POVERTY AND DEPRIVATION: USING GEOGRAPHIC INFORMATION SYSTEM IN EVALUATING THE ACCESSIBILITY OF HOUSEHOLDS TO FOOD RETAILERS IN PENANG STATE, MALAYSIA

Narimah Samat[1], Yasin Abdalla Eltayeb Elhadary, Fatimah Mahdi Hijles, Suriati Ghazali & Morshidi Sirat

ABSTRACT

Poverty eradication programs that have been devised since 1970s in Malaysia manage to reduce the percentage of poor population from 52.4% in 1970 to 12.4% in 1992 and further reduced to 3.8% in 2009. Although the number of poor population in rural or urban areas was reduced significantly, relative and urban poverty seems to be worsening, since the cost of living within urban areas is much higher than that in rural area. The government targets to reduce poverty, but many poverty alleviation programs focus on employment creation and improvement of infrastructural facilities. Furthermore, poverty eradication programs that focused on providing basic needs such as food, clothing, housing, healthcare and education failed to recognize other form of deprivation such as the accessibility of poor household to healthy and affordable food items as also an important issue. For example, hypermarkets which sold wider ranges of food items at cheaper prices tend to be located at the urban areas which are difficult to be accessed by the poor. This study mapped the location of food retailers in Penang States and identified deprived areas in term of access to healthy and affordable food retailers using Geographic Information System (GIS). Although food retailers tend to cluster with urban centers, most of the people lived within a reasonable distance from food retailers. The approach used in this study could potentially be used in finding suitable location for '*Kedai Rakyat 1Malaysia*', which provides various products at cheaper prices in close proximity to the intended households particularly the low income.

Keywords: *Geographic information systems, deprived areas, Penang state, food retailers, poverty*

INTRODUCTION

Poverty reduction has become one of the national agendas for many countries worldwide. The United Nation, for example, has started to address poverty issue and formulated the Millennium Declaration since 1988 where eradicating poverty and hunger has become one of the targets in the Millennium Development Goal (MDGs). It aim was to halve the poverty rate that is the proportion of people whose income is less than USD$1 a day in the period of 1990 to 2015 (Muhammed and Haron, 2011). In Malaysia, for example, various policies such as New Economic Policy (1971-1990), then National Development Policy (1991 -2000) and followed by National Vision Policy (2001 -2010), have been devised to address economic imbalances and eradicate poverty. These policies have succeeded in maintaining economic growth of the country (Ali et al., 2009). Subsequently, poverty eradication programs also have managed to reduce the

number of poor households significantly. The incidents of poverty in Malaysia have significantly declined from 52.4% in 1970 to 12.4 % in 1992 and further reduced to 3.8% in 2009 (Abdul-Hakim et al., 2010; Muhamed and Haron, 2011). However, the incidence of poverty in rural area is much higher than in the urban area. In 2004, the poverty rate is 11.9% and 2.5% in the rural and urban areas respectively (Malaysia, 1971 and 2006).

In 2009, the mean national poverty line was translated to an adjusted RM6.50 per capita a day (equivalent to USD3.00 per day). Consideration was given to addressing issues of relative poverty, in line with Malaysia development model, which emphasis on inclusive development approach. The main target of these approaches is the bottom 40 percent of the households, or bottom two quintiles in the income distribution (EPU, 2011). Poverty eradication program is a continuous effort. Abdul Hakim et al. (2010), for example suggested three approaches namely to increase the income and productivity of the poor, to encourage inter-sectoral mobility of the poor out of low productivity sector to higher productivity and finally, to improve the quality of life of the poor by provision of social services such as housing, health, education and public utilities.

In spite of such achievements in poverty reduction programs, there still remain pockets of poverty in many rural areas particularly in Kedah (7.0 percent), Kelantan (10.6 percent) and Terengganu (15.4 percent), Sabah (19.7 percent) (EPU, 2009; 2011). Penang state, on the other hand, has the lowest incident of poverty at 0.3 percent in 2004, and hardcore poor has been eliminated in 2009. Interestingly, although the incident of poverty in Penang is very low, this highly industrialized state could probably have high number of urban poor (Abdul Ghafor et al., 2007). This is because being the developed state with more that 85 percent of its population living in urban areas, poverty, which is measured, based on poverty line might be insufficient in measuring poverty. Other form of deprivation such as the accessibility to cheaper food retailers has not been evaluated. The proposed study evaluates the potential application of Geographic Information System (GIS) in mapping the incident of poverty and identifying deprived areas in term of accessing food retailers that sold wide variety of healthy foods. This would allow the incidents of poverty and deprivation to be visualized and thus, analyzed and used in formulating appropriate policy towards eradicating poverty.

BACKGROUND OF THE STUDY

Poverty is a problematic term; and the debate relating to exactly what poverty is, how it is to be measured, and how it is to be tackled, will continue unabated (Klasen, 2000). Several definitions have been adopted to describe poverty; however, common understanding has yet to be achieved. Most of the definitions agreed that poverty is inability to meet the minimum basic necessities of life due to the lack of income or money (World Bank, 1990; Chamhuri, 2008; Mat Zin, 2007; Elhadary and Samat 2012). This definition has been criticized as poverty is not all about money (Sen, 1999). For the Islamic relief (2008) other factors such as hunger, under nutrition, lack of access to safe potable water, illiteracy, having no access to health services, social isolation and exploitation need to be considered. Thus, two approaches of defining poverty namely monetary and capability seem to be dominated the debate. Monetary perspective has put poverty in a financial term and determined the poor by poverty line. Poverty line income means the minimum amount of money necessary to afford basic necessities and sustain human life (World Bank, 1990; Wratten, 1995). World Bank, for example, poverty is set at an income of USD$2 a day or less, and extreme poverty is set at USD$1 a day or less. This measurement has become popular

because of its simplicity; although it should be recognized that every society has its own views on what constitutes a minimum standard of living and even differences in calorie intake (Islamic Releif, 2008). For example, the 2005 poverty line for single individuals in the United States is set at USD$26.19 a day. In Malaysia, poverty is defined based on poverty line income which is at RM510 approximately (USD$170) per month for a family of 4.6 households (Abdul Gapor *et al*., 2007). Thus, those households whose income fall below RM510 for Peninsular Malaysia, RM690 Sabah and RM600 for Sarawak would be considered as poor (Abdul-Hakim & Che-Mat, 2011). For this approach, as the case of Malaysia, poverty can only be solved by increasing income; through direct raise of minimum salary, monetary assistance, and microfinance programs (Abdul-Hakim et al., 2011). However, Ramli (2010), found that most participants in the micro credits program in Pendang, Kedah had not used the money given for their economic generating activities. Thus, only small number of participants (16.7% of the respondents) were actually managed to have a comfortable life or out of poverty after starting a business financed through micro credit program.

Contrary to monetary approach, the capability approach is not solely based on financial resources (Sen 1999). It requires concentrating efforts on ensuring individuals' access to public services (Klasen, 2000; Mat Zin, 2007). For Sen (1999), poverty is not determined by the lack or deficiency of money income, but rather by the failure of individuals to realize their full human potential or live valued lives, defined particularly through ill health and lack of education. This approach argues that rather than measuring income or consumption, poverty should be measured using a combination of income and non-income measures; through real GDP per person, adult literacy, and life expectancy. This was indexed in the well-known Human Development Index (HDI) and Human Poverty Index (HPI). Both measurements do not include political freedom, security and transparency (Islamic relief 2008).

As indicated above there is no consensus of what is poverty as each country has its own definition based on their economic, social, political, and religion dimension. For the purpose of this paper, the definition that describes poverty in relation to deprivation is quoted. According to Sen (1999) poverty defined as the deprivation of basic capabilities that provide a person with the freedom to choose the life he or she has reason to value. These capabilities include good health, education, social networks, control over economic resources, and influence on decision making that affects one's life. According to Kakwani (2002) poverty should be viewed as a multidimensional phenomenon, best understood in terms of capability deprivation, encompassing not only material deprivation (measured by income or consumption) but also other forms of deprivation, such as unemployment, ill health, lack of education, vulnerability, powerlessness, and social exclusion.

All above definitions showed that there is a close link between poverty and deprivation and social exclusion. Deprivation is a concept that overlaps, but is not synonymous with poverty (Galobardes, 2006). Deprivation is a lack of resources of all kinds, not just financial, and could be defined in a broad way to encompass a wide range of aspects of an individual's living conditions (UK 2010). The different concepts of deprivation include the following: Material deprivation, which reflects the access people have to material goods and resources; Social deprivation has been separately distinguished as relating to people's roles and relationships, membership and social contacts in society (Galobardes, 2006). Understanding deprivation allows

the planners to look into the serious factors that keep people trapped in poverty such as spatial and socio-economic disparity. These factors or domains include income and material deprivation, employment deprivation, health deprivation and disability, education and training deprivation and living environment deprivation (Noble et al 2009). Another two domains have been added by the United Kingdom deprivation index namely Barriers to Housing and Services, and Crime (UK 2010). All seven domains can be combined, using appropriate weights, which can be used to rank every small area according to the deprivation experienced by the people living there.

Using deprivation index in multiracial countries like Malaysia or South Africa will help in identifying the variation of poverty among ethnic group. In South Africa, Africans nationality was deprived in a much higher proportion than whites with the largest differentials in services provision, education and healthcare (Gradín, 2011). Similarly, Klasen (2000) used the deprivation index and asserted that poverty is distributed differently by race, residence, and household structure. In particular, the most deprived are more rural, more African, and more from female-headed households. The racial gap in poverty and deprivation can be attributed to the cumulative disadvantaged characteristics of Africans, such as their current level of educational attainment, demographic structure, and area of residence, as well as to the inertia of past racial inequalities (Gradín 2011). In Malaysia ethnic differences remain marked by deprivation index with 7.3% among Malays, 1.5% for Chinese, and 1.9% for Indians (UNDP, 2005; EPU, 2011). Further study needs to be undertaken in evaluating deprivation index among different ethnic groups to address this issue at different geographic regions.

Various studies have been undertaken that investigated poverty and deprivation. The study conducted by Donkin et al (2000), for example, mapped deprived areas in term of access to food through the development of price and availability index. Mean price index was used to compare the price of food within 2-km zone in two contiguous wards in London. The study showed that GIS can effectively be used in presenting geographic variation in shop expensiveness and in price and availability of healthy food. The main concerned with the project is that the poor who usually lived within urban centers and have relatively poor access to food retailers that sell fresh or nutritional produce (Clarke et al., 2002; Apparico et al., 2007). Furthermore, other study concluded that there is an inequality in the access to healthy food and food stores according to neighborhood social status and racial segregation. Morland et al. (2002) study, for example, found that large numbers of supermarkets and gas stations with convenience stores are located in wealthier and white neighborhoods compared to the poorest and black neighborhoods. Inaccessible to supermarkets, therefore, which offer a wide variety of foods at lower prices, poor and minority communities may not have equal access to the variety of healthy food choices available to nonminority and wealthy communities.

Healthy foods need to be accessible, available in local stores, affordable and located near neighborhoods, especially low-income and rural areas (Sharkey, 2009). Distance to food stores such as grocery stores is one of the factors that affect the availability of healthy food to people. In some areas such as low-income areas, physical access to shops can be limited as retailers focus on stores with road access. In addition, where local shops exist, they tend to be more expensive compared to supermarkets. On the other hand, local shops are important to reduce dependence on transport (Saunders, 2001). However, many households with low-incomes live in

places where local shopping facilities and transport networks are limited. So, income has a direct impact on the affordability and accessibility to food retailers. Low-income shoppers usually consider a number of factors including quantity, price and quality in selecting food products (Wrigley, 2002).

Although many studies were undertaken on evaluating accessibility of households to food retailers, most of these studies were conducted in the western developed nations such as in the United Kingdom or the United States (Donkin et al., 2000; Clarke et al, 2000). Contrary to those studies, in Malaysia most hypermarkets which sold wide ranges of food products at cheaper prices tend to be located near urban areas, which might be difficult to be accessed by the rural poor. Thus, it would be interesting to map and calculate the accessibility of food retailers to households in Malaysia. Such information will be particularly useful for finding appropriate site for the location of *Kedai Rakyat 1Malaysia*, which sold items cheaper prices recently launched by the government. Furthermore, it is timely, therefore, to undertake such study in order to evaluate whether such an issue is also a problem among local people in Penang State. This information would be useful for planners and policy makers in land use allocation or retail planning in Malaysia. Perhaps more importantly, it allows for the examination of poverty from different approach and gives new outlooks into the issue.

METHODOLOGY
The study intends to evaluate the accessibility to retail food outlets which offers fresh produce and perishable (fresh) grocery items such as fish, vegetables and dairy product and items listed in food pyramid to households in Penang State. The location of these stores are also useful as a starting point for evaluating affordability and accessibility to retail food outlets. Global Positioning System (GPS) was used to locate the geographic coordinate of food retailers in Penang State. There were 11,799 retailers in Penang, but the number of food retailers was unknown. This study took the location of 392 grocery stores 18 supermarkets and markets. Sample of retailers were taken at each planning zone in Penang State. Then, their locations were mapped and prices of food items among the stores located at different sub-districts were compared. The study measured service areas of food retailers in Penang State; then, it calculated proximity of food retailers to the centroid of the sub-districts (center of the mukims). ArcGIS 9.2 GIS software (ESRI, 2006) was used to map and measure accessibility of food retailers in Penang State.

STUDY AREA AND DATA
Penang state was chosen as a study area since this state becomes urbanize with more than 82 percent of its people living in urban areas. It is one of the urbanized states in Malaysia, located on the north-west side of Peninsular Malaysia. The state is located between 5° 8' and 5° 35' latitude and 100° 8' and 100° 32' longitude. It consists of two main parts: Penang Island with two districts namely Timur Laut and Barat Daya, and Seberang Perai which is divided into Seberang Perai Utara, Seberang Perai Tengah and Seberang Perai Selatan (see Figure 1). Penang State population is 1,561,383 in 2010 (Statistics Department, Malaysia 2010). Penang state has experienced a significant increase of its population in the last 40 years where in 1970, the state population was 776,124 and it increased to 900,722 in 1980. The population continued to increase to 1,064,166 and 1,313,449 people in 1991 and 2000 respectively (Statistics Department, Malaysia, 1996; 2000). In the year 2005, Penang State population was 1,468,800 and is expected 2,357,982 by the year 2020 (Statistics Department, Malaysia, 2000; Town and

Country Planning Department, 2007). Recently, 60% of its population lives in Penang Island and 40% in Seberang Perai. This structure will change in the year 2020, where 40% of the state population is expected to live in the Island and 60% will reside in the mainland.

The study collected the location of 410 food retailers comprised of 18 hypermarkets and 392 small retailers (see Figure 1) that sold all components of healthy food as listed in food pyramid which is considered as balance food intake using Global Positioning System (GPS). The location of these food retailers was mapped using ArcGIS 9.2 software (ESRI, 2006). Furthermore, spatial data was gathered from various agencies in Penang State. Population data 2008 was obtained from Statistics Department, Malaysia (2008) and mapped at sub-district (Mukim) level. Roads which were divided into primary, secondary and local road from the original seven categories namely Expressway, Highway, Primary road, Secondary road, Service road, Local road, and urban collector road as obtained from Town and Country Planning Department, Malaysia. Figure 2 shows road networks used in the study. These roads were used to measure the accessibility of households to food retailers using network analysts in ArcMap 9.2 software. It was calculated using geometric calculation where the length of the roads was measured in meter. The travel time duration of the roads were measured in minutes using the formula of distance calculation which is "Distance equals time multiply by speed". Land use data was obtained from Town and Country Planning Department, Malaysia (Figure 2). It was divided into four major categories namely bare soil, forest area, agriculture and urban built-up areas. In addition, near function was used to calculate distance from population center (centroid of the sub-districts or *mukims*) to the food retailers. This measure would give an indication of travel distance between major population centers and food retailes.
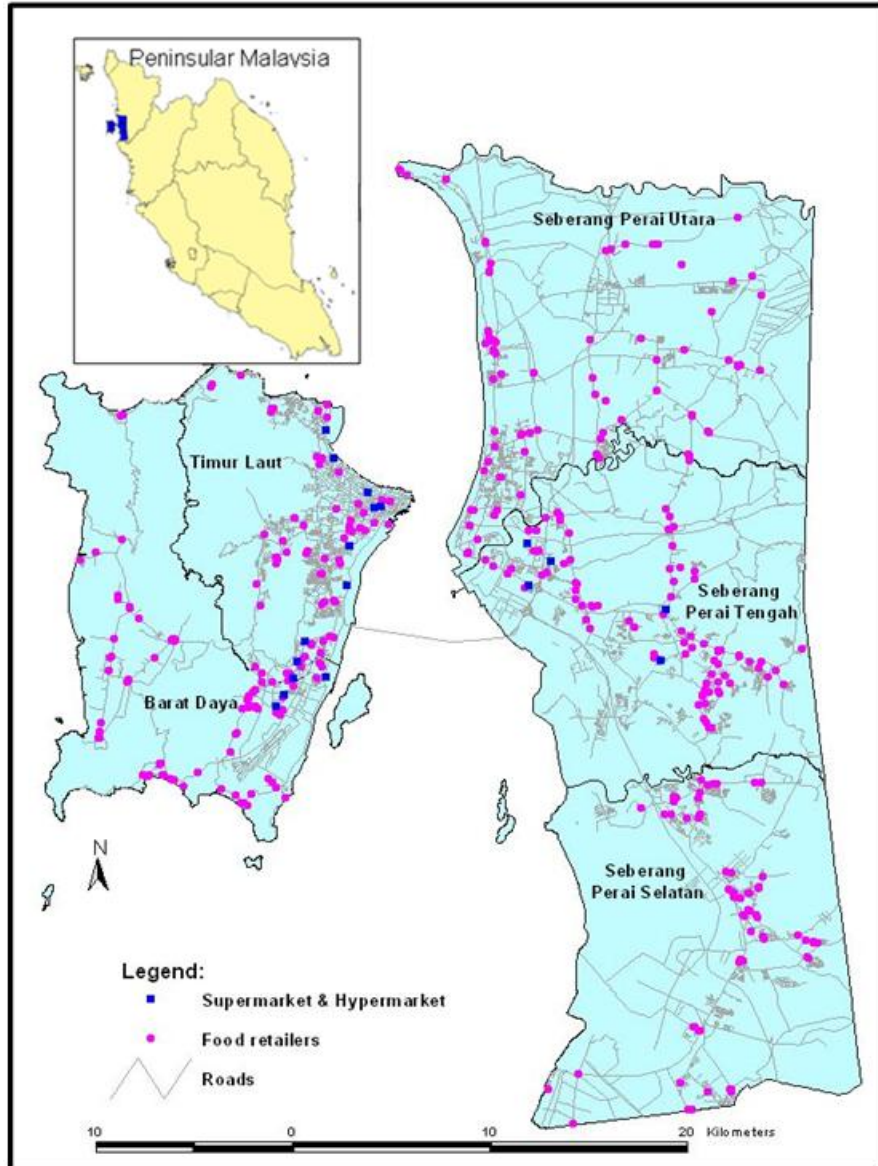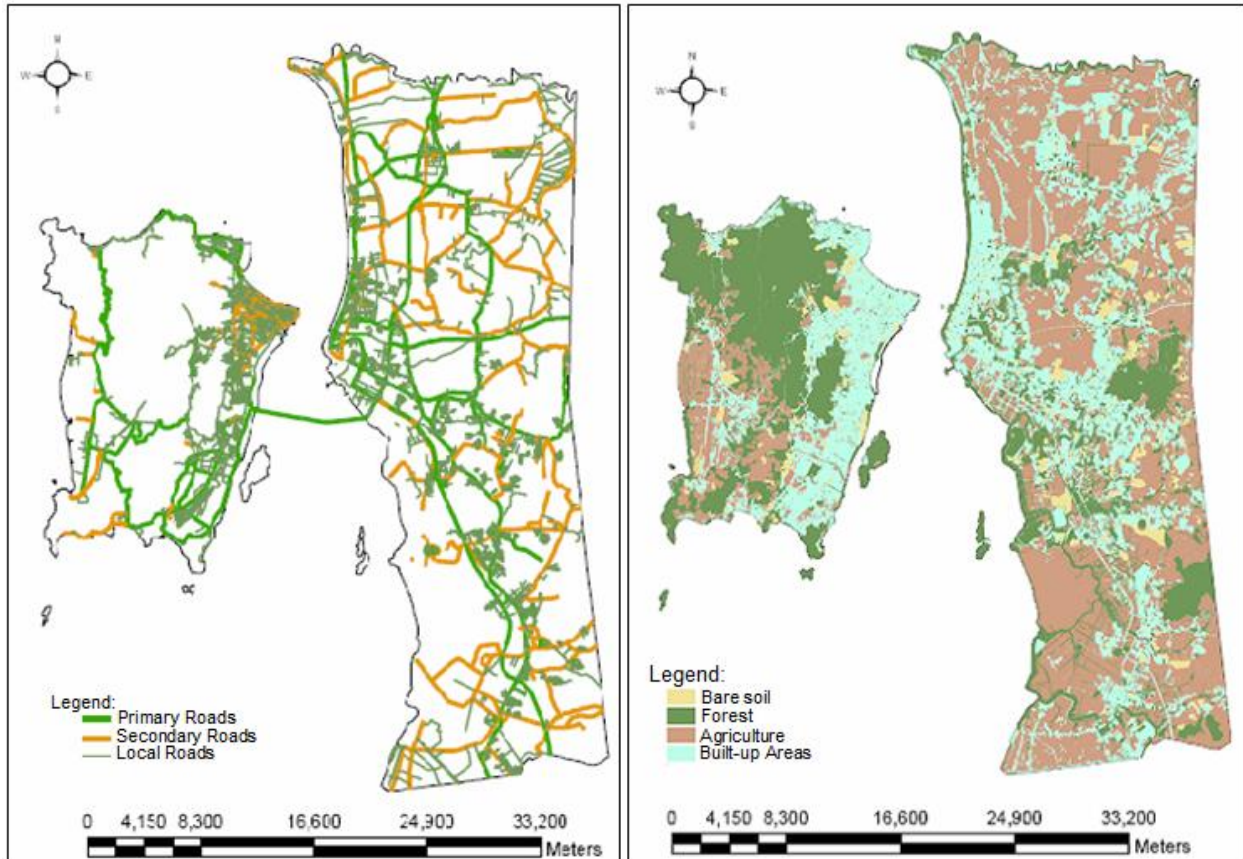
Figure 1: The study area - Penang State

Figure 2: Roads (left) and land use (right) used in the study

RESULT AND DISCUSSION

The study calculated the service area of the food retailers in Penang State using driving time on road network. It was found that people in Penang State has little problem in getting to the nearest food retailers within 5 minutes by car. Figure 3(a) below illustrates the service area for all food retailers surveyed in Penang State. From the figure, it shows that only small parts in north-west and south-west of Penang Island could not be reached within 5 minutes travelling time. The study then calculated the service area for 18 supermarkets and hypermarkets in Penang State as shown in Figure 3 (b). As shown in Figure 3(b), people from most part of Penang State can reach the supermarkets and hypermarkets within 10 or 20 minutes by car or motercycle. Combining these maps with land use map revealed that unserved area is actually forest reserved area or area and less inhabited areas. Other areas that has limited access to food retailers included Pulau Aman and the south of Seberang Perai Selatan, which are sparsely populated.
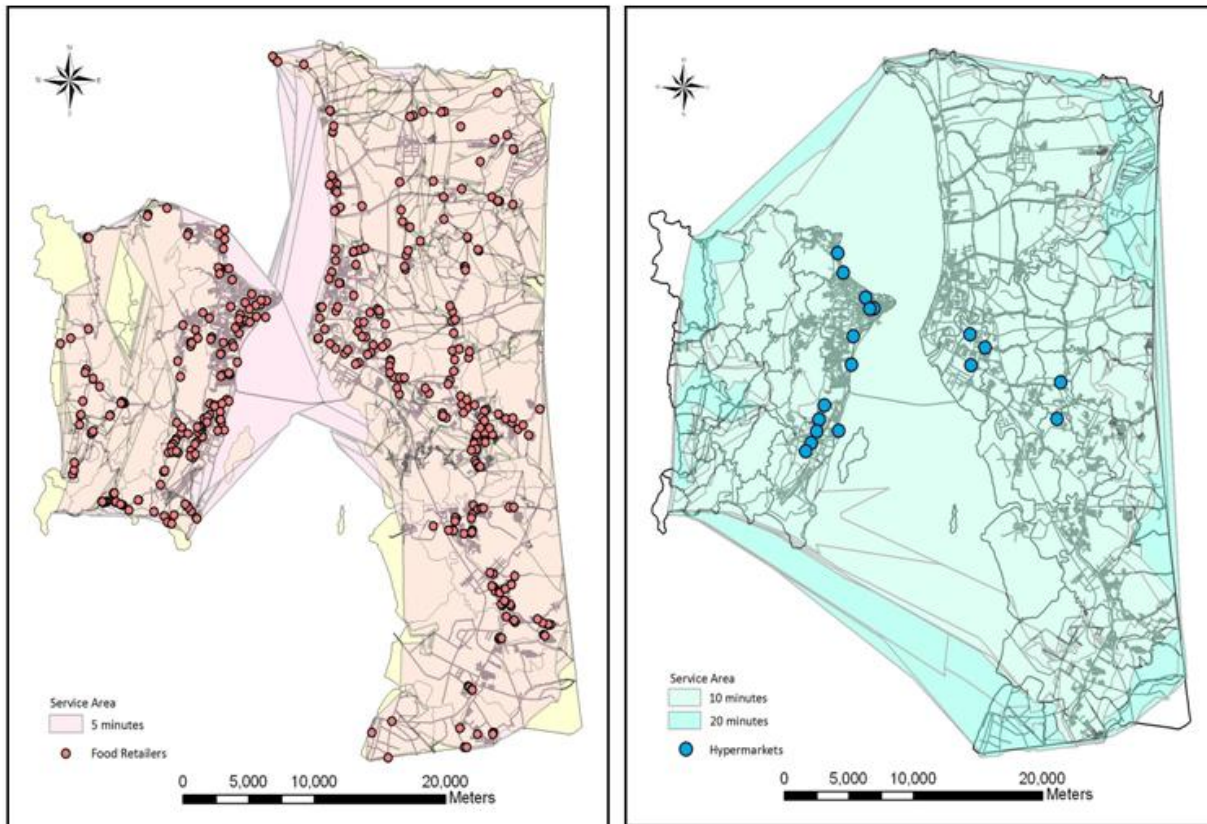
(a) Service area for food retailers within 5 minute driving time

(b) Service area for supermarkets and hypermarkets within 10 and 20 minute driving time

Figure 3: Service area for food retailers and supermarkets and hypermarkets in Penang State

The study also calculated buffer zone of 500m from all food retailers and supermarkets and hypermarkets in Penang State. This distance is considered a reasonable walking distance from the household to food retail outlets since the poor usually does not own car (Clarke et al., 2002). Figure 4 below illustrates the buffer zones drawn around all food retailers which was overlaid on distribution of population by sub-districts (mukims). Highly populated area of Timur-Laut Districts has pocket of deprived areas. However, this probably would not be too much a problem among households in Penang State, since most of low income households has a least a motorcycle as a form of travel.
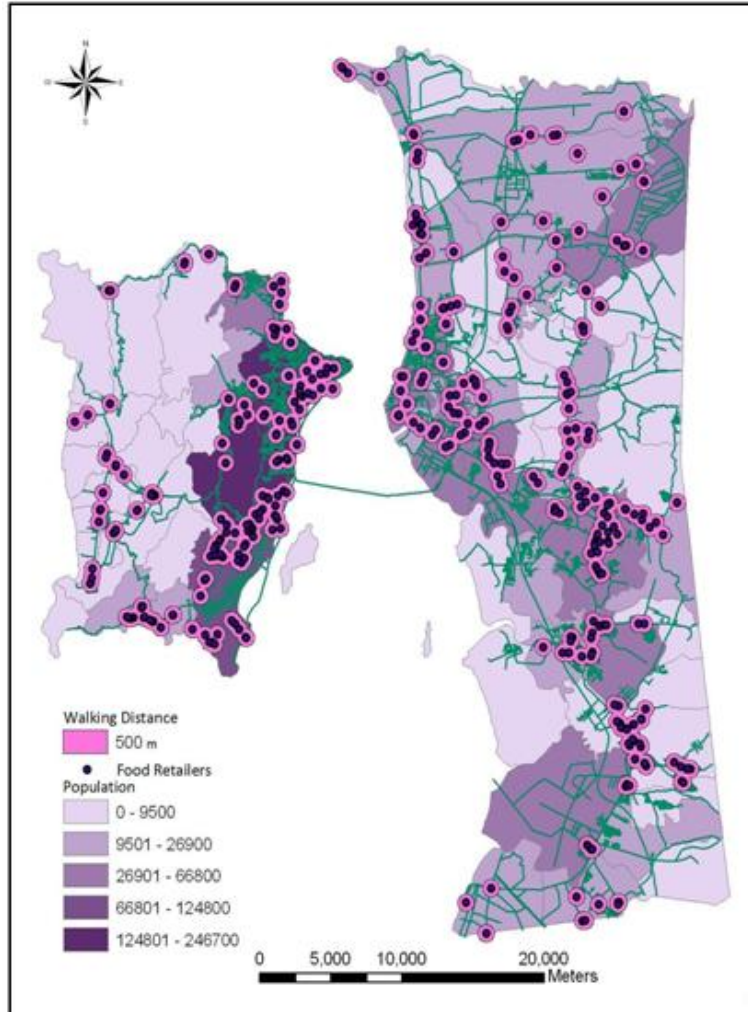
Figure 4: Reasonable walking distance of 500 m buffer zones around food retailers in Penang State.

Finally the study measured proximity between food retailers and supermarkets and hypermarkets and the centroid of each mukim. The result is shown in Figure 5 below. Most food retailers are located near population centres where the furtherst centers is approximately 7 km away from the nearest food retailers. On the other hand, supermarkets and hypermarkets are located within less than 25 km away from the furtherst population centres. Most part of Penang State does not has problem in getting to the food retailers since mixed land use allocation is being practiced in Malaysia (Town and Country Planning Department, Malaysia, 2007). Most housing development projects would include commercial units within the same neighborhood. Therefore, food retailers are usually located within walking distance to households. In addition, in Malaysia there is a requirement to mix high or medium cost houses with low cost houses at a ratio of 70:30 (Ghani Salleh and Lee Lik Meng, 1997). High-income and low-income households usually shop at the same food retailers. Contrary to the problem faced by the poor and low income households in the United Kingdom (Wrigley, 2002; Clarke et al., 2002), inaccesible to healthy and affordable food is not a problem in Penang State.

Poverty is a condition experienced by many people who have shortage of financial resources, and it means that they are likely to face difficulties in obtaining and maintaining sufficient nutrition, adequate accommodation, and long-term good health (Johnston et al., 2000: 627). Since nutrition is one of the important components in defining poverty, accessibility to cheap and healthy food is one of the important measure to understand urban poverty (Chong et al., 1984). A few studies undertaken in the United Kingdom by Whelan et al. (2002) and Wrigley et al., (2002), for example, found that due to reorganization of retailers, more food retailers tend to move to peri-urban areas near affluence neighborhoods. Contrary to that, in Malaysia, low-income household and middle income households lived within the same neighborhood and owned at least a motorcycle which provided easy access to the nearest food retailers. Furthermore, it seems that hypermarkets tend to be located within major population centers. In highly urbanized area such as George Town, Butterwoth and Bayan Baru, these stores could easily be accessed. However, areas like Balik Pulau, Bertam-Tasik Gelugor in Seberang Perai Utara and Transkrian Area in Seberang Perai Selatan were less accessible to these hypermarkerts. Therefore, these areas should probably be targeted for opening of *Kedai Rakyat 1Malaysia*, which would be beneficial for households in these areas.

LIMITATION OF THE STUDY

The study measured accessibility between households and food retailers based on travel time on road network. It does not consider barriers such as traffic jam or other kinds of obstacle that consumers might face. Traffic congestion also might slow down the traffic especially in major centers such as Georgetown. In addition, the study also could not compare prices per items at different location in Penang State since the variability of food items and brands sold at differents outlets is quite big.

CONCLUSION

The study measured the accessibility of housholds to food retailers in Penang State using GIS. It provides alternative of looking at deprived areas using proximity to existing food retailers. The analysis revealed that low income households in Penang State has no problem to get to the nearest food retailers. This is probably due to development policy practiced in Malaysia, which make a requirement for housing developers to build a ratio of 30:70 of low cost and medium and high cost houses. Thus, accessibility between the poor households and high income households to food retailers has not been much a problem. This study potentially could be used as an example of evaluating other kind of deprivation such as in health and education.
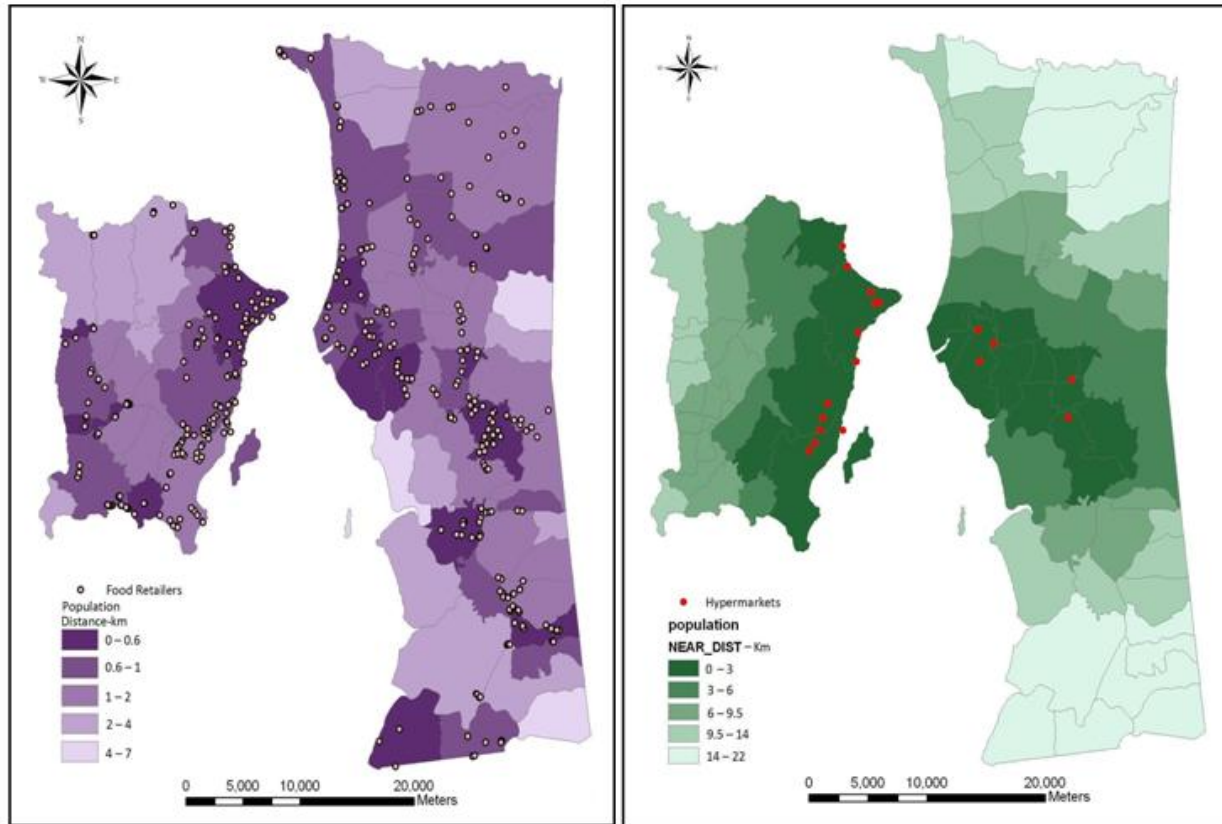
(a) Distance from food retailers to center of population

(b) Distance from supermarkets and hypermarkets to center of population

Figure 5: Proximity of food retail outlets to population centers.

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Narimah Samat
Geography Section[1]
School of Humanities
Universiti Sains Malaysia
11800 Penang, Malaysia
Phone: 04-6532854, Fax: 04-6563707
E-mail: narimah@usm.my