THE CHOICE OF SUSTAINABLE HOUSING TOWARDS SUSTAINABLE DEVELOPMENT: A CASE STUDY IN MALAYSIA

Zuroni Md Jusoh [a], Husniyah Abd Rahim [b], Elistina Abu Bakar [c], Askiah Jamaluddin [d], Roziah Mohd Rasdi [e], Zalika Md Zaini [f]

[a, b, c, d, e, f] Department of Resource Management and Consumer Studies, Faculty of Human Ecology, Universiti Putra Malaysia, Malaysia.

[a] Corresponding author: zuroni@putra.upm.edu.my

©Ontario International Development Agency ISSN: 1923-6654 (print)
ISSN 1923-6662 (online). Available at http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html

Abstract: In Malaysia, sustainable housing concept has been introduced since year 2005. Recently, Malaysian government is trying to focus more on this concept of sustainable housing. This concept is consistent with the increasing awareness in Malaysian society towards the importance of sustainable development. Nevertheless, there is the need to balance the environmental conservation with economic development (Shafii, 2007). Generally, the objective of this study is to conduct an economic study on the household demand for sustainable housing in Malaysia. Specifically, this study intends to rank the attributes of carbon dioxide (CO_2) emission, rainwater harvesting system, natural air ventilation and greeneries area according to its importance to consumers, to elicit consumers' willingness to pay (WTP) for different options, to estimate the implicit price for each attribute and the tradeoffs among the attributes. Two Choice Set formats – generic and labeled formats, have been used to estimate the implicit price for the attributes. Self-administered questionnaires were used to obtain necessary data from 800 respondents among urban households of terrace houses in urban areas. Four zones consist of the North, Middle, East and South of Peninsular Malaysia was selected through multi-stage random sampling. One state has been chosen to represent each zone. The lists of the Municipal Councils were gathered from the government website and two of them were selected to represent the chosen states. Each of the selected Municipal Council was contacted to get the list of residential areas. Consequently, one hundred respondents who stayed in these residential areas had participated in this study. The choice model technique was applied to estimate the non market values for this study. This technique begins with the assignment of the product or service attributes to levels, followed by selection of the experimental design, construction of the choice sets, measurement of preferences, and estimation (Hanley et al., 2001). SAS 9.0 and LIMDEP 8.0 NLogit 3.0 software were utilized to analyze the choice model while SPSS for Windows version 18.0 program were used for descriptive and inferential analyses. Implicit prices for environmental attributes such as natural air ventilation, greeneries area, carbon dioxide (CO_2) emission and rainwater harvesting system were estimated. The estimated implicit values for - sustainable housing attributes based on Multinomial Logit regression shows that natural air ventilation is the most important attribute. This is followed by greeneries area, carbon dioxide (CO_2) emission and rainwater harvesting system. Compensating surplus (CpS) estimation shows that the respondents were willing to pay (WTP) a 30 percent premium to obtain all the modeled attributes of sustainable housing and to attain an improvement for a number of generic and technology-specific label choice sets. Nevertheless, the results estimated were higher for generic options. The findings also reveal that Malaysian society preferred sustainable housing as compared to conventional housing. Finally, the study discusses several policy implications and incentive scheme such as tax rebate for households or developers to stimulate the development of sustainable housing industry in Malaysia.

Keywords: Choice model, compensating surplus, implicit price, sustainable development, sustainable housing

INTRODUCTION

In Malaysia, sustainable housing concept has been introduced since year 2005. Recently, Malaysian government is trying to focus more on this concept of sustainable housing. This concept is consistent with the increasing awareness in Malaysian society towards the importance of sustainable development. Sustainable development agenda in developing countries focus on relationship between construction and human development, alleviation of poverty and environment. There are together with the lack of resources and capacities to improve technologies especially on the environmental aspects. Nevertheless, there is the need to balance the environmental conservation with economic development [1].

Under Ninth Malaysian Plan (RMK9), smart and sustainable initiatives in housing have been highlighted by government and communities, however, present legislations relating to inhabitation is more focused on physical development of housing, while social, economic and environment matters are not often considered. Public policies or strategies in housing mainly deal with affordability rather than sustainable inhabitation. A study of these policy matters reveals that they provide little room for housing intervention in response to the emerging sustainability concerns.

The concept of sustainable housing uses less energy, water, and natural resources; creates less waste; and is healthier and more comfortable for the occupants. Any sustainable housing project requires a careful balancing act between being environmentally responsible, and taking into account the aesthetics of the home, sustainable homes product availability, and budget constraints. However, the common characteristics of sustainable homes include healthy indoor air quality, use of sustainable materials, and water and energy efficiency.

In order to make any building included housing becomes sustainable building, Malaysia have already launched Green Building Index (GBI) in Mei 2009. This index evaluates the eco-friendliness of buildings based on six criteria such as energy efficiency, indoor environmental quality, a sustainably managed site, optimal use of materials and resources, water efficiency, and innovativeness [2]. The evaluation based on the rating system whereby this rating is a standard for any building in its construction. So, by having this index, sustainable housing concept can be implemented in Malaysia towards sustainable development achieving.

An economic analysis was performed on the household demand for housing improvements in Malaysia, by estimating the implicit prices of housing attributes of *carbon dioxide (CO_2) emission, rainwater harvesting system, natural indoor air ventilation* and *greeneries area*. In determining the economic value of housing, an important basic study component was to identify the influence of specific technology labeling (relative to generic technology).

The aforementioned *carbon dioxide (CO_2) emission* relates to the amount of gas (CO2) that discharged through electric material utilization within one year. *Rainwater harvesting system* is catchment system to keep rain water to use for water tree, toilet torrent, washing clothes, cars and motorcycles. *Natural indoor air ventilation* refers mainly natural air flow that is sufficient for occupant's comfort in it. *Greeneries area* relates to the percentage of greeneries area based on housing area more than 5 acre.

OBJECTIVES

Generally, the objective of this examination is to conduct an economic study on the household demand for sustainable housing in Malaysia. Specifically, the objectives of this study are: (a) To rank the attributes of carbon dioxide (CO_2) emission, rainwater harvesting system, natural indoor air ventilation and greeneries area in order of importance to the consumers. (b) To elicit consumers' willingness to pay (WTP) for different options. (c) To estimate the implicit price for each attribute and the tradeoffs among the attributes.

LITERATURE REVIEW

Sustainable housing development definition is 'housing development that meets the housing needs and demands of the present without compromising the ability of future generations to meet their needs and demands' [3]. This sustainable building is an essential way to move housing development in a more direction. Sustainable building uses materials and methods of promoting environmental quality, economic strength and social or cultural improvements through design and development of the built environment, and its continuing maintenance and operations [4].

Carbon Dioxide Emissions

Energy efficiency is no doubt the best-known component of green building. Using energy efficient building products and systems can save consumers money and reduce the emissions of carbon dioxide (CO_2). Well-insulated and ventilated homes block pollutants such as moisture, dusts, pests, pollen, and radon from entering, thus creating a healthy environment. The use of energy efficient heating/cooling systems, appliances, lighting, ventilation, and insulation materials in housing construction and rehabilitation produces cost effective, healthy, and durable homes.

To create energy systems in compliance with sustainable building model, solar design provides a low-cost, yet effective means of improving energy efficiency. Lighting significantly affects energy efficient and thermal comfort. The sun is an ideal source of lighting, free and widely available [5]. Day lighting also brings outdoor light into buildings, reducing the need for artificial light sources [6]. Instead of that, solar energy is practical and as a renewable heat energy. The most practical renewable energy use is to heat with solar energy.

[7] examine that in Malaysia, there is increasing public awareness and interest in how buildings affect the environment, worker productivity and public health. As a result, both the public and private sector are beginning to demand building that optimize energy use; promote resource efficiency, and improve indoor environmental quality.

In a recent study, [8] have identified legal and social factors as well as market structural barriers and lack of consciousness as the possible explanations of low usage of energy saving systems for the case of the Swiss residential building sector. Moreover, as shown by [9] depending on the adopted assumptions and especially for ventilation systems, the discounted value of long-term savings in energy costs could be insufficient to justify such investments.

Recently, [10] adopts a choice-experiment approach to analyze the willingness to pay (WTP) for energy-saving measures in residential buildings. The results provide the first WTP estimates based on choice experiments in the context of the Swiss housing sector. The analysis includes both renovation cases and new buildings. The decisions are related to purchasing single-family houses as well as renting apartments.

Rainwater Harvesting System

Rainwater harvesting system is a technology used for collecting and storing rainwater from rooftops and land surfaces using simple techniques such as pots or tanks. The greater attraction of a rainwater harvesting system is the low cost, accessibility and easy maintenance at the household level. [11]found that harvested rainwater is a renewable resource of clean water that is ideal for domestic land landscape uses.

Rainwater harvesting has a significant role to play to meet the goal of efficient and appropriate water use. It has been reported that rainwater harvesting can promote significant water saving in residences in different countries. [12] in their study showed the potential of potable water saving in house might vary from 30 percent to 60 percent, depending on the demand and roof area. A study performed by [13] showed the potential water saving by using water harvesting in 62 cities of Brazil ranges from 34 percent to 92 percent, with an average potential for potable saving of 69 percent.

Natural Air Ventilation

Indoor air quality problems in homes can take many forms but the main way to look at problems is to remember the three “P’s” of indoor air quality: “Pollutants need a Pathway to people.” If you eliminate any one of the 3 “P’s,” the problem goes away.

When building or renovating a home, it is important to make good choices to avoid bringing pollutants into homes. Many times the building materials we choose contain the pollutants – in fact, chemically sensitive individuals must be extra careful with their material selections. Some common pollutants found in homes are volatile organic compounds (VOCs), mold, dust (pollen, dust mites, insulation fibers, etc.), carbon monoxide and other combustion products, radon, pesticides, and household chemicals. Given the amount of time individuals spend indoors, indoor air quality for comfort is essential to any green building model due to risk to residents’ health [14] estimate individuals born after 1995 will spend over 95 percent of their lives inside. As a result, the National Association of Home Builders (NAHB) [15] reports that many green building consultants cite indoor air quality as the most important feature of green homes after energy efficiency.

[16] found that in maximizing personal comfort, occupants have to adjust thermostats in terms of technology or system employed, lowering or raising blinds and drapes, and opening or closing windows.

Greeneries Area

There are some connections between greeneries area and consumer behavior. For example, effects to the occupants’ psychological. [17] in one post-occupancy evaluation of a high- rise structure found that the primary concern of tenants were the lack of greenery and their sense of disconnection from the outside. [18] also found that occupants rated views of the outside extremely important. A lack of view was related to a feeling of enclosure.

Besides that, The nature views can reduce stress, aggressiveness, mental fatigue, and improve well-being [19]. In additions, [20] found that green homes have potential to improve occupant health by creating more natural environments that help improve air quality inside the building.

House Price

Many private companies simply don't want the added expense of going green with new development projects. One United Kingdom (UK) report suggests that any green development will cost nearly 30 percent more than traditional structures.

In UK recent report released by Smart Money has suggested, an eco home could cost anywhere between 3 to 5 per cent more than a conventional home of the same size and amenities regardless of where in the world it is located. However, the same report also says that the price differential used to be 11 to 25 per cent more in pricing of eco property.

METHODOLOGY

Random Utility Theory

The choice of one particular choice set among all is an example of a discrete choice. The consumer must make an absolute choice among a set of competing alternatives. The use of discrete or qualitative data has necessitated a probabilistic approach to utility estimation that incorporates differences in individuals' characteristics such as preferences and perceptions. This behavioral approach to utility estimation also allows for the consideration of random, unobservable differences among individual consumers. Discrete choice theory allows utility estimation to be performed in accordance with Lancaster's characteristic approach to consumer theory [21], [22] & [23].

Random utility theory is a probabilistic approach to discrete choice problems that specifies the probability that an individual will choose a specific alternative from a set of alternatives given the observed research data [24] & [25].

Choice Modelling

The aim of CM was to identify marginal values for sustainable housing attributes. This is to allow identification of a desirable green housing plan from the demand side perspective. Typical profile analysis is conducted to provide insights on respondents' socioeconomic, attitudinal, and behavior.

The CM is a class of stated preference technique but has the unique flexibility to evaluate both alternative options and the marginal values of non-market attributes. With CM, it is possible to estimate the value of the individual attributes that make up an environmental good. The CM is also able to derive estimates of the value of changes in the aggregate level of non-market goods quality.

Overview of CM

The CM has the unique strength in cases where management decisions are concerned with changing attribute levels.[1] The CM is also able to derive estimates of the value of changes in the aggregate level of environmental quality. Therefore it can be used to produce estimates of the total value of multiple services or resource use alternatives. The main weakness of CM is the added cognitive burden it imposes on respondents apart from its complexity in designing it correctly and its econometric estimation.

In CM questionnaires, respondents are given a series of choice sets, where each set contains three or more resource use options. Respondents are asked to choose their preferred option from each choice set. The options in each choice set contain common attributes, which can be at various levels. The combination of attribute levels for each option in each choice set is designed using experimental design techniques. Before the choice sets are presented to the respondents, there is a description of the study site, the research issues, the proposed policy changes and its implications on attributes which are being modeled.

Model Specification

With reference to the utility theory, the paper models the choice of respondents (home ownerships) for characteristics of house. The underlying assumption is that households evaluate the characteristics of different housing alternatives and then choose the one which leads to the highest utility. By assuming that the utility of living in green home is a function of the price, the housing's attributes (CO_2, rainwater harvesting system, natural indoor air ventilation, green area), household characteristics, and a random component that captures the influence of unobserved factors. The household characteristics can include income, education, environmental consciousness, as well as site-specific characteristics of the household's actual residence. Indeed, according to the random utility theory, the utility of goods or services is considered to depend on observable (deterministic) components, including a vector of attributes (X) and individual characteristics (Z), and a stochastic element *e* [26]. Thus, the utility function of a bundle of characteristics i for individual q at choice task j can be represented as:

$U_{qij} = V(X_{qij}, Z_q) + e_{qij}$ (1)

where V is the deterministic part and e_{qij} the stochastic element. The deterministic variables that will be used in an empirical model are the housing attributes (X_{qij}) and the respondent's characteristics (Z_q). The probability that individual n will choose option i over other option j is given by:

Prob (i/C) = Prob $\{V_{iq} + e_{iq} > V_{jq} + e_{jq}\ ;\ j \in C\}$ (2)

where C is the complete choice set. It is assumed that the error terms of the utility function are independently and identically distributed (IID). A consequence of this assumption is the property of independence of irrelevant alternatives (IIA). The IIA states that the probability of choosing one alternative over the other is entirely dependent on the utility of the respective alternatives. This property may be violated by the presence of close substitutes in the choice sets as well as heterogeneity in preferences.

Assuming an extreme value distribution for the stochastic term e_{qij} in model (1), the probability of choosing alternative i out of a set of available alternatives A={1, 2, …, K} can be written in a logistic form as:

$P_{qij} = \exp(V_{qij}) / \sum^{K}_{k=1} \exp(V_{qkj})$ (3)

Expression (2) is the basic equation of a multinomial logit [27] & [28]. Utility function V is generally assumed to be linear in parameters. In our case, the number of alternatives in each choice task is limited to two possibilities. Thus, the choice set for a given choice task j can be written as A={0, j} with 0 indicating the status quo and j representing the offered alternative. The random utilities of the resulting binary logit model can be written as:

$U_{qj} = \beta X_{qj} + \alpha Z_q + e_{qj}; U_{q0} = 0$ (4)

where Z_q represent the household characteristics that do not vary across choice tasks, and X_{qj} is the characteristics of the alternative situation of choice task j for individual q. α and β are the vectors of model parameters. In a multinomial logit framework, the parameters associated with one of the outcomes are normalized to zero namely,U_{q0}=0.Therefore,U_{qj} is the random utility of choosing the alternative situation over the status quo. If all the relevant respondent's characteristics (Z_q) are observed, the model given in Eq. (4) is a simple binomial logit. In general however, Z_q can include a host of parameters, many of which are not observed. In this case, this term can be considered as an individual fixed effect. The resulting model is a fixed-effect binary logit model proposed by [29] and can be written as:

$U_{qj} = \beta X_{qj} + u_q + e_{qj}; U_{q0} = 0$ with $u_q = \alpha Z_q$ (5)

It should be noted that because of the presence of fixed effects in the model, vector X_{qj} can be equivalently replaced by the $X_{qj} - X_{q0}$, which measures the difference between the characteristics of the hypothetical alternative with the status quo. This implies that U_{qj} measures the net gained value through moving from actual situation (status quo) to a hypothetical status offered in choice task j. Given that the hypothetical alternatives may equally involve a better or worse situation regarding comfort, the individual specific term u_q can be interpreted as the (dis)utility of respondent q from changing their status quo.

Assuming a logistic distribution for the error term, the above model can be estimated by maximization of the conditional likelihood given the fixed effects (u_q). Results shows that for a consistent estimation, incidental parameters u_q should be replaced by a minimum sufficient statistic namely, the number of positive responses for a given individual. If we denote the individual q's response for J choice tasks by the sequence ($y_{q1}, y_{q2}, \ldots, y_{qJ}$), where y_{qj}=1 if offer j is chosen, and y_{qj}=0 if offer j is not chosen, then the number of positive responses (accepted offers) for individual q is obtained by the sum $s_q = \sum^{J}_{j=1} y_{qj}$. The conditional probability can therefore be written as:

$$\Pr(y_{q1}, y_{q2}, \ldots, y_{qJ} \mid u_q) = \frac{\exp\left(\sum^{J}_{j=1} y_{qj} X_{qj} \beta\right)}{\sum d_{qj \in \Omega} \exp\left(\sum^{J}_{j=1} d_{qj} X_{qj} \beta\right)} \quad (6)$$

where Ω is the set of all the sequences ($d_{q1}, d_{q2}, \ldots, d_{qJ}$) in which the number of positive responses is equal to that of the chosen sequence namely, ($\sum^{J}_{j=1} d_{qj}$ 1= $\sum^{J}_{j=1} y_{qj} \equiv s_q$. Hence, the numerator represents the probability of choosing the sequence ($y_{q1}, y_{q2}, \ldots, y_{qJ}$) and the denominator indicates the sum of the probabilities of all possible outcomes that entail the same number of accepted offers. The fixed-effect logit model is estimated using the maximum likelihood estimation method.

Once the model parameters are estimated, the marginal rate of substitution between different attributes can be calculated. If one of the attributes is a numéraire or a monetary variable like price (p) the marginal willingness to pay for attribute x can be derived as:

$$WTP = \frac{\delta V/\delta x}{-\delta V/\delta p}$$

which is equivalent to the ratio of the corresponding coefficients in Eq. (4).

Table 1: Attribute Definition and Levels in Generic and Label Formats

Attributes	Definition	Attribute levels: Existing Type 1 /Terrace House	Attribute levels: Proposed alternative Type 2 & 3 /Sustainable House 1 and 2
Carbon dioxide (CO_2) emission	Carbon dioxide amount of gas (CO2) that discharged through electric material utilization within one year.	1200kg	360kg 480kg 600kg
Rainwater harvesting system	Catchment system to keep rain water to use for water tree, toilet torrent, washing clothes, cars and motorcycles.	No	3000 liter 5000 liter
Natural indoor air ventilation	Air flow that is sufficient for occupant's comfort in it.	Not good	Good very good
Greeneries area	Percentage of greeneries area based on housing area more than 5 acre.	7%	13% 19%
Current house price	Double storey terrace house.	RM320,000	RM384,000 RM416,000 RM448,000

Table 2: A Sample Label-specific Choice Set

Attributes	Type 1 Terrace House	Type 2 Sustainable House 1	Type3 Sustainable House 2
Carbon dioxide (CO_2) emission	1200kg	360kg	480kg
Rainwater harvesting system	No	3000 liter	5000 liter
Natural indoor air ventilation	Not good	Very good	Good
Greeneries area	7%	13%	19%
Current house price	RM320,000	RM416,000	RM416,000
Please check your chosen option			

Table 3 : Respondents' Profile in Generic Format vs. Label Format

Items	Label Profile N=400	Generic Format Percentage (%)	Label Profile N=400	Label Format Percentage (%)
Gender				
Male	209	52.2	192	48
Female	191	47.8	208	52
Age				
mean	34.56		35.46	
Race				
Malay/Native	230	57.5	222	55.5
Chinese	123	30.8	126	31.5
Indian	45	11.2	45	12
Other	2	0.4	4	1.0
Number of Households				
mean	4.71		4.65	
Education level				
Not attended school	1	0.2	6	1.5
Primary school	11	2.8	9	2.2
Lower secondary school	57	14.2	50	12.5
Higher secondary school	130	32.5	106	26.5
Certificate / diploma	118	29.5	115	28.8
Degree	73	18.2	97	24.2
Master/PHD	10	2.5	17	4.2
Employment status				
Government	96	24	133	33.2
Private	219	54.8	188	47
Own bus/self-employed	54	13.5	43	10.8
Housewife / not working	27	6.8	27	6.8
Retired	4	1.0	9	2.2
Gross monthly income				
RM2000-RM3000	234	58.5	195	48.8
RM3001-RM4000	51	12.8	73	18.2
RM4001-RM5000	41	10.2	60	15
RM5001-RM6000	19	4.8	29	7.2
RM6001-RM7000	21	5.2	11	2.8
RM7001-RM8000	6	1.5	9	2.2
RM8001-RM9000	3	0.8	3	0.8
RM9001-RM10000	8	2.0	6	1.5
>RM10000	17	4.2	14	3.5

Table 4: Analysis of respondents to choice sets

Options	Generic form	Label form
Option1 / Terrace	52(12.9)	48(12.0)
Option 2 / Sustainable house 1	203(50.7)	213(53.2)
Option 2 / Sustainable house 2	145(36.4)	139(34.8)
Total	**400(100.00)**	**400(100.00)**

Table 5: Results of MNL Model

	Basic model (Model 1)		Extended model (Model 2)	
Variables	Generic form	Label form	Generic form	Label form
ASC_0	0.6310** (0.3187)	0.4455 (0.3196)	0.7042 (0.4494)	-0.5047 (0.4351)
ASC_0_AGE			-0.2711E-01*** (0.7457E-02)	0.1460E-01* (0.7611E0-02)
ASC_0_RACE			0.3106** (0.1390)	-0.3339** (0.1375)
ASC_0_GENDER			-0.1432 (0.1325)	-0.4164** (0.1298)
ASC_0_AHLI			-0.5923 (0.5233)	-0.2548 (0.5068)
ASC_0_AKADEMIC			0.3763** (0.1515)	0.6175*** (0.1850)
ASC_0_SECTOR			0.3348* (0.1739)	-0.4789 (0.1499)
ASC_0_CATEGORY			0.1939 (0.1648)	0.5596*** (0.15123)
ASC_0_INCOME			1.0841*** (0.2454)	0.1807 (0.2111)
ASC_0_TERRACE			0.1145 (0.1453)	0.4132** (0.1346)
ASC_0_BANGLOW			-0.8258** (0.3227)	0.1942 (0.3499)
ASC_0_OWN			0.1289 (0.1851)	-0.1043 (0.796)
ASC_0_RENT			0.3807E-01 (0.1941)	0.1060 (0.1967)
ASC_0_CONCEPT			0.4350E-01 (0.1430)	0.3803** (0.1365)
ASC_0_INFO			0.3815** (0.1452)	0.8677 (0.1372)
CO_2	-0.4537E-03 (0.3168E-03)	-0.4667E-03 (0.3182E-03)	-0.4869E-03 (0.3185E-03)	-0.4516E-03 (0.3194E-03)
RWH	0.1069E-03*** (0.3114E-04)	0.1804E-03*** (0.3162E-04)	0.1081E-03*** (0.3122E-04)	0.1834E-03*** (0.3179E-04)
AIR	0.2800*** (0.5791E-01)	0.3209*** (0.5829E-01)	0.2838*** (0.5813)	0.3228*** (0.5840E-01)
GREEN	0.6514E-01*** (0.1048E-01)	0.6481E-01*** (0.1054E-01)	0.6600E-01*** (0.1053)	0.6533E-01***

				(0.1057E-01)
PRICE	-0.1136E-01*** (0.1157E-02)	-0.1361E-01*** (0.1177E-02)	-0.1142E-01*** (0.1162E-02)	-0.1372E-01*** (0.1182E-02)
Summary statistics				
Log-likelihood	-2243.02	-2228.46	-2192.60	-2179.80
R^2 Adj	0.14	0.15	0.14	0.16
Iterations completed	6	5	7	6
Observation	2376	2376	2376	2376

Note: Parentheses indicate the standard errors of the respective coefficients.
*Significant at 10% levels
** Significant at 5% levels
*** Significant at 1% levels

Table 6: Variables Definition

Variables	Definition
V*i*	Individual utility taking the value of one (1) for choose an option and zero (0) not choose option
ASC_0	*Alternative spesific constant* (ASC) taking the value of one (1) for improved options and zero (0) for baseline option
CO_2	Carbon dioxide (CO_2) emission
RWH	Rainwater harvesting system
AIR	Natural indoor air ventilation
GREEN	Greeneries area
PRICE	Current house price
AGE	Age of respondent (ratio data)
RACE	Dummy variable (DV) equaling one (1) if respondent is Malay
GENDER	DV=1 for male
MEMBER	DV=1 if respondents who are members of any environmental related organizations
AKADEMIC	DV=1 if respondents who attain academic qualifications at tertiary level
SECTOR	DV=1 if respondents who are government servants
CATEGORY	DV=1 if respondents who are categorized as professionals and management related personnel
INCOME	DV=1 if respondents whose household income is more than RM5,000.00 per month.
TERRACE	DV=1 if respondents who are residing at terrace house
BANGLOW	DV=1 if respondents who are residing at banglow house
OWN	DV=1 if respondents who are residing in their own properties
RENT	DV=1 if respondents who are residing in their rent properties
CONCEPT	DV=1 if respondents who know the concept of sustainable housing
INFO	DV=1 if respondents who get information on the sustainable housing through televisión.

In this study, the experimental design is constructed based on the compensating surplus (CpS) welfare measure. It measures the change in income that would make an individual indifferent between the initial (lower environmental quality) and subsequent situations (higher environmental quality) assuming the individual has the right to the initial utility level. This change in income reflects the individual's WTP to obtain an improvement in environmental quality. Based on the indirect utility functions, the compensating surplus can be illustrated as follows:

$$V_0 (Z_i, X_0, M) = V_1 (Z_i, X_1, M\text{-}CS) \quad (7)$$

where M is income, X_0 and X_1 represent different levels of an environmental attribute, and Z_i represents other marketed goods.

Using the results from the multinomial logit, the CS can be estimated by employing the following equation [30].

$$CpS = -1/(\beta_M)\{\ln(\Sigma_i \exp^{V0}) - \ln(\Sigma_i \exp^{V1})\} \quad (8)$$

The above equation allows for the valuation of multiple sites. This study considers only one site. Therefore, following [31] & [32], equation (6) is reduced to:

$$CpS = \{- 1/(|\beta_M|)\}(V_0 – V_1) \quad (9)$$

where β_M is the coefficient of the monetary attribute and is defined as the marginal utility of income, and V_0 and V_1 represent initial and subsequent state, respectively.

Choice Model Implementation

According to choice model approach, consumers' WTP is ascertained based on their answer through questionnaire form. Respondents are asked a series of 6 very similar types of questions. This questions form also known as choice sets with three or more resource use options. Each of choice sets is defined by different levels of similar attributes. An experimental design procedure was used to form the choice sets by using SAS 9.0 statistical software.

Prior to determining the choice sets, there were several focus group sessions (FGDs) and intense literature searches to select the feasible atributes and their levels. All the FGDs members were provided with the background and issues of the study. The outcome of the FGDs with the defined attributes and levels is shown in Table 1. There were 2 formats (generic and label-spesific) used in this study because the study aspires to identify the labeling effect on the public choice for housing options.The generic format defined as Type 1 (the existing house) and Type 2 and 3 (the improved alternatives). For the label specific format, the actual name was shown, e.g., Terrace House (as existing house) and Sustainable House 1 and 2 (as the improved options).

Table 2 shows a sample of one of the final label-specific choice sets used in this study. The payment vehicle used in this choice model is the current house price for the urban area of Peninsular Malaysia.

Study Areas

The study area consist of the North, Middle, East and South of Peninsular Malaysia. Each of the selected Municipal Council was contacted to get the list of residential areas. One state has been chosen to represent each zone. The lists of the Municipal Councils were gathered from the government website and two of them were selected to represent the chosen states. Consequently, one hundred respondents who stayed in these residential areas had participated in this study.

Sampling Strategy

A total of 800 heads of urban households were interviewed: 400 respondents were surveyed using the generic format questioonaire, while 400 respondents also interviewed using the label-specific questionnaire. All of the respondents resided in the 4 selected zones consist of the North, Middle, East and South of Peninsular Malaysia was selected through multi-stage random sampling. One state has been chosen to represent each zone. The lists of the Municipal Councils were gathered from the government website and two of them were selected to represent the chosen states. Each of the selected Municipal Council was contacted to get the list of residential areas. Consequently, one hundred respondents who stayed in these residential areas had participated in this study. By considered the high survey cost and budget constraints, the sample sized was deemed comfortable for use in surveys on environmental valuation studies in Malaysia.

The survey took 3 months to complete with the employment of 9 enumerators who picked respondents randomly around the residential areas within the vicinities of chosen areas. All the enumerators attended trainings before conducting the survey. They were briefed on the choice model procedure, the idea of economic valuation, the types of sustainable housing technologies, background of the sudy and participated in role-play exercises to expose the enumerators to ways of obtaining cooperation from the respondents.

RESULTS AND DISCUSSION

All the socio-demographic data collected from the survey were analyzed (Table 3). There were two questionnaire formats (generic and label) were compared for the better understanding of respondents' profiles.

Respondents' Profile

The respondents' profile for the total sample of 800 is analyzed according to their socio-demographic and attitudinal variables. The discussion covered the aspects of gender, race, a number of households, education level, employment status and gross monthly income by comparing between generic format and label format as per Table 3.

The composition of male and female respondents was quite balanced, with a mean age of about 35 years. Malay respondents comprised the largest race composition of the survey for both formats. An average household was between 4 to 5 persons. Most of the respondents had completed at a certificate or diploma level, implying a high literacy rate of the samples. Respondents were mostly government sector workers, with the majority of them working in technical and service occupation levels. The mean household income was between MYR2001 to MYR3000.

Responses to Choice Sets

Table 4 shows the number and the percentage of respondents who preferred the different options under the 2 questionnaire forms: 12.9% and 12.0% of respondents of the generic and label-specific forms of the questionnaire, respectively, opted for the baseline option (i.e., Option1 and Terrace, respectively). The result indicates a strong preference for the sustainable house 1 in the both generic format (50.7%) and the specific label-format (53.2%). Nevertheless, there were strongly preferences for the Sustainable House 1 in the specific-label format as compared to generic format.

The finding clearly suggest that there were influenced of the realism in product characterization, i.e., specific technology labeling in the choice of options by respondents. In the choice model context, this finding suggests that researchers should consider employing and comparing the generic and specific-label formats.

Model Results

Based on the choice model analysis, there are two equations estimated by using multinomial logit (MNL) regression. The first equation is a basic model that shows the importance of the attributes in the respondents' choice for the 3 different options. The second equation is an extended model, incorporates the socioeconomic and environmental attitudinal variables. The heterogeneity in preferences can be captured by inclusion these variables. These variables also can help to estimate the effects of attribute changes on the probability that the base or improved option will be chosen.

Multinomial Logit (MNL) basic model (Model 1)

For the MNL basic model (Model 1), the utility function derived only based on the attribute variables and its' level:

Generic form

(a) Type 1 : Baseline or *status quo* (b) Type 2 and 3 : Improvement house with better environmental attributes

Label-specific form

(a) Terrace house : Baseline or *status quo* (b) Sustainable house 1 and Sustainable house 2: Improvement house with better environmental attributes

The utility of each function is determined by the attribute levels in the choice sets:

$$Vi = ASC_0 + \beta_1{*}CO2 + \beta_2{*}RWH + \beta_3{*}AIR + \beta_4{*}GREEN + \beta_5{*}PRICE$$

for i = 1, 2, 3 and $ASC_0 = 0$ for Vi = 1 and results shows in Table 5.

MNL extended model (Model 2). The MNL extended model assumes that there are several socioeconomic and environmental attitudinal variables influence the preferences and behavior of the respondents. Equation 2 is specified as:

$$Vi = ASC_0 + \alpha_1 ASC_0 AGE + \alpha_2 ASC_0 HHOLDS + \alpha_3 ASC_0 RACE + \alpha_4 ASC_0 GENDER + \alpha_5 ASC_0 MEMBER + \alpha_6 ASC_0 ACADEMIC + \alpha_7 ASC_0 SECTOR + \alpha_8 ASC_0 CATEGORY + \alpha_9 ASC_0 INCOME + \alpha_{10} ASC_0 TERRACE + \alpha_{11} ASC_0 BANGLOW + \alpha_{12} ASC_0 OWN + \alpha_{13} ASC_0 RENT + \alpha_{14} ASC_0 CONSEPT + \beta_1{*}CO_2 + \beta_2{*}RWH + \beta_3{*}AIR + \beta_4{*}GREEN + \beta_5{*}PRICE$$

for i = 1, 2, 3 and $ASC_0 = 1$ for Vi = 1

Implicit Prices

The implicit price (IP) reflects the marginal rate of substitution (MRS) between each of the identified non monetary attributes and the monetary attribute. These IP are obtained as the ratio of the coefficients of each attribute to those of the monetary attribute. These are also reflects the WTP for an additional unit of that attribute to be present, ceteris paribus. The attribute coefficients from the MNL models were used to compute the IP shown in Table 7.

Table 7: Estimates of Implicit Prices (MYR)

Attribute	Generic MNL (Model 1)	Generic MNL (Model 2)	Label MNL (Model 1)	Label MNL (Model 2)
CO_2	-0.0399[ns]	-0.0426[ns]	-0.0343[ns]	-0.0330[ns]
RWH	0.0094	0.0095	0.0133	0.0134
AIR	25.14	24.85	23.58	23.53
GREEN	5.73	5.78	4.76	4.76

[ns]Coefficient is not significant

Table 8: Estimation of Equilibrium Values in Generic Format

Atribute	MNL (Model 1)	MNL (Model 2)	Ranking of importance
CO_2	ns	ns	4
RWH	1.00	1.00	3
AIR	0.0004	0.0004	1
GREEN	0.0016	0.0016	2

[ns]Coefficient is not significant

Table 9: Estimation of Equilibrium Values in Label Format

Atribute	MNL (Model 1)	MNL (Model 2)	Ranking of importance
CO_2	ns	ns	4
RWH	1.00	1.00	3
AIR	0.0006	0.0006	1
GREEN	0.0028	0.0028	2

[ns]Coefficient is not significant

Table 10: Status quo and scenarios of improvement

Attributes	Status quo	Improvements				
		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
CO_2	1200 kg	360 kg	360 kg	480 kg	600 kg	600 kg
RWH	No	5000 liter	5000 liter	5000 liter	5000 liter	3000 liter
AIR	Not good	Very good	Good	Very good	Good	good
GREEN	7%	19%	13%	19%	13%	19%

Table 11: Estimates of Household CpS for Extended Models

Alternatives scenarios	WTP (MYR) Generic form	WTP (MYR) Label-specific form
Scenario 1	320,049	273,759
Scenario 2	260,522	221,585
Scenario 3	314,932	269,803
Scenario 4	250,289	213,674
Scenario 5	266,033	215,512

The implicit prices of the attributes estimated by the two econometric models do not differ significantly. [33] & [34] noted that the heterogeneity of the preferences of the respondents has little effect on this estimates. The smaller implicit price values, indicating that there are also possible in local valuation works.

Equilibrium Values and Ranking

The equilibrium values (EqV)of each of the non monetary attributes help to identify the tradeoffs between the non monetary attributes that would leave the individuals on the initial utility level. One's there have reference implicit price, the equilibrium values is calculated as:

$$EqV = WTP^{(\text{Reference attribute})} / WTP^{(\text{Interest attribute})}$$

Where rain water harvesting system (RWH) emission was used as the references attribute. For example, the EqV for AIR was calculated by dividing the implicit price (or WTP) of RWH by the implicit price of AIR: i.e., MYR0.0094/ MYR25.14 = 0.0004. The EqV for RWH itself is assumed to be 1.00. The EqV values calculated for each non monetary attribute, and the attributes were ranked according to their EqV values under generic and label formats (Table 8 and Table 9).

Based on the MNL Model 1, The EqV can be interpreted conceptually as the average utility derived by the households as a result of a unit improvement in RWH, 0.004 unit improvement in a natural indoor air ventilation (AIR), and 0.0016 unit improvement in green areas (GREEN) for generic format. The similar trend for label format can be calculated. The EqV allows the attributes to be ranked according to public importance, with the lowest EqV being ranked as the most important (AIR) and the highest or not significant EqV being the least important (CO_2). According to the result, the respondents are concerned about natural indoor air quality, followed by green areas, rain water harvesting system and CO_2 emission captures the least attention.

Compensating Surpluses

Compensating surpluses (CpS) is the amount of money an individual is willing to pay to attain an improvement that leaves him/her as well as if there were no improvement and no payment required. The attribute levels that characterize the status quo and alternative housing options, together with their respective CpS values, are listed in Table 10.

The CpS values were calculated based on the generic and label-specific formats for comparison. CpS estimates for each of the feasible and policy-relevant scenarios (1, 2, 3, 4 and 5) are shown in Table 11.

For example, scenario 1 shows the households on average appeared willing to pay less for the label-specific form (MYR273,759) as compared as generic form (MYR320,049). This outcome illustrates that labeling factor is important in decision making because involved 'realism' technology. The CpS estimates differ significantly between the models, indicating that public is more responsive to labeled housing alternatives, such as sustainable house 1 and sustainable house 2, than to those that are generic in nature.

CONCLUSIONS

The findings also reveal that Malaysian society preferred sustainable housing as compared to conventional housing. This study may be useful for policy makers and relevant authorities to provide more public-receptive housing facilities. Malaysian household is willing to pay for house improvements, provided that such improvements are beneficial and obvious to them. Results also are crucial, as it identifies a demand for better house options in the country. This information may help the government to strategize housing policies that are more implementable and acceptable by all stakeholders.

This result also reveals a significant labeling effect. The households is more WTP (as shown by the lower CpS) when the name ad attribute levels defining the facilities were made known to them. The relevant bodies may need to use greener or environmentally friendly for housing facilities in terms of their technology. These would give the households higher confidence in accepting the proposed options.

Finally, by weighing these values along with the market values of benefits and costs for the available improved options, policy makers such as Ministry of Housing and Local Government shall give some incentive scheme such as tax rebate for households or developers to stimulate the development of sustainable housing industry in Malaysia.

ACKNOWLEDGEMENT

This research was supported by Research University Grant Scheme (RUGS) from Universiti Putra Malaysia.

REFERENCES

[1] Shafii, F. (2007). Sustainable buildings in South-East Asia: Opportunities and implementation. *Conference on Sustainable Building South-East Asia (SB07).* Kuala Lumpur, Malaysia.

[2] Chan, S. A. (2009). Green Design Forum Preview of Green Building Index Malaysia. Retrieved from http://www.pam.org.my/Library/BA_PDF/BA_Jan09_FINAL.pdf

[3] Chiu, R.L.H. (2004). Socio-cultural sustainability of housing: A conceptual exploration. *Housing, Theory and Society, 21*(2), 65-76.

[4] Enterprise Community Partners, Inc (ECP). (2007). "Green communities criteria", Columbia, MD: Enterprise Community Partners, Inc. Retrieved from http://www.greencommunitiesonline.org/

[5] Stromberg, M. (2005). Green grow the buildings. *Planning, **7***(7), 16-21.

[6] Global Green USA (Global Green). (2006). *A blueprint for greening affordable housing: Developer guidelines for resource efficiency and sustainable communities*. Santa Monica, CA:Global Green. Retrieved from http://www.globalgreen.org/media/publications/housing.pdf)

[7] Shafii, F. & Othman, M.Z. (2007). Sustainable buildings in the Malaysian context. *Conference on Sustainable Building South-East Asia (SB07).* Kuala Lumpur, Malaysia, 5-7 November 2007.

[8] Ott, W., Jakob, M., Baur, M., & Kaufmann, Y., Ott, A., & Binz, A., (2005). *Mobilisierung der energetischen Erneuerungspotenziale im Wohnbaubestand (Mobilisation of the energy efficiency potentials of the residential building stock)*. Study on Behalf of the Research Program "Energiewirtschaftliche Grundlagen (EWG)" of the Swiss Federal Office of Energy (SFOE), Bern.

[9] Jakob, M., (2006). Marginal costs, cost dynamics and co-benefits of energy efficiency investments in the residential buildings sector. *Energy Policy, 34*, 172–187.

[10] Banfi, S., Farsi, M., Filippi, M., & Jacob, M. (2008). Willingness to pay for energy-saving measures in residential buildings. *Energy Economics, 30*, 503-516.

[11] Abdulla, F.A. & Al_Shareef, A.W. (2009). Roof rainwater harvesting systems for household water supply in Jordan. *Desalination, 243,* 195-207.

[12] Herrmann T. & Schmida U. 1999. Rainwater utilization in Germany: efficiency, dimensioning, hydraulic and environmental aspects. *Urban Water 1*, 307 – 316.

[13] Ghisi, E., Bressan, D.L., & Martini, M. (2007). "Rainwater tank capacity and potential for potable water savings by using rainwater in the residential sector of southeastern Brazil", *Building and Environment, 42*(4), 1654-1666.

[14] Platts-Mills, T.A.E. (1995). Is there a dose response relationship between exposure to indoor allergens and symptoms of asthma? *Journal of Allergy and Clinical Immunology, 96,* 435-440.

[15] National Association of Home Builders (NAHB). (2006). *NAHB model green home building guidelines*. Washington, DC: National Association of Home Builders. Retrieved from http://www.nahb.org/fileUpload_details.aspx?contentTypeID=7&contentID=1994)

[16] Wener, R. & Carmalt, H. (2006). "Environmental psychology and sustainability in high-rise structures", *Technology in Society, 28*, 157-167.

[17] Haber, G.M. (1977), "The Impacts of Tall Buildins on Users and Neighbors", In: Conway D, editor. Human response to tall building. Stroudsburg, PA: Dowden, Hutchinson, & Ross. 45-57.

[18] Nichols, K.W. (1977). "Urban office buildings: view variables", In: Conway D, editor. Human response to tall building. Stroudsburg, PA: Dowden, Hutchinson, & Ross. 72-80.

[19] Ulrich, R. (1994). View through a window may influence recovery from surgery. *Science, 224,* 420–421.

[20] Lagercrantz, L, Wistrand, M., Will, U., Wargocki, P., Witterseh, T., & Sundell, J. (2000). "Negative impact of air pollution on productivity: Paper presented at the proceedings of healthy buildings", Helsinki, Finland.

[21] Ben-Akiva, M. & Lerman, S. (1985). *Discrete choice analysis: Theory and application to travel demand*. Cambridge: MIT Press.

[22] Lancaster, K. (1991). *Modern consumer theory*. Edward Elgar, Brookfield.

[23] Manski, C. (1977). The structure of random utility models. *Theory and Decision, 8,* 229-254.

[24] Ben-Akiva, M. & Lerman, S. (1985). *Discrete choice analysis: Theory and application to travel demand*. Cambridge: MIT Press.

[25] Train, K. (1986). "Qualitative choice analysis: Theory, econometrics and an application to automobile demand", London: MIT Press.

[26] Louviere, J.J., Hensher, D.A. & Swait, J.D. (2000). *Stated choice methods—Analysis and applications*. Cambridge. Cambridge University Press.

[27] Greene, W.H. (2003). *Econometric analysis*. New York. Macmillan Publishing Company.

[28] Thomas, A. (2000). *Économétrie des variables qualitatives*. Dunod, Paris.

[29] Chamberlain, G. (1980). Analysis of covariance with qualitative data. *Review of Economic Studies, 47,* 225–238.

[30] Adamowicz, W., Louviere, J. & Williams, M. (1994). Combining revealed and stated preference methods for valuing environmental amenities. *Journal of Environmental Economics and Management, 26*, 271–292.

[31] Boxall, P., Adamowicz, M, Swait, J., Williams, M. & Louviere, J. (1996). A comparison of stated preference methods for environmental valuation. *Ecological Economics, 18,* 243-253.

[32] Morrison, M.D., Bennett, J.W. & Blamey, R.K. (1999). "Valuing improved wetland quality using choice modeling", *Water Resources Research, 35,* 2805-2814.

[33] Jamal, O., Bennett, J. & Blamey, R. (2004). Environmental values and resource management options: A choice-modelling experience in Malaysia. *Environment and Development Economics, 9,* 803-824.

[34] Pek, C.K. & Jamal, O. 2010. Household demand in solid waste disposal options in Malaysia. *International Journal of Business and Economic Sciences*, *2*(4), 229-234.

About The Authors

Name: Zuroni Md Jusoh

Description: Zuroni Md Jusoh (BSc, MEcon, UPM) is a Senior Lecturer of Consumer and Family Economics, at the Faculty of Human Ecology, Universiti Putra Malaysia. 43400 Serdang, Selangor, Malaysia.

Mailing address: A2-16, Department of Resource Management and Consumer Studies, as well as an Associate Researcher at the Centre of Excellent for Sustainable Consumption Research, Faculty of Human Ecology, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

Tel: 603-89467111

Fax: 603-89436157

e-mail: zuroni@putra.upm.edu.my