

# DECLINING LAND USE MIX: ARE RESIDENTIAL AREAS OF ISKANDAR MALAYSIA PROMOTING LOW CARBON TRAVEL?

M. Rafee Majid<sup>a</sup>, Sharifah Athirah Izyan Wan Kassim<sup>b</sup>, Anis Shazreen Azmi<sup>c</sup>

<sup>a</sup>Centre for Innovative Planning and Development, Department of Urban and Regional Planning, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia

<sup>b</sup>Urban Planning Dept., Level 7-10, Menara DBKL 1, Jln Raja Laut, 50350 Kuala Lumpur, Malaysia

<sup>c</sup>Department of Urban and Regional Planning, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia

## INTRODUCTION

Diversity in the context of land use planning refers to the variety of uses for land; and the success of diversity can be achieved through mixed use development. Although mixed land uses are popularly practised in mixed use development for the past decades, current land use practices have moved towards the separation of residential and non-residential land uses. Observing this changes in land use trend, this paper discusses the changes in mixed land use from 1980s to 2000s in Iskandar Malaysia, Johor. The study is aimed at determining the level of land use diversity and its trend within the past few decades by using diversity indices of Simpsons Diversity Index (SDI) and Shannons Diversity Index (ShaDI). It has been hypothesised that land use diversity indices have been steadily on the decrease but quickened beyond 2005. According to Harris (2000), mixed uses not only increase the density but also gives choices through diversity of land uses. It is also supported by Aurand (2010) who observed that mixed use development means the combination of commercial, residential and industrial uses within one geographical area and not separating of residential and non-residential land uses.

## METHOD

### Study Area

The study area is Iskandar Malaysia, Johor as shown in Figure 1 and there were 394 neighborhoods which the study was able to identify. For the purpose of this study, only a few neighborhoods were chosen representing construction dates of 1980s until 2000s. All the neighborhoods are planned housing areas and other than that such as villages are excluded.



Figure 1: Iskandar Malaysia, Johor, Malaysia

### Data Collection

Data for the study came from secondary sources. Data on type of land uses, road network and also digital maps of neighborhoods were sourced from Iskandar Regional Development Authority (IRDA) office. There are five main categories of land use: residential, institution and public facilities, commercial, open space and industry.

### Simpsons Diversity Index (SDI)

SDI is the measure of the probability that two types of land uses in a neighborhood being chosen randomly would be of the same type (Lambin, 2006). In order to use SDI, unit of houses and type of land uses are needed. Formula of SDI is shown below.

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

$n$  : Unit of every land uses  
 $N$  : Total  $n$  (unit of every land uses)

1-D = Neighborhood Diversity      D : SDI index

### Shannons Diversity Index (ShaDI)

ShaDI is essentially used to measure the uncertainty associated with random variables (Lambin, 2006). It gives the average of unknown variables value. ShaDI is also very sensitive towards distribution size between land uses in a neighborhood. Unit of houses and type of land uses are also needed to use the index. The formula for computing ShaDI is shown below.

$$H = -\sum_{i=1}^s p_i \ln p_i$$

$p_i = \frac{n_i}{N}$   
 $H \times (-1)$

$p_i$  : Revenue distribution between unit of every land uses and total unit of land uses  
 $\ln$  : Logarithm being used  
 $n_i$  : Unit of every land uses  
 $N$  : Total  $n$  (unit of every land uses)  
 $H$  : ShaDI Index

In both cases, values between 0-0.5 are considered less diverse while 0.5-1.0 are more diverse.

## ANALYSIS AND FINDINGS

Figures 2 and 3 show the declining diversity of land uses in planned residential subdivisions throughout the period regardless Shannon's or Simpson's diversity index was used in calculating the index. There are neighborhoods with index value of 0.0 since they contain only one type of land uses such as residential. Outlying values are associated with two neighborhoods that contain all five main categories of land uses (residential, public facilities and institution, commercial, open space and industry). These neighborhoods are assumed to have a well balance type of land uses. Similar to SDI, ShaDI index too shows that there are outliers as well as indices value of 0.0. For ShaDI, eight neighborhoods with outlying values are mostly from 1980s and 1990s neighbourhoods. Both of the indices shows that the highest index values from well-balanced land uses within neighborhoods are during the pre-1980s and 1990s. Current neighborhoods tend to have one and the most is three types of land use only. Back in the 1980s, industrial is one the most important land uses in a neighbourhood as it generates income and job opportunities for the residents but now it is different because industrial land uses have its own zoning area just for industrial without mixing it with other land uses. This would result in higher vehicle-mile-travelled (VMT) values which are certainly not low carbon travels.

Average Index of Land Use Diversity, SDI (Pre1980's-2000's)

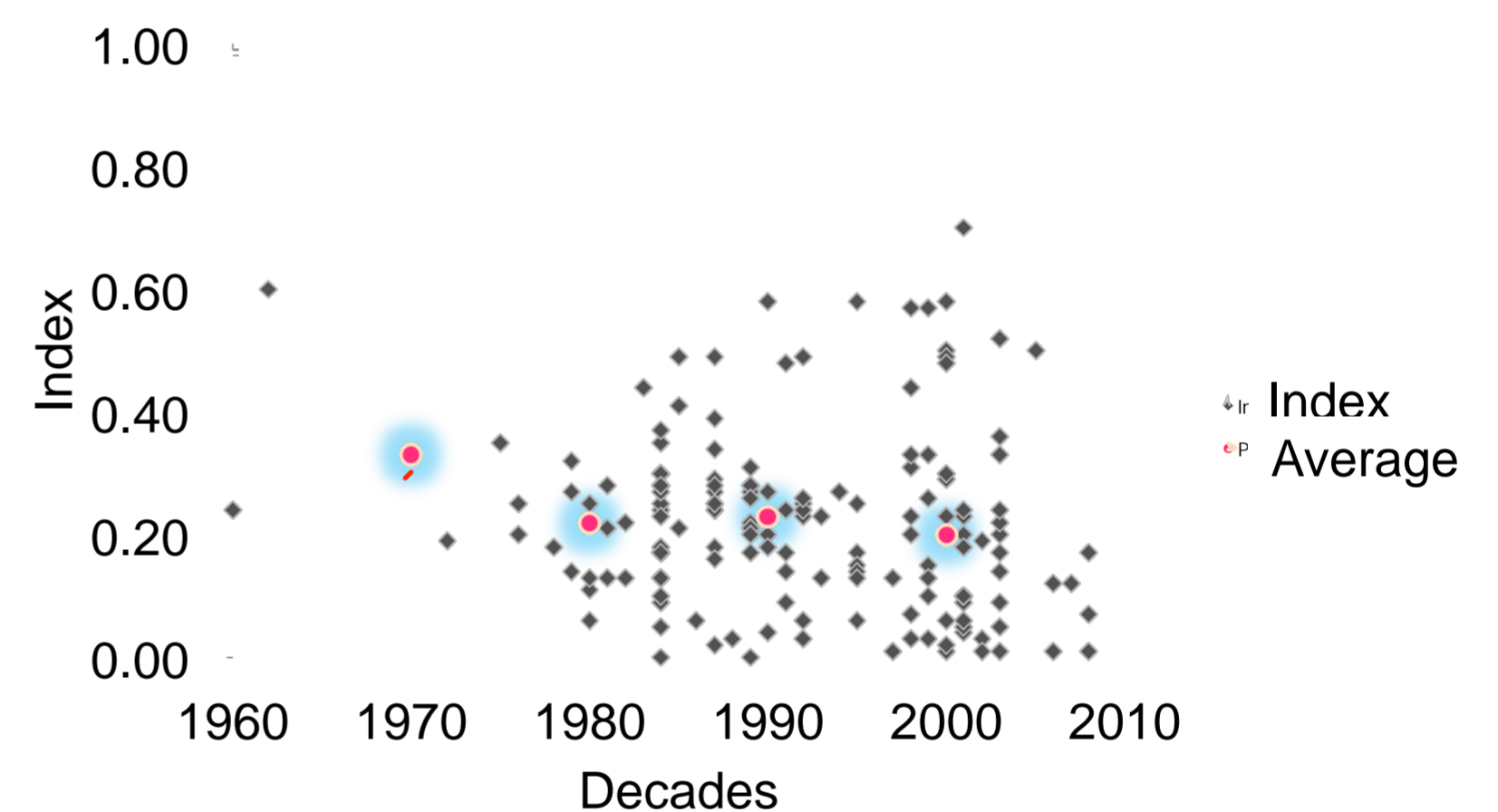


Figure 2: Land Use Diversity using SDI

Average Index of Land Use Diversity ShaDI (Pre 1980's-2000's)

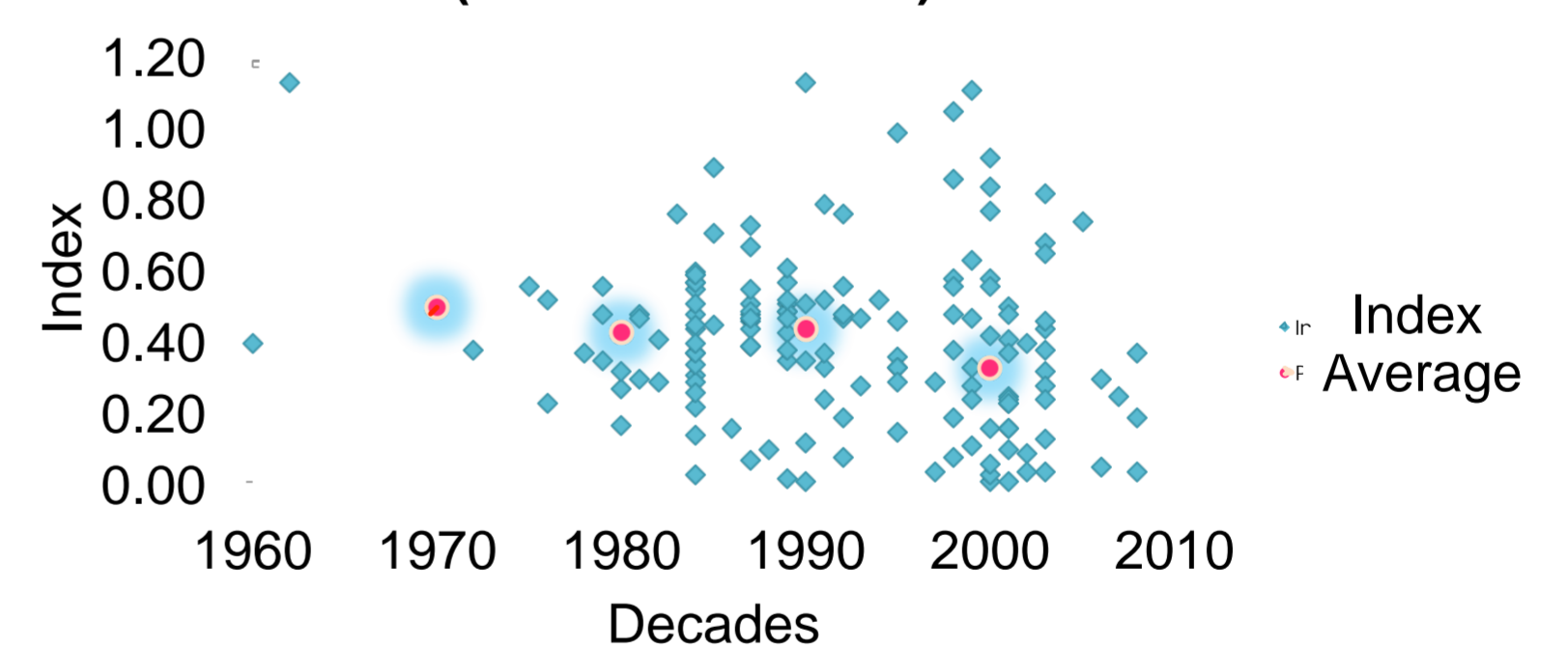


Figure 3: Land Use Diversity using ShaDI

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