

**GREEN HIGHWAY ECOLOGY AND ECOSYSTEM
PRESERVATION AND RESTORATION**

MUDATHIR OMER ADAM ARBAB

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DEDICATION

To the memory of my parents
To my beloved wife who paints a picture
of love in my heart every day
Thank you for all love and motivation
I love you today, tomorrow and forever

HASANAT IBRAHIM

And my beloved children who silently endured many
hours I spent away from them to complete this work.

ISRA MUDATHIR
OMER MUDATHIR
IKRAM MUDATHIR
JAILANI MUDATHI

Thanks for supporting me days and night, until I reached to this level, may
ALLAH bless you all.

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ABSTRACT

The issues of green highway is very important for the future generations, there are several tools lacking in the green evaluation of infrastructure projects. Many of the tools available for green evaluation lacking the ecological and ecosystem preservation and restoration issues. Today's thinking on the environmental issue become one of the significant issue worldwide that can not be neglected because of its important in improving the quality of life and ecosystem. The aim of this study is to address the problem related to the ecology and ecosystem for the green highway. The data for this research were obtained through focus experts group discussion, set of questionnaires and interviewing target respondents and professionals, such as engineer and architect that have been involved in highway projects. The data collected were analysed using Statistical Packages for Social Science (SPSS) version 18.00. From the SPSS, the results of Frequency analysis and Average Index is tabulated in order to indicate the level of 22 variable an agreement level of respondent for all question in all section. The findings of this study identified the criteria of green highway that can be use in Malaysia green highway and other part of the world. The results show that elements which have been identified will serve as a basis for the development of an assessment model for Malaysia green highway.

ABSTRAK

Isu lebu raya hijau adalah sangat penting untuk generasi pada masa hadapan dan didapati terdapat masalah kekurangan alat panduan dalam pembangunan projek hijau infrastruktur masa kini. Banyak alat yang tersedia ada menitikberatkan pembangunan hijau, tetapi ianya tidak memfokuskan tentang isu-isu pemeliharaan dan pemulihan ekologi dan juga ekosistem. Dewasa ini, pemikiran mengenai isu alam sekitar menjadi salah satu isu penting di seluruh dunia yang tidak boleh diabaikan kerana ianya penting dalam meningkatkan kualiti hidup ekosistem. Tujuan kajian ini adalah untuk menangani masalah yang berkaitan dengan ekologi dan ekosistem di lebu raya Malaysia. Oleh itu, data bagi kajian ini telah diperolehi melalui perbincangan bersama sekumpulan pakar, soal selidik dan temuduga. Responden sasaran dalam kajian ini adalah jurutera, arkitek, dan perunding projek yang berpengalaman dalam projek-projek lebu raya. Data yang dikumpul telah dianalisis dengan menggunakan Pakej Statistik untuk versi (SPSS) 18,00. Keputusan analisis frekuensi dan indeks purata diperolehi melalui analisa SPSS bagi 22 pemboleh ubah dalam kesemua soalan. Konklusinya, elemen yang bersesuaian dengan Lebu Raya di Malaysia dihasilkan dalam kajian ini untuk menyumbang kepada lebu raya hijau.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The road ecology is new discipline that focuses on understanding the interactions between road systems and the natural environment Carmond and Trusty (2005). It is an applied science, and much of the work within this field endeavors' to find ways to mitigate the detrimental effects that road systems can have on flora and fauna populations The studies generated body of knowledge of the ecological effects of highways systems which inform many of the current visions of sustainable development.

The outputs of these studies of road ecology include advances in the management of storm water runoff, transportation, land-use planning, and the development of crossing structures that allow animal's safe passage across busy roads. The construction of road networks for many centuries, and the effects of roads on the distribution and abundance of wildlife have become an important issue, Jaeger (2002), Sherwood et al. (2002), Spellerberg (2002), Forman et al. (2003), National Research Council of the National Academies (2006).

For many members of modern societies, wildlife–vehicle collisions are one of the rare occasions when they directly experience the prevailing conflicts between wildlife populations and expanding human societies. Roads and traffic fragment the habitats of many wildlife species, leading to a decrease in habitat amount and quality, increased mortality because of collisions with vehicles, reduced access to resources

on the other side of the road, and the subdivision of animal populations into smaller and more vulnerable fractions. In the case of larger land, wildlife–vehicle collisions also pose a risk to traffic safety. The **natural environment** is a source for a wide range of resources that can be exploited for **economic** profit, for example timber is harvested from forests and clean water is obtained from natural streams. However, **land development** from human economic growth often causes a decline in the ecological integrity of nearby natural habitat. Wildlife need to move across the landscape and highway corridors for seasonal migration, access to food and to establish new territories as the young mature.

1.2 Back ground

The Malaysia highway authorities undertaking investigation to establish the green highway criteria for Malaysia green highways, in which this study is taking a part to identify the criteria for green highway in term of ecology and ecosystem. As long as highways have been constructed the studies of the impact of highways have not been taken significantly. Boarder considerations of the role that roads can have on ecological processes were largely ignored, despite the great boom in highway construction that took place in whole of Malaysia.

A green highway is a roadway design based on a relatively new concept for roadway design that integrates transportation functionality and ecological. An environmental approach is used throughout the planning, design, and the construction. The result is a highway that will benefit transportation, the ecosystem, urban growth, public health and surrounding communities. When built to standards of the concept, green highways have invaluable benefits to environment. Since they are built with permeable materials that provide superior watershed-driven storm water management, leaching of metals and toxins into streams and rivers is prevented. Landfill usage is favorably reduced as construction involves recycled

materials. In addition, by using cutting-edge technologies in design, critical habitats and ecosystems are protected from the encroachment of highway infrastructure. Mobility of people and goods is an essential component of the modern world, with its emphasis on globalization and economic opportunity. However, the transportation infrastructure that enhances connectivity among human settlements often results in decreased connectivity among remaining natural habitats and wildlife populations.

This research was carried to investigate the numerous and diverse effects of roads and traffic on plants and animals and to find the mitigation tools for these effects, with most studies focusing at the level of the species groups. The term “road ecology” was first used in German in 1981 Ellenberg et al., and was later translated into English by Forman et al. (2003) for their book *Road Ecology Science and Solutions*). Since the mid 1990s, there has been a rapid increase in the number of studies, publications, and symposia, particularly from Europe, North America, and Australia. These include major national and international reports and best-practice guidelines, regular dedicated conferences such as the biennial International Conference on Ecology and Transportation .Infra-Eco Network of Europe IENE, and symposia and special issues of peer-reviewed.

This study is to identify the problems and diverse effects of roads construction and traffic on fauna and flora. The emphasis is on achieving the optimum balance of species and preserving self-sustaining functioning landscapes, while meeting safety requirements and operational capabilities. Evaluation in this category will take into account variations in the range of opportunities and possible tools inherent to the particular project’s context. Although road influences on landscapes extend much further than their physical boundaries. For instance, in some urban areas, it could be possible only to plant street trees. Other settings might allow preservation, extension, or new establishment of a more complete and self-sustaining community of over story,

understory, shrub, and forest floor. International Society of Arboriculture Mitigation Recommendations_on Tree Ordinance Guidelines for a good discussion of preservation and mitigation. The highway construction sector has recently begun to acknowledge their responsibilities towards the environment, resulting in how roads are designed, constructed and operated to make significant change to mitigate their environmental impacts. This shift in attitude has created environmentally sound for ecology and ecosystem protection and preservation on roadway.

1.3 Problem statement

The construction of roads has been inhibiting the movement of animals a crossing the landscape and highway corridors during seasonal migration, access to food on other sides of road and to establish new territories. The tress and vegetations are also affecting by the roadway activities during the preparation of the surface area of the road by cutting and demolishing. Therefore, the study of these impacts must be under taken in order to find ways to mitigate and compensate the loss during the road construction.

In previous the road construction industry was not taking into account the impact of the road construction to the ecology and ecosystem as the environment effect. Nowadays the sustainability has been the global issue, because human needs a better quality of life today and in the same time without compromising the ability of quality of life for future generations to meet their needs.

To achieve the sustainability objectives there was the need for sustainable engineering projects such as green roads construction in which occur a consideration of ecology and ecosystem. In Malaysia the Green highways are relatively new concept although the implementation for techniques involved in green highways design has been encouraged for many years. Malaysia has no green highway index, but there many efforts done by Malaysia Highway Authority to establish Green

Highway index, so this study is one of that efforts to establish the criteria of green highways for ecology ecosystem.

1.4 Aim of Study

The aim of this research was to investigate problems related to ecology and ecosystem for road way and to provide suggestions to mitigate the impact of roadway to the ecological and ecosystem components, in order to establish ways and tools for minimizing and mitigating for the preservation and restoration purposes

1.5 Objectives of Study

The study is intended to achieve the following objectives:

- 1) To identify the problems related to the ecology and ecosystem for road way.
- 2) To identify the ways to mitigate and minimize the problems related to ecology and ecosystem for the road way.
- 3) To identify the criteria and sub criteria of green road in terms of ecological & ecosystem

1.6 Scope of Study

The construction of roads has not been taken as significant in the construction industry research; despite the role it has play in the economy and development of nations. This research was focused on roadway construction and its impact to the ecology and ecosystem. The research was limited to the study of the effect on flora and fauna through the green roads in order to evaluate the and affects of the roadway on animals, trees and vegetation.

1.7 Brief Research Methodology

1.7.1 First stage: Identification of problems and scope of study

The first stage involved further understanding of research topic; consist of problem statement, aim and objectives, as well as scope and limitations of study. Literature reviews are done on previous studies, journals, statistics, books, Malaysian enacted acts, safety manuals, and newspaper.

1.7.2 Second stage: Data collections

Information and data is collected using the following methods:

- 1) Documents study from collected resources.
- 2) Interviews will be held with safety experts in order to review collected data from document study and to consult in improving questionnaires. Besides that, the views of expert panels regarding the help in to conclude the result of the study.
- 3) Questionnaires will be distributed to Class A contractor regarding the level and cost of compliance with safety and health requirements in construction site

1.7.3 Third stage: Results and data analysis

The results obtained will be presented and the frequency analysis method will be used to obtain level of compliance towards safety and health requirements.

1.8 Arrangement of Report

The arrangement of the report is the important mechanism to ensure that the data obtained from survey is represent in the systematic manner. Besides that, the arrangement of report is very important to give more understanding to the reader about the aims and objective these researches were conducted. The arrangement of report will be discussed as below.

- 1) The first chapter in this study will include the Introduction, Problem Statement, The Aim and Objectives of Study, the Scope and the Research Methodology.
- 2) The second chapter is on Literature Review: focused on the issues that are affecting road ecology and ecosystem .This literature review must relate to the aim and objectives of research in order to give more understanding to the issues and problem occurs.
- 3) The third chapter in the Research would be focused on Methodology of research whereby should discussed detailed about the method that will be used to conducted the research.
- 4) The fourth Chapter should discuss the Data analysis and Result from the questionnaire.
- 5) The Five Chapter is about the conclusion and recommendation of the study.

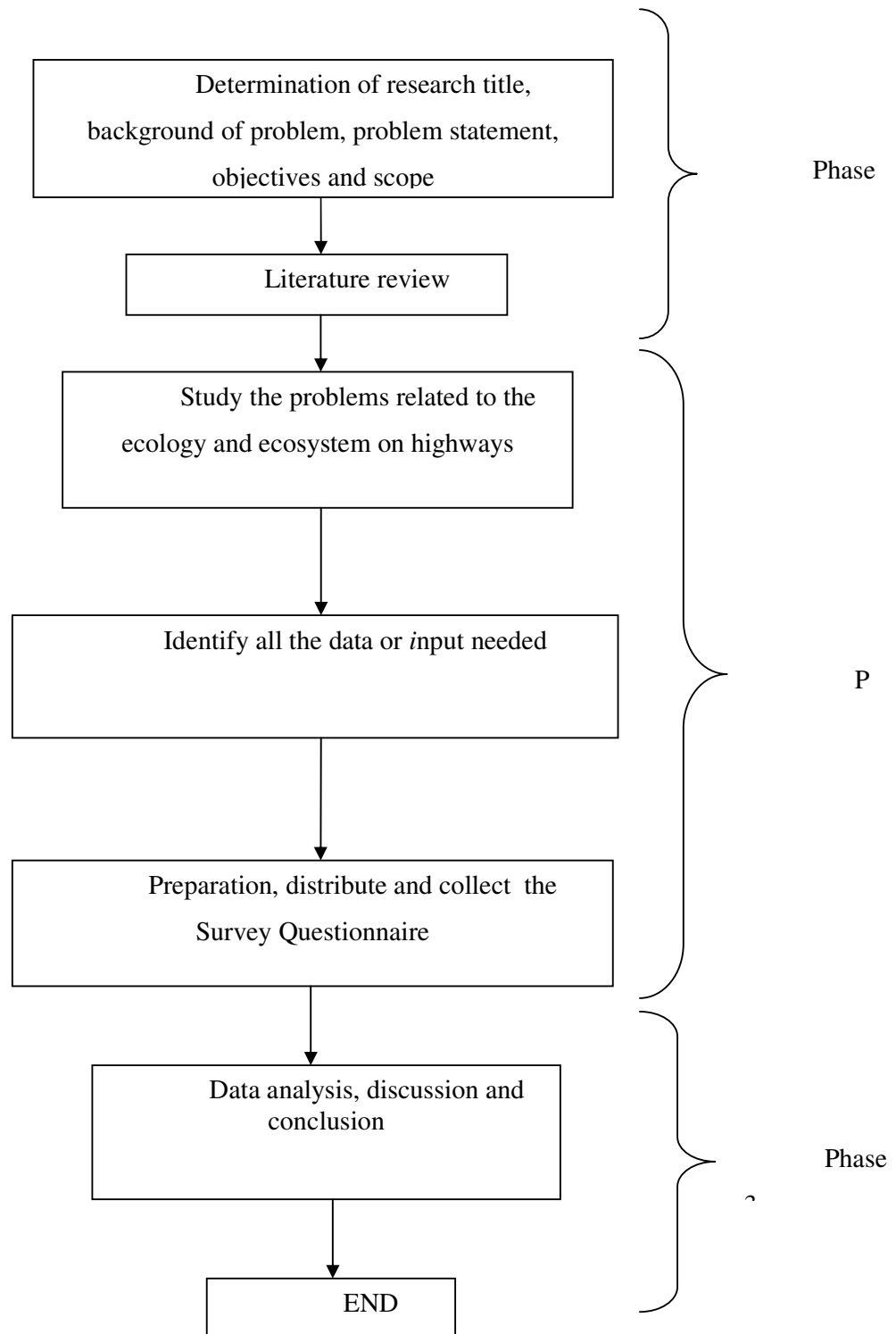


Figure 1.1: Flowchart Diagram of the Study Methodology

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