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Original Article

Consumers' Willingness to Pay for Biodegradable Shopping Bags

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Abstract

Plastic pollution has become a challenging issue worldwide, causing adverse impacts on the environment and ecosystem. Single-use plastic shopping bags and bottles are the main reasons behind plastic litter. These non-degradable bags create market externalities that can be internalized through different techniques. This study estimates the users' willingness to pay for biodegradable bags using the contingent valuation method. Data from 360 respondents were collected in a market survey through a designed questionnaire. Three market areas of Peshawar city were selected, which many consumers visit daily. Willingness to pay depends on the demographic and socioeconomic characteristics of the consumers. The Tobit model with marginal analysis yields significant results. The results show that the marginal change in the willingness to pay of an individual decreases with the increase in income. The marginal Willingness to Pay remains the same for respondents of all education categories. There is a downward trend in marginal willingness to pay when the family size of the respondent increases. 38% of the respondents were not using degradable bags. 35 percent strongly agreed on an awareness campaign. The study recommends that there should be a subsidized price on each good quality biodegradable cotton bag in shopping zones.

Keywords: Biodegradable bags, Consumerism, Contingent Valuation

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Introduction

The pursuit of economic growth and development has potentially deteriorated the global environment, and the situation might get worse if the negative environmental impacts have yet to be taken into consideration. Each country is installing more and more industries and factories in the race for development. These industries contribute to carbon emissions, hazardous chemical waste, and solid wastes as a free good to the environment that leads to rapid change in global climate over time (Jalil, Mian, & Rahman, 2013).

Plastic shopping bag consumption is rapidly increasing among consumers and retailers on a global level. Plastic shoppers are available free of cost for consumers in the market, but from an economic point of view, it is a market externality and has a huge collective social cost of disposal (Dikgang & Martine, 2010). A polythene bag has not only adverse effects on human health but is also hazardous for the environment, agriculture, and ecosystem. Landfills of plastic litter cause a reduction in land fertility and blocking of drainage systems due to litter during floods are common problems in developing countries (Gupta, 2011). At the same time, some of the countries tried to reduce the consumption and production of poly bags by making legislation and introducing alternatives. UK, South Africa, Kenya and other countries like Ireland impose charges of 0.15 euros on the consumption of each bag. Denmark had imposed a levy of 22 Danish kroner (DKK) per KG on the production of polythene bags. India and China have introduced policies to change the behavior of consumers through field experiments by providing incentives for using biodegradable bags (He, 2010).

In reducing the use of these non-degradable bags, researchers focus on market-based instruments used by different countries like indirect tax, charge system, subsidies, incentives, etc. At the same time, some provide alternative solutions like paper bags, cloth bags, and jute bags with minimum prices. Among alternatives to plastic bags, jute bags are the most popular in markets. Plastic bags are made of crude oil and natural gas. Both resources are non-recyclable in nature, which means that the supply of plastic can be limited. On the other side, jute bags are made of jute crops that can be produced year to year and it is a long-term phenomenon. Jute bags are degradable, eco-friendly, and have the same strength compared to poly bags (Pave & Supinit, 2017).

The environmental protection policy of Pakistan bans all hazardous substances that violate the National Environmental Quality Standards (EPA, 1997). After the 18th amendment to the constitution, environmental issues

were handed over to the provinces. The same policy is followed by the government of Khyber Pakhtunkhwa province (KPEPA, 2014). There are 60 small units in KP producing plastic bags, and also the illegal supply of these bags comes from other provinces and neighboring countries. Chief Minister of Khyber Pakhtunkhwa announced to ban on the use and production of polythene bags in the province as it causes choking of drainage systems and environmental issues (DAWN, 2016).

Typically, plastic bags are commonly used among consumers because they are convenient. However, they are non-degradable items made of oil and natural gas, creating litter problems and air pollution as externalities. Recognizing the issues with polythene bags, Bangladesh introduced degradable jute bags as an alternative with the same strength and capacity. Biodegradable bags are environmentally friendly and naturally decomposable. They can be degraded by natural microorganisms like bacteria, algae, and fungi. Plastic bags cannot be disposed of and remain in the environment for thousands of years, harming agriculture and the ecosystem. Various types of degradable products and additives, such as D2W, can be mixed with polymers to make plastic bags degradable. These products can be produced through biological processes or chemically synthesized procedures using natural fats, starch, etc.

Research Objectives

1. To estimate the willingness to pay of the consumers for bio-degradable bags.
2. To determine how various socioeconomic and demographic factors, awareness campaigns, and behavioral attitudes affect their willingness to pay.

Literature Review

Willingness to pay is the maximum amount that a person is ready to pay for a product or service. The market forces determine the price of the market goods. But non-market goods have no market price, and it can be calculated with a person's willingness to pay. Consumers belonging to different income classes have different willingness to pay for different goods. It depends on the price of a commodity and the socioeconomic characteristics of the individuals.

The United States generated 11 million tons of plastic, and 26.7 million tons of waste was recycled in 2003. Most of the recycled waste consists of

beverage containers, soda pop, and milk. The environmental green industry contributed 147.8 billion dollars in 2002 and employed approximately 2 million people. A conjoint analysis was carried in by comparing hypothetical and non-hypothetical experiment auctions in two different cities of the United States (US) to obtain consumers' willingness to pay for bio-degradable plant containers. Results of the linear mixed model estimation showed that survey participants were willing to pay for biodegradable containers. Mixed Probit model and ordered probit model were also used and found that willingness to pay is different for different containers (Yue, 2010).

Petroleum-based plastic, known as expanded polystyrene, is commonly used in food containers. It contains chemical materials and has a long and inefficient recycling process. In 2009, Americans used approximately 2.07 million tons of disposable plates and cups, with 710000 tons made from expanded polystyrene. Forty-four percent of polystyrene was found in the stomachs of marine species, leading to its classification as the fifth largest hazardous material. A study investigated consumer preferences and their willingness to pay for alternatives to plastic food containers. People's perceptions were analyzed based on their socioeconomic characteristics using conjoint choice models. The results from 244 respondents revealed that only 11.06 percent preferred biodegradable food containers.

Another study (Dunn, 2012) has calculated the mean willingness to pay for grocery bags and consumers' willingness to accept to use of reusable bags for all shopping trips. A hypothetical tax has been imposed on plastic bags, and respondent's preferences were investigated through the dichotomous choice contingent valuation method. During the survey, respondents were asked if they have to pay for the consumption of plastic bags by showing them some bid values as a tax on plastic grocery bags to determine their willingness to pay, and willingness to accept was determined by providing them the choice of reusable bags. 700 respondents were interviewed from different local markets of Utah in the western US. The probit (Censored regression) model was used to estimate willingness to pay for reusable bags, and the results show that willingness to pay for plastic bags was $0.33 per bag and Willingness to accept the reusable bag was $0.12 per reusable bag; therefore, the paper suggested that $0.12 of subsidy should be provided to a household that will switch their behavior towards reusable bags.

A similar approach has been used (Zaharah, 2014) to estimate consumer's preferences and willingness to pay for biodegradable shopping bags in Malaysia by using the contingent valuation method. Willingness to pay is

estimated as a function of income and the price of biodegradable bags. This model is based on Van Ravenswaay and Hoehn (1991) approach. Gender (male), income, age, and price level were the significant variables, and consumers were willing to pay an additional 3.53 RM for each biodegradable bag. The study recommends that policymakers should revise the price of degradable bags. Imran (2015) has estimated the social willingness to accept the demand for cotton bags and paper bags in Islamabad at Abpara and Sunday markets for both retailers and consumers. Data from 150 sample sizes was analyzed using the Logit model using the contingent valuation method. The study found that both shopkeepers and consumers are willing to change the tradition of plastic bags into cotton and paper bags.

Based on the literature review, it is clear that the said issue should be extensively analyzed to make policymakers aware by providing evidence. This study has also adopted CVM to estimate WTP plastic bag users' WTP but also investigated the environmental sensitivity and awareness of the respondents through open-ended semi-structured interviews.

Methodology and Theoretical Framework

Contingent Valuation Method

Ciriacy-Wantrup (1947) introduced a contingent valuation method to obtain market value for non-market goods. Plastic bags are a market externality and can be internalized through different techniques like the Pigouvian tax on consumers used in different developed countries. But here, this study will adopt the Contingent valuation method to deal with the environmental issue. The contingent valuation method is used when the preferences of the individuals cannot be determined in the market, and as a result, hypothetical questions determine an individual's preferences (Sawyer, 1996). In this method, individuals are asked to rank their preferences or state their willingness to pay for alternatives to environmental hazards to achieve betterment in environmental resources.

The CVM method has been used extensively in the fields of health economics, cultural economics, and transportation safety economics and also in environmental economics (Zaharah, 2014). The Model used (Zaharah, 2014) also helped to design the empirical model of this study.

$$WTP = f(Y, P)$$

WTP = willingness to pay

Y= Income (rupees)

P= price (rupees)

In the case of willingness to pay, (McFadden, 1995) used the Random utility model is assumed to be a utility function. It explains that the utility of an individual from good j (Uij) is the function of observed characteristics of the individual; good that is consumed and unobserved error term. The indirect utility function becomes

$$Uij = Ui(Yi, Xi, eit)$$

Yi is the income of the individual, Xi is the observed characteristics, and it is an error term.

In the Contingent valuation survey, individuals have a choice to improve the quality of the environment. Let's suppose Ti is the cost of a good quality environment. Individual WTP will change due to a change in utility from goods that are consumed. Individuals will agree on the amount for a quality environment if that individual's utility becomes greater than the existing utility.

$$Uij\ (Yi - Ti, Xi, eit) > Uij\ (Yi, Xi, eit)$$

Individuals agree on maximum willingness to pay for a quality environment the equation becomes as below

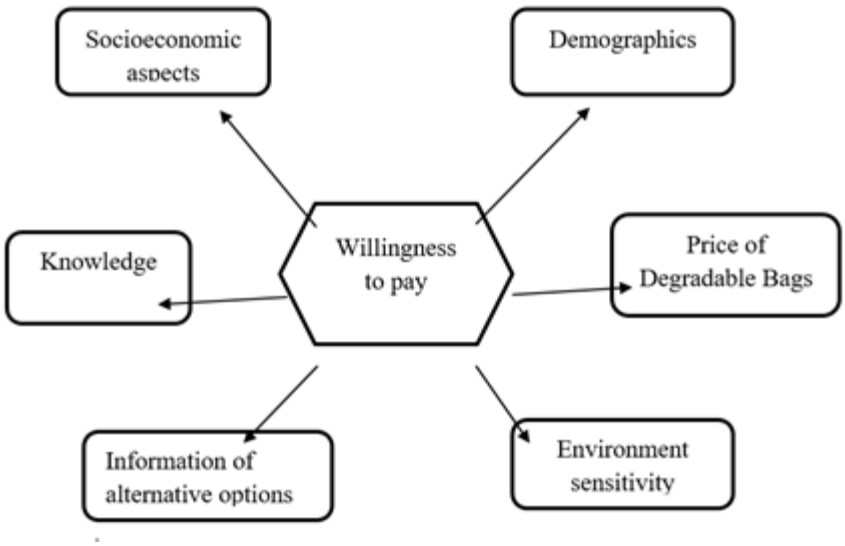
$$Max\ price = \ Uij\ (Yi - Ti, Xi, eit) > Uij\ (Yi, Xi, eit)$$

Generalizing the equation

$$WTPi = \beta iXi + eit$$

Xi represents the socioeconomic and demographic characteristics of the individual because the willingness to pay (WTP) can be calculated based on socioeconomic and demographic factors. This study utilizes various socioeconomic indicators, demographic data, information on alternative resources, market visits, and knowledge factors to determine the willingness to pay for biodegradable shopping bags.

Conceptual Framework Model



Empirical Model

The econometric model is given below.

$WTPit = \alpha + \beta x_{it} + \mathcal{E} \qquad if\ RHS > 0$

$= 0, otherwise$

Where *WTPit* is the willingness to pay for bio-degradable bags of individual *i* at time *t*, and x_{it} is the vector of independent variables with β coefficients, i.e. (Age, Education, Income, knowledge, Information, family size, occupation, and marital status, price of degradable bags and environment sensitivity) and Ɛ is an error term.

The study used the Tobit model for econometric analysis. Other researchers used Probit or Logit models because of the nominal dependent variable, but here dependent variable is in continuous form with zeroes. Therefore, the Tobit model seems most appropriate. Secondly, during data collection, some respondents were unwilling to pay for biodegradable bags, and their willingness to pay remains zero. To censor such observations, the Tobit model is useful for analysis.

Primary data from consumers in different markets was gathered through face-to-face interviews through a questionnaire containing close-ended and

multiple-choice categorical questions. Consumers of various ages, religions, and occupations were asked directly how much they would pay for biodegradable bags as an alternative to typical plastic bags. Face-to-face interview was a difficult task to convince someone to give their time for an interview, but to achieve full knowledge, it was necessary to ask all questions. Initially, some questionnaires were filled out by consumers. Still, it was noticed that the questionnaire was complicated for them because most respondents did not understand the concept of Willingness to pay terminology.

Table 3.1: *Variables of the Study*

Variables	Type	Definition and Measurement
Willingness to Pay (WTP)	Continues (Outcome)	Willingness to pay is the amount for each biodegradable bag is measured in rupees and it is continues bid value.
Age	Continues	Age of the respondent
Income	Continues	Monthly income of the respondent
Occupation	Nominal	1 if unemployed; 2 if government employee; 3 if private job; 4 if self-employed.
Education	Continues	Education of the Respondent
Family Size	Continues	Number of family members
Marital Status	Dummy	0 unmarried; 1 married
Gender	Dummy	0 Female; 1 Male
Knowledge		It is the knowledge of the respondent about hazardous impact of plastic bags on environment. 0 if no knowledge and 1 if having knowledge. Knowledge is supposed to have significant impact on willingness to pay.
Information	Dummy	If consumers having information about biodegradable bags than its value is 1 if not, then zero.
Environmental Sensitivity	Dummy	If respondent were involved in environmental activities like participation in environmental seminar, campaign, tree plantation drive or any other green activity than he or she is considered environmental sensitive, and he care about environment. A person with environment sensitivity has value is 1 otherwise zero.

Results

Table 4.1 *Marginal Analysis*

variables		Margins	Delta meth St. err	z	P> |z|	95% Co. Interval	
Occupation	Unemployed	34.71	2.89	11.99	0.00	29.06	40.42
	Govt.	36.02	2.72	13.22	0.00	30.68	41.36
	Private	34.40	3.28	10.47	0.00	27.96	40.84
	Self	36.80	24.67	3.46	0.00	30.97	42.63
BDB max price	Not willing	19.45	2.54	7.66	0.00	14.47	24.43
	Willing	41.68	1.50	27.78	0.00	38.34	44.62
Marital Status	Unmarried	36.26	2.47	14.64	0.00	31.41	41.11
	married	35.10	2.43	14.44	0.00	30.34	39.86
Info	No info	37.45	2.07	18.06	0.00	33.38	41.51
	Have info	34.40	1.74	19.74	0.00	30.98	37.81
Knwl	No Knwl	27.28	3.13	8.71	0.00	21.14	33.42
	Have Knwl	37.63	1.43	26.18	0.00	34.82	40.45
Envr. Sen	Don’t care	24.75	2.86	8.63	0.00	19.13	30.36
	Care	38.75	1.46	26.52	0.00	35.89	41.62

In marginal analysis, the probability values of z statistics for all variables are less than 0.05; it means that all the variables are strongly significant at a 5 percent level. In terms of occupation, the marginal change in willingness to pay for biodegradable bags showed mixed results for the occupation variable having four categories. If a person is unemployed, the marginal change in WTP is 34.71 rupees, but when the respondent is a government employee, the marginal WTP increases, which is evident from the more significant coefficient of 36.02. If we move from government employee to private employee, marginal change in WTP decreases to 34.40 rupees as it is also decreased in average analysis with having a negative sign. There is also an

increase in marginal WTP from 34 rupees to 36 rupees when an unemployed person changes to self-employment, which is the highest coefficient.

Respondents who were not willing to the bid price between 30 to 120 rupees per BDB but somehow were willing to below-bid price and were found with a marginal change in WTP of 19 rupees. There is a significant change in marginal WTP from 19 PKR to 41 PKRs for those consumers who were willing on the maximum price of BDB. Unexpectedly, respondents who were found with no information about biodegradable bags showed a marginal change in willingness to pay 37 rupees. However, it decreases to 34 rupees for respondents having information about BDB as compared with the respondents having no information about bio-degradable bags. The marginal willingness to pay of unmarried respondents was 36 rupees per biodegradable bag. Still, there was a one rupee decrease when the marital status of the individual changed from unmarried to married, so the marginal willingness to pay married respondents was 35 rupees for biodegradable bags. It is not controversial because a married will respond according to his or her social status.

Knowledge about the harmful impacts of plastic bags is an essential variable to trigger the willingness to pay consumers. The marginal change in WTP of respondents with no knowledge is 27 PKRs. When the response of the consumers changed from no knowledge to having knowledge, there was an incremental change of 10 PKRs from 27 rupees to 37 rupees. Environment sensitivity is the new variable that can possibly capture the respondent who cares about the environment. During the survey, respondent was asked about their participation in environmental activities. Consumers who didn't participate in any environmental activity were found with 24 rupees marginal willingness to pay. Marginal WTP changes from 24 to 38 rupees for respondents participating in environmental activities.

Table 4.2 *Education category*

S.no	Education	Margins	Delta meth St. error	z	P> |z|	95% Co. Interval	
1	0	35.82	6.11	5.85	0.00	23.83	47.82
2	4	35.78	4.48	7.97	0.00	26.98	44.58
3	8	35.74	2.91	12.25	0.00	30.02	41.45
4	12	35.70	1.58	22.47	0.00	32.58	38.81
5	16	35.65	1.48	24.06	0.00	32.75	38.56

Education has a significant impact on willingness to pay for environmentally friendly biodegradable bags. There are five categories of education, starting from uneducated, then there is incremental change of 4 classes. The marginal change in willingness to pay for uneducated respondents is 35 rupees. Marginal incremental change in willingness to pay remains the same for all levels, i.e., 35 PKRs for all levels of education. It shows that education has a negligible impact on Willingness to Pay for Biodegradable Bags.

Table 4.3: *Income categories*

S.no	Income	Margins	St. error	z	P> |z|	95% Co. Interval	
1	0	37.63	1.84	20.44	0.00	34.02	41.24
2	60000	35.69	1.28	27.84	0.00	33.18	38.20
3	120000	33.75	1.83	18.41	0.00	30.16	37.35
4	180000	31.82	2.92	10.88	0.00	26.09	37.55
5	240000	29.88	4.14	7.21	0.00	21.75	38.01
6	300000	27.94	5.41	5.16	0.00	17.33	38.55
7	360000	26.00	6.70	3.88	0.00	12.87	39.14
8	420000	24.07	7.99	3.01	0.00	8.39	39.74
9	480000	22.13	9.29	2.38	0.01	3.90	40.35
10	540000	20.19	10.60	1.90	0.05	-.58	40.98
11	600000	18.25	11.91	1.53	0.12	-5.08	41.60

Income is the main variable in the regression model. In the above table income of the respondents is divided into 11 groups having an incremental of 60000 rupees. The marginal change in WTP for BDB of the respondent having zero income is 37 PKRs. When the income level changes from zero to 6000, the marginal change in willingness to pay goes downward from 37 PKRs to 35 PKRs. For all respondents of all income groups, a change in marginal willingness to pay is found with a downward trend of 2 units. This result is opposite to other studies as incomes increase, willingness to pay for biodegradable bags also increases (Zaharah, 2014).

Table 4.4: *Age categories*

S. No	Age groups	Margins	Delta meth St. error	z	P> |z|	95% Co. Interval	
1	18	36.09	2.67	13.51	0.00	30.85	41.32
2	28	35.83	1.57	22.77	0.00	32.75	38.92
3	38	35.58	1.38	25.75	0.00	32.87	38.29
4	48	35.33	2.32	15.16	0.00	30.76	39.89
5	58	35.07	3.61	9.72	0.00	28.00	42.15
6	68	34.82	4.97	7.00	0.00	25.07	44.57

In the above table, age has six categories, and marginal change in age shows that a slight decrease in WTP occurs when we have a 10-year shift in age factor. The marginal change in willingness to pay is 36 rupees when the respondent is 18. Marginal change in WTP decreases to 35 PKRs when the respondent's age changes from 18 to 28. There is a decrease in marginal willingness to pay as age increases, but the age factor also has opposite results. Older people were found with more WTP as compared with younger..

Table 4.5: *Family Size Categories*

S.no	Family size groups	Margins	Delta meth. St. error	z	P> |z|	95% Co. Interval	
1	2	36.97	2.75	13.44	0.00	31.58	42.37
2	6	35.88	1.33	26.79	0.00	33.25	38.50
3	10	34.78	2.09	16.59	0.00	30.67	38.89
4	14	33.68	3.92	8.59	0.00	26.00	41.37
5	18	32.59	5.89	5.53	0.00	21.03	44.14

From the above table, families with two members have a marginal change in willingness to pay PKR 36. There are five categories of family size, with a difference of 4 in each category. Family size increases from 2 to 6 members, then the change in marginal willingness to pay decreases from 36 to 35 rupees. Similarly, there is a decrease of one-unit change in marginal willingness to pay as family size increases from one group to another.

Conclusion and Recommendation

The study concluded that the average willingness to pay is between PKR 30 to 40 for bio-degradable shopping bags. Employed people are more willing

to pay the premium for using bio-degradable bags. Income remains the main variable in WTP, and marginal change in WTP decreases with increased income. The aims of the study were also to check the awareness about biodegradables among consumers and to make them aware of negative effects of plastic bags on society. During the interview, 139 respondents out of 360 agreed with the ban on plastic bags, including 126 strongly agreeing with the ban decision. Most of the respondents consider awareness to be a key factor for the adaptation of bio-degradable bags.

Based on the findings, it is strongly recommended that biodegradable cloth bags should be provided to retailers at subsidized prices to initiate cloth bags as an alternative to plastic bags. Also, there is a dire need for awareness regarding the hazardous impacts of plastic bags on the environment and human health. Policymakers should aware general people about plastic bag alternatives through different strategies like print media, social media, and market campaigns, especially seminars and awareness drives in educational institutions, schools, and colleges.

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