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LAND USE CHANGES IN RURAL TOWN: A CASE STUDY OF KUALA NERANG, KEDAH

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Abstract

Urbanization is the process of transforming a characteristically rural society into an urban one. The urban population is growing at an increasing rate while the rural population is declining, giving rise to imbalances in the development between urban and rural areas. The government's strategy is to distribute the development to the major settlement centres in the rural areas, which are experiencing the same effects of urbanization as the urban areas in terms of changes to the use of land, especially the reduction of agricultural land and the increase in built-up areas. This study used the method of overlay in GIS applications to investigate land use changes, the speed of urban expansion and direction of development that has taken place from the period 2001 to 2018 in the town of Kuala Nerang, Kedah. This town has undergone a change in its status from a main settlement centre to a district administrative centre. Agricultural lands, which were targeted for development in the rural areas, have been converted into built-up areas. The speed of urban expansion has been slow, although some areas have recorded a higher rate. The development is moving towards the west along the main road connecting the major towns in this part of the state. The functions of the district administrative centre have influenced land use changes.

Keywords: land use changes, rural development, GIS

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INTRODUCTION

Urbanization is the process of converting an area and its population into an urban pattern, pervaded with elements of urbanization. Urbanization transforms the character of a rural society into one that is generally urban (Embong, 2011). In Malaysia, the urbanization scenario can be divided into two stages, namely, before and after the 1970s. The first stage was the period following the Second World War until independence (1947-57), where the population was growing at an average rate of 6.2 percent annually, while the second stage of urbanization was after the implementation of the New Economic Policy in 1971, encompassing the industrial policies, agricultural development and urbanization of the country, which had a direct impact on the rate of growth of the urban population (Rostam, 2001). It can be seen that the number of people living in the urban areas has been on the rise until today. According to the Department of Statistics Malaysia (2010), the number of urban residents in the country has been increasing from 20.82 million (72%) in 2011 to 25.04 million (77%) by 2020.

This rise in the urban population has resulted in a decline in the number of people, especially youths, in the rural areas, from 8.2 million (28%) in 2011 to 7.4 million (23%) by 2020 (Department of Statistics Malaysia, 2010). This drop in the rural population in Malaysia has created an imbalance in the development between the urban and rural areas. This has led to the establishment of strategies and efforts by the government to distribute the urban development, especially in the industrial sector, to the rural areas through the existing development corridors in order to open up new growth centres that can offer employment opportunities to those living in the rural areas (Ngah, 2009).

The establishment of these new growth centres, known as small towns, can help drive rural development. In general, these small towns are to function as services, commercial and administrative centres for the districts. The existence of various activities such as commercial, services and administrative activities in the small towns can bring about land use changes, which are often related to the urbanization process in urban areas (Ngah, 2012). The urbanization process also involves the conversion of land from non-built-up to built-up areas. According to Johnson (1974), urbanization has resulted in land-use conflicts, threats to agricultural activities and speculative land markets. The establishment of small towns as a result of urbanization has brought about land use changes in rural areas (PLANMalaysia, 2016). Therefore, this paper is aimed at studying the land use changes in Kuala Nerang, which is the administrative centre for the district of Padang Terap in Kedah. The results of this study on land use changes will be used to identify the speed of urban expansion and direction of the development that is taking place in Kuala Nerang.

LAND USE CHANGES IN RURAL AREAS

Land use activities refer to the actions of humans to cultivate and modify the surface of the ground in order to meet their needs (Carvalho, 2006). Land use changes are the result of ever-increasing human development and activities (Idrus, Sian & Hadi, 2004). According to Asnawi & Choy (2016), factors such as the various government policies aimed at national development, the economic development in the industrial sector and the development of infrastructure as well as built-up areas in town centres have caused the urbanization process to spread to the rural areas and to indirectly affect the pattern of land use changes in those areas. Rural settlement centres are the areas that frequently undergo the urbanization process. This is because these settlement centres are hubs for the economic, social, services and community activities of the locals. The availability of infrastructure facilities along the main routes connecting the urban to the rural areas has attracted housing, industrial, institutional, commercial and other activities to the rural areas to achieve a balanced economic growth and to provide opportunities for employment (Antrop, 2004).

The existence of educational and training institutions has also given rise to the urbanization process as it has spurred rural development (Noor & Choy, 2018). Educational and training institutions can produce skilled youths for the development of the rural areas while providing employment opportunities to rural residents. This increase in employment opportunities will reduce the rate of rural migration to the cities. The population growth has also resulted in an increase in the demand for the conversion of agricultural land in the rural areas to built-up areas to accommodate the needs of the population. The urbanization process has had a huge impact on land use changes, especially the conversion of agricultural land for other land use activities such as housing, commerce, industries, transportation and so on to meet the growing needs of the people (Salleh, Badarulzaman, & Salleh, 2013). Land for tourism and recreation activities has also increased in the rural areas, especially in those areas with natural attractions. Tourism activities have been much more productive than agricultural activities in view of the assistance provided by the government in terms of infrastructure development to increase the income of the rural population. Indirectly, the rapid economic development in the rural areas has reduced the amount of land available for agriculture and forests due to the pressures of development, while having a negative impact on the quality of the natural environment that may give rise to the risk of natural disasters (Samat,Eltayeb, Hasni & Radad, 2010; Hussain & Ismail, 2016).

Land use changes will continue to occur in tandem with the establishment of government policies and strategies to improve the living standards of urban and rural communities. Nevertheless, it is also necessary to exercise some control over development to ensure that the rural areas do not undergo drastic changes that will alter the original activities of the population and

have a negative impact on environmentally-sensitive areas. The urbanization process can indirectly aid rural development in terms of the provision of good infrastructure facilities, the existence of institutions and the establishment of functional small towns that can increase employment opportunities and so on provided the urbanization process is well-controlled so that future generations will be able to enjoy a comfortable life (Samion et al., 2014).

STUDY AREA

The area that was selected for the study is the town of Kuala Nerang, which is located in the district of Padang Terap, Kedah, Malaysia (Figure 1). According to the Draft of the Kedah State Structure Plan 2035 (PLANMalaysia, 2017), this town is categorised as the administrative centre for the Padang Terap district, while under the Kedah State Structure Plan 2020 (PLANMalaysia, 2011), this town is a major settlement centre. The upgraded status of Kuala Nerang from a major settlement centre to a district administrative centre can potentially impact land use changes around the town. Kuala Nerang town is located in Mukim Belimbing Kanan, which covers the West Padang Terap Planning Block area.

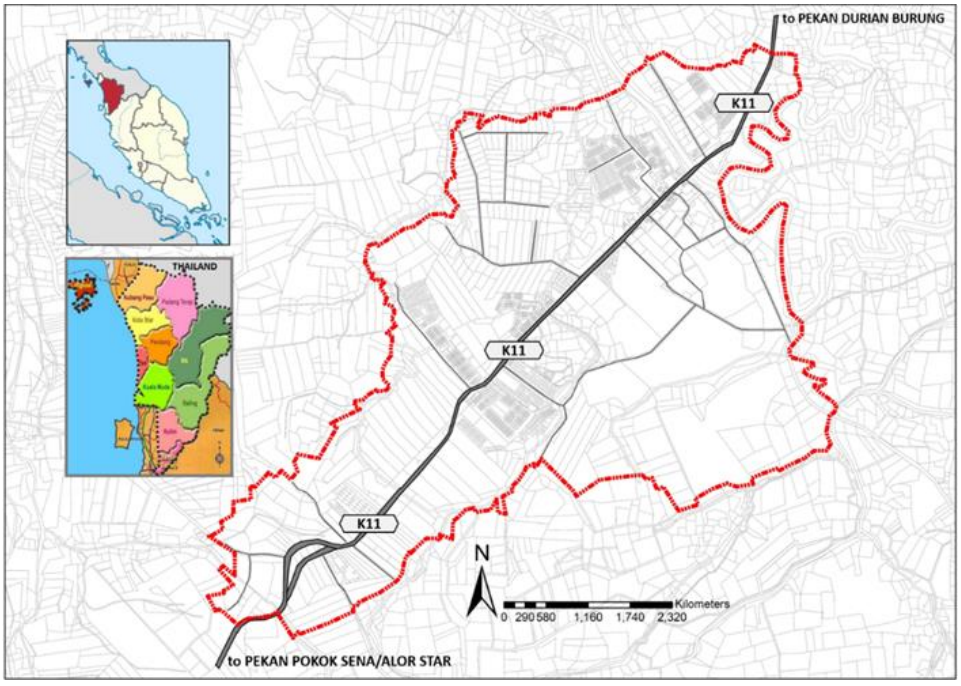

Figure 1 Location of Kuala Nerang, Kedah

The administrative boundary for Kuala Nerang, as determined by the Kedah Land Administrative Boundary's Code and Name (JTSM, 2011), covers an area of 2,146.41 acres. The town has two sections, namely, Section 1 and Section 2. Kuala Nerang is connected via the K11 State Route from Pokok Sena to the Durian Burung and to the border of Thailand. The main policies and strategies for the Padang Terap district in the Padang Terap District Local Plan 2020 (PLANMalaysia, 2018) are concentrated between Kuala Nerang and Durian Burung, characterised by the linear development corridor. This corridor is linked by major roads and is supported by the major settlement centres surrounding it, which have become the nodes to that linear development. Kuala Nerang is an existing node that has been identified as one of the major contributors to the services, commercial and administrative sectors of the Padang Terap district.

METHODOLOGY

The aim of this study is to identify the land use changes that occurred in Kuala Nerang town from 2001 to 2011 and from 2011 to 2018, from which the speed of urban expansion and direction of development in the town could be determined. The secondary data for this study came from written sources such as the Draft of the Kedah State Structure Plan 2035, the Kedah State Structure Plan 2020, the Padang Terap District Local Plan 2020 and other reports related to this study.

The analysis of land use changes involved the data on land use for the years 2001, 2011 and 2018. The data on land use for 2001 was obtained in digital format (GIS format) from the Northern Zone Project Office, PLANMalaysia (Federal Department of Town and Country Planning), in Alor Setar, Kedah, while the data on land use for 2011 was obtained through the georeferencing method by using satellite images and ArcGIS (10.4) software. The data on land use for 2018 was obtained through the gathering of information in the field. The land use changes were analysed using GIS software (ArcGIS 10.4) by the overlapping method. From the results of the analysis of land use changes, the direction of development could be determined with the support of the secondary data.

To examine the speed of urban expansion in Kuala Nerang, a fishnet of the study area was generated using ArcGIS software. This fishnet produced grid cells measuring 100m x 100m as a unit of space. The rate is calculated using formula by (Hu, Du, & Guo, 2007), as given below.

$$\mathbf{X}_{i,\,t+n} = \mathbf{\{(B}_{i,\,t+n} - \mathbf{B}_{i,t}\mathbf{)} / \mathbf{T}_i \times \mathbf{100\}}$$

where,

$X_{i,\,t+n}$ = the annual expansion intensity index of spatial unit i,
$B_{i,\,t+n}$ = urban area in the spatial unit i at time t + n,
$B_{i,t}$ = urban area in the spatial unit i at time t, and
T_i = the land area of spatial unit i.

Table 1 Annual expansion intensity index and its grade

Value	Grade
$X_{i, t+n} > 1.92$	High-speed expansion
$1.05 > X_{i, t+n} > 1.92$	Fast-speed expansion
$0.59 > X_{i, t+n} > 1.05$	Medium-speed expansion
$1.05 > X_{i, t+n} > 0.28$	Slow-speed expansion

Source: (Hu, Du, & Guo, 2007)

DATA ANALYSIS AND FINDINGS

This section discusses the data analysis and the findings on the pattern of land use changes, and the speed of urban expansion and direction of development in Kuala Nerang town for the period 2001 to 2018.

Pattern of Land Use Changes in Kuala Nerang

As shown in Table 2, a total of 1,364.17 acres (63.42%) of the land was used for agriculture in 2001, followed by 337.18 acres (15.77%) for housing and 165.71 acres (7.75%) for transportation. However, there was a drop in the total land use from 2001 to 2011, particularly for agriculture, which was reduced by as much as 91.87 acres (4.3%), while the use of land for infrastructure and utilities was reduced by 1.01 acres (0.04%) and for water bodies by 0.10 acre (0.01%). This decline was due to the conversion of land to meet the demand for other land uses such as for transportation, housing, institutions and social amenities, commerce as well as for open spaces and recreation. This can be explained by the development of new housing estates from Kuala Nerang to Pokok Sena and also the upgrading of the K11 State Road. In addition, there has also been the development of educational and government institutions such as the Padang Terap Community College, the Padang Terap District Office, and the Padang Terap Lower Syariah Court. Most of these have been developed on agricultural land. Meanwhile, the use of land for industrial activities has shown a decline due to the conversion of such land for transportation purposes. Vacant land began to be classified as a land use category PLANMalaysia in 2008.

Between 2011 and 2018, agricultural land continued to show a decline from 1,272.30 acres to 1,243.71 acres (1.34%), while vacant land dropped from 2.00 acres to 0.15 acres. This decline was also due to the increase in the use of land for housing, commerce, institutions and social amenities, and transportation. There were several new developments such as housing estates, commercial areas, places of worship and so on. There were no changes to the use of land for industries, vacant land and recreation as well as infrastructure and utilities during that period. This was because the proposed development of an industrial area was located outside the study area, namely at Planning Block 4 (Padang Terap/Kota Putra). The Kuala Nerang town centre has been developed as an area for services, commercial and district administration activities.

Table 2 Land Use Changes in Kuala Nerang (2001-2018)

Land Use	YEAR						CHANGES			
	2001		2011		2018		2001-2011		2011-2018	
	Area (acre)	%	Area (area)	%	Area (acre)	%	Area (acre)	%	Area (acre)	%
Housing	337.2	15.8	368.4	17.2	383.6	17.9	31.2	1.5	15.3	0.7
Commercial	14.7	0.7	23.8	1.1	27.4	1.3	9.1	0.4	3.6	0.2
Industry	5.9	0.3	2.4	0.1	2.4	0.1	-3.5	-0.2	0.0	0.0
Institution & Public Fac.	147.5	6.9	168.1	7.9	171.9	8.0	20.6	1.0	3.8	0.2
Open Space &Recreation	53.9	2.5	56.4	2.6	56.7	2.7	2.5	0.1	0.3	0.0
Vacant Land	-	-	2.0	0.1	0.2	0.0	2.0	0.1	-1.9	-0.1
Transport	165.7	7.8	196.8	9.2	204.4	9.6	31.1	1.5	7.5	0.4
Infrastructure & Utilities	2.7	0.1	1.7	0.1	1.7	0.1	-1.0	0.0	0.0	0.0
Agriculture	1364.2	63.4	1272.3	59.1	1243.7	57.8	-91.9	-4.3	-28.6	-1.3
Water Body	54.7	2.6	54.6	2.6	22.1	2.6	-0.1	0.0	0.0	0.0
Total	**2146.4**	**100.0**	**2146.4**	**100.0**	**2146.4**	**100.0**				

Based on the analysis of land use changes from 2001 to 2011, it was found that the use of land for agriculture experienced a severe decline of as much as 91.87 acres. The built-up areas benefitted from this decline in agricultural land. The three types of land use that saw the largest increase were housing, which increased by 31.18 acres (1.46%), transportation by 31.13 acres (1.46%), and institutions and social amenities by 20.61 acres (0.96%). A similar trend was detected for land use changes between 2011 and 2018, where the use of land for agriculture dropped by as much as 28.59 acres. Three types of land use that showed the biggest increase were housing, by as much as 15.27 acres (0.71%), transportation, by 7.54 acres (0.35%), and institutions and social amenities by 3.76 acres (0.18%). These land use changes are shown in Figure 2.

The details of each land use changes are illustrated on the matrix of land use changes for the period between 2001 to 2011 as shown in Table 3 (Note: The matrix for land use changes between 2011 to 2018 is not shown here due to not many changes during this period as compared to 2001 to 2011). Agriculture is the prominent land use that is experiencing decreasing land area to other land use activities. The highest change was the agricultural land use for housing to involving the construction of new housing estates (44.62 acres) to accommodate the population demand. The second highest change was from agriculture to transportation at 26.04 acres. This is particularly for the upgrading of K11 state road and construction of roads in new housing areas. The third highest change was from agricultural land use to institutions and community facilities of 16.61 acres. This is to accommodate the construction of government institutions and education to strengthen Kuala Nerang's function as district administration center. According to Samat, Ghazali, Hasni, Hadary, & Hassan (2012), the urbanization process in the rural areas has resulted in the loss of an important agricultural land as a source of income to the rural population. However, in Kuala Nerang, most of these agricultural lands are potential development areas.

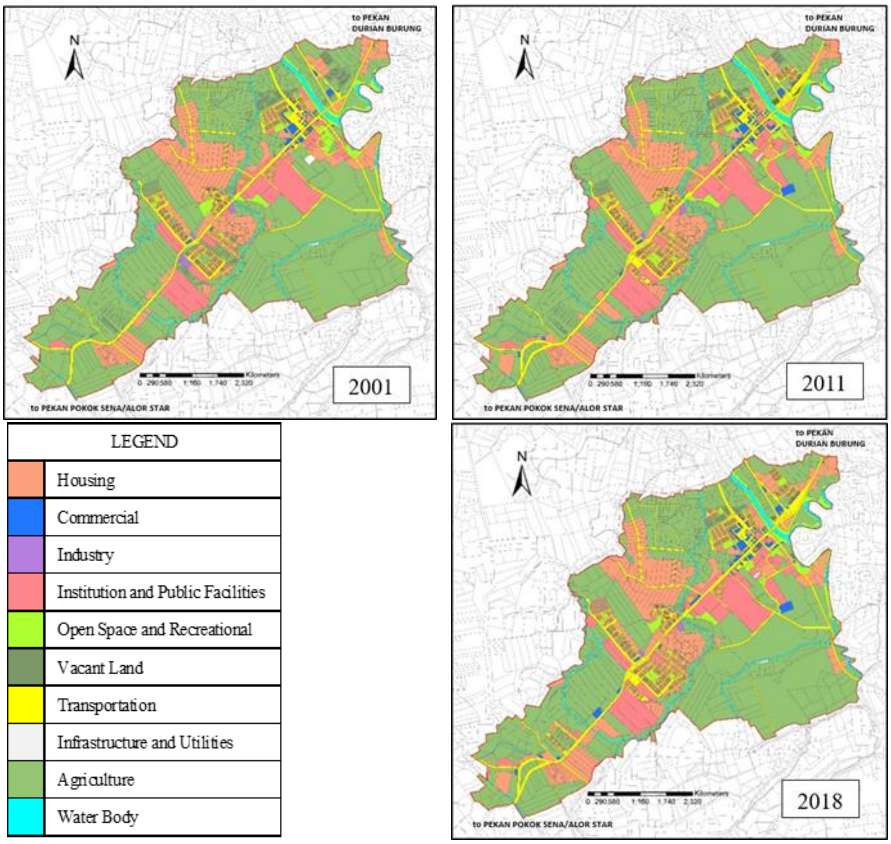

Figure 2 Land Use Changes in Kuala Nerang 2001, 2011 and 2018

Table 3 Matrix of Land Use Changes in Kuala Nerang (2001-2011)

		Landuse 2011 (acre)										
		House	Comm	Ind.	Inst.	Open space	Vac. land	Trans-port	Infra	Agri	Water body	Total
LANDUSE 2001 (acre)	House	323.6	0.7		0.1			2.0		10.9		337.2
	Comm	0.1	14.3				0.1	0.1				14.7
	Ind.			2.4				3.5				5.9
	Inst.		0.4		147.1							147.5
	Open space		2.1		3.6	48.1		0.2				53.9
	Vac. land											
	Transport		0.4			0.4		164.9				165.7
	Infra				0.8	0.5			1.4			2.7
	Agri	44.6	5.9		16.6	7.5	1.9	26.0	0.3	1261.4		1364.2
	Water	0.1									54.6	54.7
	Total	368.4	23.8	2.4	168.1	56.4	2.0	196.8	1.7	1272.3	54.6	2146.4

This clearly showed that non-built-up areas such as agricultural land and forests are often the main targets for development activities in rural areas. Their low market prices and physical features that are easy to develop encourage the growth of built-up areas such as for housing, commerce, institutions and social amenities, transportation and so on. According to Salleh, Badarulzaman, & Salleh (2013), such land use changes are one of the effects of the on-going urbanization process.

SPEED OF URBAN EXPANSION IN KUALA NERANG

The speed is determined through the annual expansion intensity index produced through an analysis of land use changes over a certain period of time. For Kuala Nerang, the analysis of land use changes revealed that there was an increase of 35 acres in the built-up area from 2001 to 2011, and it continued to increase by as much as 12.21 acres between 2011 and 2018. This change involved a reduction in agricultural land from 1,364.17 acres to 1,272.30 acres for the period 2001 to 2011, and this continued to decrease to 1,243.71 acres between 2011 and 2018.

An analysis of the speed of urban expansion using the fishnet revealed that from 2001 until 2011, 820 pixels experienced a slow expansion, while 140 pixels experienced rapid increase in the Kuala Nerang town area. This could also be seen from the results of the analysis between 2011 and 2018, where 921 pixels experienced a slow speed of urban expansion and 53 pixels experienced rapid expansion. Figure 3 below shows that the areas that experienced a rapid urban expansion were concentrated more in the northeast and southwest of the town, and it can be seen that this high rate of urban expansion occurred more between 2001 and 2011 compared to the period 2011 to 2018. The area in the northeast is the Kuala Nerang town centre, which provides a range of commercial activities and services, while the activities in the south-western area are focused more on institutions and social amenities. Both these areas are located along the main road, namely the K11 State Route that links Pokok Sena to Kuala Nerang and on to Durian Burung near the border of Thailand. The development of government and higher education institutions is concentrated more in areas that are less than a kilometre from this main road. This could be because in these areas the land is cheap; there is minimal control over development, and also to avoid a heavy concentration of urbanization activities along the main road. Rostam (2001) regarded such development as a catalyst to economic growth in rural areas. Apart from providing employment opportunities, it also increases the demand for economic, social and urbanization activities in these areas.

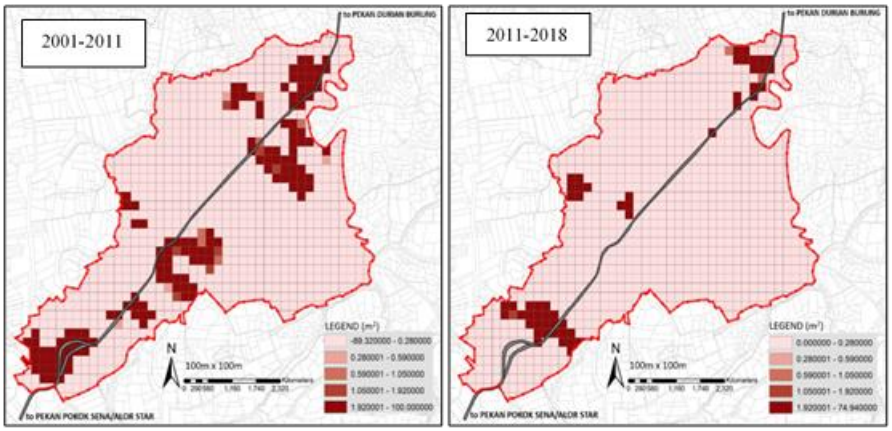

Figure 3 Speed of Urban Expansion in Kuala Nerang

Direction of Development in Kuala Nerang

The development trend in Kuala Nerang is determined by the results of the analysis on land use changes for the periods 2001 to 2011 and 2011 to 2018. Land use changes in Kuala Nerang were quite slow during both periods. The speed of urban expansion was also quite slow as the economic, social and services sectors in the town were still concentrated more in the main towns such as Alor Star, Jitra and Pokok Sena, located in the western part of the state of Kedah. The Kedah RSN Executive Inspection Report 2035 (PLANMalaysia, 2017) states that the eastern area of Kedah is receiving very little attention from investors and visitors due to poor accessibility even though it has the potential to be an eco-tourism area. In addition, there are many environmentally-sensitive areas such as permanent forest reserves and water bodies such as lakes in this section. The continued control of development in these sensitive areas will hamper land use changes as well as delay the development of Kuala Nerang town. It was found that the direction of development in Kuala Nerang is increasingly towards the west, in line with the main road (K11), which is connected to urban areas such as Pokok Sena and Alor Star (refer to Figure 4). Improved transportation and infrastructure facilities in this sprawling area will change the rural landscape in the future. In addition, the analysis of land use changes also showed that the development in this town is scattered, is close to the main road and is not concentrated in certain areas such as the town centre. Nevertheless, the eastern part of the state of Kedah, which is mainly comprised of agricultural and forest areas, should also be given attention as they have the potential to be developed for eco-tourism and agro-tourism.

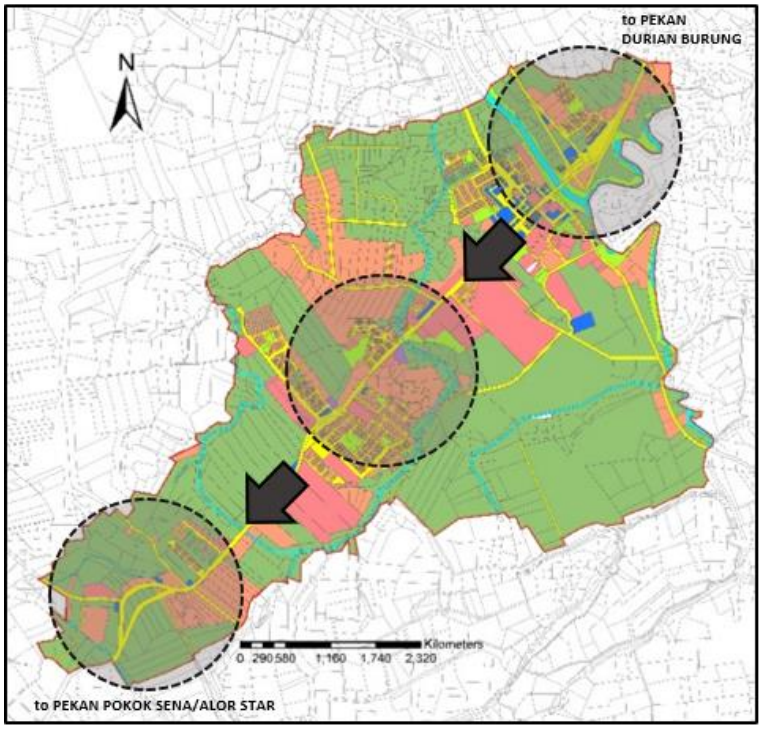

Figure 4 Direction of Development in Kuala Nerang

CONCLUSION

The results of this study showed that a small town that serves as a district administrative centre has the potential to experience changes to its land use in terms of the aspects of space and time. Agricultural land and green areas are often targeted for new development purposes as their physical features can be easily and cheaply developed. The market price for such land is usually much lower than land that is used for other purposes. The investment returns from agricultural activities are also much lower than from other land use activities such as housing, commerce, industries and so on. In terms of land administration, the process for the conversion of agricultural land to other land uses such as residential or industrial land is much easier to implement without strict conditions. This study found that three types of built-up development benefit from the decline in agricultural land, namely housing, transportation and institutions and social amenities. Although several areas have experienced rapid urban expansion, in general, the speed of urban expansion in this town is still slow. The trend and location of land use changes from 2001 to 2018 show that the direction of development in this town is towards the west and is influenced by the availability

of better transportation and infrastructure facilities in this section. The land use changes in this town can generally be said to be slow even though it is a district administrative centre. The eastern part of this state is not receiving much attention from investors and has less tourism activities because of poor accessibility and lack of viability. It is hoped that the proposed high-impact projects in the Padang Terap District such as the Kedah Rubber City and the proposed new highways, namely, the Central Spine Highway and the Trans Eastern Kedah Interland Highway (TEKIH) will further boost the economy and improve accessibility to these rural areas in the future.

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