DEVELOPMENT OF WEIGHTAGE FACTOR ON ECONOMIC CRITERIA AND SUB CRITERIA FOR GREEN RURAL ROAD

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A project report submitted in partial fulfilment of the
Requirements for the award of the degree of
Master of Engineering (Construction Management)

School of Civil Engineering
Faculty of Engineering
Universiti Teknologi Malaysia

JANUARY 2020

DEDICATION

This project report is dedicated to Dr. Eeydzah Aminudin and Assoc. Prof. Dr. Rozana Zakaria, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my family, who taught me that even the largest task can be accomplished if it is done one step at a time. Thank you.

ACKNOWLEDGEMENT

In preparing this thesis; Thank you for the Lord's grace in helping me to complete this continuous nerve- racking study.

Thank you for dear husband, my sons and daughters for all the contribution tangible or non-tangible. I appreciate you all very much.

To my supervisor Dr. Eeydzah Aminudin. I wish to express my sincere appreciation for always have time for appointment, guidance, critics, suggestions, knowledge, continuous encouragement, moral support and friendship while completing this study. I am also very thankful to Associate Professor Dr Rozana Zakaria for their guidance, advices and motivation. I am also very thankful to Dr. Nur Izieadiana Abidin for contribution and guidance in SPSS Analysis. This thesis would not have been the same as presented here without their continued support and interest.

Finally, I would like to convey my appreciation towards all of the focus group as my respondents who had contributed their time and ideas while answering the survey and also for those who have involved whether directly or indirectly.

Sincerely, thank you.

ABSTRACT

Green Rural Road (GRR) is important for daily routine infrastructure which is the main economic access towards the development of economic growth especially in the agricultural, estates, manufacturing, tourism and industrial services which provide easier mobility alternative roads to existing roads in connecting the remote settlements within the nearest town. Currently, numbers of green rating systems apply but rarely indicates the needs of green rating tools for rural roads. Hence, the study aim is determining the most critical economic criteria and sub criteria for GRR. There are three (3) objectives has been inline which consists of the investigating the critical economic criteria and sub criteria for GRR, determine the potential of succeeding in economic criteria and sub criteria that suitable for GRR and to develop the Weightage Factor based on economic criteria and sub criteria for GRR. From the early benchmarks it shows that the Value Engineering; Risk; Cost Benefit and Financing are the main component to access the GRR approach that drives towards the success of the implementation. Towards the end, the development of Weightage Factor based on economic criteria and sub-criteria for GRR were determined. Qualitative and quantitative method has been used for the study. 100 questionnaires have been distributed and 73 respondents had given the feedback. In the early screening session, five (5) sub criteria in economic criteria which are the Economic Evaluation, Economic Method of Construction, Improve Economic Access, Socio-Economic and Social Carbon Cost Saving. Factor Score for Weightage Factor shows that sub criteria in Social Carbon Cost Saving is 28%, Economic Method of Construction is 28%, Improve Economic Access is 18%, Economic Evaluation is 16% and Socio Economic is 10%. Hence it can be concluded that the Social Carbon Cost Saving and Economic Method of Construction are the main domain that effect economic criteria of GRR; Parallel to Sustainable Development Goals No. 9 initiatives indicates that infrastructure able to drive the stability, uplifting and promoting operational excellence which can enhance the economic expansion responsibility.

ABSTRAK

Jalan Luar Bandar Hijau (JLBH) adalah akses penting untuk infrastruktur rutin harian yang merupakan kejayaan ekonomi utama ke arah pembangunan dalam pertumbuhan ekonomi terutama didalam bidang pertanian, estet, pembuatan, pelancongan dan perkhidmatan perindustrian yang menyediakan laluan alternatif mobiliti yang lebih mudah kepada jalan sedia ada dalam menghubungkan penyelesaian jauh dengan bandar terdekat. Sekarang, nombor sistem penarafan hijau memohon tetapi jarang sekali menunjukkan keperluan alat-alat penarafan yang hijau bagi jalan luar bandar. Maka, tujuan kajian menentukan kriteria ekonomi yang paling kritikal dan kriteria bawah untuk JLBH. Terdapat tiga (3) objektif telah digariskan yang terdiri daripada menyiasat kriteria ekonomi kritikal dan sub kriteria bawah untuk JLBH, menentukan potensi kejayaan dalam kriteria ekonomi dan sub kriteria yang sesuai untuk JLBH dan membangunkan Faktor Terberat berdasarkan pada kriteria ekonomi dan sub kriteria bawah untuk JLBH. Dari penanda aras awal ia menunjukkan bahawa Nilai Kejuruteraan; Risiko; Kos Faedah dan Kewangan ialah pendekata komponen utama untuk akses JLBH bagi memandu ke arah kejayaan pelaksanaan. Akhirnya, pembangunan Faktor Terberat berdasarkan kriteria ekonomi dan sub kriteria untuk JLBH telah ditentukan. Kaedah kualitatif dan kuantitatif telah digunakan untuk kajian ini. 100 soal selidik telah diagihkan dan 73 orang responden telah memberi maklum balas. Dalam sesi pemeriksaan awal, lima (5) sub kriteria dalam Kriteria Ekonomi di mana ialah Penilaian Ekonomi, Kaedah Ekonomi bagi Pembinaan, Penambaikkan Ekonimi Akses, Sosio-Ekonomi and Kos Simpanan Karbon Sosial. Faktor Skor untuk Facktor Terberat menunjukkan sub kriteria itu dalam Kos Simpanan Karbon Sosial ialah 28%, Kaedah Ekonomi bagi Pembinaan ialah 28%, Penambaikkan Ekonimi Akses ialah 18%, Penilaian Ekonomi ialah 16% dan Sosio Ekonomi ialah 10%. Maka ia boleh disimpulkan bahawa Kos Simpanan Karbon Sosial and Kaedah Ekonomi bagi Pembinaan ialah penguasaan utama iaitu kesan kriteria ekonomi bagi JLBH; Selari dengan Matlamat Pembangunan Lestari No. 9 inisiatif menunjukkan bahawa infrastruktur mampu memandu kestabilan, menaikkan dan mempromosi kecemerlangan operasi yang boleh meningkatkan tanggungjawab perkembangan ekonomi.

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LIST OF ABBREVIATIONS

P.W.D	-	Public of Department
J.K.R	-	Jabatan Kerja Raya
SPSS	-	Statistical Package for Social Sciences
SDGs	-	Sustainable development Goals

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Infrastructure is very important for faster in economic growth a lessening of poverty in every country all over the world including Malaysia. The sustainability road infrastructure development especially in road construction needs to plan and to be considered in depth in the context of sustainability and green in the performance. The growing of Rural Road infrastructure development will increase the construction of road infrastructure and increases the uses of the route in rural area and all at once will lead to increase in carbon emissions. The emission of greenhouse gases (GHGs) and other pollutants should be minimized by efficiently using energy and resources (Baek J. K., 2015). Green infrastructure is a strategically planned and delivered network comprising the broadest range of high quality green spaces and other environmental features. Green Road and Green Rural Road project is very important to make sure can achieve the green performance by green assessment to align by the sustainable infrastructure development as SDGs goals; Established by United Nation on September 2015.

Economic is the most critical criteria need to look forward in earlier stage as design stage in the phase of project lifecycle in Green Road and also in Green Rural Road project which is green initiative should be taken for better align sustainability efforts with long term needs. The cost to construct of Green Road and Green Rural Road is expensive and need to consider in the valuation of the project estimation. Valuation is how to estimate the worth of something, be it a product, service, or attribute of something. In welfare or wellbeing economics, the valuation means more than just monetary valuation. Value Engineering is important to evaluate. The Value Engineering should be evaluating to know the risk; cost benefit must have the analysis

in Cost Benefit Analysis (CBA), Life Cycle Cost Analysis (LCCA), and others by the earliest stage as design phase of the proposed project. Economic Analysis such as ROI, LCC and the profit must take into account because the green road and also Green Rural Road is quite expensive to develop compare to ordinary or normal road. Economic valuation is a way to understand how much something is worth to particular people or to society or road infrastructure development like green road or green rural road project as a whole. It is important to decide whether to proceed as normal road or green road project. Economic valuation is one way to, at least partially, redress this imbalance. The best practice should be to use all sorts of high quality evidence to support better decisions and including different interpretations of 'value' of resources and our choices.

Green Rating Tools is the most important for sustainable assessment to measure the potential improvement sustainable of the road infrastructure especially in rural road construction. Green Rating Tools for road infrastructure development were developed to monitor the projects under each of the classes of construction across the world in order to fulfil the Sustainability Goals and plan action produced especially for people, planet and prosperity; Decided to be fully implemented by 2030 as well as to encourage more sustainable infrastructure project and to assure economic, environment and social balance. There were many Green Road Rating Tools for road infrastructure was introduced across the world and the rating system has been widely developed by many organizations around the world and successful in practice. This system is developed in line with statutory guidelines, rules and requirements that the sustainable elements in the development of infrastructure including road infrastructure can be measure. There is several green road rating systems have been developed and implemented the green practices in the road construction in United State (U.S). The categories, indicators and credit were evolved by reviewing the categories and credit utilized in current green road rating structures in U.S together with Green-guide, STARS, BE2ST, GreenRoads, GreenLITES, GreenPave, I-LAST, Envision, CEEQUAL and INVEST. So the present green rating tools need to improvise to adopt a sustainable approach in developing infrastructure in rural areas that can be utilized to achieve sustainable road rural road construction. Many tools related to sustainable infrastructure development are still in the conceptual or development phase [United Nations ESCAP. 2006, S. Sarsam, 2015]. Sustainability tools in Malaysia making

CEEQUAL as fundamental to develop Malaysian Sustainable Infrastructure Rating Tool (CIDB, 2017).

In Malaysia, Public work of Department (PWD) and Malaysian Highway Authorities (MHA) is a Statutory Body under Work of Ministry was authorized the Government for the road system. The road network infrastructures in Malaysia by Public work of Department (PWD) are classified into two broad categories, namely Federal Roads and State Roads. State Roads generally comprise of the primary roads; namely as Normal Road divided in two categories that consist of Urban Road and Rural Road. Rural Road is under the minor road category. Normally, Rural Road is the last link of the transport network; however, it is often form the most important connection in terms of providing access for the rural area population. All these road categories need to have green rating tools to measure the sustainable and to achieve the green road status. Green infrastructure can be defined as "…as planned and managed natural and semi natural system that provides products and services with environmental, social, economic and or health benefits" (Thomé et al., 2016). Hence, there is the need the assessment in establishing the green rural road tools in order to fulfil the green rural road performance in economic criteria and sub criteria since design stage.

1.2 Problem Statement

Rural roads are the backbone of the transportation system in rural areas and the last link of the transport network, however, it is often form the most important connection to provide access for the rural population. Rural roads are associated with several environmental impacts. The approach of constructing rural roads shall consider the environment and rural poverty alleviation measures to approach of green road is to provide to be a sustainable. There are various terms and definition of Rural Road for every country. The most of the rural road definition toward on the minor road, that providing access for rural habitations facility centres. Some are for to provide direct access for the rural villages and rural area communities to economic and social services, also known as track that is used for minor public roads and other country had

define the rural road which the road is located in forested and rangeland settings that serve residential, recreational and resource management uses and some country define rural road as road that providing access for multiple uses in non-urban, resource production and wild lands. Green Rural Road shall develop to meet the similar characteristic as Green Road projects and had been designed and implemented to a higher level of sustainability and green practice than ordinary road projects. The sustainability features in green roads mainly include economic, social and environmental sustainability and also include the quality, pavement technology and innovation.

There were many Green Road Rating Tools for road infrastructure was developed across the world but not for Green Rural Road. A green rating system offers hints that help green practices and technology in road construction and therefore reduces the road's environmental effect whilst improving its associated social and financial benefits. Several public agencies in the United States (US) have developed and implemented green road rating systems but not suitable with the Malaysia road condition, local geographic and social environment. Malaysia has developed a few sustainability tools as an assessment system that used to ensure the establishment of sustainability indicator to lead the better performance through several parties but not suitable in Green Rural Road assessment. Thus, *Penarafan Hijau JKR* Manual is pHJKR are not directly suitable to implement for assessment in Green Rural Road project because only focus on maintenance and operation phase of green road project lifecycle. In pHJKR; There is no directly one major economic criteria and sub-criteria to evaluate the green road performance which is some criteria may be similar but different in element features in green road rating tools but the Economic Evaluation is most of the important criteria. It's also does not inclusive a Green Rural Road assessment for sustainable performance for minor road in rural area. Meanwhile; Green Highway Index is MyGHI sprightly focus on Highway only not relates with road in rural area. So that; Malaysia cannot use pHJKR and MyGHI as Green Road Rating Tools to measure the performance of Green Rural Road as green assessment to determine the level rating of the sustainability or sustainability features. Somehow, if there are have the same factor or criteria out of Malaysia in Green Road Rating Tools, but it is may not important to the Malaysian local situation such as Malaysian climate, geography and social environment and local road condition.

Economic aspect is always related with the cost, financing and the risk of the project development. Economic assessment is very important in earlier stage of project life phase; as earlier as design stage because it is quite expensive to construct compare to ordinary road. Cost engineering is the engineering practice allocate to the project cost management and also emphasis on economics and analysis. It is involving such activities as estimating, cost control, cost forecasting, investment appraisal and risk analysis. The Cost Engineering focus on the budget, plan and monitor investment projects and will look for the optimum balance between cost, quality and time requirements. The Economic Valuation and the estimates of the economic valuation is the most economical to value from earlier stage which is the valuation is based on the concept of Total Economic Value. Basic premise of economics and the valuation takes place for a marginal change in the deterioration or improvement of the decision making in preceding the Green Rural Road project development by the owner, stakeholder, developer or any parties. Although the economic valuation is not establish in any green road rating tools, but the economic approach had been specify in several philosophy such as the PMBOK US;PMI Standard, 2003, Guidelines for Economic Analysis project Asian Development Bank, (ADB,2017),Handbook on Green Infrastructure and some of the literature study in Cost Benefit Analysis(CBA) and Life Cycle Cost Analysis (LCCA) that can be quantify economic criteria and sub-criteria for the green assessment toward of sustainability.

Economic criteria and sub criteria for Green Rural Road assessment are the most critical to investigated by comparing the existing Green Road Rating Tools, several guideline and other literature contents. Then; determine the potential of succeeding in economic criteria and sub-criteria that suitable for Green Rural Road. Hence; Weightage Factor based on economic criteria and sub-criteria shall be develop to know which economic criteria and sub-criteria may dominant in the percentage chart. Therefore; Development of Weightage Factor on economic criteria and sub criteria for Green Rural Road will be study in measuring the green performance assessment in Green Rural Road.

1.3 Aim and Objectives

The aim of this study is to determine the most critical economic criteria and sub criteria for Green Rural Road. Hence, to achieve this aim, the objectives listed are:

(a) To investigate the critical of economic criteria and sub-criteria for Green Rural Road.

(b) To determine the potential of succeeding in economic criteria and sub-criteria that suitable for Green Rural Road.

(c) To develop the Weightage Factor based on economic criteria and sub-criteria for Green Rural Road.

1.4 Scope of Study

This study is on the investigation of critical economic criteria and sub criteria in existing of Green Road Rating Tools, other Green Infrastructure Philosophy or benchmarks such as PMBOK US;PMI Standard, 2003, Guidelines for Economic Analysis Project Asian Development Bank, (ADB,2017),Sustainable Framework , Guideline and also Handbook in Economic Valuation and the literature review on economic criteria and sub criteria in Green Roads that possible to applicable in Green Rural Road. This study focuses for the rural road which is to scope for the state road in the rural area only. The literature if more focus in economic valuation and survey is to focus group by expert. The study is focus for Malaysia Rural Road. The novelty is shows in Figure 1.1 and figure 1.2 below.

Therefore, the research outcomes are expected the most critical economic criteria and sub criteria to be applicable in Green Rural Road to assess the green performance. The results will contribute to an increase of understanding of weightage of Green Rural Roads and will be useful to improve the performance of green rural road projects on the sustainability features.

1.5 Significant of Study

The findings of this study will contribute the benefit of the Green Rural Road infrastructure development considering the concept of sustainability in construction of Rural Road. It is important and need to investigate the critical economic criteria and sub criteria and should and determines the potential of succeeding in economic criteria and sub-criteria that suitable for the applicable for Green Rural Road. There were many green rating tools for road infrastructure had been developed but no specify the economic criteria as main criteria to evaluate the green road performance which is some criteria may be similar but different in element features in green road rating tools but the Economic Evaluation and Value Engineering is most of the important in economic criteria as the condition to assess the green performance. This study will be able to provide an overview on the how Malaysian sustainability should developed the Weightage Factor on economic criteria and sub criteria for Green Rural Road.

There is no Green Rating Tools for Rural Road in Malaysia, lack of specific economic criteria and sub criteria was established in existing Green Infrastructure Rating Tools and it's not suitable with local rural road. Economic Valuation and Value Engineering is very important to evaluate from earlier stage as design stage. Although Economic Valuation and Value Engineering not specify as main specific criteria in any green Road rating tools but it was established in other benchmarks and Guideline of infrastructure development such as in Guide to the Project Management Body of Knowledge; PMBOK US ;PMI Standard, 2003, Guidelines for Economic Analysis project Asian Development Bank, 2017), International Institute For Sustainable Development (IISD,2017); Sustainable Asset Valuation Tool: Roads and others literature reviews.

Green Rural Road Tools in some countries include together in their Green Road Rating Tools not relevant and not suitable with our Malaysia local geographical, local road condition and environment and also different meaning of definition and different focused area for Rural Road in every different country. Somehow, if there has the same factor or criteria out of Malaysia but it is may not important to the Malaysian local situation such as Malaysian climate, geography and social environment. Therefore; as such a thorough study was conducted to fill three gaps in previous research and

literature review on economic criteria and sub-criteria for Green Rural Road project by a development of weightage factor on economic criteria for Green Rural Road.

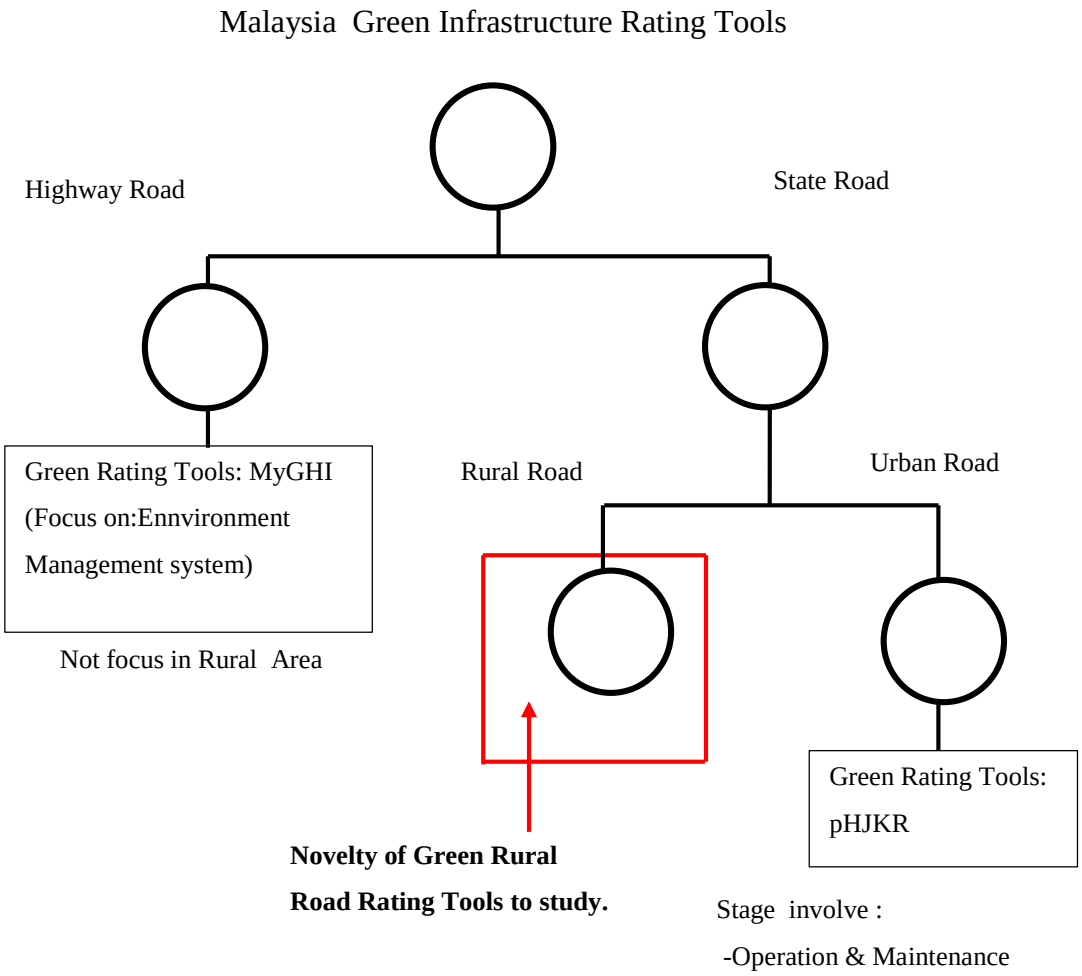

Figure 1.1: Sustainable Green Element by Role of Public Work Of Department of Malaysia

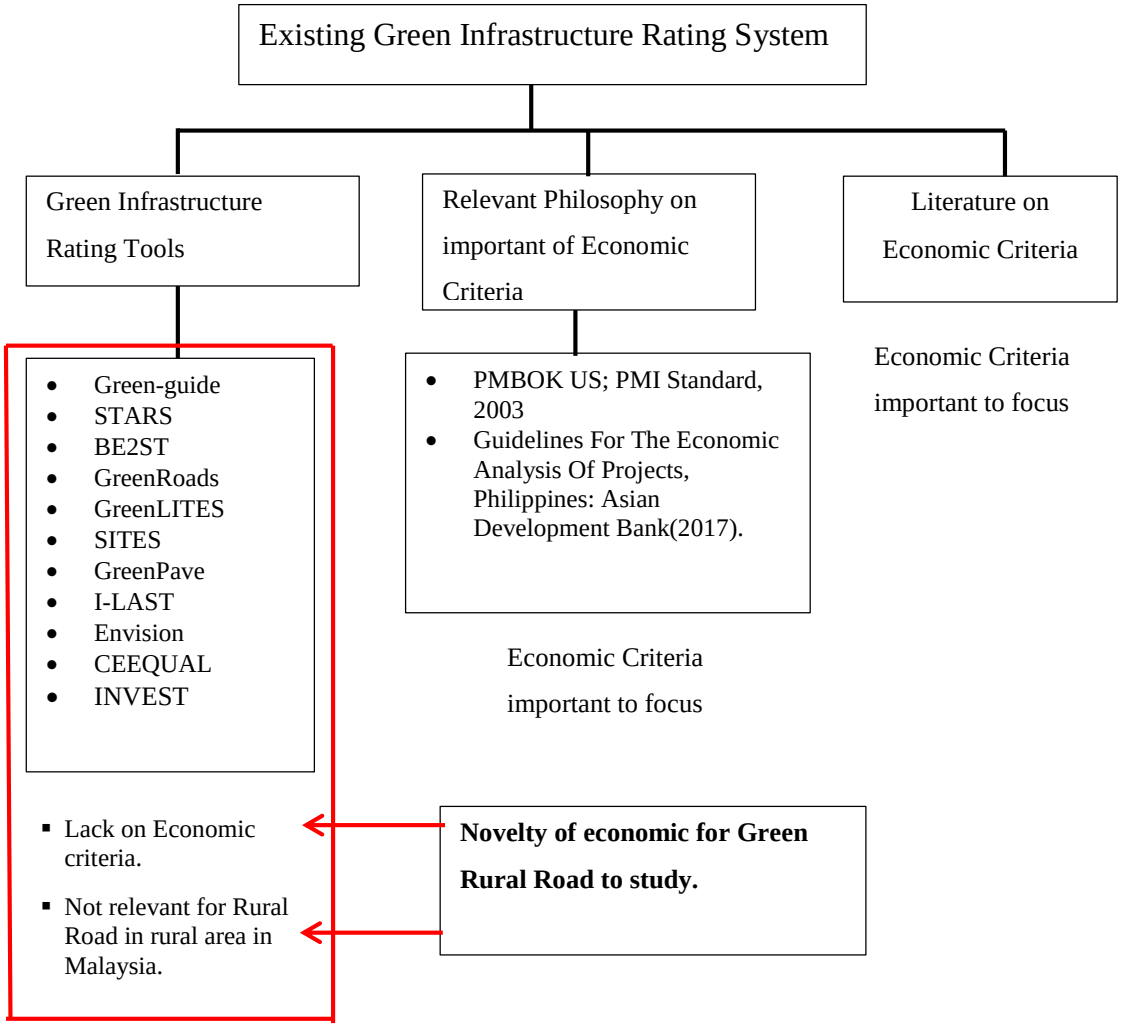

Figure 1.2 Existing Infrastructure Rating System

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