Consumers' Willingness to Pay for Environmental Attributes of a Cut Flower in Ethiopia: A Choice Experiment Approach

Ahmed Seid Hassen*

Abstract

The paper aims at valuing consumers' willingness to pay for environmental attributes of a cut flower using choice experiment and hence identifying the presence of a hypothetical market for environmental friendly flowers. Considering the local and global environmental impacts of floriculture, two environmental attributes of a cut flower namely, Eco-labeling (EHPEA-CP label) and Carbone footprint together with a price attribute were selected for choice experiment. Survey data from 200 randomly selected consumers were employed and two multinomial logit models and a random parameter logit model were used for estimations. The estimated results from all models reveled that respondents had the willingness to pay for both environmental attributes of a cut flower and they were willing to pay 1.98 birr and 10 birr for eco-label and carbon footprint attributes of a cut flower respectively, valuing carbon footprint more than eco-labeling. Based on the welfare estimates, consumers were willing to pay 10.47 birr for a bronze labeled and carbon neutral cut flower; 12.45 birr for a flower with silver brand and medium (neutral) carbon footprint and 24.43 birr for brand gold and carbon saving (low) flower. Thus, environmental friendly flowers may find a niche market in Ethiopia.

Key Words: Environmental attributes; choice experiment; willingness to pay (WTP); cut flower

1 Introduction

Floriculture is an emerging industry in the world and has become a very important source of export products for several developing countries in East Africa, South and Central America and the Middle East. The demand for cut flowers in international markets of Europe, North America, and East Asia, which accounted for %90 of world demand in 2012, has been growing rapidly over the last few years. At global level, the export of cut flowers has been growing recently by %10 each year and it reaches 25 billion USD in 2012. (International-Trade-Center, 2012)

The suitable and diverse agro-climatic conditions make Ethiopia the right place to engage with floriculture sector. It is a country with 12 river basins, 18 national lakes and 3.7 million hectares of potentially irrigable land together with weather condition and well-drained soil suitable for growing horticultural products including cut flowers. (Embassy of Ethiopia in USA, 2006)

Floriculture develops as one of the booming sub-sectors in Ethiopia with extremely fast growth and successful diversification to non- traditional export products. (Gebreeyesus and Iizuka, 2012) Supported by government incentives, private investment in the Ethiopian floriculture industry has been rising and its contribution to the national economy has become significant in recent years. In 2011/12, the country has earned around 170 million USD by exporting more than 1.7 billion cut flowers, produced by 80 flower farms. Besides, more than 350,000 people have benefited from the horticulture

*Corresponding author. Tel.: +90-553-541-1249; E-mail address: ahmedseid999@gmail.com or ahmed.seid.hassen@os.gazi.edu.tr

where floriculture has the lion's share. This is a big potential not only in earning foreign exchange but also in diversifying exportable products and opening huge job opportunities (Beza, 2012; EHPEA, 2012).

However, the floriculture industry undesirably and adversely affects the natural environment despite its economic role. Firstly, excessive use of chemical inputs and disposal of waste residual are extremely hazardous for the local environment. According to Ministry of Agriculture, Ethiopian floriculture industry has been applying more than 300 types of chemical pesticides and fertilizers (Sisay, 2007). But it is estimated that only %0.1 of the applied pesticides reaches the target pest, discharging %99.9 as pollutant in to the environment (Pimentel, 1995). According to a study by Malefia et al. (2009), the high level of fertilizer residuals releasing to Lake Ziway reduces the irrigable capacity of the Lake.

Secondly, the production and transportation of cut flowers emits greenhouse gases and hence affect the global environment. Flower production uses excessive energy, especially when cultivated under greenhouses, causing air pollution and global warming (Michaud et al., 2012). Moreover, more than 90% of pesticides can be volatile, i.e. evaporates and contaminate the environment within a few days of application (Glotfelty and Schomburg, 1989; Majewski and Capel, 1996)

Although Ethiopian Horticultural Producers and Exporters Association (EHPEA) Code of Practice was introduced in 2007, almost all growers that comply with the practice are of only at Bronze level which set a much lesser standards than internationally recognized codes such as International Code of Conduct (ICC), Floriculture Environmental Program (MPS) and Fair Flowers Fair Plants (FFP)(Mulugeta, 2009; EHPEA, 2011). In addition, this is not a label that communicates producers with end users but only a certificate that communicates producers with buyers. Furthermore, compliance with the code and cultivating under the standards reduces productivity and hence raises cost of production causing price difference among flowers. Thus, a grower who complies with the standards will transfer the extra cost to consumers by labelling its cut flower and adding a price premium.

Thus, in providing valuable information to mitigate the environmental impact of floriculture industry, the study tries to identify the presence of a hypothetical market for environmental friendly flowers by valuing consumers' willingness to pay (WTP) for environmental attributes of a cut flower using choice experiment approach. It aims to estimate consumers' marginal willingness to pay for environmental attributes of a cut flower in Ethiopia; and also to determine the socio economic characteristics that influence consumers' willingness to pay for environmental attributes of a cut flower.

2 Literature review

2.1 Environmental Valuation Techniques

Environmental valuation of non-marketable goods and services is a technique employed to attach a value for the benefit obtained from the environment and natural resources. Valuation of natural resources like forests, water sources and fishery; and environmental services like clean air, recreations and amenities is useful as such resources yield flows of service to people in increasing its welfare. (Freeman, 1993) The non-market value of environmental attributes of a cut flower needs to be determined and expressed in monetary terms so that policy makers can use it in attempting to mitigate environmental impacts of floriculture industry in Ethiopia. Information on WTP of consumers for environmental friendly flowers will also be used as an input for cost benefit analysis of flower farm projects.

Various valuation techniques have been developed and employed by environmental economists. As one of the direct stated preference techniques, contingent valuation method is used in assessing perception of respondents about their willingness to pay for a hypothetical scenario. This is used to estimate the use and non- use values of environmental resources. The method consists of designing the survey instrument and construction of scenario; collection of data about ?willingness to pay or accept'; assessing and analyzing the surveyed data including estimating values of ?willingness to pay or accept';

calculating aggregate ?willingness to pay and accept' and implementing sensitivity analysis. (Perman, 2003)

As an alternative to contingent valuation method, choice modelling is employed. This is a survey-based methodology where respondents are presented with various alternative descriptions of a good differentiated by their attributes and attribute levels. Respondents, then, are asked to choose, rank and rate attributes and attribute levels in accordance with their preference. It can be used to estimate both use and non-use values of environmental goods. Selection of environmental attributes; assignment of attribute levels; choice of experimental design; construction of choice sets to be presented to respondents; measurement of preferences as either ranking, rating or choice; and estimation procedure are the steps in using choice experiment. Choice modelling is advantageous to contingent valuation as it is apposite with situations where changes are multi-dimensional and the trade-offs between them are of particular interest. (Hanley et al., 2001) It is also relatively more efficient since it reduces potential sources of biases, and enables welfare estimates and benefit transfers and eases context flexibility. (Alpizar Rodriguez et al., 2001)

Travel cost method is another variant form of revealed preference valuation technique which is employed to value recreational uses of natural resource system. The method is mostly used to value recreational sites like parks and is based on the idea that environmental good is approximated by the cost that visitors incurred in order to enjoy the service rendered by the good. Hence, the survey data about the number of trips to and the total cost from a recreational site is used to estimate values of parameters of compensating demand function via ordinary least squares. Then from these surrogate demand functions, which depict the relationship between number of visits and admission fee, marginal consumers' surplus is determined. (Freeman, 1993)

2.2 Empirical Evidence

There are many researches done on valuation of environmental goods and services in Ethiopia. Nevertheless, a single study couldn't be found that estimate willingness to pay for environmental attributes of a cut flower in the country. In Netherlands, however, Michaud et al. (2012), on their study entitled "Willingness to Pay for Environmental Attributes of Non-Food Agricultural Products: A Real Choice Experiment" investigates consumers' willingness to pay (WTP) a price premium for two environmental attributes of a non-food agricultural product. The study investigates individual's preferences for roses associated with an eco-label and a carbon footprint attributes using an economic experiment combining discrete choice questions and real economic incentives involving real purchases of roses against cash. It analyses data with a mixed logit model and reveals significant premiums for both environmental attributes of the product. The study finds that individuals positively and significantly value for environmental attributes of roses, i.e. carbon footprint and FFP (Fair Flowers Fair Plants) label but they interestingly value a low carbon footprint than the FFP eco label. The study divulges that individual respondents were willing to pay ϵ1.73 for the attribute of FFP eco-label while they showed their willingness to pay ϵ4.09 for the attribute of carbon footprint. Moreover the study finds that being male and organic purchaser had a significant effect on probability of choice.

There are various studies conducted to value environmental goods and services in Ethiopia and elsewhere. A study conducted by Chengyan et al. (2010) estimated the premium that floral consumers are willing to pay for biodegradable plant containers using choice modelling. Sangkapitux et al. (2012), on the other hand, conducted their research on consumers willing to pay for environmental and ethical attributes of fruit and vegetables in the highlands of northern Thailand. Daisuke (2006) employed choice experiments as a method to estimate tourists' willingness to pay for the development of ecotourism in Uaxactún, Guatemala.

Metkel (2011) used choice experiment in order to estimate non market welfare gain from various improved solid waste management alternatives for households in Axum Town, Ethiopia. Nega (2012) on his thesis analysed the determinants of households' willingness to pay for irrigation water supply in South Gondar using contingent valuation and choice experiment methods. Using choice experiment, Getnet (2012) identified four attributes i.e. biodiversity, water availability, recreational facility and monetary attribute to assign monetary value for the multi functions and services offered by Choke mountain wetland ecosystem, Ethiopia.

3 Methodology

3.1 Data Source and Sample Size

The data for the study was obtained from primary sources. It was randomly collected from a sample of respondents who were flower purchasers from a flower shop in Addis Ababa. The sample size for the study was limited to 200. In specifying a flower shop that the survey was conducted, Bole sub city was purposefully selected from among ten sub-cities in Addis Ababa. This is due to the reason that most flower shops with many customers exist in the sub city. Again from flower shops which were functioning in the sub-city, a big flower shop with many customers (Hirut Natural Flowers) was purposely chosen and its customers were selected as target population purposefully. In doing so, systematic random sampling technique was employed in collecting the data. Thus, the data was randomly collected from every second customer of the shop for four consecutive weeks in March and April, 2013.

After review of literatures around the topic, two environmental attributes of a cut flower together with a payment attribute were selected. These are i) Ethiopian Horticultural Producers and Exporters Association (EHPEA) - Code of Practice Certificate Eco-label; ii) carbon foot print and iii) price.

The attributes were determined based on environmental impacts of cut flower cultivation. The environmental impacts can be grouped in to two major classifications. The first one relates to the heavy use of pesticides, fertilizers, water and energy during cultivation. This results in soil and water pollution and thus harms the local environment. To mitigate such problems, flower are cultivated under specific standards and dedicated to eco-labels such as the American ?VeriFlora Certified Sustainably Grown' and the European ?Fair Flowers Fair Plants (FFP)' label which assures least environmental impact production. (Michaud et al., 2012) The Ethiopian equivalent is EHPEA Code of Practice. Thus, purchasers of a cut flower were faced with three alternative purchases plans for environmentally friendly labelled flowers, other than the status quo of unlabelled one. These were Bronze, Silver and Gold level of EHPEA-CP Eco-label.

The second environmental characteristics of flowers relates to the emission of greenhouse gases during production and transportation. Energy consumptive nature of flower cultivation under greenhouses emits carbon dioxide to the environment. Thus, carbon footprint attribute of flowers was assigned to capture such an impact. (Michaud et al., 2012) Regulation plan for lowering carbon emission embraces three alternative scenarios. High level of emission with no regulation (High); reducing emission by %25 (Medium); and reducing it by %50 (Low), thus, are the three attribute levels.

A price attribute was included and it is the price of a cut flower in Addis Ababa that includes the premium for its environmental attribute. Birr 1.5 per cut was the status quo price level and Birr 3, 4.5, 6 and 7.5 were presented to respondents as alternative price levels for flowers with environmental attributes of various kinds.

3.2 The Choice Experiment Model Specification

Random utility theory formulated by Luce (1959) and McFadden (1974) and consumer choice model formulated by Lancaster (1966) are foundations for choice experiment. These foundations are used in estimating the effects of product attributes and individual characteristics and in computing willingness to pay indicators. (Michaud et al., 2012) In such kind of method, various alternative descriptions of the good with its attributes and levels will be provided to respondents to observe their choice. (Hanley et al., 2001). Thus, the total utility derived from consumption of a good is a function of the observable component whose value depends on the attributes of the good and the unobservable error term which is assumed to be independently and identically distributed (Louviere et al., 2000). The models I used for choice experiment were employed by Michaud et al. (2012).

3.2.1 Multinomoial Logit Model

By using Multinomial Logit (MNL) model, the choice probabilities can be estimated assuming i) the random components are independently and identically distributed (IID), implying that the options to be chosen are independent from irrelevant attributes (IIA), ii) the choice probabilities of the alternatives depend only on the differences in the systematic utilities of different alternatives and not on their actual values and iii) the probability range between 0 (when the utility of the alternative is very low relative to other alternatives) and 1 (when the utility of the alternative is very high relative to other alternatives). (Alpizar Rodriguez et al., 2001))

For a decision maker i, the utility (or net benefit or wellbeing) of choosing option j is a function of the characteristics of the alternative j. The utility function, U_{ij} is composed of a systematic part, V_{ij} which in turn is composed of environmental attributes of cut flower (Z_{ij}) and socioeconomic characteristics of the individual (S_{ij}), and a random part E_{ij} that stands for all unobserved random variables. (Michaud et al., 2012)

$$U_{ij} = V(Z_j, S_j) + E_{ij} \tag{1}$$

But it is impossible to predict and understand preferences perfectly because of the random component. Therefore, preferences are interpreted in terms of probabilities (Hanley et al., 2001). Thus the probability of choosing alternative j is expressed in equation (2).

$$P(i/C_n) = P(u_j > u_h) = P(v_{jn} - v_{hn} > \varepsilon_{jn} - \varepsilon_{hn}) \tag{2}$$

Expressing the systematic component of the utility function by vector of explanatory variables and their coefficients can be presented as equation (3) . (Adamowicz et al., 1998)

$$V_{jn} = \beta' x_{jn} \tag{3}$$

Inserting equation (3) into equations (1) and (2) and rearranging gives the probability that consumer n will choose an option in terms of the systematic and error components and hence enables to estimate the values of vectors of parameters (β's). (Adamowicz et al., 1998)

$$P(i/s_n) = P[(\beta' x_{jn} + \varepsilon_{jn}) > P(\beta' x_{hn} + \varepsilon_{hn})], \forall j \in c \tag{4}$$

The criterion for the utility maximizing consumer i of this flower with environmental attributes to choose option j from option h in the choice set C_n is that the systematic and unobservable components of option j is greater than that of option h. (Adamowicz et al., 1998)

The probability of choosing alternative scenario j in MNL model has the following expression, assuming the IID distribution of the random term and independence between alternative scenarios and individual attributes.

$$P(j) = \frac{\exp^{\lambda \beta x_j}}{\sum \exp^{\lambda \beta x_h}} \tag{5}$$

λ is the scale parameter. (Adamowicz et al., 1998)

The model can be estimated by maximum likelihood estimation taking the log likelihood function.

$$\log L = \sum_{i=1}^{N}\sum_{j=1}^{J} y_{ij} \log\left[\frac{e^{v_{ij}}}{\sum_{j=1}^{J} e^{v_{ij}}}\right] \tag{6}$$

y_{ij} is an indicator variable that takes a value of 1 if respondent i choose option j and 0, otherwise. (Hanley et al., 2001)

3.2.2 Random Parameter Logit Model (RPL)

The applicability of MNL model is limited as its assumption of independence of irrelevant alternatives (IIA) and taste homogeneity of individuals are mostly violated. Hence Mixed logit models such as random parameter logit (RPL) model and the error components logit (ECL) model are currently quite popular as they allow for heterogeneity of preferences while the IID behavior of random components is still assumed. Accordingly, random parameter logit model, among other mixed logit models, has been employed by recent empirical studies as it allows for random taste variations accommodating heterogeneity for observed attributes (Mariel et al., 2013).

By relaxing the assumptions of the conditional logit model, the utility of person i from choosing alternative j in the random parameter logit model is given by equation 7. (Mariel et al., 2013)

$$U_{ji} \equiv V_{ji} + \varepsilon_{ji} \equiv Z_j(\beta + \mu_i) + \varepsilon_{ji} \tag{7}$$

The utility (U) of a respondent i from choosing option j is a function of the systematic component (V) and random term (ε). The indirect component is functionally related to Z which represent k vector of observed attributes with β vector of mean attribute utility weights in the population that may vary across respondents by a random error μ_i. Socio-economic characteristics can be included in the model as constants.

Thus, the probability of choosing option j from each of the choice sets will have the following form. (Hanley et al., 2001)

$$P = \frac{e^{Z_{ji}(\beta+\mu_i)}}{\sum e^{Z_{hi}(\beta+\mu_i)}} \tag{8}$$

The RPL model allows for interaction between the socio-economic characteristics of respondents and the attributes or the alternative constant term (ASC) and thus, taste variation among respondents can be incorporated in to the model (Alpizar Rodriguez et al., 2001)

Moreover the RPL model is more superior to MNL model in terms of overall fit, welfare estimates and consideration of taste variation across populations. The systematic component can be written as follows. (Birol et al., 2006)

$$V_{ij} = ASC + \sum \beta_k Z_k + \sum \beta_m S_m \tag{9}$$

ASC is the alternative specific constant which captures the status quo bias i.e. the effect of attributes that are not included in the model (Adamowicz et al., 1998) or/and following Mogas (2006), Hoyos (2010) indicated that it is interpreted as utility premium for moving away from status quo to alternatives; k is the number of attributes; and m is the number of socio-economic characteristics of subjects; (Alpizar Rodriguez et al., 2001)

3.2.3 Estimates of Willingness to Pay Premiums and Compensating Surplus

The willingness to pay (WTP) premium for a unit change of a given attribute of a product can be computed as the marginal rates of substitution between the quantity expressed by the attributes and the price of the product. (Louviere et al., 2000) Since utilities are modelled as linear functions of the attributes of the flowers, the marginal rate of substitution between two attributes is the ratio between their coefficients. (Michaud et al., 2012)

The WTP premium for environmental attributes of a cut flower is, thus, expressed as follows.

$$WTP = (\partial V/\partial X_k)/(\partial V/\partial Price) = (-\beta_k)/\beta_{price} \tag{10}$$

k's are the attributes and β's are the estimated coefficients of each attributes in the MNL and RPL models.

Given the indirect utilities obtained from status quo and changed plans as V_0 and V_1;

and β as price coefficient, compensating surplus, an estimate of welfare measure, takes the following form. (Birol et al., 2006)

$$\text{Compensating surplus} = -(V_0 - V_1)/\beta_{price} \tag{11}$$

3.2.4 Specific Equation for Choice Experiment Method

In both MNL and RPL models, three utility functions were estimated for three alternatives, i.e. status quo, environmental purchase plan 1 and plan 2. The basic and extended MNL models are expressed in the following general forms:

$$V_i = ASC + \beta_1 ECOL + \beta_2 CARBF + \beta_3 PRICE \tag{12}$$

$$\begin{aligned} V_i = ASC + \beta_1 ECOL + \beta_2 CARBF + \beta_3 PRICE + \theta_1 ASC_i * GENDER \\ + \theta_2 ASC_i * AGE + \theta_3 ASC_i * INCOME + \theta_4 ASC_i * EDUC \\ + \theta_5 ASC_i * MARITAL + \theta_6 ASC_i * ORGH + \theta_7 ASC_i * AWARN \end{aligned} \tag{13}$$

ASC_i is alternative specific constant and takes the value 0 for status quo option and 1 for purchase alternatives 1 and 2; β_1, β_2, and β_3 are coefficients associated with eco-labelling, carbon footprint and price attributes respectively. V_i is the indirect utility for alternative i, where i is between 0 and 2. $ECOL$ stands for eco-label and $CARBF$ for carbon footprint. Gender ($GENDER$), age (AGE), monthly income ($INCOME$), educational status ($EDUC$), marital status ($MARITAL$), organic purchase habit ($ORGH$) and environmental awareness ($AWARN$) were included as socio-economic variables. θ_i is the coefficient of the variables associated with these socioeconomic characteristics.

3.3 Experimental Design

The combination of attributes and levels yields choice sets. Accordingly, eco-label takes four levels, carbon footprint attribute has three levels and the monetary (price) attribute takes four levels. The number of cut flower purchase alternatives that can be generated from three attributes with five, four and three attribute levels is 60 (51*41*31=60). This is the complete factorial design that yields very large and non-practicable combination (Richard et al., 1994). Thus, fractional factorial design was employed and six choice sets were selected as optimal choice sets from 60 possible combinations. This was done using the SAS software in orthogonal design method using OPTEX procedure. Each respondent was asked to choose from six choice sets with three options, two with various combinations of attribute levels and one status quo. An example of choice sets is presented in Table 1.

Table 1: Example of a Choice Set

Attributes	Alternative 1	Alternative 2	Status quo
Eco-label	Bronze	Bronze	unlabelled
Carbone footprint	Medium (Emission reduced by 25%)	Low (Emission reduced by 50%	High
Monetary payment (Price)	Birr 3/cut flower	Birr 7.5/cut flower	Birr 1.5/cut flower

Source: Researcher's Compilation

4 Empirical data analysis

4.1 Descriptive Analysis

The descriptive statistics reveals that 58% of respondents were female and the rest are male. From the total of 200 respondents, 56% (112) of them came from Bole sub city since it is where the survey was conducted. The average age of the respondents were 30.4 years with a minimum of 16 and maximum of 58 years. Respondents have a minimum of 3 years and a maximum of 20 years of education with more than 45% of them hold their first degree. This is because literate people are expected to have flower purchasing habit than illiterate ones in Ethiopia. Married respondents constitute nearly 46% of the total, while 52% of them were single. Self-employment constitutes more than 35% of means of livelihood of respondents and the average monthly income was calculated as 6864.33 birr per month. Out of the total respondents, 77% of them have a purchasing habit of organic products and 66% of them frequently purchase flowers.

Information about attitude and perception of respondents were collected in the survey in order to capture their knowledge and observation about the impact of flower production and transportation on the natural environment. Following this, the surveyed data confirms that 85% of them have awareness about the impact, despite economic contributions, of economic activities on environment. More than 95% of respondents agreed on the statement that flower industries have environmental impact beside economic contribution. Furthermore, nearly 77% of them agreed on the presence and significance of the problem in the floriculture industry of Ethiopia.

Table 2: Descriptive Statistics

Variable	Mean	St. Dev.	Minimum	Maximum
AGE	30.4031	7.89994	16	58
EDUC	14.4447	2.52792	3	22
GENDER	0.425278	0.494454	0	1
INCOME	6864.33	9499.23	0	50000
MARITAL	0.459722	0.498444	0	1
ORGH	0.774722	0.417823	0	1
AWARN	0.85	0.357121	0	1

Source: Survey Data

The perception of respondents about environmental and health impacts of floriculture was ranked based on severity in terms of air pollution, water pollution, impact on aquatic life, reduction of amount of water, impact on animal health, impact on workers' health, impact on soil organisms and soil quality degradation. Extensive literature review was done in pointing out the impacts. Accordingly, 31.9% of them rank the impact of flower production on health of workers and the community living around flower farms as the most severe problem. This is followed by the impact it imposes on the life of soil organisms and soil quality degradation. Following these, air pollution, water pollution, impact on animal health, reduction of amount of water and impact on aquatic life were also mentioned by respondents in respective of their severity.

Excessive use of chemicals such as fertilizers (specifically phosphorus and nitrogen) and pesticides (herbicides, fungicides and insecticides) on the farms and the limited care facilities provided by owners to workers are the major justifications for these problems. According to Ministry of Agriculture, Ethiopian floriculture industries use more than 300 chemicals as pesticides (insecticides, fungicides and nematocides) and growth regulators (Sisay, 2007)

In addition, the cultivation of flowers under greenhouses emits greenhouses gases causing air pollution and contributing to global warming. Moreover, cultivation of flowers is highly energy consumptive, especially when grown under greenhouses (Michaud et al., 2012). Waste materials when discharged from the farms to the nearby environment pollute water and degrade soil quality.

More than 44% of respondents considered government as the major responsible body for the presence as well as alleviation of the problem. Almost 40% of them mentioned both flower farm owners and government as responsible bodies for the environmental problems of flower farms and hence for the solutions.

To reduce the impact of flower production and transportation, respondents indicated major environmental protective measures. Majority of respondents pointed out that environmental regulation on the use of fertilizers and pesticides and on the emission of carbon dioxide as well as the recycling of waste products should be strictly taken into consideration by concerned bodies as a measure at least to reduce the environmental influence of flower cultivation and transportation caused by the use of chemicals, disposal of waste materials and cultivation under green houses. More than 26% of respondents emphasized on the use of organic inputs as a possible alternative.

Table 3: Respondents' perception on Possible Measures to be taken to mitigate the Problem

Measures	**Frequency**	**Percentage (%)**
Environmental regulation on the use of fertilizers and pesticides	125	22.7
Environmental regulation on the Emission of carbon dioxide	112	20.4
Recycling and proper disposal of waste products	135	24.5
The use of organic inputs	147	26.7
Abolishing flower farms from the country	5	0.9
Other measure	26	4.7
Total	550	100.0

Source: Survey Data

Respondents also indicated other solutions such as using non- fertile and non- farm land; limiting the number of farms to a specified number; using technologies towards organic production and bed growing; and locating farms in a way local farmers may not be displaced; and locating farms far away from urban dwellings. In addition, creating environmental compensation mechanisms to those the activity costs a lot; undertaking extensive research; and learning useful and feasible experiences of other countries and creating awareness to the community about environmental impacts of economic activities and environmental protection were also suggested.

4.2 Econometrics Results and Analysis

For estimation, LIMDEP8.0 NLOGIT4.0 econometrics software was employed and results from the basic and extended multinomial logit models as well as the random parameter logit model is presented in Table 4, Table 5 and Table 6 respectively.

4.2.1 The Basic Multinomial Logit Model

The estimation of the basic multinomial logit model reveals that all attributes, namely eco-labelling ($ECOL$), carbon footprint ($CARBF$) and monetary attribute ($PRICE$) possess the expected sign and significance. This reveals that a cut flower is more likely to be chosen if it is labelled at high level, if its carbon footprint is low and if it is cheap. This is to mean that an increase in the level of eco-label and carbon footprint attribute; and a decrease in the level of price attribute, will significantly raise the probability of choosing environmental friendly alternative flower with the higher levels of the attribute.

Additionally, estimation of the model reveals a negative and significant value for the alternative specific constant (ASC). This means that the utility of respondents decreases as they move away from the status quo to alternative purchase plans. According to Samuelson and Zeckhauser, such kind of result might be due to status quo bias. Status quo bias is a common economic phenomenon and is supported by lots of evidences from literatures. (Adamowicz et al., 1998) In our cases there were 26 respondents choosing the status quo option in all choice sets, valuing the current situation more than improved ones. This could be due to mistrust of concerned bodies to mitigate the local and global environmental impact of floriculture through standardizing production and reducing carbon emission. In addition, choosing among options might be complex to these respondents and they might be uncertain whether they are willing to make trade-offs or not. Choosing current conditions could also be considered as protest response. But ignoring such a clear preference for status quo and excluding from the model will definitely results in a bias estimation. (Adamowicz et al., 1998)

Table 4: Results of the Basic Multinomial Logit Model

Variable	Coefficient	St. Error	b/St.Error	P[|Z| > z]
ASC	-0.40521750**	0.13272937	-3.053	0.0023
$ECOL$	0.80947865***	0.12112121	6.683	0.0000
$CARBF$	6.13747642***	0.44340277	13.842	0.0000
$PRICE$	-0.6539125***	0.08384249	-7.799	0.0000
Log Likelihood Function				-476.1119
R-squared				0.35872
Number of Observations				1200

**** Significant at 1%; **significant at 5%*
Source: Survey Data

4.2.2 The Extended Multinomial Logit Model

The extended multinomial logit model incorporates variables of gender, age, monthly income, educational status, marital status, organic purchase habit and environmental awareness. These variables were allowed to interact with the alternative specific constant (ASC) to account for heterogeneity of preferences. (Metkel, 2011)

The inclusion of these variables improves the overall fit of the model as the likelihood function of the model decreases in absolute term and the pseudo R-square increases. But surprisingly, all coefficients for the interactions of ASC with socio-economic and demographic variables were found to be insignificant although some of them have the expected signs in relating with the probability of choosing environmental friendly flower. This is to mean that socio-economic characteristics are not important sources of preference heterogeneity among respondents.

The estimated value of the pseudo R-square in the basic and extended multinomial logits models are 0.35872 and 0.35962 respectively. This dictates the overall significance and good fit of both models, for it lies between 0.2 and 0.4 which is a reference range. (Hensher et al., 2005)

Table 5: Results of the Extended Multinomial Logit Model

Variable	**Coefficient**	**St. Error**	**b/St.Error**	P[$\|Z\| > z$]
ASC	-0.21338417	0.57340502	-0.372	0.7098
$ECOL$	0.81079208***	0.12126015	6.686	0.0000
$CARBF$	6.14513623***	0.44389745	13.844	0.0000
$PRICE$	-0.6549925***	0.08393559	-7.804	0.0000
$ASC * INCOME$	0.895973D-06	0.94753D05	0.095	0.9247
$ASC * EDUC$	-0.00651828	0.03342840	-0.195	0.8454
$ASC * AGE$	0.00418424	0.01228081	0.341	0.7333
$ASC * GENDER$	-0.14807242	0.17063126	-0.868	0.3855
$ASC * MARITAL$	-0.05577831	0.18634234	-0.299	0.7647
$ASC * ORGH$	-0.11366835	0.21619036	-0.526	0.5990
$ASC * AWARN$	-0.05660912	0.24265636	-0.233	0.8155
Log Likelihood Function				-476.1119
R-squared				0.35872
Number of Observations				1200

**** Significant at 1%; **significant at 5%*

Source: Survey Data

4.2.3 The Random Parameter Logit Model

As indicated in Table 6, the pseudo R- square is higher and the absolute value of the log likelihood function is lower than that of the multinomial logit models. This validates the better explanatory power of the random parameter logit model, still allowing for heterogeneity of preferences while the IID behaviour of random components is assumed.

The estimates demonstrate that the attributes of eco-label ($ECOL$) and carbon footprint ($CARBF$) retain the expected sign and 1% significance. This confirms that respondents had the willingness to pay a premium for environmental attributes of a cut flower. Though incurs extra money, respondents gain more utility by purchasing and consuming labelled flowers produced under specific environmental standards and carbon saving (low) technology. The coefficient of price attribute ($PRICE$) tells a fact about significant and inverse relationship between the price of a cut flower and the utility obtained from consuming labelled flowers with low carbon footprint. In addition, the significance of the standard deviations shows an important heterogeneity in consumers' preference for the eco-label and carbon footprint attributes (Michaud et al., 2012).

Contrary to estimation of the MNL model, the sign of coefficient of the alternative specific constant (ASC) is positive, adding an evidence for the superiority of RPL model over MNL model in terms of overall fit, welfare estimates and consideration of taste variation across populations. Therefore, the utility of respondents increases as they move away from status quo to alternative purchase plans. In

Table 6: Results of the Random Parameter Logit Model

Variable	**Coefficient**	**St. Error**	**b/St.Error**	P[|Z| > z]
ASC	0.02525411	0.30084860	0.084	0.9331
BECOL	1.92821559***	0.32595546	5.916	0.0000
BCARBF	9.74112817***	1.00985968	9.646	0.0000
BPRICE	-0.9737419***	0.15445791	-6.304	0.0000
Log Likelihood Function				449.4603
R-squared				0.39462
Prob[χ^2 > value]				0.0000
Number of Observations				1200

****Significant at 1%*

Source: Survey Data

other words, respondents will be well off by consuming environmental friendly flowers than unfriendly ones.

4.2.4 Estimates of Marginal WTP Premiums

Marginal willingness to pay represents the rate at which subjects are willing to pay a premium for increased level of attributes and thus exposes the relative importance of the attributes to respondents. (Hanely et al, 2001)

Table 7: Estimates of Marginal WTP Premiums (in Birr/Cut Flower)

Attributes	**MWTP in Birr/cut flower**	**St. Error**	**b/St.Error**	**P[|Z| > z**
ECO-LABEL	1.98021222***	0.29057130	6.815	0.0000
CARBON FOOTPRINT	10.0038093***	1.25217558	7.989	0.0000
Wald Statistic				77.60052
Probability from Chi-squared[2]				0.00000

****Significant at 1%*

Source: Survey Data

Table 7 provides a brief presentation of the marginal WTP premium estimates from the random parameter logit model. Accordingly, respondents' marginal WTP a price premium for carbon footprint and eco-label attributes of a cut flower is 10 birr and 1.98 birr respectively. The values of these premiums endorse that the presence of theses environmental attributes generally raises the overall utility from consuming a cut flower (Michaud et al., 2012). Consumers have the enthusiasm to pay a price premium for both attributes but they value the attribute of carbon footprint more than that of eco-label. Such kind of concern for the global impact of carbon-dioxide emission more than the local (distant) effect of flower production might be due to various reasons. Firstly, the lower price premium of eco-label attribute may be interpreted as respondents were living in Addis Ababa and thus may not be much concerned about and are not directly confronted with the local environmental impact of flowers produced outside the city. In the second place, the current global concern and media coverage about climate change and global warming might force individuals to pay higher for low carbon footprint characteristics of flowers. The third justification may be related to lack of awareness and experience of environmental labelling of products in Ethiopia. In addition, the information on carbon emission and its regulation seems accurate and promising but there is only incomplete information that might be obtained to value and control carbon emission (Michaud et al., 2012)

4.2.5 Welfare Estimates of Alternative Purchase Plans

Estimation of consumer surplus allows deriving welfare of consumers that comes from the change in alternative purchase plans. In our case, economic welfare estimates the compensating surplus and is the change in income that will leave the purchaser indifferent between purchasing unbranded flower with high carbon footprint; and buying environmentally friendly flower characterized by various environmental attributes.

Table 8: Estimates of Compensating Surplus

Alternative Plans	Purchase	Willingness to Pay for environmental friendly flower under alternatives (in birr)
Environmental Plan-1	Purchase	10.47
Environmental Plan-2	Purchase	12.45
Environmental Plan-3	Purchase	24.43

Source: Survey Data

Economic welfare measures for three scenarios were derived and compared with the status quo. The status quo is the current situation where the cut flower is unlabelled and the production and transportation of the flower emits high level of carbon. The first scenario introduces Environmental Purchase Plan-1 in which the cut flower is supposed to be produced under Bronze standard set by EHPEA Code of Practice; and the emission of carbon from production and transportation set to be reduced by 25%. The second scenario involves with Environmental Purchase Plan-2 that allow the flower to meet Silver standard and the emission of carbon-dioxide to be reduced by 25%. Lastly, Environmental Purchase Plan-3 assumes the cut flower to entitle the Gold label (the highest) and thus produced under the safest way in mitigating local environmental impacts; and the emission of carbon-dioxide to be reduced by 50%.

The estimates of consumers' surplus reveal that welfare of respondents improves as they move away from the status quo condition to alternative purchase plans. In other words they are willing to pay for flowers with environmental attributes. As can be easily shown from Table 8, respondents were willing to pay 10.47 birr for a bronze labeled cut flower with medium carbon footprint. This is to mean that respondents were willing to pay 10.47 birr to move away from status quo option to environmental purchase plan 1. Similarly for silver branded and medium carbon footprint flowers, respondents were willing to pay 12.45 birr per cut flower. For flowers produced under restrictive environmental standards of brand gold and low carbon emission, respondents showed their willingness to pay 24.43 birr per cut flower, which is the highest.

5 Conclusions

The welfare estimates demonstrate that respondents were willing to pay for flowers produced under specific standards that mitigate the local and global environmental impacts of floriculture. Thus, it can be said that environmental friendly flowers may find a niche market in Ethiopia. This has a meaningful implication in attempting to solve environmental influences of floriculture by creating local markets for environmental friendly flowers.

The estimated values of marginal willingness to pay and compensating surplus and consumer side information about environmental impacts of floriculture should be considered in formulating and implementing environmental standards towards mitigating environmental impacts of floriculture industry in Ethiopia. The hypothetical market created for environmental friendly flowers should be put into reality to alleviate environmental impacts of floriculture. Environmental regulations and EHPEA Code of Practice should be effectively enforced and monitored and a more sustainable and internationally acceptable cultivation of flowers should be assured to the extent of complying with Silver and especially Gold standards of EHPEA-Code of Practice. Suggested measures such as application of technologies towards organic production, locating the farms in a way farmers are not displaced and which are far away from urban dwellings, creating environmental compensation mechanisms to whom the activity costs a lot, undertaking extensive research and learning useful and workable experiences of other countries and creating environmental awareness to the society should also be considered towards alleviating environmental impact of floriculture industry in Ethiopia.

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