



UNIVERSITI PUTRA MALAYSIA

***ECONOMIC VALUE OF BIODIVERSITY CONSERVATION PERCEIVED
BY LOCAL VISITORS IN FRIM SELANGOR FOREST PARK***

MUKRIMAH ABDULLAH

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By

MUKRIMAH ABDULLAH

**Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfillment of the Requirements for the Degree of Master of Science**

September 2017

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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September 2017

Chairman : Associate Professor Mohd Rusli Yacob, PhD
Faculty : Environmental Studies

Biodiversity is the variability among living organism from all sources includes terrestrial, marine, and other ecosystems and the ecological complexes of which they are parts. Conservation of biodiversity is one of the efforts to ensure sustainability of biodiversity which often under-valued and ignored especially in decision making process. One of the principles of Malaysia's NPBD (1998) stated that biodiversity is a national heritage and it must be sustainably managed and wisely utilized today and conserved for future generation. In order to manage and conserve biodiversity, information about the economic value of biodiversity conservation must be obtained. Environmental valuation technique can provide useful evidence to support such policies by quantifying the economic value associated with the protection of biological resources. This valuation will give the monetary value to FRIM's biodiversity and will make a contribution in order to obtain the status as a world heritage site by UNESCO, expected to achieve in 2019/2020. Therefore, this study was conducted to estimate the economic value of biodiversity conservation at FRIM Selangor Forest Park (FRIM). FRIM offers a variety of forest ecosystem services such as biodiversity conservation, recreation, ecotourism and nature-environmental education.

The data for this study was obtained by using face-to-face interview with guided questionnaire and survey toolkits. A total of 433 respondents were successfully interview in four month from September to December 2014, where most of them are the first time visitors. This study employed the Choice Modelling (CM) and Contingent Valuation Method (CVM) approaches to estimates the economic value of conserving biodiversity and to evaluate their preferences towards the biodiversity conservation attributes. For CM, a hypothetical scenario was created by combining four attributes (excluding price) at few different levels. Information on the level for each attributes can be from any related sources such as annual reports, and expertise

judgement. In this study, the selected attributes were wildlife protection, carbon sequestration, recreation and nature education where, each attributes may consist of one to three levels depending on the attributes. The level can be the improvement from the current condition, or to the other management options. In this study, baseline information for levels was taken from FRIM's Annual Report, Books published by FRIM, and data published by FRIM's researchers.

The CM findings showed that visitors are willing to pay for an improvement from the status quo to better levels. The variable WLIFE2, CARBON2, CARBON3 and RECR3 were statistically significant at one percent level while RECR2, EDU2 and EDU3 were statistically significant at five percent level. Price has negative sign which is in line with the theoretical expectation; this indicates that as the conservation fee increases, respondents are less likely to contribute because of the decrease in the utility level. The CM results found that on average, the marginal values are between RM3.11 to RM9.44 per entrance for the presence of the attributes (carbon, wildlife protection, recreation and education) and all attributes are highly favored compared to the status quo (baseline) and statistically significant below five percent. This finding shows visitor were willing to pay for the improvement at minimum RM3.11 and maximum at RM9.44 per entrance for conserving biodiversity specifically at FRIM which could contribute extra revenue between RM 1.4 million to RM 4.2 million annually (by taking into account 455,014 visitors on average visitors from 2007 to 2016).

For CVM results, frequency analysis shows the level of willingness to pay (WTP) for biodiversity conservation fund was between RM1.00 to RM30.00 per entrance with the mean WTP of RM5.67 per entrance. The Pearson Correlation analysis shows that the respondents' maximum willingness-to-pay and the bid price posted is significant at 1% level. Few variables were included into three models and found that the highest estimated mean WTP was RM8.12 per entrance compared to another two models with WTP for logistic and OLS are RM7.90 and RM5.70. The yearly calculated conservation value or benefits of FRIM's biodiversity conservation based on the highest mean willingness to pay computed for the year 2007 until 2016 ranged from RM 1.5 million to RM 8.1 million with average of RM 3.5 million. Estimated benefits of conserving biodiversity for the past 10 years increase almost 228% or 2.2 times in year 2016. If there is a proposal to charge (e.g. in the form of tax) to contribute to biodiversity conservation fund, the amount found in this study was RM8.12 per entrance. This value can be used by the authorities to determine the fees conservation / appropriate conservation. It is noted that visitors were only willing to pay for the improvement of biodiversity attributes and its conservation only. That means the conservation fee collected must be used for the conservation of biodiversity at FRIM only.

The results suggested from the visitor's interest to contribute in conserving biodiversity at FRIM, it also indicates that more concerted effort is needed by management to conserve and protect FRIM. The findings of this study provides useful evidence to support and helps the formulation of policies that protect biodiversity by

quantifying the economic value associated with the protection of biological resources; help the management or stakeholders (government or private sectors) to improve in sustainable forest management and assist the conservation of biodiversity for the benefits of present and future generations and lastly contribute in realizing FRIM's aspiration to become a World Heritage site by United Nations Educational, Scientific and Cultural Organization (UNESCO) by 2019/2020.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENILAIAN EKONOMI PEMULIHARAAN BIODIVERSITI BAGI
PENGUNJUNG TEMPATAN TAPAK WARISAN KEBANGSAAN, FRIM
SELANGOR FOREST PARK (FRIM)**

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Biodiversiti adalah kepelbagaian antara organisma hidup daripada semua sumber termasuk daratan, marin, dan ekosistem lain dan kompleks ekologi. Pemuliharaan biodiversiti adalah salah satu usaha untuk memastikan kelestarian biodiversiti yang sering diberikan nilai yang rendah dan diabaikan terutamanya dalam proses membuat keputusan. Salah satu prinsip NPBD Malaysia (1998) menyatakan bahawa biodiversiti adalah satu warisan negara dan ia perlu diurus secara mampan dan digunakan dengan bijak hari ini dan dipelihara untuk generasi akan datang. Untuk mengurus dan memulihara kepelbagaian biologi, maklumat tentang nilai ekonomi pemuliharaan biodiversiti mesti diperolehi. Teknik penilaian alam sekitar dapat memberikan bukti berguna untuk menyokong dasar tersebut dengan mengkuantifikasi nilai ekonomi yang berkaitan dengan perlindungan sumber biologi. Penilaian ini akan memberi nilai kewangan kepada kepelbagaian biologi FRIM dan akan memberi sumbangan untuk mendapatkan status sebagai tapak warisan dunia oleh UNESCO, yang dijangka dapat dicapai pada 2019/2020. Oleh itu, kajian ini dijalankan untuk menganggarkan nilai ekonomi pemuliharaan biodiversity di Institut Penyelidikan Perhutanan Malaysia (FRIM). FRIM menawarkan pelbagai perkhidmatan ekosistem hutan seperti pemuliharaan biodiversiti, rekreasi, eko-pelancongan dan pendidikan alam-alam sekitar.

Data kajian ini diperolehi menggunakan teknik temubual *face-to-face* dengan berpanduan borang soal selidik. Seramai 433 responden telah temubual dalam empat bulan dari bulan September hingga Disember 2014, di mana kebanyakan daripada mereka adalah pelawat kali pertama. Kajian ini menggunakan teknik *Choice Modelling* (CM) dan *Contingent Valuation Method* (CVM) bagi menganggar anggaran nilai ekonomi pemuliharaan biodiversiti dan untuk menilai keutamaan

mereka terhadap atribut pemuliharaan biodiversiti. Bagi kajian CE, satu senario hipotetikal telah direka dengan menggabungkan empat atribut (tidak termasuk harga) pada beberapa tahap yang berbeza. Sifat-sifat yang terpilih adalah perlindungan hidupan liar, penyerapan karbon, rekreasi dan pendidikan alam. Maklumat mengenai tahap untuk setiap atribut boleh diperolehi dari mana-mana sumber seperti laporan tahunan, dan penilaian dari pakar. Dalam kajian ini, atribut yang dipilih adalah perlindungan hidupan liar, penyerapan karbon, pendidikan dan pendidikan alam semula jadi di mana setiap sifat boleh terdiri dari satu hingga tiga tahap. Tahap boleh menjadi peningkatan dari keadaan semasa atau kepada pilihan pengurusan yang lain. Dalam kajian ini, maklumat asas untuk tahap diambil dari Laporan Tahunan FRIM, Buku yang diterbitkan oleh FRIM, dan data yang diterbitkan oleh penyelidik FRIM.

Dapatan kajian menunjukkan bahawa responden sanggup membayar untuk satu peningkatan daripada status quo ke tahap yang lebih baik. Pembolehubah WLIFE2, CARBON2, CARBON3 dan RECR3 adalah signifikan secara statistik pada tahap satu peratus manakala RECR2, EDU2 dan EDU3 secara statistik signifikan pada tahap lima peratus. Harga (Price) mempunyai tanda negatif yang selaras dengan jangkaan teori; ini menunjukkan bahawa semakin tinggi kenaikan yuran pemuliharaan, responden kurang berkemungkinan untuk menyumbang kerana terdapatnya penurunan tahap utiliti. Keputusan CM mendapati bahawa secara purata, nilai marginal antara RM3.11 hingga RM9.44 sekali masuk untuk kehadiran atribut (karbon, perlindungan hidupan liar, rekreasi dan pendidikan) dan semua atribut dipilih berbanding dengan status quo dan secara statistiknya di bawah lima peratus. Penemuan ini menunjukkan pelawat sanggup menyumbang peningkatan minimum RM3.11 dan maksimum RM9.44 setiap kemasukan untuk memulihara kepelbagaian biologi khususnya di FRIM yang boleh menyumbang hasil tambahan antara RM 1.4 juta hingga RM 4.2 juta setahun (dengan mengambil kira 455,014 pengunjung pada purata pelawat dari tahun 2007 hingga 2016).

Untuk hasil CVM, analisis frekuensi menunjukkan tahap kesanggupan untuk membayar (WTP) dana pemuliharaan biodiversiti adalah di antara RM1.00 hingga RM30.00 setiap kemasukan dengan min WTP RM5.67 setiap kemasukan. Analisis korelasi Pearson menunjukkan bahawa kesediaan-untuk-bayar maksimum responden dan tawaran harga yang dipaparkan adalah signifikan pada aras 1%. Beberapa pembolehubah diambilkira ke dalam beberapa model dan mendapati bahawa anggaran min WTP tertinggi adalah RM8.12. Manfaat anggaran pemuliharaan biodiversiti FRIM telah dikira berdasarkan pengagregatan pada min WTP tertinggi dan bilangan ketibaan pelawat. Manfaat anggaran pemuliharaan biodiversiti dianggarkan sejumlah RM 1.5 juta sehingga RM 8.1 juta sejak 10 tahun lalu meningkat hampir 228% atau 2.2 kali ganda dengan purata RM 3.5 juta setahun. Sekiranya ada cadangan untuk mengenakan bayaran untuk menyumbang kepada dana pemuliharaan biodiversiti, kadar yang diperolehi dalam kajian ini adalah RM8.12 setiap kali kemasukan. Nilai ini boleh digunakan oleh pihak berkuasa untuk menentukan yuran pemuliharaan yang sesuai. Perlu di ambil perhatian bahawa pengunjung hanya bersedia untuk menyumbang kepada peningkatan atribut biodiversiti dan pemuliharaannya sahaja. Ini

bermakna yuran pemuliharaan yang dikutip mesti digunakan untuk pemuliharaan kepelbagaian biologi di FRIM sahaja.

Keputusan menunjukan pengunjung sudi menyumbang dalam memelihara kepelbagaian biologi di FRIM, ia juga menunjukkan bahawa usaha yang lebih bersepadu diperlukan oleh pihak pengurusan untuk memelihara dan melindungi FRIM. Penemuan kajian ini memberikan bukti berguna untuk menyokong dan membantu penggubalan dasar-dasar yang melindungi biodiversiti dengan mengukur nilai ekonomi yang berkaitan dengan perlindungan sumber biologi; membantu pengurusan atau pihak berkepentingan (kerajaan atau sektor swasta) dalam pengurusan hutan lestari dan membantu pemuliharaan kepelbagaian biologi untuk faedah generasi sekarang dan akan datang dan akhirnya menyumbang untuk merealisasikan aspirasi FRIM untuk menjadi tapak Warisan Dunia oleh *United Nations Educational, Scientific and Cultural Organization* (UNESCO) menjelang 2019/2020.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

a.s.l	Above Sea Level
BRAHMS	Botanical Research and Herbarium Management System
BV	Bequest Value
CBD	Convention on Biological Diversity
CE	Choice Experiments
CM	Choice Modeling
CS	Consumer Surplus
CSR	Corporate Social Responsibility
CV	Compensating Variation
CVM	Contingent Valuation method
DEFRA	Department for Environment, Food and Rural Affairs, UK
DUV	Direct Value
EPA	Environmental Protection Agency
ES	Ecosystem Services
EV	Equivalent Variation
EV	Existence Value
FRI	Forest Research Institute (currently FRIM)
FRIM	Forest Research Institute Malaysia
GDP	Gross Domestic Production
GTZ	German Agency for Technical Cooperation
HP	hedonic pricing
IDV	Indirect Value
IUCN	International Union for Conservation of Nature
KBG	<i>Kepong Botanical Garden</i>
MEA	Millennium Ecosystem Assessment
MFRDB	Malaysian Forestry Research and Development Board

MOSTE	Ministry of Science, Technologies and Environment (Currently MOSTI)
MOTAC	Ministry of Tourism and Culture Malaysia
MoTOUR	Ministry of Tourism Malaysia (currently: MOTAC)
NPBD	National Policy Biodiversity on Biological Diversity
NRE	Ministry of Natural Resources and Environment
NTFP	Non-Timber Forest Products
OV	Option Value
PA	protected areas
PES	Payment on the Ecosystem Services
R&D	Research and Development
RMK	Malaysia Plan
RUT	Random Utility Model
SFM	Sustainable Forest Management
SPSS	Statistical Package for the Social Sciences
SYABAS	<i>Syarikat Bekalan Air Selangor</i>
TC	travel cost
TEV	Total Economic Value
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization
WTA	Willingness to Accept
WTP	Willingness to Pay
WWF	World Wildlife Fund

CHAPTER 1

INTRODUCTION

1.1 Background

Convention on Biological Diversity (CBD) defines biodiversity as the variability among living organism from all sources including terrestrial, marine, and other ecosystems and the ecological complexes of which they are parts. Biodiversity includes genetic diversity, species diversity and ecosystem diversity (United Nation, 1992). Biodiversity is the basic support for life on earth, which provides varieties of ecosystem services such as food supply, raw water, and fuel as provision services and water purification, climate regulation as regulating services. It also provides us with supporting services such as soil regulation, watershed and carbon storage, besides social and aesthetic benefits like research and education, recreational, ecotourism, and cultural values. World Development Indicator stated that Malaysia has only 0.2% of the world's land mass, but its rich diversity of flora and fauna species makes it one of the richest countries in the world in terms of biodiversity per unit area. Other than that, Malaysia also had been recognized by Global Diversity Outlook as one of the 12 mega-diversity countries in the world in 2001 (NRE, 2006).

The biodiversity also known as biological diversity contributes benefits to economic well-being of country, food resources, environmental safeguard and national heritage. It is also crucial for human being because it provides us with various indirect goods and services and vast human activities and development may cause biodiversity reduction (Nijkamp *et. al*, 2007). Reduction of biodiversity leads to loss of genetic resources, affects the quality and quantity of water and food resources and soil productivity also decrease. Potentially uncover useful natural resources also might be lost due to decline in biodiversity.

Nowadays, with all the environmental and natural resources issues, government now more concerned in preserving and rehabilltee biodiversity by formulated the first National Policy Biodiversity on Biological Diversity (NPBD) in 1998 (MOSTE, 1998).

Other than that, this policy also formulated to ensure conservation of biodiversity for present and future; to encourage more research and development of new technology, nature education, maximize social benefits, culture and heritages; and lastly to focus on biosafety in biotechnology.

Since the first NPBD, Malaysia has undergone drastic increase of its population and increase standard of living. In 2015, the population increased to 30 million compared in 1998 with the total population of 23 million and gave positive impact to Malaysia's

per capita GDP. The country's transition to become a developed country and high-income nation has pressures on biodiversity. Other pressures that threaten Malaysia's biodiversity include habitat fragmentation, invasive alien species, pollution, poaching, increasing competition for land as well as climate change. Consequently, in 2016 the 2nd NPBD (2016-2025) was formulated to provide the direction and framework to conserve and wise use of Malaysia's biodiversity (NRE, 2016).

There are two (2) categories of conservation practices in Malaysia, which are *In-situ* and *ex-situ* conservation. *In-situ* conservation is maintaining plants and animals in their original habitats and must consider having as each of natural habitats to sustain the populations. The examples of *in-situ* conservation efforts by government is the cluster of protected areas (PAs), which includes national, state and marine parks, wildlife sanctuary and reserve. These PAs not only function to conserve flora and fauna, but it is also as watershed or water catchment areas.

Ex-situ conservation is maintaining species outside of their original habitat. One of the examples are arboretum like fruit trees, commercial timbers, medicinal and ornamental plants; gene banks like seed and in-vitro; zoological gardens; captive breeding center especially for endangered species like sambar deer, seladang, and Sumatran rhinoceros; and rehabilitation center for Orang Utan. The examples of *ex-situ* conservation efforts in Malaysia are botanical garden in Penang and Kepong; Zoo Negara; and Turtle Sanctuary in Rantau Abang.

However, there are still lack of conservation efforts, implement by both federal and state governments. Some of the reasons are important habitats such as wetlands are not represented well. Wetland areas such as mangrove, peat and freshwater swamps serve as habitats for variety kind of unique species of flora and fauna; and also become temporary habitats for migrated birds. Furthermore, due to lack of expertise, a conservation effort is usually focused on big animals such as rhino and elephants, and less focus on small species such as insects and fish. Lastly, biodiversity were always been given less priority when involves the trade-off of land-use. Therefore, these issues must be given attention and highlighted in order to realizing the conservation efforts of government.

1.2 Problem statement and significant of research

One of the principles of Malaysia's NPBD (1998) stated that biodiversity is a national heritage and it must be sustainably managed and wisely utilized today and conserved for future generation. In order to manage and conserve biodiversity, information about the economic value of biodiversity conservation must be obtained. Christie (2006) stated that environmental valuation technique can provide useful evidence to support such policies by quantifying the economic value associated with the protection of biological resources. FRIM has obtained the status of National Heritage site in 2009, and become sources of knowledge and assets to Malaysia. This valuation will give the monetary value to FRIM's biodiversity and help to maintain this status. Moreover,

the FRIM biodiversity information also will make a contribution in order to obtain the status as a world heritage site by UNESCO, expected to achieve in 2019/2020.

In order to ensure the sustainability of biological diversity is by conserving, preserving and managing it well. Hence, the rate of biodiversity rate will decrease. Biodiversity is one of the crucial elements in ecosystem services other than carbon sequestration, and watershed protection. This component is always been under-valued and ignored especially in decision making process (Harrison and Hester, 2010). This may lead to the loss of goods and externality. Externality refers to the benefits than are not paid and also not internalized in decision making process. FRIM is one of research institutes that offer a variety of ecosystem services such as biodiversity conservation, recreation, ecotourism and nature education. These services are limited in supply and may lead to the reduction of the environmental goods the biological resources are not been maintained, managed, and conserved well. Irregular exploring actions, inefficient management, and irresponsible action of visitors may cause the loss of externality thus affecting ecotourism development of the institute.

Since 1998, FRIM management implemented the fee system named “Entrance Fee” for the visitors who come to FRIM. The entrance fee (in form of tickets) to FRIM for local is RM1.00 per adult and RM0.50 per retiree, while for foreigner it is RM5 per person. The entrance fee for students (both local and international) is RM1 per pax. An additional fee of RM5 per car is charged for entering FRIM. This entrance fee is credited as revenue into FRIM Trust Fund, which is used in managing, protecting, conserving, monitoring, educating and researching programs in the institute. However, there is no specific funding only to cover and maintains the biodiversity in FRIM. New funding mechanism such as Carbon Taxing, Payment for Ecosystem Services (PES) can be further explored to support FRIM Trust Fund in safeguarding biodiversity at FRIM.

Other than that, valuation of biodiversity conservation in a protected area that serves as a tourist spot also is important. FRIM is listed as a one of the tourism spots by Tourism Malaysia, with the tourist arrival of 707, 297 in 2013. The institute also received visit from more than 296 organizations for ecotourism and 1,484 organizations for educational visit in 2013. Besides that, there is a lack of information on public perceptions regarding biodiversity conservation at the institute. Public awareness and education is important to ensure that biodiversity conserved. Furthermore, this information also can help the management or stakeholders (government or private sectors) to improve forest management and assist conserving biodiversity for the benefits of present and future.

1.3 Research Questions

In the process of valuing biodiversity conservation in FRIM National Heritage Site (FRIM), the research questions that need to be answered are:

- i. How much are visitors willing to pay for the conservation of biodiversity?
- ii. How much are visitors willing to pay for each biodiversity attributes in order to explored new funding mechanism?
- iii. What are the visitors demographic factors influencing the value of biodiversity conservation in FRIM?
- iv. What kinds of visit characteristics are found among visitors in FRIM?

1.4 Objectives

The general purpose of this study is to assess the value of biodiversity conservation by using environmental economic tool to enable formulation of management policies for sustainable development and conservation in forest ecosystem. The main objectives are as follows:

1. To estimate the economic value of biodiversity attributes using the Choice Modeling Method (CM); and
2. To evaluate the economic value of biodiversity conservation using Contingent Valuation Method (CVM).

CM analysis was conducted because it has the ability to identify which attributes are significant determinates of the values people place on the non-market goods and it also able to implied raking of these attributes amongst the relevant population. Meanwhile, CVM was conducted to assess the biodiversity conservation in total. CM results can be used to further explore new funding mechanism appropriate in safeguarding biodiversity at FRIM.

1.5 Significance of research

FRIM towards World Heritage Site (WHS): FRIM has obtained the status of National Heritage site in 2009, and become sources of knowledge and assets to Malaysia. This valuation study will support the facts in the process of documenting the dossier for the nomination of FRIM as World Heritage Site (WHS) which the information on the economic value of FRIM's natural assets is important. Hence, this economic valuation study will give the monetary value to conservation of 544.3ha FRIM area and make a contribution to obtain the status as a World Heritage site by UNESCO under cultural criteria which are Criteria I and Criteria V.

<i>Criteria I</i>	<i>Masterpiece of human creative genius</i>
<i>Criteria V</i>	<i>A Human interaction with the environment</i>

Forest beyond timber: The value also can be used as a guide for FRIM managements to create new or alternative options of utilisation of FRIM's ecosystem services in line with the national aspiration of "Forest beyond Timbers". In this valuation also, we are able to determine and identify the new potential sources of income to FRIM generated from ecosystem services that provided by FRIM such as payment for watershed protection at FRIM.

Formulation of policy: Provides supporting evidence in assisting the formulation of policies that protect biodiversity. Assigning monetary values to biodiversity is thus important since it allows the benefits associated with biodiversity to be directly compared with the economic value of alternative resource use options (Christie et al., 2004). The importance of measuring the economic value of biodiversity and identifies a wide range of uses also recognised by OECD (2001).

1.6 Organization of thesis

The first chapter discusses problem statement, significance and objectives of this study while, chapter 2 consists of the overview concept of ecosystem, its services and payment of the services. The basic information on biodiversity focusing on flora, fauna and activities (ecotourism, recreation and educational) in study site also is explained in this chapter. In this chapter also, elaborates of the biodiversity conservation history, and biodiversity conservation management plan for current and future. Literature review on the related present research will be discussed in chapter three where the theoretical and methodological will be discussed. Chapter four describes the study area description and explains the research methodology. It also outlines the questionnaire design and implementation, techniques and data collection. Chapter five will be the result presentation, interpretation and implication of the research findings. The last chapter, which is chapter six, provides the summary of the research results, along with the conclusion, implication of findings, and limitation of the study.

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