Non-Market Measurement Techniques of Willingness to Pay, the Case of Environmental Resources: A Review

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Abstract: *The objective of this study is to review measurement techniques of willingness to pay (WTP), comparison of techniques and review of empirical evidences to support the theoretical concept of willingness to pay measurement methods. Particularly, the review mainly focuses on stated preference method. To address these objectives, intensive literature review was under taken. Finally, the result of the review was presented in narration, tabular and diagrammatic form. The review indicated that the concept of WTP has been applied in different field of study to assign monetary value using observed market behavior and hypothetical market scenarios for non-marketed goods and services. There are two commonly used methods for estimating WTP into revealed and stated preference methods. Depending on the type of goods or services in question, the time and research resources available, both methods can be useful though they have their own advantages and disadvantages. Revealed preference technique is used to estimate the use value only; on the other hand, stated preference technique is applicable to estimate both use and non-use value. This indicates that stated preference technique has broader scope than revealed preference.*

Keywords: Choice experiment, contingent valuation, non-use value, revealed preference, stated preference, use value

1. Introduction

Environmental resources provide material and non-material benefits to the society. These benefits play a great role for the day to day activities of human beings, plants and animals. According to Kasaye (2015)the benefits of environmental resources can be categorized into use value and non-use value. As discussed by Dlamini (2012) use value refers to the benefit a user derived from the actual use of the resource; whereas, non-use values do not involve any actual physical consumption of the resource. The value of environmental resources is very important to estimate their social benefit in monetary value. To do this, economists have employed different techniques which are called economic valuation of environmental resources. Economic valuation is a technique in which economists draw on to estimate the economic value of market and non-market goods.

According to Pearce and Özdemiroğlu (2002) non-market goods refers to those which may not be directly bought and sold in the market place. This implies that market has no price to estimate the monetary value of these goods and services. As a result, incorporating non-market values into the policy or decision-making process requires the adoption of a suitable valuation framework that captures all values (Philcox, 2007). For those resources for which markets exist, economists typically rely on directly observable behavior in the form of market transactions to reveal preferences or the value that individuals place on goods and services and their willingness to pay to avoid loss of such goods and services (Lipton *et al.*, 1995).

Economic value is a measure of what the maximum amount an individual is willing to give up in other goods and services in order to obtain some good, service, or state of the world. This measure of welfare is formally expressed in a concept called willingness to pay (WTP). According to Breidert (2007)willingness to pay is defined as the highest price an individual is willing to accept or pay for some goods or services. It is a survey method that presents the interviewees with hypothetical scenarios about a certain intervention or specific program which is intended to be evaluated (Mould Quevedo *et al.*, 2009). It is indispensable tool to develop optimal

pricing strategy to forecast market response to price changes and for modeling demand functions (Breidert *et al.*, 2006). The application of WTP in cost benefit assessments and decision-making processes has made this tool one of the most requested in the area of natural resource and health economics (Mould Quevedo *et al.*, 2009).

The approach of measuring willingness to pay has gained much more attention in the literature of environmental economics (Belete and Assefa, 2003; Alemayehu *et al.*, 2009; Amfo-Otu *et al.*, 2012; Hagos *et al.*, 2013), natural resources economics (Bogale and Urgessa, 2012; Angella *et al.*, 2014; Senayet, 2014),health economics and management sciences(Habtewold, 2009; Agago, 2014; Ahmed, 2016). So, methods that are used to estimate willingness t o pay support decision makers, researchers and experts to apply this concept practically in their day to day activities. Consequently, a number of methodological approaches exist to measure the value of non-market goods and services (Lee *et al.*, 2010).These methodological approaches are broadly categorized into two groups: revealed preference and stated preference method (Philcox, 2007; Stephens, 2010; Selam, 2013). According to Lee *et al.* (2010) and Stephens (2010) valuations based on revealed preferences are derived from prices paid for goods or services; whereas, stated preferences reflect a willingness to pay for a good or service (or a willingness to accept to forego it) expressed in terms of a stated choice in hypothetical scenarios presented to respondents. In light of the above explanation, this study aims to review non-market measurement techniques of willingness to pay and econometric models to estimate willingness to pay in the area of environmental resources, compare and contrast measurement techniques of willingness to pay and review empirical evidences to support the theoretical concept of WTP measurement and estimation.

2. Economic Values of Environmental Resources

According to Abdullah *et al.* (2011), economic valuation refers to the assignment of monetary values to non-marketed goods and services where the monetary values have a particular and precise meaning. Almost all environmental goods are non-market goods. From this concept, we can draw the definition of what does environmental valuation mean. Environmental valuation is an attempt to put monetary values to environmental goods and services or natural resources. It is a key exercise in economic analysis because it provides important information about values of environmental goods and services(Abila *et al.*, 2005). This implies that environmental valuation has an important role to play in environmental planning and management activities to answer questions like what is the value of conserving a certain environmental resource and to whom does the value accrue.

The Total Economic Value (TEV) that people attach to an environmental resource is the summation of use value and non-use value (Robinson, 2001; Abdullah *et al.*, 2011; Abebe and Geta, 2014). Use values relate to actual use of the good in question (e.g. a visit to a national park) while non-use values are non-instrumental values which are in the real nature of the thing but unassociated with actual use, or the option to use the thing(Dlamini, 2012; Kasaye, 2015).

According to Abila *et al.* (2005) and Jantzen (2006), use values are divided into direct and indirect use value. Direct use value of environmental resources refers to the active use of these resources in terms of the current values that people are deriving from their actual use (Abebe and Geta, 2014; Selam, 2013); whereas, indirect use value relates to indirect utilization through ecosystem function and regulation services (e.g. water purification, erosion protection or carbon sequestration) (Abila *et al.*, 2005).Option value is the value that people attach to environmental resources that they may use in the future though they do not use them currently (e.g. future visits to national parks, clean surface and ground water, avoiding of erosion to enable future use of pastures) (Jantzen, 2006; Dlamini, 2012; Selam, 2013).

The environment contributes to people's wellbeing in ways that do not directly involve markets (Baker and Ruting, 2014). Unlike market goods, the value of environmental goods goes largely unmeasured because markets do not provide these goods (Abdullah *et al.*, 2011). In addition to this, non-market values are often associated with market failures; as a result , markets do not adequately take into account the outcomes of both market and non-market value of environmental resources (Baker and

Ruting, 2014). This notion of an apparent failure of the market to account for non-use values of environmental services has led to a proliferation of studies to develop appropriate techniques to estimate a total economic value for environmental resources (Robinson, 2001). Specially, the stated preference technique is the only valuation method to capture use, non-use and option values of environmental resources (see Table 1 and Figure 1).

3. Methods of Measuring WTP

The total economic value comprises explicit use benefits as well as implicit non-use benefits (Kjær, 2005). There are different types of economic values, in which the sum of all the values (i.e. WTPs) defines the total economic value of any change in wellbeing due to an intervention. Several authors proposed different hierarchical classification frameworks to organize existing methods to WTP estimation (Kjær, 2005; Breidert *et al.*, 2006; Stephens, 2010). At the highest level, the literature classifies the different methods for estimating WTP into revealed and stated preference methods (Stephens, 2010). So, this paper clearly explains the advantages and disadvantages of these techniques (Table 1). Depending on the type of goods or services in question, the time and research resources available, both methods can be useful (Kjær, 2005; Stephens, 2010). But stated preference techniques can be used in more applications than revealed preference techniques because they are the only approaches that can be used to estimate non-use values (Morrison, 2009). Revealed preference is a generic term for market analysis and refers to the observation of preferences revealed by real market behavior; whereas, stated preference method uses a direct approach (survey method) to estimate willingness to pay (Freeman, 1992).

Table 1. Comparison of measurement techniques of WTP

Criteria	Revealed Preference	Stated preference
Approach	Consumers' preferences are revealed through their actions in real markets which are related to the value of interest	Consumers are asked to state their preferences for hypothetical alternatives that comprise a set of attributes and different levels of these attributes
Behavior	Observed	Hypothetical
Methods		
Direct	Market price	Directly asking individuals their WTP
Indirect	Travel cost method Hedonic pricing method	choice experiment (estimation of WTP by use of price variable)
Goods and services	Real	Real and hypothetical
Total economic value	Merely capture use value	Capable of capturing total economic value (use value, option value and non-use value)
Advantages	External validity is maximized because the choices observed are real market choices in which consumers have committed money, time and/or other resources Low-cost evaluation used for comparing the influence of policies on consumer behavior(Samuelson, 1938)	Provides preferences and information that are impossible to reveal when actual choice behavior is restricted in some way Applicable to estimate economic value of non-market goods and services (use value, option value and non-use value) Allows the researcher complete control over the choices offered and their attributes (no co linearity problem unlike revealed preference technique) Ensures sufficient variation in data Direct valuation method used to solicit value measured
Disadvantages	Limited to the supplying of information regarding values that have been experienced Limited number of cases where non-market values/goods exhibit a quantifiable relationship with market goods Choice sets, attributes of choice options and individual characteristics are not controlled i.e. co-linearity problem Not applicable to estimate economic value of non-market goods and services assumes that the preference scale remains constant over time; The inability to define or measure preferences independently;	Observed preferences may not reflect actual behavior Influenced by respondents to provide accurate responses Require large sample size Prone to strategic bias Costly evaluation

Adapted from Kjær(2005)

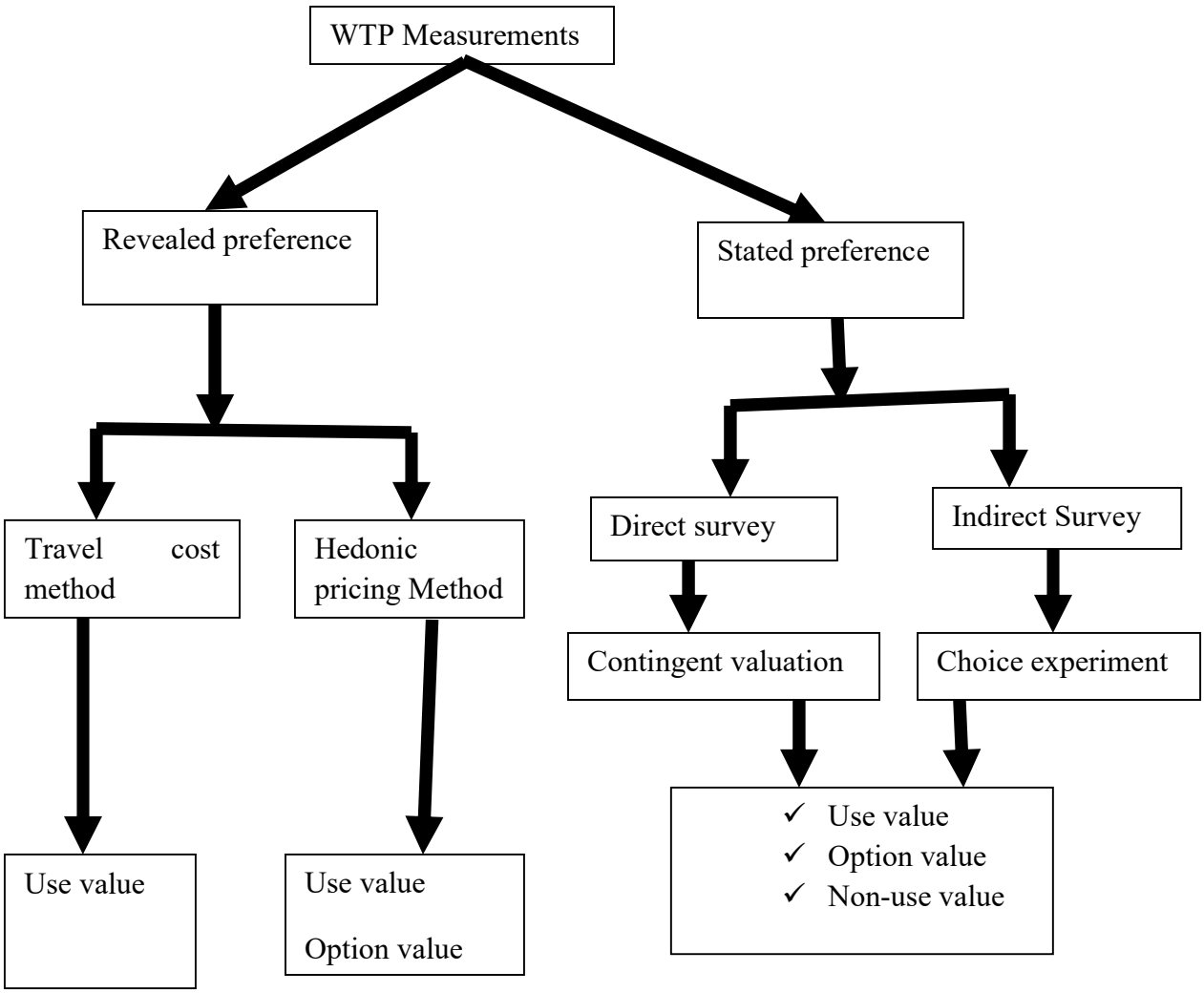

Figure 1. Summary of measurement techniques of WTP; Adapted from (Breidert et al., 2006)

3.1 Revealed preference techniques

3.1.1 Travel cost method

The travel cost method is the oldest and the first non-market valuation technique and was developed for use in environmental valuation (Kjær, 2005). The travel cost method is an indirect valuation technique mainly used for the valuation of environmental resources which has recreational sites (Dlamini, 2012). This method measures the benefit (WTP) for a recreational experience by examining household expenditures on the cost of travel to a desired recreational site i.e. parks (Stephens, 2010). The costs associated with travelling to the resource (fuel, mechanical maintenance of vehicle, time spent in travelling) become the variables to be used to determine the value of a resource (information on these costs reveals how much people are willing to pay for recreational services (Dlamini, 2012). Travel cost method uses survey data on direct costs and, in some cases, opportunity costs of time spent travelling to and from a site, evaluated at some fraction of the average wage rate (Bishop, 1999).

3.1.2 Hedonic pricing method

Hedonic pricing method is used mostly to estimate the willingness to pay for variations in property values due to the presence or absence of specific environmental attributes, amenity service of the environment and access to infrastructure (Ulibarri and Wellman, 1997). Similarly, the hedonic pricing approach is a method of ascertaining the value of or the pleasure felt from attributes of a good by comparing the market value of properties having different degree of a specific attribute and analysts

extract the implicit value of the attribute to property buyers and sellers (Ulibarri and Wellman, 1997). This indicates that the hedonic pricing method is used to estimate economic values for ecosystem or environmental services that directly affect market prices. It is most often applied to differences in housing prices that reflect the value of local environmental attributes. Use of data already available (selling prices of properties) and best applied to land and property but it needs high quality information (Kassahun, 2009).

3.2 Stated preference techniques

This technique includes choice experiment and contingent valuation(Robinson, 2001). Choice modeling does not ask questions directly whereas, CVM is used when markets do not exist for environmental resources by asking questions directly (Hausman, 1993). Likewise, choice experiments differ from contingent valuation in that respondents are presented with more alternatives involving different attributes and their levels, compared with contingent valuation (Haji, 2013). In a choice experiment, respondents are presented with a sequence of choice sets, each containing its own alternatives differentiated by its attributes and levels (Howley, 2011).

Moreover, choice experiment can do better in elicitation of preferences than CVM in measuring the marginal value of changes in the characteristics of environmental goods because it is easier to disaggregate values for environmental resources into the values of the characteristics that describe the resource (Woretaw *et al.*, 2017)

Table 2. Summary of stated preference techniques

Criteria	Contingent valuation	Choice experiment
Time scale	Shorter	Longer
Complexity of design	Less complex	Highly complex
Software and analysts	Less sophisticated	sophisticated
Complexity of task for respondents	Less complex	More complex
Valuations	Total package	individual attributes/choose between different alternatives/
Compliance bias	High/survey-based technique/	Low
WTP questions	Directly asking individuals their WTP/WTA	Estimate WTP by including price as one attribute/no direct questions about valuation/
WTP estimation	Total WTP for the good or service	Relative WTP values for different attributes of a good
	Used to measure use values , option values and intangible values (TEV)	Used to use values and option values but not use to measure none use values
Response efficiency	Respondents provide a single response	Each respondent may provide multiple responses for estimating WTP
Flexibility	Highly flexible and adaptable to many non-market valuation tasks	Less flexible and adaptable to many- none market valuation tasks.
Result interpretation	Result analysis interpretation is easy	Result analysis interpretation is difficult because of its complexity
First application	First application on recreation (1963) on existence values	First application to travel choice (1982)

Adapted from (Stephens, 2010)

3.1.1. Choice experiment

Choice experiment is a stated preference technique in which respondents choose their most preferred option from a number of alternatives (Haji, 2013). It is a recent innovation in stated preference method and its theoretical grounding were inspired by the Lancastrian microeconomic approach in which individuals derive utility from the characteristics of the goods rather than directly from the goods themselves (Woretaw *et al.*, 2017).It assumes that any good/service can be defined as a combination of levels of a given set of attributes and the utility that an individual derives from that product is determined by those attributes (Tinelli, 2016). Recently, choice experiment has been applied to value non-market goods in environmental and health economics (Tinelli, 2016; Woretaw *et al.*, 2017).

Ina choice experiment survey, the respondents are presented with several alternatives and are asked to choose their most preferred alternative (Haji, 2013; Howley, 2011). The alternatives consist of different combinations of attribute levels and each set of alternatives (choice set) (Ezebilo, 2010). Definition of attributes and attribute levels, experimental design, construction of choice sets, questionnaire development and sample and sampling strategy are the core steps involved in the design of a choice experiment (Clark, 2014).

Specially, definitions of attributes and their level is one of the most important stages when conducting a choice experiment study. The most efficient experimental design and advanced modeling of analysis cannot compensate if the attributes and levels are not appropriate. From this we can conclude that misspecification of the attributes and attribute levels has a negative implication for the construction of choice sets which leads to a risk of producing biased choice experiment results.

In choice experiment study, the construction of the choice set must be based on the main elements that influence the choice modeled. These elements can be divided into four stages: establishing attributes and their levels; creating a choice set and measuring design efficiency; constructing the survey instrument and collecting data and analyzing the data (Coast, 2012; Tinelli, 2016).

3.1.2. Contingent valuation method

According to Hoyos and Mariel (2010), the economic valuation of environmental resources using stated preference information has come to be known as contingent valuation method. Contingent valuation method is one of the most commonly used techniques for environmental resource valuation (Jantzen, 2006).

The contingent valuation technique has great flexibility, allowing valuation of a wider variety of non-market goods and services than is possible with any of the indirect techniques (Khalid, 2008). In the contingent valuation method, respondents are asked various questions directly on the basic issues such as the maximum amount they are willing to pay to access and enjoy any welfare gain due to an improvement in environmental quantities, qualities or both or the minimum amount they are willing to accept in compensation for welfare loss due to deterioration in environmental quantities or qualities or both (Kasaye, 2015). In environmental resources, contingent valuation studies generally derive values through the elicitation of respondents' willingness to pay to prevent injuries to environmental resources or to restore injured environmental resources (Khalid, 2008). Contingent valuation is one of the few methods used to assign dollar values to non-market and non-use values of the environmental goods and services (Philcox, 2007).

There are different elicitation methods to be used in a CVM application (Table 3). The choice of an elicitation technique however, depends on the type of resource being valued and the nature of the sample. CVM has four value elicitation formats: open ended, bidding game, payment card and dichotomous or discrete choice formats. Dichotomous choice contingent valuation questions have gained popularity over the last several years due to their purported advantages in avoiding many of the biases known to be inherent in other formats used in the contingent valuation method, but it comes at the cost of efficiency (Cameron and Quiggin, 1994). In the dichotomous or closed-ended format, respondents are asked for a yes–no answer to the WTP question (are you willing to pay X birr) (Hoyos and Mariel, 2010). If the answer is positive, a new question with a higher value for X is asked, and if the answer is negative, a new question with a lower value for X is asked

(Cameron and Quiggin, 1994; Hoyos and Mariel, 2010). Table 3 clearly shows the advantages and disadvantages of each elicitation formats and econometric models used to estimate the result.

Table 3. Contingent valuation formats

Format	Pros	Cons	Econometric models
Open ended	Straight forward No anchoring bias (avoiding starting point biases); Very informative since maximum WTP can be identified for each respondent; and, Highly statistically efficient	It leads to large non-response rates, Protest answers Zero answers and Outliers; Respondent' faces difficulty to pick a value out of the air without some form of assistance.	• Multiple linear regression • Tobit
Bidding game	This may facilitate respondents' thought processes and Encourage them to consider processes and encourage them to consider their preferences carefully.	Prone to starting point bias and succeeding bids used; It also leads to large number of outliers; and Bidding games cannot be used in mail surveys and other self-completed questionnaires.	• Multiple linear regression • Tobit • Bivariate probit/ Logit • Binary logit • Binary probit
Payment card	Provides a context to the bids, while avoiding starting point bias at the same time (starting point bias being a form of anchoring bias whereby bids are linked to the researcher's statement of the first amount); The number of outliers is also reduced in comparison to open ended format; and, some versions of the payment card show how the values in the card relate to actual payment; contain a large array of possible willingness to pay amounts	Prone to range and starting point bias; The location of the benchmarks; and requires the respondent to be literate, and little use in LDCs where illiterate rate is high and, it cannot be used in telephone interviews	• Multiple linear regression • Tobit
Single bounded	it is thought to simplify the cognitive task faced by the respondents Minimizes non-response and avoids outliers; and,	Starting point bias, i.e. answers are 'anchored' on the initial figure stated by the questioner Require larger sample size and Sophisticated design and Analysis techniques	• Binary logit • Binary probit
Double bounded	More efficient than single-bounded dichotomous choice and bidding game; More information is elicited about each respondent's WTP ("follow up" question in addition to the "yes-no" options of the single bounded dichotomous choice) Increase statistical efficiency	Starting point bias Require larger sample and Statistical assumptions	• Multiple linear regression • Tobit • Bivariate probit • Binary logit • Binary probit • Multivariate probit

Source: Own review (2018)

4. Empirical Studies

We reviewed different articles in relation to willingness to pay the case of environmental resources. Finally, we used narration and tabular form to summarize and present the results of the review. The study conducted by Han *et al.* (2011) estimated willingness to pay for forest conservation using contingent valuation method. The result indicated that 73% of the respondents were willing to pay for the conservation of the forest with average WTP of $8.03 but 27% of the respondents were not willing to pay anything at all. Similarly, Kalbali *et al.* (2014) analyzed factors affecting the willingness to pay of visitors and the amount they are willing to pay for Ghorogh Forest Park using contingent valuation and application of Tobit model. The report revealed that average willingness to pay per visitor for each visit of the Ghorogh Forest Park was estimated 2623 Rials and annual recreational value of the forest park was estimated to be around 4 billion Rials. Additionally, Cho *et al.* (2005) measured rural homeowners' willingness to pay for land conservation easements using contingent valuation method. The estimated result reported that household's WTP to participate in an easement program ranges from $10.97 to $21.79 per year per household.

Similarly, Mekdes (2014) analyzed visitors' willingness to pay for recreational use value of Menagesha Suba Forest Park using Tobit model. The result indicated that monthly income and quality of the recreational site had significant positive effect on visitors' willingness to pay; conversely, initial bid and employment status had negative effect on visitors' willingness to pay.

In the same way, Siew *et al.* (2015) estimated the visitors' willingness to pay for conservation of Pay Indah Wetlands using contingent valuation method. The result indicated that the mean willingness to pay of the respondents for the conservation of the wetland was 7.12 RM. Bogale and Urgessa (2012) used bivariate probit model to identify explanatory variables that influence households' WTP for improved rural water supply. Their result demonstrated that total household income, educational level, credit access and annual water expenditure were found to have statistically significant positive effect; in contrast, age of the household head and distance from water source had statistically significant negative effect (See Table 4 for detail information).

Table 4. Summary of studies conducted on household's willingness to pay

Study	Dependent variable	Independent variable	Model	Valuation technique
(Tilahun *et al.*, 2011)	Forest conservation	Gender, age, annual income, educational status, initial bid, access to radio, land size, dependency ratio, residence	Bivariate probit	CVM
(Han *et al.*, 2011)	Environment conservation	Gender, age, educational status, residence location, attitude	Binary logit	CVM
(Gatto *et al.*, 2014)	Forest ecosystem services	Recreation, carbon sequestration, biodiversity conservation, landscape, cost	Multinomial logit	CE
(Youe and Pabuayon, 2011)	Flooded forest conservation	Gender, age, educational status, household size, participation in training, income, distance	Multiple regression	CVM
(Amare *et al.*, 2016)	Church forest	Sex, age, formal education, household size, land size, livestock ownership, irrigation practice, credit access, extension service, church forest benefits	Heckman two stage	CVM
(Kasaye, 2015)	Soil	Sex, educational level, family size,	Bivariate	CVM

	conservation	dependency ratio, land size, total livestock, farm income, slope of land, distance to market, bid1, perception of soil conservation, credit access	probit	
(Nuva *et al.*, 2009)	Ecotourism Resources Conservation	age, gender, marital status, residential area, income level	Binary logit	CVM
(Mamat *et al.*, 2013)	Environmental environment	Age, education, income, visitors perception on recreational facilities & services provided, number of visit, dichotomous choice bid assigned, foreign visitors	Bivariate probit	CVM
(Gebremaria, 2012)	Soil conservation	age of the household head, sex, education level, family size, perception, land tenure, Total Livestock Units, initial bid	Bivariate probit	CVM
(Alemayehu *et al.*, 2009)	Environmental service restoration	Educational level, age, asset holdings, number of trees planted, number of livestock, training, assistance in land and water conservation techniques, distance to the office of agriculture	Interval regression	CVM
(Tilahun, 2009)	Soil and water conservation	Education, age expectations about yields in irrigated agriculture, wealth of the household, off-farm activities, distance to market, dependency ratio, randomly assigned bid working days	Binary logit	CVM
(Cho *et al.*, 2008)	Land Conservation	Household income, knowledge about land development issues, property used as a primary residence, property within city boundaries of highlands	Ordered probit	CVM
(Abebe and Geta, 2014)	Irrigation water	Sex, age, educational level, family size, farm experience, income, Livestock ownership, productivity, credit access, distance to market, initial bid, labor shortage	Tobit	CVM
(Abu *et al.*, 2011)	Soil conservation	Age, educational status, household size, farm size, farm experience, information access, occupation, source of capital, credit access, labor	Logit	CVM
(Angella *et al.*, 2014)	Irrigation water	Educational status, household size, land size, farm experience, market distance, training, credit access, off-farm income activity, irrigation water source	OLS	CVM
(Tang *et al.*, 2013)	Irrigation water	Age, gender, educational status, family size, income, land size, bid, satisfaction of water management	Binary logit	CVM

Source: Own review (2018)

5. Conclusion

Depending on the reviewed document and empirical results of selected articles regarding to environmental resources, this study concluded and recommended the following core ideas.

Even though several authors proposed different hierarchical classification frameworks to organize

existing methods to WTP estimation, literatures classify those techniques into two: revealed preference and stated preference techniques. Revealed preference is a generic term for market analysis and refers to the observation of preferences revealed by real market behavior; whereas, stated preference method uses survey method to estimate willingness to pay. In addition to this, each technique has its own approach, behavior (observed versus hypothetical), methods to elicit WTP (both direct and indirect), nature of goods and services (real versus hypothetical) and total economic value (use value versus non-use value). Those parameters are used to compare and contrast the two methods to apply in our field of study. Travel cost method and hedonic pricing are the two common revealed preference techniques used to estimate monetary value of resources which have recreational value and resources having different degree of a specific attributes, respectively. On the other hand, stated preference technique includes contingent valuation and choice experiment. Contingent valuation method is the direct method of estimating willingness to pay of individuals using survey questions; whereas, choice experiment is an indirect method of stated preference technique used to estimate WTP of each attribute using price variable of each attribute. Contingent valuation and choice experiment can be evaluated by cost of the survey, time scale, software and analysts, WTP estimation (total or individual attribute), accuracy of the result response task and efficiency. As a result, researchers take into account those criteria to use either of the two methods.

Dichotomous choice contingent valuation (single and double bounded) questions have gained popularity due to their advantages in avoiding many of the biases known to be inherent in other formats used in the contingent valuation method. Double bounded formats more efficient than single bounded dichotomous choice and bidding game. So, the application of double bounded yields better result as compared to other value elicitation formats of contingent valuation. The empirical result of mean willingness to pay is also better in double bounded than other formats.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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