

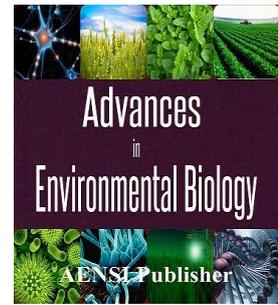


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### Towards Green Roads in Malaysia

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#### ABSTRACT

Although road infrastructure have been properly developed in Malaysia, environmental issues related to the roads have increased significantly. In spite of government efforts to adapt the environmental regulations, road problems in terms of environmental issues have remained unsolved with a great gap towards green road standards. Malaysian roads are faced from two perspectives in terms of environmental problems: Environmental Impacts of roads such as urban heat island (UHI) and Environmental Hazards on roads such as floods. Green road standards as an environmental rating system have been introduced worldwide; however, such efforts need to be developed in Malaysia. Based on thorough review of previous literature, this paper discusses the current challenges and required strategies towards green road infrastructure in Malaysia.

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### INTRODUCTION

As roads are expanded with their impervious and artificial surfaces due to rapid Malaysian metropolitan development, similar amounts of forests and vegetation are decreased. The roads affect majorly the environmental impacts such as increasing ambient temperature. At the same time, they are affected by environmental hazards such as floods. Accordingly, in order to solve these road problems, green road standards should be implemented in Malaysia. This study scrutinizes the challenges of Malaysian road infrastructure from the environmental point of view and discusses the required strategies towards Malaysian green roads.

#### Methodology:

By using a secondary data, this research aim to reveal the existing literature on Malaysian road infrastructure problems environmentally. It also identifies the required strategies to explore future plans to address Malaysian roads problems environmentally by using the finding of former studies.

#### Findings and Discussion:

*i: Environmental hazards and environmental impacts facing Malaysian roads:*

Roads influence the environmental impacts, while they are simultaneously affected by environmental hazards due to decreasing number of forests and vegetation created by human activities [1, 2]. Roads in Malaysia that are located in risk prone regions of natural disasters are highly affected by rapid urbanization and the extended roads would cause HUI due to the low albedo pavements [3, 4]. Based on previous studies, Malaysian roads are faced on two problems related to environmental issues, namely environmental hazards and environmental impacts.

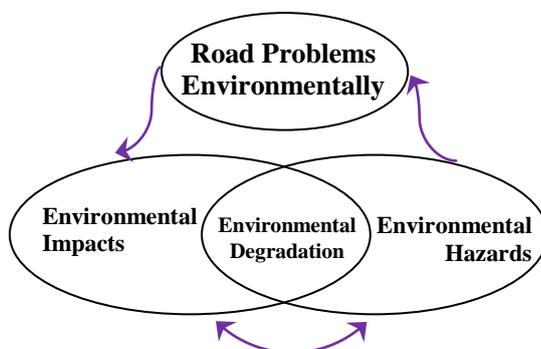
First, flooding is the most substantial natural hazard to affect Malaysian roads due to potential future growth by 2020. Deforesting of dense natural tropical forests and hill slopes as a result of human activities and replacing them with impervious and artificial surfaces such as road pavements two major contributing factors to increasing the flood risk in the near future. The Department of Irrigation and Drainage (DID) Malaysia, estimated that nine percent of the total land area of country is located in a flood hazard region. The Public Work Department (PWD), reported that the repair costs of the roads and the bridges were RM147 million as of January 2007 that some of these repaired roads had been affected by annual flooding. Meanwhile, almost RM 1.790 billion had been spent on structural flood mitigation efforts from 2001 to 2005 [5].

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Second, increasing environmental impact like HUI is another problem of Malaysian roads. Indeed, land cover changes with the replacement of natural surface by impervious road surfaces make higher surface temperature, lead to increasing the ambient temperature of many Malaysian urban areas compared to the rural areas which is known as UHI [2,6]. Covered urban land surfaces such as the very low albedo materials contribute to UHI due to high heat absorption. Comparatively, the specific heat capacity of moist soil is approximately 50% greater than that of concrete and asphalt [7]. Shaharuddin and Hashim found that high soil moisture content reduces the land surface temperature, hence, removing the effect of the Malaysian urban heat island intensity [8]. Elsayed stated that due to reducing amount of trees in Kuala Lumpur, the ambient temperature has been increased recently [9].

Since 1972, Sham has been a pioneer in measuring the heat island intensity in Kuala Lumpur over a 20-year period. He figured out markedly the higher temperatures in larger urban areas by contrast to rural areas. Additionally the studies have revealed greater heat island intensity during the night compared to daytime with a vertical thermal impact extended up to 500 m and above [10, 11]. Additionally, nocturnal heat island intensity of different locations in Kuala Lumpur was examined by Elsayed, shifted from Chow Kit area to Puduraya area increasing up to 1.5°C [12]. Moreover, in order to investigate the intensity of the heat island in Muar, one of the rapid growing cities in the south of Malaysia, Rajagopalan *et al.* (2011) found 4°C temperature changes during the day and 3.2°C at night caused a changing air temperature pattern in this city [2].

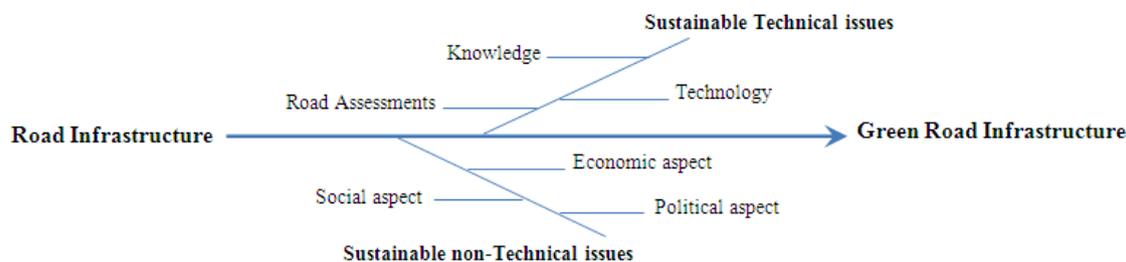
Overall, in Malaysian metropolises, natural forests and vegetation have been replaced by the artificial and impervious road surfaces. This increased the flood risks as an environmental hazard while simultaneously caused higher surface temperature that resulted in increased heat island intensity and therefore increased the environmental impact of the roads.



**Fig. 1:** Roads faced environmental impacts and environmental hazards

ii: *Malaysian Green Road: required strategies to address roads problems environmentally:*

Solutions to address the environmental problems of Malaysian roads should lead to the implementation of green road standards despite the fact that these issues are still infancy in the road construction sector in spite of years of effort by the Malaysian government [13]. Green roads, as a system reducing the environmental impacts on road infrastructure, introduces sustainable practices including materials management, energy reduction, stormwater management and road lifespan. Based on the literature review [6, 13, 14, 15], two overall strategies are theorized with regards to the implementation of green roads in Malaysia involving sustainable technical strategies and sustainable non-technical strategies as shown in figure 2.

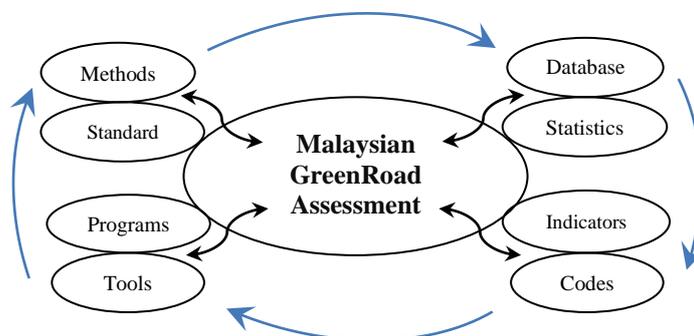


**Fig. 2:** Required strategies to achieve Malaysian green road

1. *Sustainable road technical strategies: Assessments/ Technology/Knowledge:*

Although a Green Building Index has been established in Malaysia, as a sustainable building assessment method, green road assessments are still new in the Malaysian road construction industry while sustainability has become important in road infrastructure worldwide to improving the green roads [14]. In summary, it seems

that in order to establish green roads assessment in Malaysia based on previous studies; first it needs to have a road database that allows users to get the required information to create and maintain the system environmentally friendly. It should be noted that green road methods and standards should be created as well. Green road programs, tools, indicators and design codes should be applied within the system. Figure 3 illustrates the implementation requirements to achieve a Malaysian green roads assessment.



**Fig. 3:** Implementation requirements of Malaysian green roads

Furthermore, technology is another important aspect as sustainable technical solutions to replace a problematical road with an environmental friendly road. In order to achieve this goal, many technologies exist to reduce the environmental impact on roads. The use of advanced planning, intelligent construction, and efficient maintenance techniques need to be incorporated into every modern highway design [13, 15].

It is notable that knowledge, in general, regarding sustainability affects the rest of the strategies that will be acquired with good levels of knowledge in sustainable design and construction in Malaysia. Knowledge adequacy, knowledge acceptability and knowledge appropriateness are major themes for this aspect [6, 13].

#### *2. Sustainable road non-technical strategies: Economic/ Social/ Political Aspects:*

Economic, social and political factors are known as the non-technical issues which affect the technical ones as factors required to achieve the green roads. Economic issues are inextricably tied to the knowledge which can introduce the economic benefits of sustainable approaches as well as technology which are the major concerns among the Malaysian road construction industry. Meanwhile, there are social issues in terms of readiness and acceptance of sustainable road methods among the Malaysian construction industry that would make easier access to the green road target. Potential support from the government is political issue in terms of providing incentives as well as enforcing green roads as a regulatory mechanism affects the rest of the strategies created to address the Malaysian road problems environmentally and thus changing them to green roads [13].

#### *Conclusion:*

The challenges of road construction industry in Malaysia can be viewed from two perspectives. They are involving environmental impacts of road such as urban heat island and environmental hazards on roads such as flash floods. Land cover changes with reduction and replacement of natural vegetation and forest by artificial road surfaces increase the ambient temperature while simultaneously, rise the flash flood risks. Essential strategies to solve these problems should lead to the implementation of green road assessments. To implement green roads in Malaysia, two required strategies are theorized including sustainable technical strategies and sustainable non-technical strategies. In conclusion, Malaysian road construction industry should look forward to establish and practice the green road standards in future to address both side of Malaysian road problems related to the environmental issues namely urban heat island and flooding affected the roads surfaces.

#### **ACKNOWLEDGEMENT**

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