



UNIVERSITI PUTRA MALAYSIA

***HOUSEHOLD WILLINGNESS TO ACCEPT COLLECTION AND
RECYCLING OF WASTE COOKING OIL FOR BIODIESEL
INPUT IN PETALING DISTRICT, SELANGOR,
MALAYSIA***

IBRAHIM KABIR

FPAS 2014 19



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MALAYSIA**

By

IBRAHIM KABIR

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

October 2014

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DEDICATION

**This work is dedicated to my lovely Parents, Family Members, Wife and
Children.**



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Abstract of the thesis Submitted to the Senate of Universiti Putra Malaysia in fulfilment of the Requirement for the Degree of Master of Science

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MALAYSIA**

By

IBRAHIM KABIR

October, 2014

Chairman: Associate Professor Mohd Rusli bin Yacob, PhD

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In recent years, considerable attention has been given to waste cooking oil (WCO) management. The main reasons for the growing concern for this residue are the externalities associated with its improper discharge on the one hand and viability input in biodiesel production on the other. The programme of WCO collection and recycling for biodiesel input in Petaling district is monitored by the three local authorities under the district; Subang Jaya Municipal Council (MPSJ), Petaling Jaya City Council (MBPJ) and Shah Alam City Council (MBSA). Although, the authorities have been currently struggling to improve the programme, an economic valuation studies could help to gather consumer preferences that can facilitate the programme.

This study was conducted to determine the households' willingness to accept for collection and recycling of WCO for biodiesel input so as to recommend for policies that could encourage consumer participation and propose pricing policy for a quantity of WCO which does not exist currently. Dichotomous Choice Contingent Valuation Method (DC-CVM) was used on samples of 360 households, who were interviewed face to face from February to June, 2013. The questionnaire for this study contain questions basically on households' socio-demographic background, current practices regarding reuse, disposal and recycling of WCO as well as their perceptions on recycling of WCO into biodiesel.

The results of this study have shown that majority of the households positively perceived WCO recycling into biodiesel as significant, yet only a small proportion engaged into it. The logistic regression result revealed that the households are willing to accept for WCO collection and recycling programme and bid amount, income, age, education (university), races (malay and chinese), and gender (female) were the significant determinants of their WTA. The average monthly quantity of WCO generated per household in the district was 2.34 kg, the mean WTA of the

households was RM 0.72 per kg of WCO, and the annual environmental protection cost for WCO collection and recycling programme among households in Petaling district was estimated as MYR 9, 438, 829. Findings from this study can be useful to the policy makers, contracted recycling companies and other relevant authorities in their efforts to enhance the effectiveness of WCO collection and recycling programme.



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

**KESANGGUPAN ISI RUMAH MENGUMPUL DAN MENGITAR SEMULA
SISA MINYAK MASAK SEBAGAI INPUT BIODIESEL
DI DAERAH PETALING, SELANGOR,
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Kebelakangan ini, perhatian khusus telah diberikan terhadap pengurusan sisa minyak masak (WCO). Faktor utama yang menyumbang ke arah kesedaran mengenai sisa minyak masak tersebut adalah dipengaruhi oleh faktor luaran yang berkaitan dengan teknik pembuangan yang tidak betul dan input yang berpotensi digunakan dalam penghasilan biodiesel. Program pengumpulan dan kitar semula sisa minyak masak (WCO) di daerah Petaling dipantau oleh tiga pihak berwajib tempatan; Majlis Perbandaran Subang Jaya (MPSJ), Majlis Perbandaran Petaling Jaya (MBPJ) dan Majlis Perbandaran Shah Alam (MBSA). Walaupun pihak berwajib sedang berusaha menambah baik program tersebut, kajian penilaian ekonomi juga dipercayai dapat membantu mengkaji pilihan pengguna dan memudahkan program ini.

Oleh itu, kajian ini dijalankan bagi menentukan kesiediaan isi rumah untuk mengumpul dan mengitar semula WCO sebagai input biodiesel disamping mencadangkan dasar-dasar yang boleh menggalakkan lagi penyertaan pengguna. Kajian ini juga mencadangkan satu dasar harga bagi kuantiti WCO yang tidak ada pada masa ini. Kaedah penilaian kontingen (DC-CVM) telah digunakan untuk 360 sampel isi rumah dimana responden telah ditemuramah secara berhadapan dari Februari hingga Jun 2013. Soal selidik untuk kajian ini merangkumi aspek latar belakang isi rumah, amalan semasa penggunaan semula, pelupusan dan kitar semula dari WCO serta persepsi mereka mengenai kitar semula dari WCO sebagai input biodiesel.

Hasil kajian menunjukkan sebahagian besar isi rumah menyokong penggunaan WCO yang telah dikitar semula sebagai input biodiesel, namun hanya sebahagian kecil dari responden yang terlibat dengan kempen tersebut. Hasil logit regresi menunjukkan harga bid, pendapatan, umur, pendidikan (universiti), bangsa (melayu dan cina) dan jantina (perempuan) adalah signifikan dan mempengaruhi kesanggupan

isi rumah untuk menerima program pengumpulan dan kitar semula minyak masak (WCO). Jumlah purata bulanan WCO yang dihasilkan oleh setiap isi rumah di daerah ini adalah 2.34 kg, WTA min terendah adalah RM 0.72 per kg WCO, dan kos perlindungan alam sekitar tahunan bagi koleksi WCO dan program kitar semula di kalangan isi rumah di daerah Petaling dianggarkan sebagai MYR 9, 438, 829. Dapatan hasil daripada kajian ini adalah sangat berguna kepada pihak penggubal dasar, syarikat kitar semula dan pihak berwajib yang berkaitan dalam usaha mereka untuk meningkatkan keberkesanan kutipan WCO dan program kitar semula.



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I certify that a Thesis Examination Committee has met on 27 October 2014 to conduct the final examination of Ibrahim Kabir on his thesis entitled "Household Willingness to Accept Collection and Recycling of Waste Cooking Oil for Biodiesel Input in Petaling District, Selangor, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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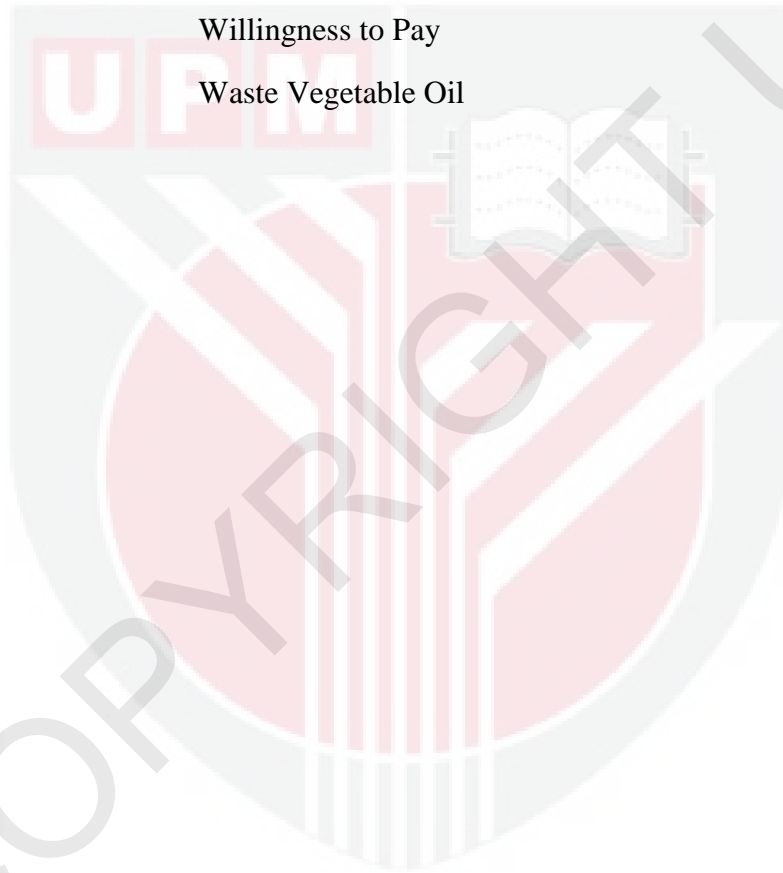
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LIST OF ABBREVIATIONS

ABM	Averting Behaviour Method
BAU	Business as Usual
CLM	Conditional Logit Model
CM	Choice Modelling
CM	Choice Experiment
CV	Compensation Variation
CVM	Contingent Valuation Method
DC	Dichotomous Choice
EPA	Environmental Protection Agency
ES	Equivalent Variation
F2F	Fryer to Fuel
HPM	Hedonic Pricing Method
KETTHA	Ministry of Green Technology and Water
Kg	Kilogram
LGA	Local Government Area
LIMDEV	Limited Dependent Variable
LDL	Low Density Lipoprotein
MBSA	Shah Alam City Council
MBPJ	Petaling Jaya City Council
MOU	Memorandum of Understanding
MPOB	Malaysian Palm Oil Board
MPSJ	Subang Jaya Municipal Council
MYR	Malaysian Ringgit
NGO	Non-Governmental Organisation
PFM	Production Factor Method
RPM	Revealed Preference Method
RVO	Recovered Vegetable Oil
SPM	Stated Preference Method

SPSS	Statistical Package for Social Sciences
TCM	Travel Cost Method
TEV	Total Economic Value
TWTA	Total Willingness to Accept
UCO	Used Cooking Oil
WCO	Waste Cooking Oil
WFO	Waste Fried Oil
WTA	Willingness to Accept
WTP	Willingness to Pay
WVO	Waste Vegetable Oil



CHAPTER 1

INTRODUCTION

1.1 Introduction

Cooking oil is made from nut and vegetable sources with a high fat content. Palm oil, corn oils, and sunflower oils are good examples of edible vegetable oils. It plays a vital role in food preparation especially in frying process. It gives our food good taste, attractive aroma and colour, and makes our food more presentable (Hanisah *et al.*, 2013). Our contemporary societies use cooking oil as an additive or ingredient and medium of heat transfer. As the consumers fry more foods, the quantity of waste cooking oil (WCO) generated increases (Phan and Phan, 2008). Kulkarni and Dalai, (2006) reported that huge quantities of WCO is produced all over the world. It was estimated that there were 40,000 tonnes per year of WCO produced in each of most Asian countries comprising Malaysia, China, Hong Kong, India, Indonesia and Thailand (Hanisah *et al.*, 2013).

The WCO interchangeably called used cooking oil (UCO), waste vegetable oil (WVO) or waste fried oil (WFO) denotes cooking oil which has been used in food processing and no longer feasible and safe for reuse (Gui *et al.*, 2008; Upham *et al.*, 2009). Households, restaurants, food vendors, hotels, catering establishments and industrial kitchens are the common sources of WCO.

Improper discharge of WCO results to certain environmental and infrastructural problems. Communities that disposed of their WCO improperly pay the consequences in the long run when the residue damaged sewer systems, clogged drains and polluted their environment (Chhetri *et al.*, 2008). The improper discharge of this residue is generally attributed to the lack of efficient ways of its disposal, where for decades the consumers simply release it into public drains. And the effects of such acts include soil and water contamination, clogging of sewer systems, destruction of water treatment facilities, and causing odour and vermin among others (Kalam *et al.*, 2011).

However, it was when these effects deteriorate due to increase in human population and food consumption as well, that relevant authorities in various countries deem it fits to come-up with the possible measures to deal with the externalities arising from improper disposal of WCO among consumers. The most current approach is the use of WCO into biodiesel production. Recycling of WCO into biodiesel has been considered as one of the sustainable and economical way of its management (Chhetri *et al.*, 2008).

The WCO collection and recycling processes involve the establishment of its collection centres in cities and towns where WCO from various sources are send for collection before finally taken to the biodiesel manufacturing companies recycling. It also involves the provision of recycling plants around the WCO sources so as to enable users directly recycle their WCO into biodiesel in their domain. Door to door or per community collection of WCO by contractors among households is also a

feasible approach of the WCO collection and recycling programme in various parts of the world (Gui *et al.*, 2008).

Interestingly, if the WCO collection and recycling programmes become successful, WCO which is freely wasted could be used to produce biodiesel. Biodiesel is a clean, renewable and environmental friendly fuel which is produced from both fresh and WCO and used in a diesel engine as an alternative to petrol-diesel (Chhetri *et al.*, 2008; Hassan *et al.*, 2011). From the perspective of waste-to-energy, recycling of WCO into biodiesel is an effective technique for waste management as well as a beneficial form of energy recovery (Singhabhadhu and Tezuka, 2010).

The WCO collection and recycling programme has been in practice for decades in developed countries or regions like the EU, Japan, United States, and Taiwan (Zhang *et al.*, 2012). For instance, in England, councils have created Road Refuse and Recycling Centres where residents can get rid of their WCO. The Australian government has created an online directory listing all WCO drop-off stations, collectors and recyclers. Countries like Thailand, Singapore, Mexico and China are also engaged into WCO recycling into biodiesel (Sheinbaum-Pardo *et al.*, 2013).

1.1.1 Waste Cooking Oil Management in Malaysia

Although, the sources from local authorities in Petaling district stated unanimously that there is no existing policy which directly regulate the issue of WCO management, it is found that the Malaysian constitution has authorized the local authorities to handle waste management issues at their jurisdictions. The power of the local authorities regarding waste management especially the discharge into public drains, streams or other watercourses is stipulated under section 69 of the Local Government Act 1976.

Part XII Section 69, Local Government Act 1976

“Any person who commits a nuisance or deposits any filth in or upon the bank of any stream, channel, public drain or other watercourse within the local authority area shall be guilty of an offence and shall on conviction be liable to a fine not exceeding two thousand ringgit or to a term of imprisonment not exceeding one year or with both and to a further fine not exceeding five hundred ringgit for each day during which the offence is continued after conviction”.

(Local Government Act, 1976)

According to this act, the local authorities are expected to arrange and monitor for waste collection services either directly or via contractors, so as to attain acceptable environmental quality in the communities within their authority, and must find economical and sustainable ways of disposing collected wastes. Thus, it was based on that in 2009, when the local authorities discovered the externalities associated with improper WCO discharge, they go on board to establish the programme of WCO collection and recycling in their respective local government areas (MBPJ, 2013).

The authorities run the programme by engaging sub-contractors to assist them in the process of collecting the WCO from various sources and recycling to produce biodiesel (MPSJ, 2013). Subang Jaya Municipal Council (MPSJ), Petaling Jaya City

Council (MBPJ) and Shah Alam City Council (MBSA) are the three (3) existing local authorities which monitor the programme of WCO collection and recycling in Petaling district.

The authorities in their efforts to encourage participation in the programme, they are into series of public awareness programs including workshops and round-table discussion between participants and representatives from the Local Authorities, Government Agencies, representatives from the Ministry of Green Technology and Water (KETTHA) and non-governmental organisations. They also signed a Memorandum of Understanding (MOU) with companies that recycle WCO into biodiesel in order to enable collection of WCO from its various sources for recycling into biodiesel (MBSA, 2013).

1.2 Problem Statement

The greater part of the WCO that is being generated in various parts of the world is disposed of into the environment despite the fact that some countries use it in the manufacturing of soap and other valuable items (Chhetri *et al.*, 2008). Like other parts of the world, Malaysia faces predictable waste management problems resulting from poor participation and lack of full consumer compliance in waste management activities including waste collection and recycling.

As regard to WCO generation and disposal in Malaysia, Kheang, (2006), in his study which examined the health hazards associated with continues reuse of WCO in food preparation specifically reported that the country alone discharges an estimated 500,000 tons of WCO freely into the environment without any proper waste treatment annually.

Unlike other countries like Japan, United States, Taiwan, China and Singapore, the Malaysia has not yet come up with a policy which specifically regulates waste cooking oil management. Thus, it was due to the discovered externalities arising from WCO improper disposal which basically results in water pollution, aquatic lives destruction, clogging of drains, sewer overflow, odour and vermin in surroundings, and provision of breeding ground for bacteria and viruses among other impacts; that some local authorities in the country have from 2009 deem it fits to establish and monitor WCO collection and recycling programmes under their respective areas.

Petaling district is not an exception, as all three (3) existing local authorities; MPSJ, MBPJ and MBAS introduced and monitor the WCO collection and recycling programmes in the district. The programme which operates under the signed MoU between contracted recycling companies and the local authorities is primarily established to reduce WCO contamination in public drains and waters, reduce waste water treatment operational and maintenance costs and protect consumers from the health hazards associated with it.

However, among these local authorities, MPSJ in particular has so far achieved about 30% consumer participation especially among restaurants and food vendors, the main challenges facing the programme in the whole district include; poor participation and preferences of some consumers to sell their WCO to unauthorised recycling companies who pay higher incentives than the government contracted companies (MPSJ, 2013).

The WCO collection and recycling programme is indeed a non-market service which has no tangible price. Therefore, it needs to be evaluated by specific valuation technique. Based on this scenario, the current contingent valuation method (CVM) study will serve as a good input in providing relevant information that would help the authorities in encouraging consumer participation and proposing pricing policy that would be reasonable in regulating the consumers' act of selling WCO to unauthorised recycling companies in Petaling district.

1.3 Objectives of the Study

The general objective of this study is to determine the economic value of households' participation in the collection and recycling of WCO for biodiesel input in Petaling district.

The specific objectives of this study include:

1. To determine household's current practices regarding reuse, recycling and disposal of waste cooking oil.
2. To determine household's perception about recycling of waste cooking oil.
3. To estimate the household's willingness to accept for collection and recycling of waste cooking oil for biodiesel input.

1.4 Significance of the Study

A study about "Household's willingness to accept for collection and recycling of WCO for Biodiesel input in Petaling District, Selangor" has special importance to the contracted recycling companies and of course to the local authorities which monitor the WCO collection and recycling programme in Petaling district.

The WCO collection and recycling programme is at the infancy stage in Petaling district and thus, we hope that the outcomes of the study which provide enough information about the households' current practices regarding WCO reuse, disposal and recycling; households' perceptions about WCO recycling; willingness to accept for WCO collection and recycling for biodiesel input; and the factors which influence the households' decisions on whether or not to accept would make the relevant authorities to take better decisions. The results of this research would also make a timely and relevant contribution towards resolving issues which discouraged or make some households not to fully engaged into WCO collection and recycling programme in the district.

The involved authorities and policy makers would also find the results of the study useful in their efforts to improve the effectiveness of the WCO collection and recycling programme. The results will guide them on the need to provide reasonable cash incentives that will encourage consumer participation and a proposed pricing policy that will regulate the price of a unit quantity of WCO. The outcomes will inform the authorities on budgetary demand for running cost of the programme in

order to avoid externalities resulting from improper discharge of WCO in Petaling district.

The academic and research contributions of this study is three-fold. First, currently, there is lack of information about the households' WCO handling practices and the existence of WCO collection and recycling programmes under local authorities. Only a few studies were generally conducted regarding WCO management in Malaysia, hence the results reported from this study help to add more information on the subject. Secondly, CVM was used in this study to value the WCO collection and recycling which finally arrived at an economic value of households' willingness to accept for the programme. Therefore, the estimated economic value could be used in future studies to conduct cost-benefit analysis so as to check the viability and sustainability tendencies of running the programme under the signed MoU between the local authorities and their contracted recycling companies. Finally, this study contributes to the knowledge of CVM by examining its application in WCO management among various liquid wastes which contaminate the environment.

1.5 Scope of the Study

This study covers households' samples from areas under MPSJ, MBPJ and MBSA all in Petaling district of Selangor State, Malaysia. It also specifically includes only households among various WCO generation sources ranging from restaurants, food vendors, hotels to other catering establishments and industrial kitchens.

The instrument used for this study was only questionnaire designed based on stated preference CVM, where the households' heads or their representatives were directly asked about their willingness to accept for collection and recycling of WCO for biodiesel input. According to Champ *et al.*, (2003) a well-designed and prudently administered household surveys of actual or hypothetical scenario can provide reliable and feasible information on economic value for environmental goods or services.

1.6 Organization of the Thesis

This thesis is arranged into five chapters in an ascending order of counting numbers. Chapter 1 introduces the subject; WCO sources and generation rate, its associated issues and possible ways of its collection and recycling for biodiesel production. The chapter also discusses themes such as problem statement, research objectives, significance and scope of the study.

Chapter 2 builds upon the first by digging into the cooking oil consumption rate as it relates to the generation and availability of WCO. This was followed by review of some literatures on WCO from its perspective of being menace to the environment and on the other hand as among the suitable input for biodiesel production. The feasibility of WCO and associated benefits to be derived through its recycling into biodiesel and the significant roles of biodiesel towards achieving environmental and economic sustainability as cleaner fuel were reviewed. The chapter also reviewed case studies on successful WCO collection and recycling programmes and followed

with review on economic valuation techniques, where both revealed and stated preference techniques were discussed. It further outlined and discussed some widely used economic valuation methods with much emphasis on CVM. Finally, it dwells on the review of some previous empirical studies that applied WTP/WTA on households' surveys.

Chapter 3 discusses the research materials and methods employed in this study. It gives the general structure of the survey, described the survey area with map and discusses other aspects such as research sample size, sampling techniques, data collection mode, questionnaire design, estimation technique, descriptive analysis, pilot study and econometric models applied in this study.

Chapter 4 was used to present and discuss the outcomes of this study. The arrangement starts with the respondents' profile, current practices regarding reuse, disposal and recycling of WCO, perceptions about recycling of WCO into biodiesel, results of Cronbach's alpha test and results of willingness to accept for collection and recycling of waste cooking oil for biodiesel input.

Chapter 5 offered summary, conclusion, policy implication, and limitations and recommendations based on the study results and observations.

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