommended that the government undertakes strict measures on water quality control and taking preventative actions as well.

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## REFERENCES

- Al-Kharabsheh, A. A. (1999). Influence of urbanization on water quality at WadiKufranja basin (Jordan). *Journal of Arid Environments*, 43(1), 79-89.
- Adams, V.D. (1989). *Water and Wastewater Examination Manual* 1st Edition. Boca Raton: CRC Press.
- APHA. (1989). *Standard methods for the examination of water and wastewater*. 17th ed. Washington, DC: American Public Health Association.
- Carpenter, S.R., Caraco, N.F., Correll, D.L., Howarth, R.W., Sharpley, A.N. & Smith, V.H. (1998). Nonpoint pollution of surface waters with phosphorus and nitrogen. *Ecological applications*, 8(3), 559-568.
- DOE (2010). Present land use map Kedah and Langkawi, Department of Agriculture Malaysia, 2010. Putrajaya.
- Ducrot, R., LePage C., Bommel, P. & Kuper, M. (2004). Articulating land and water dynamics with urbanization: an attempt to model natural resources management at the urban edge. *Computers, Environment and Urban Systems*, 28, 85-106.
- Francis, R.A. & Chadwick, M.A. (2013) *Urban Ecosystems: Understanding the Human Environment*. Oxon: Earthscan from Routledge.
- Ginn, F. and Francis, R.A. (2014). Urban greening and sustaining urban natures in London. In R. Imrie and L. Lees (Eds.). *Sustainable London? The future of a global city*. Bristol, UK: Policy Press. 283
- Goda, T. (1991). Management and Status of Japanese Public Waters. *Water Science Technology*, 23(1-3), 1-10.
- Gupta, R. K. (2002). Water and energy linkages for groundwater exploitation: a case study of Gujarat State, India. *International Journal of Water Resources Development*, 18(1), 25-45.
- Ismail, W.R. & Ibrahim, M.N. (2015). An Assessment of Sediment and Nitrogen Input in the Upper Merbok River. *Water Quality Exposure and Health*, 7(1), 79-88.
- Kotoski, James E. (1997). Information on Phosphorus Amounts & Water Quality. Phosphorus Minifact & Analysis Sheet. Retrieved at [http://osse.ssec.wisc.edu/curriculum/earth/Minifact2\\_Phosphorus.pdf](http://osse.ssec.wisc.edu/curriculum/earth/Minifact2_Phosphorus.pdf)
- LAWA (Landerarbeitsgemeinschaft Wasser) (1998). *Beurteilung der Wasserbeschaffenheit von Fließgewässern in der Bundesrepublik Deutschland – Chemische Gewässergüteklassifikation, Kultur-* buchverlag Berlin.

- LeBlanc, R. T., Brown, R. D., & FitzGibbon, J. E. (1997). Modeling the effects of land use change on the water temperature in unregulated urban streams. *Journal of Environmental Management*, 49(4), 445-469.
- myMalaysiabooks.com (2015). Alor Star and Sungai Petani. Retrieved from <http://www.mymalaysiabooks.com/Kedah/ASandSP.htm>.
- Phillips, J.D. (1989). An evaluation of the factors determining the effectiveness of water quality buffer zones. *Journal of Hydrology*, 107(1), 133-145.
- Ren, W., Zhong, Y., Meligrana, J., Anderson, B., Watt, W. E., Chen, J., & Leung, H.L. (2003). Urbanization, land use, and water quality in Shanghai: 1947–1996. *Environment International*, 29(5), 649-659.
- Shen, Z., Hou, X., Li, W., Aini, G., Chen, L., & Gong, Y. (2015). Impact of landscape pattern at multiple spatial scales on water quality: A case study in a typical urbanised watershed in China. *Ecological Indicators*, 48, 417-427.
- Svendsen, E., Northridge, M.E. & Metcalf, S.S. (2012). Integrating Grey and Green Infrastructure to Improve the Health and Well-being of Urban Populations. *Cities and the Environment (CATE)*, 5(1), Article 3. Retrieved from <http://digitalcommons.lmu.edu/cate/vol5/iss1/3>
- Wang, X. (2001). Integrating water-quality management and land-use planning in a watershed context. *Journal of Environmental Management*, 61(1), 25-36.
- Water Environment Partnership in Asia/WEPA (n.d.). Interim National Water Quality Standards For Malaysia. Retrieved from [http://www.wepa-db.net/policies/law/malaysia/eq\\_surface.htm](http://www.wepa-db.net/policies/law/malaysia/eq_surface.htm).
- Wetzel, R.G. (2001). *Limnology*. Academic Press, New York. 1006.

**APPLICATION OF SPATIAL ANALYSIS IN ASSESSING THE EFFECT OF COASTAL LAND RECLAMATION AND DEVELOPMENT ON SEAGRASS *Halophila ovalis* AND *Halophila beccarii* DISTRIBUTIONS IN PENANG WATERS**

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**ABSTRACT:** The aim of this study is to ascertain the possible effects of coastal land reclamation and development on existing seagrass spatial distribution of *Halophila ovalis* and *Halophila beccarii* surrounding a man-made islet within Penang waters. The hypothesis was that coastal land reclamation and development has a negative effect on existing seagrass distribution and density. The ArcGIS 10 spatial analysis tools, Standard Deviational Ellipse (SDE) and Standard Distance (SD), were applied to determine phase shifts as an indicator of possible effect of coastal land reclamation on the seagrass distribution. Seagrass shoot densities data used were from year 2003, 2006 and 2009; where 2003 and 2006 represented pre-coastal development period, while 2009 represented on-going coastal development period. Results showed SDE of seagrass experienced shifts from west to north-west direction from 2003 to 2009, which is away from the coastal land reclamation site. In addition, SD result showed seagrass distribution in the islet had shifted from west to east, and was more compacted and concentrated in 2009. The shifts of seagrass mean centre from west to the east also coincided with SD analysis where the largest distance value of 28.21m calculated from centroid occurred in 2009. The shifts in seagrass SDE, SD and mean centres strengthened the hypothesis that the coastal land reclamation and development had a negative effect on seagrass spatial distribution and density in Penang waters. The directional trend, compactness and mean centre of seagrass observed to be directed away and concentrated further from the coastal development site by 2009.

**Keywords:** coastal reclamation, *Halophila ovalis*, *Halophila beccarii*, standard deviational ellipse, standard distance

## INTRODUCTION

Powerful and appropriate biological indicators have commanded vital roles in the measurement of ecological quality in the environment. In coastal waters seagrass has been suggested as a sensitive indicator for an overload of nutrient inputs from land use practices. Losses have occurred all over the world. Land reclamation had always been thought to denude seagrass in its nearby area (Isobe, as cited in Terawaki et al., 2003). They were normally found to be in poor condition within the vicinity of reclaimed area and healthier further away (Bianchi et al., as cited in Montefalcone et al., 2007). Fine sediment released from reclamation sites were thought to increase turbidity and reduction in benthic vegetations, which includes seagrass (Zainal et al., 2012). Apart from that, increased in water velocity resulted from reclamation sites also lead to seagrass decline (Park et al., 2009).

Omran and Wah (2012) on a study of the possible impact of waterfront projects in Penang Island found out that the projects had thought to be destroying the nature beach and affecting its ecosystem. In addition, a study by Ramly (2008) on the impact of Tanjong Tokong land reclamation project on the coastal areas of Penang showed that land reclamation had impacted the wave transformation, sediment transport, and coastal evolution of the nearby area. The project had increased wave erosion and change in sediment transport rates mainly due to the influence of incoming local wave height and direction.

In this case, the land reclamation of the Light Waterfront development, which was built on an approximately 30 hectares reclaimed land off the eastern coast of Penang Island in front of the study area 'Pulau Gazumbo' (see Figure 1), had caused concern to the seagrass status in the islet due to its proximity. The Light Waterfront development is feared to have affect and deteriorate the seagrass and marine lives in the islet. GIS had been associated with seagrass mapping. Nevertheless, studies on spatial analysis particularly SDE and SD analysis in seagrass mapping have yet to be found to date.

Due to this, the need to look further on the impacts is essential to gain a different perspective particularly in terms of spatial analysis.

## MATERIALS AND METHODS



Figure 1: Location of the study area 'Pulau Gazumbo', Penang

### Study site

The study site 'Pulau Gazumbo' (5°21'N, 100°19'E, 3482m<sup>2</sup>) is a man-made island situated on the north east of Penang Island, Malaysia. It is a pea-shaped man-made islet as a result of dumped dredged materials from the South Channel when the Penang Bridge was constructed in October 1985 (Razalli et al., 2011). 'Pulau Gazumbo' has a climate similar to Penang Island due to its proximity; sunny throughout most of the year with temperature between 23°C to 32°C.

The coastal vegetations in the islet was landscaped by main contractor responsible for the Penang Bridge construction (Hyundai Company) which are mostly Casuarinas, Coconut palm, Sumatran Pine (*Pinus merkusii*) and Sea Hibiscus (*Hibiscus tiliaceus*) (Choong, 2003). Apart from that, Sea Morning Glory (*Ipomoea pes-caprae*), nature's answer as the ideal perennial creeper plant for coasts across the tropics, grew just above the high tide line.

In addition to this, a small mangrove stand, mainly of *Avicennia* sp., is located at the western-southwestern section of this islet. Since mangroves are also nature's own sediment trap it is also within this area that most mudflats are found. Colonization of submerged vegetations occurred over the years through a series of succession around the coastal waters of the islet. These submerged vegetations are mostly: seagrass species of *Halophila ovalis* (Razalli et al., 2011) and *Halophila becarri* (Yasin and Tan, cited in Razalli et al., 2011); *Halophila spinulosa* (Yasin et al., cited in Razalli et al., 2011) and *Enhalus acoroides* (Nadiah, 2008) which are seasonally spotted. Apart from

that, the islet is also home for other marine lives such as horseshoe crab *Tachypleus gigas* (Mohammad, 1994), gastropods (Bong, 2008), bivalves (Nur Najmi, 2001) and sea anemones (Looi, 2003; Fathen, 2011).

### Data analysis

Standard Deviational Ellipse (SDE) and Standard Distance (SD) from GIS software ArcGIS 10 was applied in this study. Secondary data of seagrass shoot density year 2003 (Choong, 2003), 2006 (Abdullah et al., 2010) and 2009 (Krishnan, 2009) were used. Seagrass data were obtained from two littoral zones around the waters of 'Pulau Gazumbo': (1) upper littoral zone and (2) lower littoral zone. Eight stations were designated in each zone, and each station has 5 quadrat samples (see Figure 2). Maps of seagrass growth area and 'Pulau Gazumbo' that were used in this study were digitized earlier with ArcGIS 10.

Two steps were needed in these analyses. First, seagrass shoot density data which was stored in Microsoft Excel was transferred as an attribute data into ArcGIS 10. Next, SDE and SD analysis in the *Spatial Statistics Tools-Measuring Geographic Distributions* in ArcGIS 10 were applied. Centroid of 'Pulau Gazumbo' and mean centre of the seagrass shoot density data were calculated using the *Spatial Statistics Tool* in ArcGIS 10. Centroid which calculates the centre location of 'Pulau Gazumbo' sets as a reference point for the movement of SDE and SD, while mean centre calculates the centre of concentration of seagrass shoot density. Four quadrants were divided across the centroid for scientific measurement purposes where it serves as a reference for the directions of both SDE and SD ellipses.

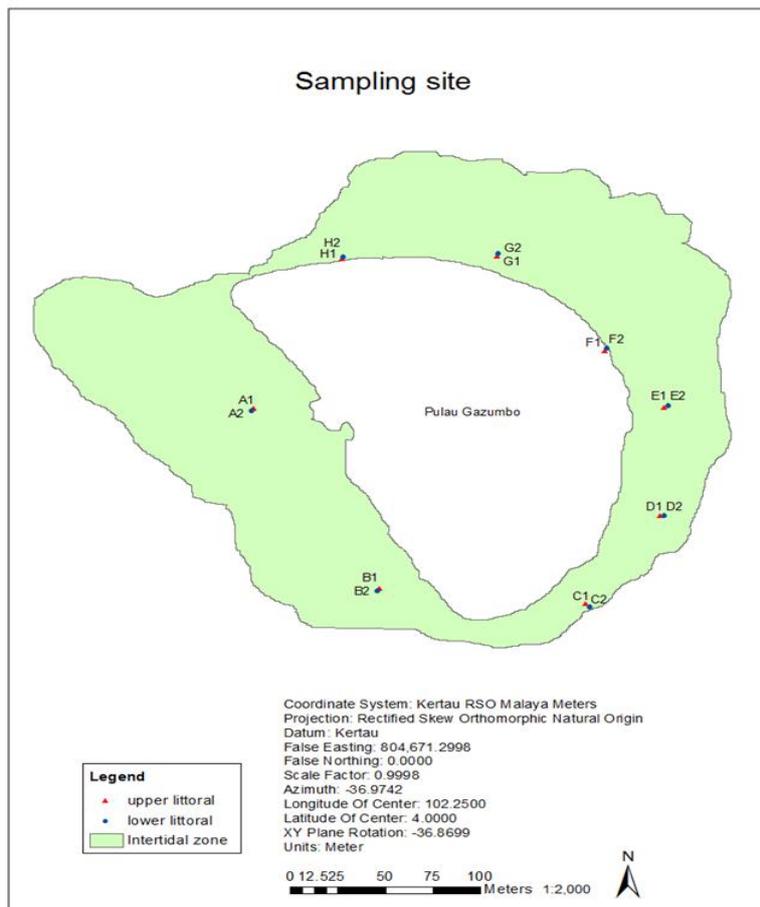


Figure 2: Sampling stations in 'Pulau Gazumbo', Penang

## RESULTS

SDE ellipses which depict the directional trend of seagrass abundance had shifted from west to the north-west direction as it goes along from 2003 to 2009 (see Figure 3). Meanwhile, the SD ellipses which depict the compactness of the seagrass abundance had shifted from west to the east as it goes along from 2003 to 2009. The SD ellipse was observed to be more compact in 2009 than in 2003 and 2006 (see Figure 4).

The mean centre which depicts the concentration of seagrass abundance had also shifted from west to the east as it goes along from 2003 to 2009. The mean centre was at 22.65m in the south-west of the centroid in 2003; 6.93m in the west of the centroid in 2006; and 28.21m in the east of the centroid in 2009.

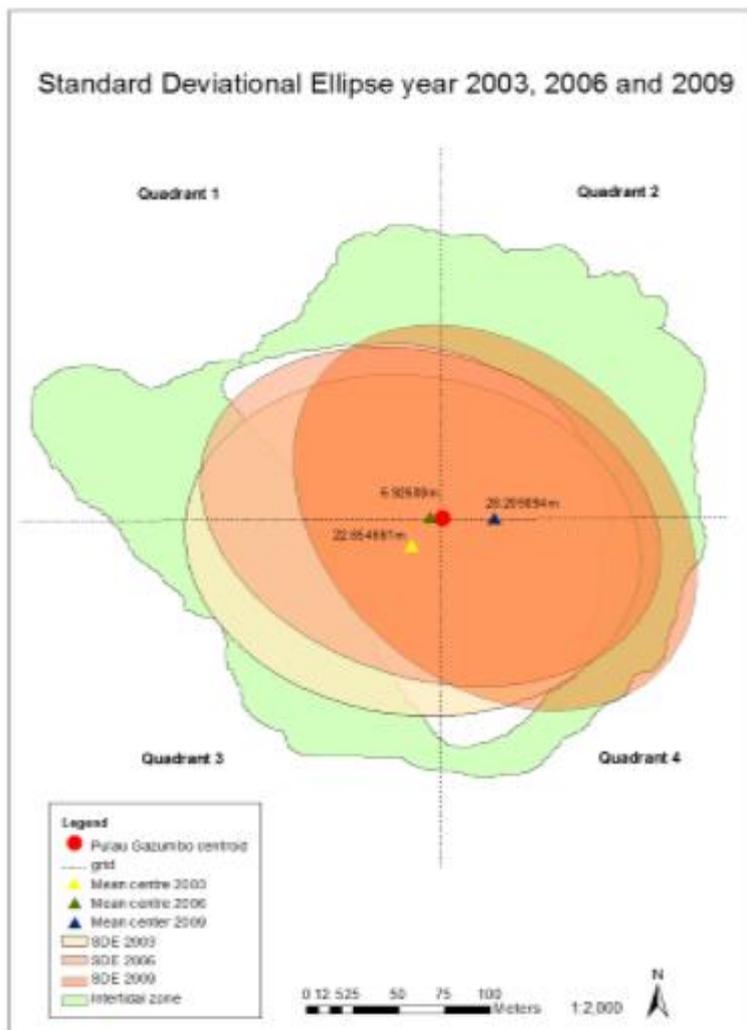


Figure 3: Temporal changes of Standard Deviational Ellipse and mean centre of seagrass mean shoot density year 2003, 2006 and 2009

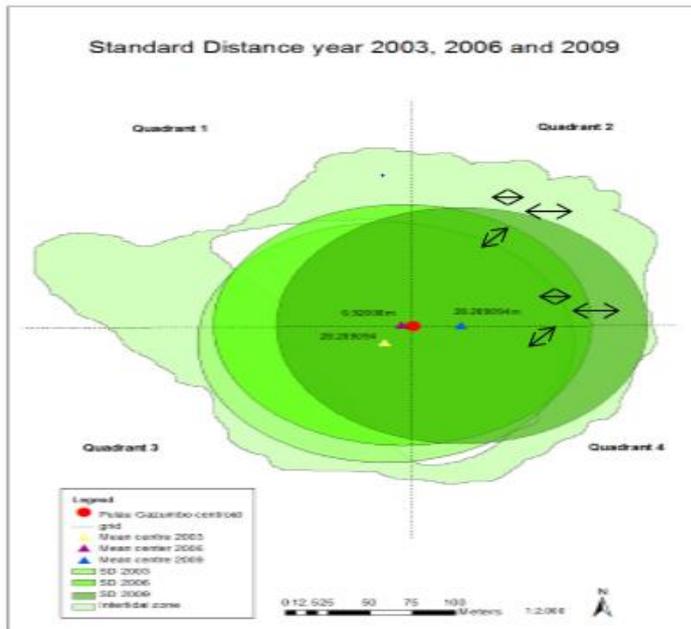


Figure 4: Temporal changes of Standard Distance and mean centre of seagrass mean shoot density year 2003, 2006 and 2009

## DISCUSSION

Disturbance from the coastal development in the west might have contributed to the shift of both SDE and SD ellipses. The shifts of SDE ellipses' directions show that seagrass in 'Pulau Gazumbo' had experienced shifts in its directional trend. A higher abundance of seagrass in station 1 was thought to have influenced the directional trend of the ellipse in 2003. In 2006, the direction of ellipse turned slightly to the north. High seagrass abundance recorded at station 1 was thought to influence the predominant orientation of the ellipse in the west. However, the increment of seagrass abundance in station 8 could have caused the ellipse to tilt towards the north direction in 2006. In 2009, the ellipse had completely tilted towards the north-west direction. Decrement of seagrass abundance in station 1, and increment of its abundance in station 5 and 4 had probably caused the SDE to shift from west to the east side of the islet.

Meanwhile, spatial analysis of SD shows that the dispersion of seagrass abundance in 'Pulau Gazumbo' had shrunk in 2009 which is during the coastal development. The movement of SD ellipses was similar as the movement of seagrass mean centre. The calculation of SD coincides with the mean centre. The movements of SDE, SD and seagrass mean centre strengthen the hypothesis where the Light Waterfront development had an effect on the spatial distribution of seagrass abundance in 'Pulau Gazumbo'.

## CONCLUSION

SDE analysis correspondingly showed changes of directional trend before and during the Light Waterfront coastal development. Directional trend of seagrass was towards the west in 2003 but had shifted to north-west in 2006 and 2009. Additionally, SD analysis also showed that seagrass abundance was more concentrated in the east of the islet in 2009 (during reclamation) compared to 2003 and 2006 (before reclamation) where they were more dispersed. SDE and SD spatial analysis adopted in this study proved that these methods are very informative and constructive in determining the effect of coastal development on seagrass abundance and/or density particularly where conservation and management of coastal and marine natural resources are concerned. The directional trends, degrees of compactness and the shift in distance of dispersion furnish informative data for decision making process to support conservation efforts. This is invaluable to conservation because

with the world's fast dwindling seagrass ecosystems, every bit of even the smallest seagrass beds is worth conserving to maintain the ecosystem services which human beings rely and depend on.

### Acknowledgement

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### REFERENCES

- Abdullah, A., Krishnan, D., Yasin, Z., & Razalli, N. M. (2010). *The effect of coastal development on ecosystem services: the case of seagrass communities in Penang waters*. Paper presented at the 1st National Seminar on Environmental Humanities.
- Bong, S. H. (2008). *Diversity of gastropods in intertidal zone of Pulau Gazumbo, Penang*. (BSc. Dissertation), Universiti Sains Malaysia, Penang.
- Choong, S. Y. (2003). *Pertalian saiz partikel dan kadar sedimentasi dengan taburan rumput laut di 'Pulau Gazumbo', Pulau Pinang*. (BSc. Dissertation), Universiti Sains Malaysia, Penang.
- Fathen, A.Y. (2011). *The population characteristics of sea anemone in Pulau Gazumbo, Penang*. (BSc. Dissertation), Universiti Sains Malaysia, Penang.
- Krishnan, D. (2009). *Taburan dan diversiti spesies rumput laut serta perkaitannya dengan sedimen di "Pulau Gazumbo Besar", di perairan Pulau Pinang*. (BSc. Dissertation), Universiti Sains Malaysia.
- Looi, Y. L. (2003). *Taksonomi dan kepelbagaian buran laut (Order Actiniaria) di perairan Pulau Pinang dan Kedah Darul Aman dengan penekananan taburan dan ekologi Stichodactyla gigantea di Pulau Gazumbo, Pulau Pinang*. (BSc. Dissertation), Universiti Sains Malaysia, Penang.
- Mohammad, H. A. (1994). *Tabiat pembiakan dan populasi belangkas, Tachypleus gigas di Pulau Gazumbo, Pulau Pinang*. (BSc. Dissertation), Universiti Sains Malaysia, Penang.
- Montefalcone, M., Albertelli, G., Morri, C., & Bianchi, C. N. (2007). Urban seagrass: Status of *Posidonia oceanica* facing the Genoa city waterfront (Italy) and implications for management. *Marine Pollution Bulletin*, 54(2), 206-213.
- Nadiah, S. A. (2008). *The seagrass communities of Pulau Gazumbo, Pulau Pinang*. (BSc. Dissertation), Universiti Sains Malaysia, Penang.
- Nur Najmi, B. A. K. (2001). *Kepelbagaian gastropoda dan bivalvia yang hidup di perairan intertidal di Pulau Gazumbo, Pulau Pinang*. (BSc. Dissertation), Universiti Sains Malaysia, Penang.
- Omran, A., & Wah, W. S. (2012). The possible impact resulted from the implementation of waterfront projects in Penang Island. *International Journal of Research and Rviews in Applied Science*, 10(2).
- Park, S. R., Kim, J. H., Kang, C.K., An, S., Chung, I.K., Kim, J.H., & Lee, K.S. (2009). Current status and ecological roles of *Zostera marina* after recovery from large-scale reclamation in the Nakdong River estuary, Korea. *Estuarine, Coastal and Shelf Science*, 81(1), 38-48.
- Ramly, S. (2008). *Impact on the coastal areas of the Tanjung Tokong Land Reclamation Project, Penang, Malaysia*. (Master), Lund University.
- Razalli, N. M., Peng, T. C., Yusof, M., Mohd, S., Mohamed, J., Hwai, T. S., Yasin, Z., & Abdullah, A. (2011). Distribution and Biomass of *Halophila ovalis* (R. Brown) Hook. f. at Pulau Gazumbo, Penang, Straits of Malacca. *Publications of the Seto Marine Biological Laboratory*, 41, 71-76.
- Terawaki, T., Yoshikawa, K., Yoshida, G., Uchimura, M., & Iseki, K. (2003). Ecology and restoration techniques for *Sargassum* beds in the Seto Inland Sea, Japan. *Marine Pollution Bulletin*, 47(1), 198-201.
- Zainal, K., Al-Madany, I., Al-Sayed, H., Khamis, A., Al Shuhaby, S., & Al Hisaby, A. (2012). The cumulative impacts of reclamation and dredging on the marine ecology and land-use in the Kingdom of Bahrain. *Marine Pollution Bulletin*, 64, 1452-1458.

## **URBAN PARK AND EDUCATIONAL BENEFITS OF ECOSYSTEM: CASE STUDY OF TAMAN PERBANDARAN PULAU PINANG**

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**ABSTRACT:** The potential of urban parks in providing education on ecosystem is important as a mean to increase socio-ecological well-being. Sustainable development requires the quality and sustenance of the socio-ecological system which pose a need for knowledge on how ecosystems fulfil social needs. This dependence can be described in the operational definition of ecosystem in providing services, benefits or products to meet human needs, directly or indirectly, which occurred along natural processes and ecosystem structure known as ecosystem services. Hence, the importance of education on ecosystem services to ensure socio-ecological well-being. The article intends to identify ecosystem services that can be found in the urban park and identify potential educational activities to be established in the urban park. Firstly, observations were used to map and identify ecosystem services of the park. Secondly, purposive sampling with two sets of semi-structured interview with 100 urban park visitors and five representatives from five focus groups. The results show that the ecosystem in Taman Perbandaran Pulau Pinang is able to provide benefits to humans in terms of supporting services, regulating services, provisioning of services and cultural services to the users. These services can be used in educational activities to improve knowledge on the importance of ecosystem for social well-being. At present, only labels indicating plants' name are available at the park. Therefore, other forms of ecosystem educational activities could be established in cooperation with various stakeholders and the park management to further enhance the functions of the urban park ecosystem landscape. In summary, urban parks provide educational benefits to urban communities through reinforcing knowledge of ecosystem services that are important for social well-being.

*Keywords:* ecosystem services, urban parks, educational activities

### **INTRODUCTION**

Degradation of ecosystem worldwide has led to greater crisis of ecosystem services for human well-being (MEA, 2005). Theoretically, ecosystem services gives benefits to human but it is not learned practically and have led to various environmental issues, locally or globally. Ecosystem services can be divided into four categories namely: supporting services, cultural services, regulating services and provisioning services (MEA, 2005). At present, more than half of the world's population and human activities are situated in cities, hence urban areas can be considered as major consumers of the ecosystem services and a key source of global environmental impacts in a time when ecosystem are in rapid decline (Wilkinson et al., 2013). In addition, increasing population in Malaysia shows that almost 73% of urban population will share the benefits from recreational park in 2020 (Nor' Aaini and Kamarul Ain, 2007). However, managements of the landscape in urban green spaces are still unable to address urban sustainability in providing opportunities to urban communities to gain benefits from ecosystem services. There is a need to have systematic management and stakeholders' cooperation in ecosystem services in order to meet human needs in term of health, social cohesion, safety and security, education, living standards, leisure time, spiritual and cultural fulfilment, life satisfaction and happiness, and connection to nature (Smith et al., 2013).

Exploring the gap between ecosystem services and human needs, Education for Sustainable Development (ESD) is used as a platform to deliver relevant knowledge on ecology and environment based on knowledge, skills, perspectives, values and issues required for sustainable future. According to the educational services provided by cultural services, it has been seen to address the environmental issues. MEA (2003) states that education on urban environment can influence the attitudes and actions of an individual to the ecosystem and its services. Therefore, the relationship between human and nature is affected by the socio-ecological aspects.

## **LITERATURE REVIEW**

Urban sustainability depends on ecological and human well-being involving the relationship between human and the use of natural resources and their impact on a city (Seitzinger et al., 2012). There is a need to fulfil human needs but it requires decision makers to have ecological and environmental knowledge to manage quality and maintenance of socio-ecological system (Indrawan et al., 2013). However, there is constraint in achieving socio-ecological well-being due to the lack of understanding of relationship between ecosystem services and declining socio-ecological wellbeing. Educational services provided by the ecosystem are able to improve the socio-ecological wellbeing as the green space can provide educational needs besides serving recreational purposes and social relationships (Giffurida, 1996). Wu (2013) states ecosystem services can also improve human well-being and the relationship has been widely accepted by most parties.

Place-based education like bio-physical and social place is crucial in exploring the theory linking an individual experience within the environment and integrating effective, practical and transparent environmental education with environmental factors (Ardoin, 2006). In addition, urban park is seen to have potential in providing education on ecosystem based on its functions, well-equipped facilities and well-structured landscape (Von Kursell, 1997; Farzaneh and Mohammad Rahim, 2012). Therefore, place-based education is important in achieving educational objectives based on existing facilities and ecosystem. Tidball and Krasny (2008) state that environmental education also has led to practical actions or activities involving interaction between social and ecological processes. Eipstein et al. (2013) states the relationship between community experiences towards environment for over 50% of the urban population in the world requires implementation of education in urban green spaces. Although education on ecosystem is important, informal education is difficult, inconsistent, lack cooperation, and has little education policies and strategies for adults and other urban communities (Varkuleviciene and Motiejūnaitė, 2013). Svendsen and Campbell (2008) state that community involvements in environmental education are also being carried out in small scale and have focused at schools and universities involving the formal education.

Therefore, the lack of knowledge on ecosystem services has led to ineffective management where the services are not aligned with the theoretical-based ecosystem services. The low maintenance and poor management can also be major barriers within region areas causing ecosystem functions and other main functions of developed areas not being achieved (Glaser et al., 2008; Zaikanov and Kiseleva, 2008; Wals and van der Leij, 2007). A well-managed landscape can also improve the relationship between ecosystem services and human well-being (Wu, 2013). Walker and Salt (2006) state the range of consistent and systematic organization that exists in society. Scientists, teachers and students contribute to the achievement of the objectives of activities. Besides that, collaboration between academic researchers, civil servants and volunteers of environmental organizations in promoting social learning is seen as crucial in managing the environment. The usage of urban park is dependent on alternative uses and the availability, accessibility and facilities provided by management in the park (Harnick, 2003). Apart from that, McCarthy (2006) found that the integration of knowledge is important in social learning process involving planning and environmental management

## **METHODOLOGY**

Through observation, the researcher has conducted an ecosystem mapping of the study area. The ecosystems were mapped based on the land cover including concrete landscape and abstract landscape. Respondents have been categorised into groups of park visitors and focus groups using two different sets of questions, semi-structured interviews and in-depth interviews. A total of 100 park visitors were randomly selected and were interviewed on environmental and ecosystem aspects including their importance, types of activities that can be carried out, planning and implementation of activities, roles of respondents, and challenges in implementing the activities. Meanwhile, a total of five focus group representatives consisting of an urban park management personnel, three members representing three different Non-Governmental Organizations (NGO), and an academic, were interviewed about the same aspect but more on their roles and functions.

## **MAPPING OF ECOSYSTEM SERVICES AT TAMAN PERBANDARAN PULAU PINANG**

Diversity of ecosystem has been found at Taman Perbandaran Pulau Pinang based on its land use as an open space. Figure 2 shows the land use of Taman Perbandaran Pulau Pinang in three main zones where the recreational area is in Zone A and field, surrounded by trees is in Zone B. Meanwhile, Zone C is Laman Flora with a large variety of plants. Taman Perbandaran Pulau Pinang is fully equipped with exercise facilities as it is a popular site for recreational activities with basic facilities such as parking lot within the CP1 and CP2 zone. Besides that, the urban park is surrounded by forests in order to preserve the diversity of ecosystem, which is also one of the attractions of the urban park.

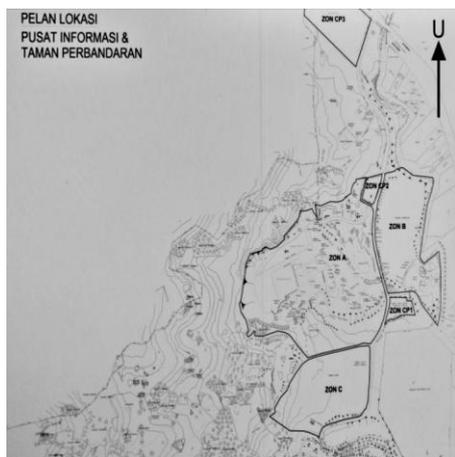


Figure 1: Location Plan of Pusat Informasi and Taman Perbandaran Pulau Pinang  
Source: Jabatan Rekreasi, Pelancongan dan Perhubungan Antarabangsa

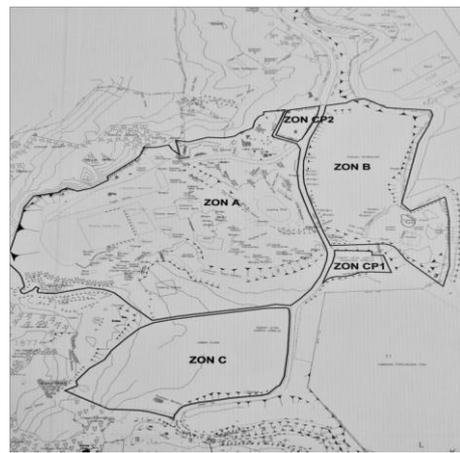


Figure 2: Land use at Taman Perbandaran Pulau Pinang  
Source: Adapted from Location Plan of Pusat Informasi & Taman Perbandaran Pulau Pinang

Theoretically, the diversity of ecosystem in Taman Perbandaran Pulau Pinang is able to provide benefits and services in terms of provisioning of services, regulating services, supporting services and cultural services to the community. However, realistically, the results of the mapping valuation illustrates that none of the 39 ecosystem services coded were found in every zone of Taman Perbandaran Pulau Pinang, as summarised in Table 1.

The findings indicate that almost all respondents agreed that the urban park has the potential in providing educational activities on ecosystem to the communities. Although the urban park did not specify its role in providing educational services or educational activities on ecosystem, nonetheless, it provides the range of services and benefits that can be implemented as educational activities based on ESD such as acquisition of knowledge, skills, values, perspectives and issues. It is important to note that the interaction between environmental and learning aspects can lead to positive results as place-based education like bio-physical and social place reinforce the integration of these aspects (Ardoin, 2006). Although the results show that urban park has the potential in providing educational activities on ecosystem, it also provides other benefits such as recreational, aesthetic, spiritual, and health. In fact, cultural services are the biggest benefits provided by urban park as urban green space, including educational activities (Chiesura, 2004). Furthermore, the benefits obtained is influenced by the function of urban park itself, which is as a recreational area with diversity of ecosystem as the use of urban park depends on accessibility and management of the park (Harnick, 2003).

Meanwhile, the study found several challenges in implementing educational activities on ecosystems. One of them is the lack of knowledge about the ecosystem services, thus, led to ineffective management and narrow services and benefits to meet human needs. In this case, ecosystem services can fulfil the human needs by having effective management and stakeholders' cooperation (Smith et al., 2013). Thus, communities in urban park are concerned about improving the wellbeing as well-managed landscape can improve the relationship between ecosystem services and human well-being.

The management and planning of ecosystem services in urban parks should take social (stakeholder), environmental (ecosystem) and economic (financial aid) aspects into account due to the sustainability of the ecosystem services as it is seen as playing an important role in improving the quality of life (Mat et al., 2009). The quality of life is dependent on the ecosystem services apart from social, ecological and economic aspects. The stakeholders should cooperate and play their roles in implementing educational activities on ecosystem in the urban park as learning process provide a framework of community involvement instead of individual involvement (Lave and Wenger, 1991). It is important to note that most of the respondents do not have broad knowledge of ecosystem services and do not explore the concept of ecosystem services as it is still relatively new. However, the results show that the respondents are aware of the importance of environment in their lives despite the lack of knowledge on ecosystem services.

Table 1: Ecosystem services at Taman Perbandaran Pulau Pinang

<b>Supporting Services</b>		<b>Zone A</b>	<b>Zone B</b>	<b>Zone C</b>	<b>Zone CP1</b>	<b>Zone CP2</b>
A1	Water cycling	x	x	x		
A2	Soil formation	x	x	x		
A3a	Nutrient cycling – carbon cycle	x	x	x		
A3b	Nutrient cycling – nitrogen cycle					
A3c	Nutrient cycling – sulfur cycle					
A3d	Nutrient cycling – phosphorus					
A4	Primary production	x	x	x		
A5	Photosynthesis	x	x	x		
A6	Biodiversity	x	x	x		
Subtotal – Supporting		5	5	5	0	0
<b>Provisioning Services</b>						
B1	Food – agriculture					
B2	Food – commercial fishing					
B3	Food – wild					
B4a	Water – fresh water	x	x			
B4b	Water – energy					
B4c	Water – transportation					
B5	Biochemicals/ genetic resource	x	x	x		
B6	Fiber	x	x			
B7	Fuel	x	x			
Subtotal – Provisioning		3	3	0	0	0
<b>Regulating Services</b>						
C1a	Climate regulation – local	x	x	x		
C1b	Climate regulation – global					
C2	Air quality regulation	x	x			
C3	Water purification/ waste treatment	x	x			
C4	Water regulation	x	x			
C5	Disease regulation	x	x	x		
C6	Pest regulation					
C7	Natural hazard regulation	x	x	x		
C8	Erosion regulation/ soil retention	x	x	x		
C9	Pollination	x	x	x		
C10	Seed dispersal	x	x	x		
C11	Noise regulation	x	x	x		
Subtotal – Regulating		10	10	7	0	0
<b>Cultural Services</b>						
D1	Social relations	x	x	x		
D2	Cultural landscape, heritage values	x	x	x		
D3	Sense of place	x	x	x		
D4	Aesthetic	x	x	x		
D5	Inspirational	x	x	x		
D6	Recreation and eco-tourism	x	x	x		
D7	Educational and knowledge	x	x	x		
D8	Health	x	x	x		
D9	Spiritual and religious values	x	x	x		
Subtotal – Cultural		9	9	9	0	0
Total		27	27	21	0	0

Source: Adapted from Abdul Rahim and Abu Bakar (2014)

This is consistent with Chiesura (2004) who found the experience acquired from the urban environment to be positive and fulfils non-material needs. The importance of environment in human lives is not just a reflection of what they felt, observed and experienced. In fact there are many other benefits and services provided by the ecosystem. However, community well-being in urban park has been declining due to lack of knowledge regarding how ecosystem services can improve human well-being (Wu, 2013). Issues of biodiversity and climate change have been noticed worldwide based on global assessment. This study has identified some active and passive educational activities based on ESD. In exploring the active educational activities related to issues of biodiversity, the range of activities that can be done include: identifying the types of flora and fauna (knowledge), using the plants as medicine (skill), preserving the heritage values of plants (value), and realising the importance of flora and fauna (perspectives). Educational activities related to climate change is used to explore how plants can overcome the climate change (knowledge), planting trees (skills), fostering awareness of the importance of trees (value), and regulating climate change (perspective). Meanwhile, the provision of signage for each plant allows individuals to learn about the types of trees (knowledge), explore the benefits of the plants after knowing the names (skill), acquire knowledge themselves (value) and understand plants extinction based on the knowledge obtained. This type of activity is known as passive educational activity.

## **CONCLUSION**

The results show that urban parks can provide a wide range of ecosystem services including supporting services, regulating services, provisioning of services and cultural services based on its function and structure, which occurred along the natural process. These services can be used in educational activities to enrich knowledge on the importance of ecosystem for socio-ecological well-being. However, poor understanding about ecosystem services has created barriers for communities to receive the benefits and services. This is despite most respondents indicating that urban parks has potential in providing educational activities on ecosystem based on community needs and in cooperation with various stakeholders and the park management. Overall, informal educational activities have great potential in the urban park. At the same time, well-planned management will further enhance the functions of the urban park in achieving objectives of the educational activities. All stakeholders should play their roles and functions regarding the educational activities on ecosystem in the urban park that provide benefits to urban communities as it is important for socio-ecological well-being. Other case studies of urban park in Malaysia are required to provide more insights of the phenomenon in Malaysia and also to provide a model to integrate educational benefits of ecosystem with urban parks management.

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## **REFERENCES**

- Abdul Rahim, A. & Abu Bakar, M. A. (2014). A preliminary investigation on ecosystem services addressed in the local authority planning documents in Malaysia. *International Journal of Environment, Society and Space*. 2(1), 77-90.
- Ardoin, N.M. (2006). Toward an Interdisciplinary Understanding of Place: Lessons for Environmental Education. *Canadian Journal of Environmental Education*. 11, 112–126.
- Chiesura, A. (2004). The role of urban parks for the sustainable city. *Landscape and Urban Planning*. 68, 129–138.
- Epstein, G., Vogt J. M., Mincey, S. K., Cox, M., & Fischer B. (2013). Missing ecology: integrating ecological perspectives with the social-ecological system framework. *International Journal of the Commons*. 7(2), 432–453.

- Farzaneh, R. & Mohammad Rahim, R. (2012). Ecological Analysis of Urban Parks (Case Study: Mashhad Metropolitan). *International Journal of Applied Science and Technology*. 2, 7.
- Giffurida, L. (1996). Planning an interpretation programme. In N. Gonz'ales (Ed.), *Cultivating Green Awareness*. Proceedings of the Second International Congress on Education in Botanic Gardens. 189–193.
- Glaser, M., Krause, G., Ratter, B., & Welp, M. (2008). Human/Nature Interaction in the Anthropocene. Potential of Social-Ecological Systems Analysis. *GAIA*. 17(1), 77–80.
- Harnick, P. (2003). *The Excellent City Park System: What Makes it Great and How to Get There*. The Trust for Public Land.
- Indrawan, Mochamad, Yabe, Mitsuyasu, Nomura, Hisako & Harrison, Rhett (2013). Deconstructing satoyama – The socio-ecological landscape in Japan. *Ecological Engineering*. 64, 77 - 84.
- Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Mat, S., Sopian, K., Mokhtar, M., Ali, B., Hashim, H.S., Rashid, A.K.A., Zain, M.F.M., & Abdullah, N.G. (2009). Managing sustainable campus in Malaysia-Organizational approach and measures. *European Journal of Social Sciences*. 8, 201-214.
- McCarthy D. P. Daniel. (2006). *A Critical Systems Approach to Socio-Ecological Systems: Implications for social learning and governance*. (Ph. D Thesis). University of Waterloo.
- MEA. (2003). *Millennium Ecosystem Assessment. Ecosystem and human well-being: a framework for assessment*. Millennium Ecosystem Assessment Series, Island Press, Washington DC.
- MEA. (2005). *Millennium Ecosystem Assessment. Ecosystem and human well-being: biodiversity synthesis*. Island Press, Washington DC.
- Nor' A aini, O., & Kamarul Ain, K. (2007, November). Keeping the green in urban area: An approach towards sustainable development. *Proceedings of the Seminar Kebangsaan Rupabandar Malaysia*, 28 - 29 November 2007, Lumut, Perak.
- Seitzinger, S. P., Svedin, U., Crumley, C. L., Steffen, W., Abdullah, S. A., Alfsen, C., Broadgate, W. J., Biermann, F., Bondre, N. R., Dearing, J. A., Deutsch, L., Dhakal, S., Elmqvist, T., Farahbakhshazad, N., Gaffney, O., Haberl, H., Lavorel, S., Mbow, C., McMichael, A. J., deMorais, J. M. F., Olsson, P., Pinho, P. F., Seto, K. C., Sinclair, P., Smith, M. S., & Sugar, L. (2012). Planetary stewardship in an urbanizing world: beyond city limits. *Ambio*. 41, 787-794.
- Smith, L. M., Case, J. L., Smith, H. M., Harwell, L. C. & Summers J.K. (2013). Relating ecosystem services to domains of human well-being: Foundation for a U.S. index. *Ecological Indicators*. 28, 79-90.
- Svendsen, E. S. & Campbell L. K. (2008). Urban ecological stewardship: understanding the structure, function and network of community-based urban land management. *Cities and the Environment*. 1(1), 4.
- Tidball, K. G. & Krasny, M. E. (2008). *Trees and rebirth: Urban community forestry in post-Katrina resilience*. Community Forestry and Environmental Research Fellows Program Report. Berkeley CA.
- Varkulevičienė, J. & Motiejūnaitė, O. (2013). Green classes as an element of natural science education in consumer society. *Procedia - Social and Behavioral Sciences*. 83, 506 – 513.
- Von Kursell, A. A. (1997). *Replanning Urban Parks*. (Unpublished Masters of Urban and Rural Planning Thesis). Technical University of Nova Scotia, Halifax, Nova Scotia, Canada.
- Walker, B. & Salt, D. (2006). *Resilience thinking: Sustaining ecosystems and people in a changing world*. Washington, DC: Island Press.
- Wals, A., & van der Leij, T. (2007). Introduction. *Social learning: towards a sustainable world*. Wageningen Academic Publishers, Wageningen, the Netherlands. 17-32.
- Wilkinson, C., T. Saarne, G. D. Peterson, & J. Colding 2013. Strategic spatial planning and the ecosystem services concept – an historical exploration. *Ecology and Society*. 18(1), 37.
- Wu, J. (2013). Landscape sustainability science: ecosystem services and human well-being in changing landscapes. *Landscape Ecology*. 28(6), 999–1023.
- Zaikhanov, V. G. & Kiseleva, V. V. (2008). Recreation and nature conservation: resolving the problem of balance. Paper presented at the Joint final conference of forest for recreation and tourism (COST E33) and 11th European forum on urban forestry (EFUF), Finland, 28–31May2008.