Chapter Three

Theoretical and conceptual framework

The purpose of this chapter is to present a theoretical and conceptual framework of the study under a conventional utilitarian framework. A preliminary model of valuation of environmental goods is presented in this study. The theoretical and conceptual framework is to a great extent influenced by the findings presented in the literature reviewed earlier. The model provides the framework for the research design and data analysis. The following concepts and theoretical framework serve as the foundation to the proposed model.

Two dominant concepts in the literature on valuation of environmental goods are environmental values and environmental economic values key to the model developed for the current study. According to Bishop and Woodward (1995) environmental deterioration can be defined as the loss of natural capital. Environmental accounting is the paradigm of conservation and preservation of such capital. Environmental-economic accounts provide the conceptual framework for integrated statistics on the environment and its relationship with the economy, including the impacts of the economy on the environment and the contribution of the environment to the economy. A coherent set of indicators and descriptive statistics can be derived from the accounts that inform a wide range of policies, including, but not limited to, green economy/green growth, natural resource management and sustainable development.
Valuation of environmental goods and services is a prerequisite to control and contain the damages caused to the environment by society. The following section presents a brief review of related concepts.

3.1 Economic Valuation of Environmental Goods and Services

In modern economic jargon goods that nature provides, such as, air, water, flora and fauna are valuable, since they provide a flow of services to society. Economic valuation of goods and services provided to mankind by nature in the form of natural resources is a part of the cost-benefit approach to valuation problems. In compliance with this statement an enlarged view should be adopted, in order to correctly capture the actual flow of services supplied to society and economy by nature. The flow of services from natural goods are either be in the form of vital economic inputs (fossil fuels, lumber and other forestry resources, minerals, etc.) or as indispensable elements of human life (breathable air, livable climatic condition, etc.).

Nature is also a supplier of a series of reconstructive and background opportunities and finally is a system capable of receiving and assimilating the waste generated by all kinds of usual human activities. Consequently environmental economic value may be defined as the sum of the net discounted values of the flows of all services provided by nature to society.

The benefits of an increase in provision of any environmental service flow must be reflected in the increase of the discounted value of the service. On the other hand pollution damages correspond to a reduction in the service flow. The individual utility does not depend only on consumed public or private goods but also on the quantity and the quality of nonmarket goods and services provided by natural or environmental resources (e.g. recreational opportunities, landscape services, etc.).
Economic value expresses the extent to which a good or service satisfies individual wants and preferences. These preferences can be expressed in terms of utility (or satisfaction derived), an unobservable ranking or ordering of preferences, or by a less theoretically appealing, but more practical money metric approach. Thus, economic value can be measured by the sum of money an individual is willing to pay for a good or service or the amount of money an individual is willing to accept as a compensation for forgoing the good or service. Willingness to pay (WTP) and willingness to accept (WTA) are measures that can be revealed in exchange. Many goods and services are exchanged on a market, which routinely reveals their value. The market, however, is capable of revealing only one component of the total economic value. This component, known as direct use value, refers to WTP or WTA for only an actual use of the good or service. The direct use component tends to dominate the total value of most ordinary (non-environmental) goods such as books purchased to be read, food bought to be eaten, or cars acquired for transportation.

**Figure 3.1 Total Economic Value**

![Diagram of Total Economic Value](image_url)
For some natural resources, their value is almost solely related to their direct use. The primary example of such a natural resource is crude oil. We are willing to pay for it only as much as the energy it creates is of some value to us. Many other natural resources are also highly valued for their direct use, although direct use may be only one of several mechanisms that contribute to their overall plea. For example, lakes, oceans and rivers can be used for swimming, fishing or water sports; forests are sources of wood and timber (not so these days as the drive against deforestation prevents tree cutting for timber), fruits, honey berries, herbs, as well as recreational opportunities; wetlands offer opportunities for bird watching.

Many goods and services, particularly environmental ones, are valued for reasons not connected to a direct use. However, no consent exists in the academic community as to what set of categories is really exclusive and exhaustive in capturing the residual elements of the total value. Components of value and their relationship to each other (Figure 3.1) are discussed in a way that represents the interpretation most usually agreed upon by environmental economists.

Total value consists of two main elements: use value and nonuse value. Use value captures indirect use in addition to direct use as described previously. Indirect use is related to special functions of some ecosystems. For example, lakes, oceans, and rivers assimilate waste, and provide habitats for wildlife; forests act as carbon sinks, prevent soil erosion and encourage soil production; wetlands offer flood control and trap nutrients and sediments.

Goods and services may also be valued for their potential to be obtainable in the future by future generations. These potential future paybacks compose an option value, a concept first introduced by Weisbrod in 1964. It may be thought of as an insurance premium one may be willing to pay to ensure the supply of the environmental good later in time. For
example, people may be willing to pay for preserving biodiversity or genetic materials to make sure the option of having these goods in the upcoming future. This value component is a controversial element of the total value. There is no agreement even among environmental economists as to the precise assignment of option value among use and non-use components. The likely interpretations are schematically represented by arrow lines in Figure 3.1. Some consider option value to be one of the use components, which suggests that it is value of assuring future direct or indirect use of the good. Others interpret it as a nonuse component, since option value is not related to any current use of the good. Some even argue that option value should be well thought-out a separate value category in addition to the use and nonuse ones, thereby allowing it to capture both future use and nonuse benefits.

The final value component, known as nonuse value, was first proposed by John V. Krutilla in 1967. It captures those elements of value that are not linked to a current, future, or potential use.

Existence value reflects benefits from basically knowing that a certain good or service exists. For example, some people derive satisfaction from the fact that many dying out species are protected against extinction. Many people are willing to pay for safety of these species’ habitats, even those located in remote, hard to access areas. Although those placing the value will most likely never travel to these places, or see the species, they nevertheless value the knowledge that such species exist.

Bequest value, the other nonuse component, refers to benefits from ensuring that certain goods will be preserved for future generations. For example, many of us are concerned with future damages from global warming and would be willing to pay to reduce them, despite the fact that the vast majority of the damages are expected to affect the Earth long
after our generation is gone. Policies associated with either a long-term or permanent impacts can lead to losses that consist primarily of bequest value.

3.2 Methods for Valuing the Environment

The society obviously values environmental resources. Environmental valuation is mostly based on the assumption that individuals are willing to pay for environmental gains and, on the other hand are willing to accept compensation for some environmental hazards or losses. The individual demonstrates preferences, which, in turn, put values on environmental resources. Environmental economists have developed a number of market and non-market-based techniques to assess the environment. Figure 3.2 presents some of these techniques and classifies them according to the basis of the monetary valuation, either market-based, surrogate market, or non-market-based.

Figure 3.2 Environmental Valuation Methods

Source: National Oceanic and Atmospheric Administration (NOAA)
Market Based Methods: Economists normally prefer to rely on direct, observable market associations to place monetary values on goods and services. Markets allow economists to measure an individual's willingness to pay to acquire or preserve environmental services. In turn, consumers reveal their preferences through the choices they plan in allocating scarce resources among competing alternatives. Three market-based methods of environmental valuation are: (a) factor of production approach, (b) change in producer/consumer surplus, and (c) examination of defensive expenditures.

The value of a natural resource can be monetized based on its value as a factor of production. The output of any firm is a function of several important inputs (e.g., land, capital, natural resources), which are collectively known as "factors of production." In their role as factors of production, raw materials and environmental inputs are used in the production of other goods. When a natural resource has direct value as a factor of production and the impact of environmental degradation on future output of that resource can be accurately measured, the resultant monetary value of the decline in production or higher cost of production can be measured. For example, a decline in water quality and waste management could have a direct and detrimental impact on the productivity and health of residents. This technique is however, limited to those resources that are used in the production process of goods and services sold in markets. Because many goods and services produced by the environment are not sold in markets, the factor of production method generally fails to capture the total value of the resource to society.

The standard method used to measure the net economic benefit of a good or service in a market involves an examination of consumer and producer surplus. Consumer surplus is the difference between what each customer is willing to pay and the price of the good or service. Producer surplus is the difference between what a producer is paid for a good or
service and what it costs to supply. The total economic benefit of a sale is the sum of the consumer and producer surplus.

A final market-based valuation method is that of defensive expenditures, which are made on the part of industry and the public either to prevent or counteract the adverse effects of pollution (Feather 1995) or other environmental stressors. The defensive expenditures method, also known as the averting behavior approach, monetizes an environmental externality by measuring the resources spent to avoid its negative impacts on the surrounding community. Types of defensive expenditures include water purification devices, beach nourishment etc.

**Surrogate Market Methods:** In the absence of clearly defined markets, the value of environmental resources can be derived from information acquired through surrogate markets. The most ordinary markets used as surrogates when monetizing environmental resources are those for property and labor. The surrogate market methods discussed below are the hedonic price method and the travel cost method.

The hedonic price technique of environmental valuation uses surrogate markets for placing a value on environmental quality. The real estate market is the most normally used surrogate in hedonic pricing of environmental values. Air, water, and noise pollution have a direct impact on property values. By comparing properties with otherwise similar characteristics or by examining the price of a property over time as environmental conditions change and correcting for all non-environmental factors, information in the housing market can be used to estimate people's willingness to pay for environmental quality.

The travel cost method is employed to measure the value of a recreational site by surveying travelers on the economic costs they incur (e.g., time and out-of-pocket travel
expenses) when visiting the site from some distance away. These expenditures are considered an indicator of society's willingness to pay for access to the recreational benefits provided by the site. The travel cost method can be used to measure not only the elimination of a site but also the impact of access restrictions and changes in environmental quality. The travel cost method, however, is limited in application and captures only direct recreational benefits and only when there are measurable travel costs to examine. The travel cost method also does not measure non-use and intrinsic values or other sources of value, such as commercial values.

**Non-Market Methods:** The Contingent Valuation Method (CVM) is a non-market-based technique that elicits information concerning environmental preferences from individuals through the use of surveys, questionnaires, and interviews. When deploying the contingent valuation method, the examiner constructs a scenario or hypothetical market involving an improvement or decline in environmental quality. The scenario is then posed to a random sample of the population to estimate their willingness to pay (e.g., through local property taxes or utility fees) for the improvement or their willingness to accept monetary compensation for the decline in environmental quality. The questionnaire may take the type of a simple open-ended question (e.g., how much would you be willing to pay) or may involve a bidding process (e.g., would you pay Rs. 10, would you pay Rs. 20) or take-it-or-leave-it propositions. Based on survey responses, examiners estimate the mean willingness to pay for an environmental improvement or willingness to accept compensation for a decline in environmental quality.

The CVM is extremely flexible and can be used to value most any environmental asset. Further, CVM and other non-market methods are required accurately to capture non-use values. This is a significant point in a world comprised of ecosystems under great stress from human impacts, where increasing attention is being given to non-use values.
The primary disadvantage of CVM is that it may not yield accurate results due to biases that may be introduced in the survey or through respondents' behavior. These biases include strategic bias, where the respondent's belief that his answers may be used to affect government policy leads him to intentionally understate or overstate his willingness to pay to achieve the desired policy result. The payment vehicle cited in the questionnaire may also result in bias due to an aversion to certain taxes or fees. The availability of information or misperceptions concerning environmental quality can also result in bias. To minimize bias, analysts must be extremely careful in how they design surveys and conduct interviews. An extensive body of economic literature addresses the sources of inaccuracy in CV studies and the development of methods to deal with specific issues of survey design and implementation. A primary source of information is the Report of the NOAA Panel on Contingent Valuation, a document detailing the findings of a blue ribbon panel convened by the National Oceanic and Atmospheric Administration (NOAA) which examined the drawbacks to CVM, investigated key issues surrounding the design of CV surveys, and presents guidelines for completing CV studies.

Contingent valuation studies are focused on valuing specific changes in environmental conditions. Thus, individuals who are surveyed in CV studies are typically presented with a specific program or action and asked to value it in its entirety. Conversely, in choice experiments respondents are presented with a menu of alternatives relative to environmental policy options, such that preferences for various components or attributes can be examined at a more refined level. Whereas CVM produces a single value for a change in environmental quality, choice experiments provide independent values for the individual attributes of an environmental program. The emphasis on examining the attributes of the program reduces bias attributed to yes-saying (simply approving of the
general policy and agreeing to fund it at an excessively high level) and provides the analyst with a more complete understanding of individual preferences.

It can be concluded that environmental valuation techniques are primarily driven by the principle that individuals are self-interested and demonstrate preferences that form the basis of market interactions. These market interactions demonstrate how individuals value environmental goods and services. The market-based nature of economic theory emphasizes the maximization of human welfare. The market, in turn, determines resource allocation based on the forces of supply and demand.

The environment, thus, is used as an instrument to achieve human satisfaction. In turn, the environment can be treated like any other commodity and its associated value can be broken down into many elements. Environmental valuation can be viewed as a mechanistic approach in which the total value of an environmental system is assessed in terms of the value of its individual parts.

To quantify existence values accurately within the framework of environmental valuation is difficult. Revealed preference methods (e.g., travel cost method and hedonic pricing methods) measure the demand for the environmental resource by measuring the demand for associated market goods. Existence values are not adequately captured using these methods. Existence values are only revealed through surveys of individual willingness to pay for the environmental resource or willingness to accept compensation for environmental losses.

### 3.3 Willingness to Pay Survey

One important way in which economic analysis of a public service can contribute to public policy is to ascertain whether the population receiving the service values that service enough to justify the costs of the service. In the case of solid waste services, the goal of the
economic analysis is to identify whether the households served would collectively be willing to pay enough of their own money to finance the costs of the service. It also can be used to determine whether the benefits exceed the cost. The analyst also will need to examine how much this consumer may already be paying for a substitute service. In the case of solid waste service, this means that all the relevant aspects of the proposed service(s), as well as the alternative(s) available if the service is not provided, must be conveyed to the consumers in order for them to make an informed choice. If this is done properly, then this survey method can make a very important contribution to policymaking. In this regard, it lets the analyst know what choices the affected citizens would make if empowered to make the choice themselves over how to spend their incomes and how much they would spend for the service under review. If the survey is properly designed, the data from a large sample of survey subjects can be used to estimate a demand function to describe aggregate preferences of the population of interest. This method is referred to as contingent valuation (CV) – it is a valuation contingent upon a hypothetical choice (Bernstein, 2004).

The CV method is commonly performed by phone interview, written survey returned by mail, or face-to-face interview, with the latter considered the most reliable. In most developing countries and transitional economies, however, face to face interviews are recommended. The respondent is presented with material that includes the following three elements (Mitchell and Carson 1989):

1. A detailed description of the good(s) being valued and the hypothetical circumstance under which it is made available to the respondent. The market scenario presented should be as realistic as possible. It should include descriptions of the baseline level of service, the availability of substitutes, the means by which the good is to be provided, and the payment
method. In order to construct a demand curve, several different price service levels may be presented to the respondent for valuation.

2. Questions which elicit the respondent's willingness to pay for the good(s) being valued.

3. Questions about respondents' characteristics, such as age, income, race, education, gender, etc., and questions about respondents' preferences relevant to the good(s) being valued and their use of the good(s). Parts of this information may be elicited before and after the presentation of the scenario. These variables are included in regression equations to estimate a valuation function for the good. If the valuation function includes coefficient estimates consistent with theory, then the findings of the study have more credibility.

The CV method is controversial within the economics profession, but it is indispensable in the valuation of goods not widely available in markets. In practice, it generally seems that respondents in CV methods have a tendency to state higher willingness to pay values than they would exhibit in actual market behavior. This bias is noted by a prominent panel assembled by the U.S. National Oceanic and Atmospheric Administration (NOAA, 1993), who presented their findings after having examined numerous studies carried out up to that time. The NOAA panel recommends several strategies to address these concerns.

The first is that the studies should be conservative. The researcher must understand that there is likely to be a bias in respondents' answers toward higher statements of willingness to pay than the respondents would demonstrate in an actual market. Statistical estimates should be interpreted conservatively. Respondents should be reminded of the costs of the proposed goods and of other goods on which they or government bodies might spend their money.
A second means to enhance the validity of a CV study's findings is to estimate a valuation function that is internally consistent and consistent with theory and the findings of other studies.

For example, willingness to pay for solid waste services and environmental amenities should be increasing in respondents' incomes. Respondents should have a higher willingness to pay for a proposal with a higher level of service than they do for a proposal with a lower level of service. Respondents who have greater need for waste disposal services (for example, because they have fewer alternatives available or have more waste to dispose of) should have a higher willingness to pay for improvements in waste management services, other things equal. Obviously, respondents will have many reasons for favoring or opposing the policy proposed to them, but statistical relationships like to these examples promote greater confidence in the survey's findings.

3.3.1 The Form of the Willingness to Pay Question

The preferred format for the willingness to pay question is dichotomous choice. The respondent is offered two alternatives and asked to indicate which he or she prefers. For example, the choice might be between the status quo and some improved level of solid waste service that may cost an additional amount of money per household per month. The respondent is asked whether he or she would prefer the new policy if it means having to pay that additional amount of money per month. This type of question is much easier for the respondent to understand and provides much more reliable answers than other question formats (NOAA, 1993, Choe, 1994). Finally, in some studies the dichotomous choice question is followed by an open-ended follow-up question (“what are the most you would pay for ...?”).
3.3.2 Representative Sample

As in any study based on a sample of the population, the ability to generalize to the larger population from the sample depends on the validity of the sampling method. The analysts should use a selection method that ensures randomness and selects from the entire population with equal probability (or, if stratified, from each stratum) to the greatest extent possible. Moreover, once a household is selected, repeated attempts should be made to contact that household to ensure that selection bias is not introduced at this point. With respect to the research design for a dichotomous choice CV study, a rule of thumb is to randomize prices among the respondents and ensure that there is a minimum of 30 respondents at each price at each site. Thus if residents of one town is involved in the survey, and there are 5 different prices, it is necessary to include 150 households in the sample (1x5x30 = 150).

3.3.3 Understanding of the Cost

The survey must make explicit to the respondent the means by which the proposed program will be financed, and the respondent should be able to easily identify what the cost will be to his or her household. Any non-monetary inputs that would be expected from households should also be clearly stated in the scenario. For example, if the household would be required to sort and store recyclable materials for separate disposal, that should be clearly conveyed. If the household would be required to carry waste to a central collection point, the likely location of that collection point should be conveyed.

3.3.4 Possible Scenario Rejection

Scenario rejection can result if the respondent does not believe that the scenario can actually happen. The CV method is explicitly saying to the respondent: “Assume that the service as described occurs. Would you be willing to pay Rs. X per month for it?” If the
respondent does not believe that the government (or non-governmental or private sector) organization identified in the scenario will be capable of providing the service as described, the respondent may have difficulty accepting the premise. In this case, a negative response to the willingness to pay question does not say “I do not think this service is worth Rs. X per month;” rather, it says “I don't believe this scenario will happen.” It is therefore important to present the scenario specifically and clearly, and follow-up negative responses to understand the respondent's reasoning. Distrust about the agency designated to implement the policy is an important piece of information to consider in the policymaking process. It is also important that such protest votes be identified in order to better estimate the willingness to pay for the service, if the service were truly to be implemented. Focus groups and pre-testing of the survey instrument can provide general information about respondents' expectations and should be used in designing the survey instrument. Questions should also be included in the survey to help identify this reasoning for negative responses (NOAA, 1993). Since the contingent valuation method appears to have a net positive bias in its estimates of willingness to pay, in standard practice adjustments are typically not made for these types of answers. However, the contingent valuation scenario and willingness-to-pay questions are typically pre-tested and modified if necessary to minimize this problem.

### 3.3.5 Identify the Appropriate Payment Vehicle

A common payment method used in CV surveys is a monthly fee on a utility bill (if households typically pay such a bill). The respondent is familiar with this method of payment and understands its effects on disposable income. Moreover, if there is already a water or sewer bill being paid, imagining the waste services fee as an add-on has the added advantage of there being some connection between the proposed service and a fee that is also related to environmental services? Through the focus group discussion the analysts
should identify a payment vehicle that satisfies the needs of the CV study and that citizens accept as a reasonable method. The payment method to be implemented to finance the plan should also be discussed, and if participants take issue with that method, the report should acknowledge this fact. If there is controversy, then questions could also be added to the survey to elicit respondents' attitudes towards alternative payment vehicles. If such questions are included on the survey, then it would be best to ask them after the willingness-to-pay questions.

3.3.6 Identify Key Willingness-To-Pay Values

For use of single question dichotomous choice, fitted in a logit or probit model, it is important to identify where the tails of the willingness-to-pay distribution lie. Common models include 4 or 5 different prices offered, with the highest price typically about where at least 90 per cent of the respondents give a negative response and the low price where at least 90 per cent of the respondents give a positive response. The additional prices offered are then spaced between the high and low prices. Some information about these key price points can be found in the focus groups and additional information can be obtained through the pretesting.

3.4 Theoretical Framework

Economists have a distinctive definition of value based on the ideals of rationality and consumer sovereignty - an individual consistently knows what he or she wants and needs (rationality) and is best able to make choices that affect his or her own welfare (consumer sovereignty). However odd the choices may appear to the outsider, a rational individual’s consumption decisions are consistent with his or her purpose. If a person prefers grapes to bananas, rationality requires her to consistently select grapes (if both are free) and consumer sovereignty allows her to make that choice. The same logic applies to
environmental goods and services – if the individual prefers improved urban waste management services to a new shopping mall, rationality allows her to consistently rank waste management over the shopping mall.

Based on this foundation of rational choice, individuals are assumed to value changes in environmental services despite their absence from the market. If a change occurs such that the person believes she is better off in some way, she may be willing to pay money to secure this improvement. This willingness to pay reflects her economic valuation of improved environmental services. Alternatively, if the change makes her worse off, she might be willing to accept compensation to allow this deterioration. This willingness to pay (WTP) and willingness to accept (WTA) represent the two general measures of economic value for an environmental service. These measures of value are what economists would like to estimate so that environmental services and other non-market goods can be included in policy decisions on how to prioritize and allocate public monies. The WTP and WTA measures of economic value can be used as restrictions to guide policy or can be included, with caution, in the bottom-line cost-benefit analysis used to support public policy.

Utility is an observable, continuous index of preferences. If a policy is imposed that changes the consumption bundle so that utility increases, then economists measure this change as consumer surplus – the money metric of the unobservable utility function. Consumer surplus can be either a willingness to pay or a willingness to accept compensation measure. Thus preferences that are indexed by a utility function and changes in utility are captured by consumer surplus measure. With the appropriate restrictions, an individual’s willingness to pay for a change in environmental quality is based on a theory of rational choice, and is therefore a consistent estimate of preferences.

Given the individual’s economic problem, the problem that now concerns us is formally defining the economic value of an increase in the level of the environmental services (say
sustainable urban waste management for instance) to $Q_1$ from $Q_0$. Since differences in utility are not measurable, economists have introduced the concept of consumer surplus—the money metric of changes in utility.

Since the economic value of environmental services is usually not reflected by direct market prices, consumer’s surplus measures are used to capture the value of changes in these services. If we increase the level of environmental services to $Q_1$ from $Q_0$ keeping non environmental goods $x$ – fixed, the individual’s utility increases to $U_1$ from $U_0$ – more of $Q$ gives the individual more utility. Now first of two questions is, what is the maximum he or she is willing to pay (WTP) to secure this change to $Q_1$ from $Q_0$?

The answer is the individual would give up the composite market good until he or she reached his or her original utility level. He would not give up more because then he would be worse off than he started; if he gave up less that would not be the maximum he was willing to pay. Given an increase in the level of environmental service, the maximum WTP is just the amount that would return him to his original level of utility – no more, no less.

This maximum willingness to pay is called the Hicksian compensating surplus, named after Sir John Hicks. A value measure is a compensating surplus measure if two conditions hold – the original level of utility, $U_o$, and the new level of environmental quality, $Q_1$. Alternatively we may define consumer’s surplus as the difference between levels of expenditures, often an easier way to obtain the economic value of interest.

**3.5 Binary Choice Model**

Suppose an individual $n$ is faced with a choice between two alternatives from a choice set $C_n = (i, j)$, where alternative $i$ represents choosing to vote “yes” for tax payment of Rs. $A$ for public good $G$ and alternative $j$ represents choosing to vote “no” for tax payment of Rs. $A$ for public good $G$. An individual $n$ derives utility $U_{in}$ by choosing alternative $i$ and $U_{jn}$.
by choosing alternative j. Following Hanemann (1984), if we define $G = 1$ if $i$ and $G = 0$ if $j$ and using the condition that in consumer equilibrium entire income is spent on goods and/or services, meaning that utility of all other goods can be represented by income $I_n$, utilities $U_in$ and $U_jn$ can be formulated as following:

$$U_{in} = V_{in} + e_{in} = v (1, I_n - A_n, S_n) + e_in \quad (3.1)$$

$$U_{jn} = V_{jn} + e_{jn} = v (0, I_n, S_n) + e_{jn} \quad (3.2)$$

Where $V_{in}$ and $V_{jn}$ are assumed non random, systematic components of the $U_{in}$ and $U_{jn}$ respectively, while $e_{in}$ and $e_{jn}$ are assumed random components of the $U_{in}$ and $U_{jn}$ respectively. $S_n$ represents vector of observable attributes of an individual $n$ that might affect his/her preferences and $A_n$ represents tax payment of Rs. A that respondent $n$ can pay for the public good $G$.

Probability of an individual $n$ choosing alternative $i$ is then defined as:

$$P_n(i) = Pr (U_{in} = U_{jn})$$

$$= Pr (V_{in} + e_{in} = V_{jn} + e_{jn})$$

$$= Pr \{v (1, I_n - A_n, S_n) + e_{in} = v (0, I_n, S_n) + e_{jn} \}$$

$$= Pr \{ e_{jn} - e_{in} = v (1, I_n - A_n, S_n) - (0, I_n, S_n) \} \quad (3.3)$$

While probability of an individual $n$ choosing alternative $j$ is defined as

$$P_n(j) = 1 - P_n(i) \quad (3.4)$$

Under the assumption that $e_n = e_{jn} - e_{in}$ is logically distributed, probability that an individual $n$ will choose alternative $I$ can be written as
\[ P_n(i) = \frac{\exp^{\mu v_{in}}}{\exp^{\mu v_{in}} + \exp^{\mu v_{jn}}} = \frac{1}{1 + \exp^{-\mu (v_{in} - v_{jn})}} \] (3.5)

This is a binary logit model.

This chapter has presented the theoretical and conceptual framework associated with the study based on past research. A preliminary model of environmental goods valuation was developed as a basis of analysis and dominant concepts surrounding the model were discussed. A detailed analysis of two dominant theoretical concepts—environmental values and environmental economic values were discussed as part of an overview of the environmental goods valuation, and the method of willingness to pay survey, which form the basis of this survey. The following chapter will discuss the method employed for the study and the preliminary analysis of the data.