Valuation of Choke Mountain Range Wetland Ecosystem, East Gojjam, Amhara Region, Ethiopia: Application of Choice Experiment Valuation Method

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This is to certify that the thesis prepared by Getnet Berhanu, entitled: *Valuation of Choke Mountain Range Wetland Ecosystem, East Gojjam, Amhara Region, Ethiopia: Application of Choice Experiment Valuation Method* and submitted in the partial fulfillment of the requirement for the degree of Master of Science in Economics (International Economics) complies with the regulations of the university and meets the accepted standards with respect to the originality and quality.

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ABSTRACT

Valuation of Choke Mountain Range Wetland Ecosystem, East Gojjam, Amhara region, Ethiopia: Application of Choice Experiment Valuation Method

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Choke Mountain Range Wetland Ecosystem is one of the most productive natural resource of the country. The mountain is considered as the water tower of the Upper Blue Nile River (or Abay in Amharic). More than 59 rivers and 273 small springs which are the main tributaries of Blue Nile or Abay originate from this mountain. In addition to approximately 3386 km^2 wetland area, the mountain is endowed with resources for potential recreation. The main attractions of the mountain include the existence of an impressive landscape, unique and common biological diversity and the cool temperate agro-ecological (Wurch) zone.

However, the resources are facing critical problems of high degree of exploitation and degradation. Some of the responsible factors for the degradation of the area are limited awareness of the society about the multidimensional values derived from these mountain wetlands, ever-mounting population pressure, over grazing and lack of intervention by government. Consequently, 607 km^2 of seasonal wetland with low moisture and 22.4 km^2 of open water of the mountain have lost within the last 20 years. In addition to this much fauna and flora species also disappeared.

To assign monetary values for the multi-functions and services offered by this mountain wetland ecosystem, the study applied choice experiment valuation method by using four identified attributes i.e. biodiversity, water availability, recreational facilities and lastly the monetary payment attribute. Multinomial and random parameter logit models were used to analyze the data collected from a sample of 250 respondents (farmers). All the attributes were significant in affecting the probability of choosing an alternative scenario and had the expected sign except negative effect of biodiversity. The result for biodiversity is perhaps because of farmers' expectations about the negative effects of future policy change on their current consumption of the mountain resources and perhaps limited awareness about the use and non use values derived from biodiversity. But the marginal willingness to pay for availability of water was the highest (birr 155 annually) which was followed by availability of recreational facilities (birr 36 per year). Moreover, the estimated compensating surplus for high impact improvement scenario, medium impact improvement scenario, and low impact improvement scenario were birr 444, birr 490 and birr 143 respectively.

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List of Acronyms

ASC	Alternative Specific Constant
CE	Choice Experiment
CEC	Commission of the European Communities
CS	Compensating Surplus
CVM	Contingent Valuation Method
DC	Dichotomous Choice
EPA	Environmental Protection Authority
ICUN	International Union for the Conservation of Nature
IIA	Independence of Irrelevant Alternatives
IPCC	Intergovernmental Panel on Climate Change
MNL	Multinomial Logit Model
MRS	Marginal Rate of Substitution
MWTP	Marginal Willingness to Pay
Mt	Mountain
NOAA	National Oceanic and Atmospheric Administration
RPL	Random Parameter Logit
TCM	Travel Cost Method
WTA	Willingness to Accept
WTP	Willingness to Pay

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Wetlands are one of the most multifunctional ecosystems of the world that provide a range of economical, biological, ecological, social, and cultural functions and services to human beings (Barbier et al., 1997). These vital ecosystems are distributed throughout the world and the estimated size of wetland area is approximately 12.8 million km^2 (Finlayson et al., 1999) that covers 6.4% of the surface of the planet earth. Even though savannahs and hot deserts are common in the African continent, wetlands covered a significant part of the continent. In particular, the coverage is estimated to vary between 1% and 16% or 220,000 and 1,250,000 km^2 of the total area of the continent respectively (Koohafkan, 1998; Bullock et al., 1998).

In Ethiopia all types of wetlands except coastal and marine-related wetlands and extensive swamp-forest complexes are found and they are estimated to cover more than 2% of the area or 22500km^2 (Deribe, 2004). For instance wetlands such as riverine, lacustrine, alpine formations, palustrine and floodplain are common in different parts of the country mainly in Lake Tana, Ashenga, Bale Highlands, Western Highlands, Lakes of Bishoftu, South west Rift Valley, Awash River System, Afar Depression, Western River Floodplains, Central Ethiopian Highland Wetland Complex etc (Hailu, 2003) and in Choke mountain range (Teferi et al., 2010).

However, more than half of the wetlands of the world have been lost since the 1950s by human beings for different reasons (Moser et al., 1996; OECD, 1996). For instance

America has lost 87 million hectares of wetland (Tiner, 1984), and in Europe i.e. Netherlands, Germany, Spain, Italy, Greece and Portugal have lost 55%, 67%, 57%, 60%, 66%, and 63% of their total wetlands respectively (CEC, 1995) within less than a century. In addition to these Philippines has lost 300,000 hectares (67%) of its wetland ecosystems within 60 years (Zamora, 1984). Even though many of the wetland ecosystems of Africa including Ethiopia are drying up and disappearing, it is difficult to quantify the loss due to limited research work on wetland resources.

The Choke Mountain range which covers 17443 km^2 constitutes various types of wetlands (Teferi et al., 2010). However, these resources are characterized by serious degradation and exploitation because of rapid agricultural expansion, overgrazing, resettlement and excessive soil erosion etc. which call for wetland conservation, improvement and management efforts.

Thus, an important starting point towards solution to these serious problems is providing information as an input to policy makers and managers about the value of such ecosystems. In order to estimate the value of wetland ecosystems, different valuation techniques such as contingent valuation, hedonic pricing, and replacement cost, choice experiment, and production function can be used. In this study choice experiment valuation technique is used in order to estimate the economic value of multiple goods and services which are provided by mountain Choke wetland ecosystems.

1.2. Statement of the Problem

Choke Mountain range**,** center of attention of this study, is found in East Gojjam Zone, Amhara region, Ethiopia. It is located with Lake Tana and Bahir Dar in the north and Debre Markos in the south. The mountain lies between the altitudes of 810 m and 4070 m above sea level. Choke Mt.range is considered as the water tower of the upper Blue Nile river system in Ethiopia. It is the source of more than 59 rivers, and 273 small springs which are the main tributaries of Upper Blue Nile (Teferi et al., 2010). Among the major rivers that are originated from this mountain, Chemoga, Temecha, Gedeb, Tijan, Tefe, Teme, Azewari, Sede, Inat Muga, Gilgel Muga, Zimbl, Komed, Oromo Meshageriya, Tiliku Abeya, Tinishu Abeya, Ayabab and Gudela are few of them. In addition to this Choke Mountain have many potential resources that can be used as a destination for many local and foreign tourists just like other sites of the country. Among the potential resources, the existence of marvelous landscape, the four stepped mountains (Arat Mekeraker in Amharic) and many unique and common biological diversity like Gibra (Giant Lobelia rhynchopetalum) and Key Kebero (Ethiopian Wolf), and the cool temperate agro-ecological (Wurch in Amharic) zone are the few. Therefore, Choke Mountain can contribute for ecotourism development of the country like Semen and Bale Mountains. The other most remarkable feature of this mountain is the virtual existence of wetland ecosystems ranging from sedge swamps to seasonally flooded grasslands which covered more than 3386km^2. Out of this figure, seasonal wetlands with high moisture, seasonal wetlands with low moisture, and open water constitutes 3000km^2, 340km^2 and 46km^2 respectively (Teferi et al., 2010).

The above resource bases of Mt.Choke range have both national and international contributions. It provides resources like food, water for drinking and small scale irrigation, grazing, raw materials for building, and recreational or tourism services. It is also used for the maintenance of ecosystem stability, flood control, habitat for various fauna and flora species, climatic stabilization, and scientific researches and trainings. Generally these ecosystems are vital for ensuring food security and poverty reduction and hence achieving sustainable development directly or indirectly to the country. Choke Mountain currently is home to more than 132,069 families who are engaged in traditional farming (ORDA, 2011). Therefore these are the peoples who are the first beneficiaries from the improvement of the mountain and again they are the first to be hearted from the extreme degradation of the mountain.

It is also internationally crucial ecosystem by supplying water for millions of downstream Nile basin countries particularly Sudan and Egypt. They are using it for irrigation, hydroelectric power generation, drinking, transportation, tourism and recreation, and habitat for various fauna and flora.

However, given these crucial roles that mountain Choke wetland ecosystem plays, the resources are facing critical problems of high degree of exploitation and degradation. The main factors which threaten the Choke mountain range wetland ecosystems and fueled the degradation of the resources in the region include the expansion of poverty, ever-mounting population pressure and a long history of human settlement, climate change, reduction and even extinction of biodiversity, soil erosion and hence reduction of soil fertility, over grazing, cutting trees and bushes by farmers and lack of intervention by government are some of them. The climate change vulnerability feature of wetland

ecosystem has also aggravated the degradation (IPCC, 2001). Due to the above mentioned factors, 607 km^2 of seasonal wetland with low moisture and 22.4 km^2 of open water were lost in the Choke mountain range from 1986 to 2005 (Teferi et al., 2010). In addition to these, lack of knowledge on the multidimensional values of wetlands for the society including the environmental policy makers and hence absences of strong national wetland policy or strategy are the other fundamental reasons that aggravate the depreciation of these resources. Unless restoration, enhancement, conservation and management mechanisms to these ecosystems are implemented, the above multiple wetland benefits are being lost as a result.

There are few studies carried out in the wetland ecosystems of the country. These include valuation of recreational wetland of Wondo Genet (Mesfin, 2010), measuring wetland loss in the Choke Mountain range by using Remote Sensing (Teferi et al., 2010), valuing the benefits of improved quality of Lake Awassa (Girma G. Selassie, 2006) and valuation of fishery and watershed of Lake Tana (Fitalew, 2009). However, to our knowledge, comprehensive studies on valuation of the multi-functions and services of wetland ecosystem have not yet been undertaken in the country in general and Choke Mountain range wetlands in particular.

In order to fill this gap, this study was conducted on estimating the economic value of mountain Choke wetland ecosystem. Therefore, decision makers can use the result to compare the environmental and developmental values and then decide on allocation of budget for wetland enhancement and management programmes based on the result of such study. In addition to these the study tries to determine the preference of stakeholders

for different attributes and estimate the welfare impacts of each wetland scenarios by using choice experiment method.

1.3. Research Objectives

The general objective of this study is to measure the total economic contribution of the Choke mountain range wetland ecosystem to the welfare of the society and assign monetary values for the multi-functions and services offered by this wetland ecosystem by using choice experiment method.

The specific objectives are:

- To identify the multiple benefits of the wetlands rendered to farmers.
- To estimate the farmer's marginal willingness to pay and welfare impacts of improvements in each attribute of the wetland ecosystem.
- To identify threats of the wetland ecosystems and the factors that affect the willingness to pay for different attributes of Mt.Choke wetland ecosystem.
- To suggest alternative policy options which enable decision makers to maintain the quality of the ecosystem for current or future generation.

1.4. Significance of the study

Understanding the values and functions provided by wetland ecosystem is vital for decision making. This wetland valuation study estimates the benefits of these resources to the society and financial experts and policy makers can use the result to carry out a cost-benefit analysis for different environmental conservation scenarios. Cost-benefit analysis compares the benefits and costs of management scenarios to society and then they are

used to select the best of policies to improve the ecosystem. In addition to these, the study provides input to the policy makers and other stakeholders that need information on valuation of wetland ecosystems. It is also used to increase the awareness of the stakeholders and users about the crucial functions and services of these ecosystems. Broadly speaking the beneficiaries from the result of this paper can be classified in to four groups. The farmers around Choke Mountain are the first who will benefit from the study result. Mitigating the threats occurring on the Choke mountains and restoring their natural resources, mainly wetlands, and creating an enabling environment in the region improves the livelihood of the societies. Secondly, the benefit of the study goes to the country by reducing poverty and achieving sustainable development via sustainable environmental management. The millions of the Nile basin countries' communities are also the third indirect beneficiaries from the management and improvement of these resources. In addition to these, the paper contributes to the limited but growing wetland valuation literature in the country.

1.5. Limitation of the study

Undertaking original environmental valuation research incurs high cost. The study implemented the survey via questionnaire in order to collect primary data from the case study area which is 450 km far from Addis Ababa. Thus, collection of the data is very difficult and too costly. Therefore, financial constraint was the main limitation of the study that affected the size of the sample size. The other limitation of the study was time constraint. This is because it took long time to collect the survey data.

CHAPTER TWO

2. LITERATURE REVIEW

The literature review part is concerned with both theoretical and empirical literatures on the issues of wetlands and the benefits obtained from valuing these ecosystems.

2.1. Theoretical Framework

2.1.1. Concepts of wetland ecosystem and environmental valuation

2.1.1.1. Definition of wetland ecosystem

Because of the existence of different types of wetland ecosystem across nations, providing one precise definition for wetlands is so difficult (Barbier et al., 1997). As a result, different scholars define wetland ecosystem in different ways at different time and place. But the most common definition for wetland resources is found in the Ramsar convention which was adopted in Iran in 1971. According to the definition of Ramsar Convention article 1.1, wetlands are:

"…areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters" (Ramsar Convention, 1971).

2.1.1.2. Functions and services of wetland ecosystems

Wetland resources are the most vital ecosystem in the world. Because of the multiple functions and services that are derived from wetland ecosystems, they have been described both as "the kidneys of the landscape", and the "biological supermarkets*"* (Mitsch and Gosselink, 1993) and (IUCN, 2006) respectively. Wetlands play a paramount role in the life of human beings by providing ecological functions such as the maintenance of ecosystem stability, habitat for various fauna and flora and climatic stabilization; a socio-esthetical service such as the role of ecosystems in development of cultural heritage; intrinsic value, which is the value that resides in the environmental asset itself and an economic functions by providing resources like food, water, raw materials for building , clothing and recreational services, which are monetary measures for benefits or costs of environmental change (Kirsten, 2005). The general functions and services of wetland ecosystems are summarized in the following table.

Table 1: Functions and Services of Wetland Ecosystems

Services	**Descriptions of services**
A) Provisioning Service	• Food • Fresh water • Fiber and fuel • Biochemical products • Genetic materials
B) Regulating Service	• Climate regulation • Water or hydrological regulation

	• Water purification and waste treatment • Erosion regulation • Pollination • Natural hazard regulation
C) Cultural Service	• Spiritual and inspirational • Recreational • Educational • Aesthetic
D) Supporting Service	• Soil formation • Nutrient cycling • Biodiversity

Source: Finlayson, (2005)

2.1.2. Economic Values of Wetlands

Different scholars such as economists, ecologists and sociologists define the term value in different ways. The difference between the willingness to pay for the good or service and the cost of supplying it is what economists call economic value of the good. But in this particular case we are enjoying the products and services provided by these environmental resources without incurring any cost. Therefore the value of such resources is our willingness to pay to them alone (Barbier et al., 1997).

Wetlands provide multiple economic, social, cultural, and ecological functions and services which are crucial for the local, national and global society. The value of some of these functions and services could be determined by the market forces of demand and supply. However, many of them have non-market values. Therefore, the total economic values (TEV) of wetland ecosystems like other environmental resources are disaggregated into two broad categories of use and non-use values (Barbier et al., 1997).

Total Economic Value = Use Value + Non Use Value

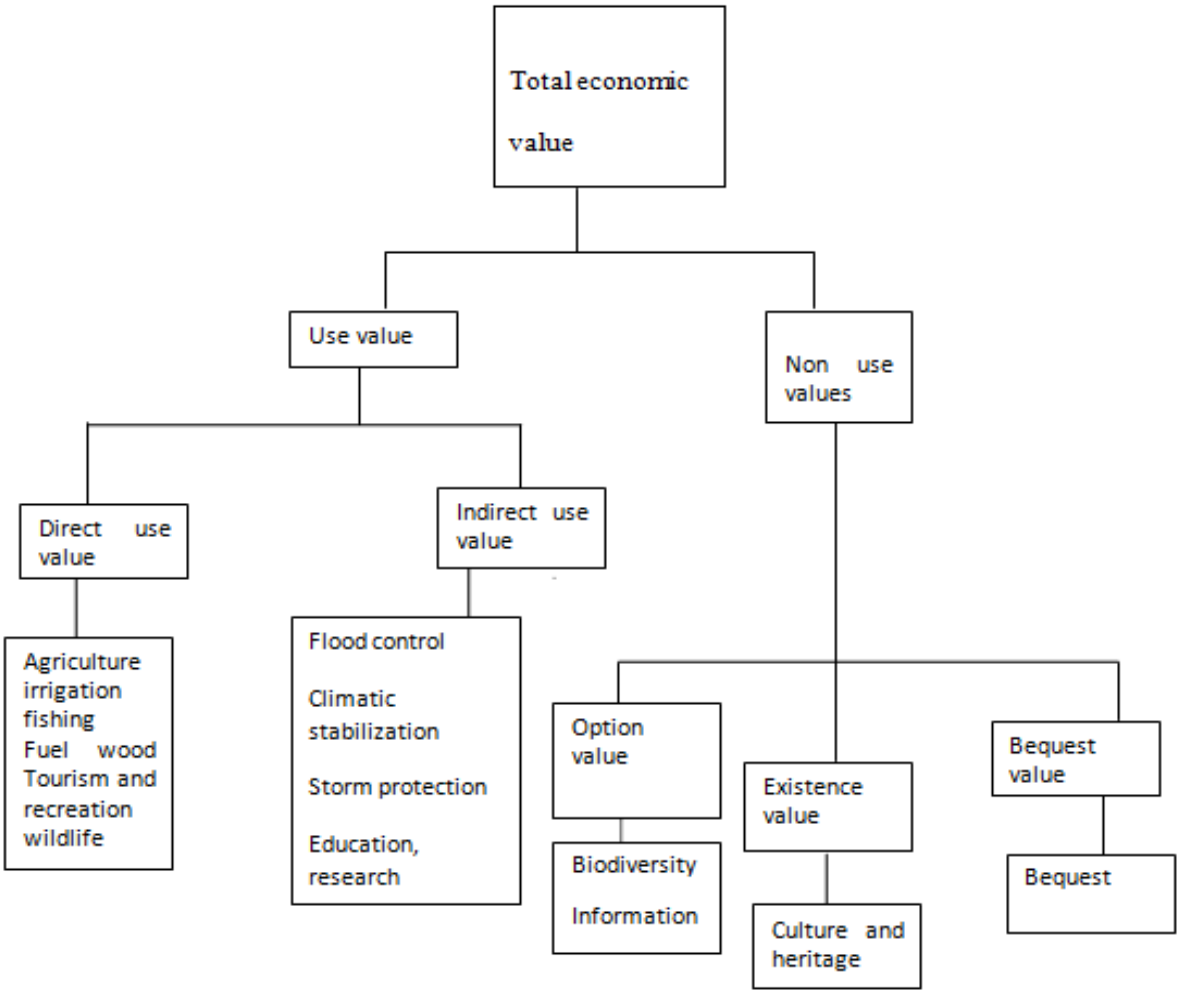
Use values are related with the utilization of the resources by concerned individuals. In other words, it is the value of the environmental resources that exist while the goods and services are used by the households or firms. The use values are further divided in to two sub-categories of values, namely direct use values (DUV) and indirect use values (IDUV).

Direct or 'consumptive' or 'structural' or 'extractive' use values are the benefits derived from direct consumption of the environmental resources in this particular case wetlands. Examples of direct uses of wetlands are fishing, hunting, and fuel wood extraction, water use for irrigation and drinking, tourism and recreation. Indirect use or 'functional' or 'non extractive values' are values which are obtained from indirect consumption of the environmental goods. Or it is found from the aesthetic and functional services. It is the value related with the life support services of the environment (Perman et al., 2003). Flood control, micro-climatic stabilization and carbon sequestration are some of the indirect uses of wetland ecosystem.

Non-use values are the intangible values of resources which are not directly related to the use of resources. Rather the non use values of resources are based on their appreciation and existence (Pearce and Warford, 1993). Existence values, option values and bequest values are the three main types of non-use values.

Existence value: is value attached to a resource for its existences. Bequest value is the value that people attach for the resources in order to sustain them for future generations. Option values are the third types of non-use values which are given for possible future use of something. Generally the total economic values of wetland ecosystem are illustrated in the following diagram.

Figure1. Total economic values of wetland ecosystems



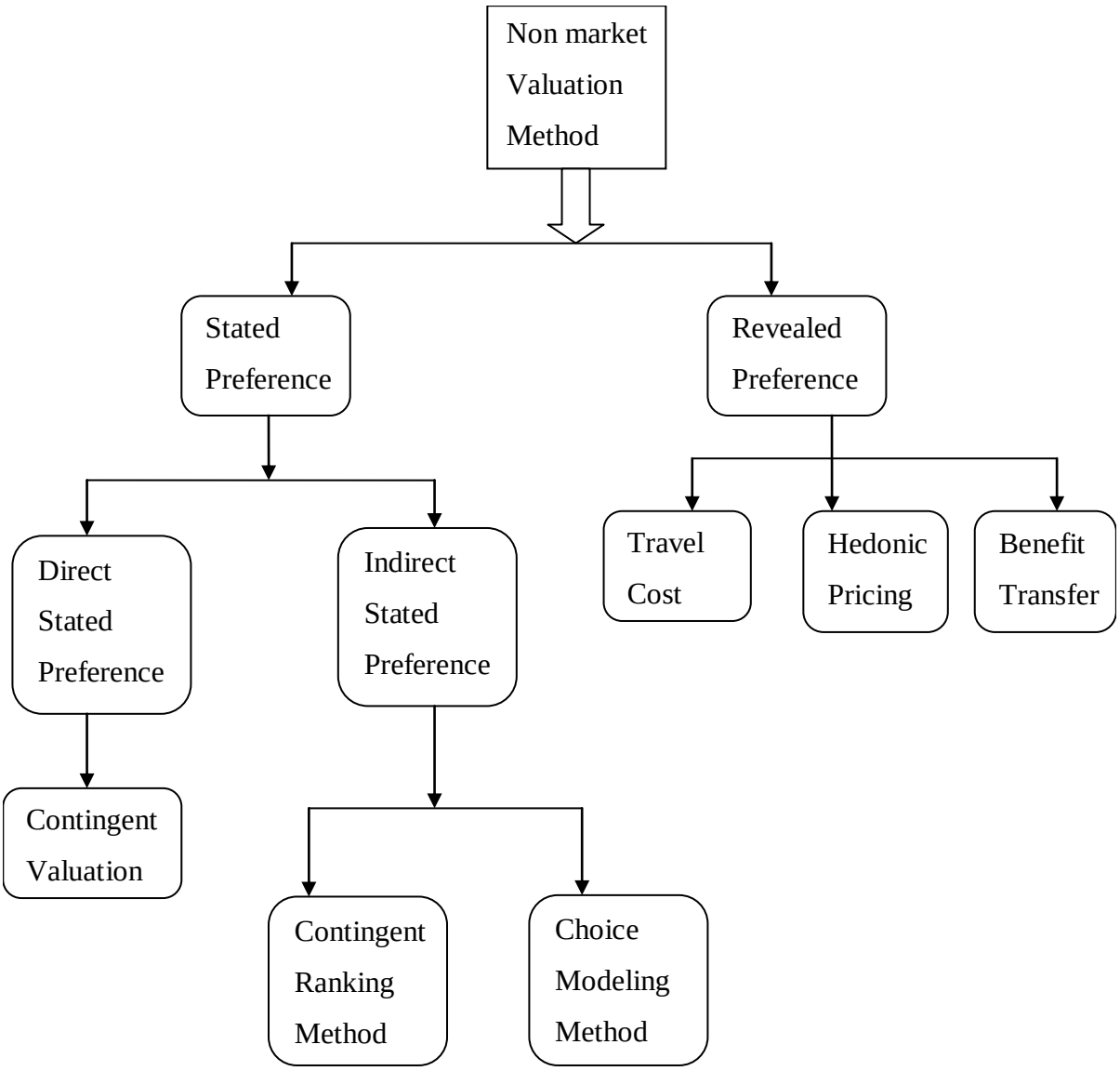
Source: Barbier et al., (1997)

2.1.3. Classifications of Environmental Valuation Techniques

In order to provide information to planners and decision makers and then for managing the wetlands appropriately, their total economic value should be determined and expressed in monetary forms. Consequently, environmental managers can use the determined monetary values for cost benefit analysis of development projects which

assists them for decision making. Different market and non- market valuation methods have been developed by environmental economists to perform such activities. Some of those non market valuation techniques with their classification category are demonstrated in the following diagram.

Figure 2: Types of valuation techniques



Source: Perman et al., (2003)

A. Travel Cost Method

Travel cost method which is part of revealed preference valuation approach is based on the idea that the value of the environmental resources is approximated by the cost that visitors incurred in order to enjoy the service offered by the resources (Freeman, 1993). Mostly it is used to estimate the values of recreational sites like national parks. By using the survey data on the number of visits and total cost from the recreational site, it is possible to estimate the values for the parameters of compensating demand function and then marginal consumer surplus (MCS) is determined from surrogate demand function that shows the relationship between visits and admission fee via ordinary least square method (Freeman, 1993).

Limitations of TCM

- Linearity assumption on the trip generating function without testing the data is unrealistic. Because the functional form which is compatible with the data may be other than linear such as logarithm form.

- The estimates of the trip generating function parameters are biased due to several reasons. The first factor is because of the use of ordinary least square method of estimation which is inefficient. Omission of relevant variables from the model like income level of visitors is the reason for the biasness of the estimators.

- Difficulty of measuring travel cost is the other problem of travel cost method.

B. Contingent valuation method

Contingent valuation is one of the direct stated preference methods where sample of respondents are asked their willingness to pay for the hypothetical scenario which is used to estimate the use and non-use values of environmental resources. Five main steps are identified in order to use contingent valuation technique (Perman et al., 2003). Designing the survey instrument and construction of scenario is the first step for CVM implementation. The second step is collection of the data (marginal willingness to pay or accept) from the sample population using the designed survey instrument in step one. Analyzing and assessing the collected data is the third step. In this step the value of average willingness to pay (WTP) or willingness to accept (WTA) is estimated. Fourthly, aggregate WTP/WTA for the population will be computed. Cost benefit analysis by using the total WTP/WTA could be conducted. Finally, sensitivity analysis will be implemented using the estimated valuation function in step four. Even though contingent valuation method has the advantage of valuing both the use and non-use values (passive use values) of environmental resources, there are various possible problems in this valuation method.

Limitations of CVM

Valuation of environmental resources via contingent valuation techniques yield biased results. There are various sources of possible biases such as strategic bias, hypothetical bias, information effects, embedding effect bias, sampling bias, problem of interviewer, response bias etc (Mitchell and Carson, 1989).

C. Choice experiment method

Adamowicz (1994) was the first person who applied the choice experiment model for the first time on the valuation of Highwood and Little Bow Rivers in Alberta, Canada (Birol et al., 2005 and Hanley et al., 1998). Daniel McFadden won the Nobel Prize in 2000 for his pioneering work in developing basis for discrete choice models used, among others, in choice experiment studies. Choice experiment was commonly used by marketing researchers, transportation planners, public finance, labor economists, health research, psychologists and other literature. Because of the advantage of choice experiment over contingent valuation technique in reducing potential sources of biases and in providing abroad base data from respondents, the application of choice experiment model in valuation of multiple functions and products of public goods and services has been increasing in the last decades (Alpizar et al., 2001).

Both the model of consumer choice (Lancaster, 1966) and random utility theory (Luce, 1959 and McFadden, 1974) are the basic theoretical foundations of choice experiment application. These two economic theories are used to estimate the use and non-use values of different environmental attributes. Its basic idea is obtaining the marginal willingness to pay or marginal willingness to accept for environmental resources by creating a hypothetical market situation and elicits individual stated preferences for the attributes and alternative scenarios. In choice modeling respondents are given with various alternative descriptions of the good with different attributes and their levels and asked to choose their most preferred alternative (with the highest expected utility) in a given choice set that consists status quo and other proposed improvement alternatives. Choice experiment valuation technique is used to determine the total utility that an individual

obtains from the various combinations of attributes and compares the relative significance of each attribute (Ryan, 2000). Therefore in this study choice experiment modeling was applied for valuing the multiple goods and services provided by Mountain Choke wetlands.

Stages in choice experiment method

According to Bennett (2001) choice experiment modeling involves seven stages in order to estimate the value of the environmental resources or public goods and services. These are described below.

Stage one: Identification of attributes: in this stage attributes which are important for the valuation of the environmental resources are identified by using different mechanisms such as focus group interview, from literatures or in consultation with environmental economists, ecologists, hydrologists, biologists etc.

Stage two: Selection of attribute level: the levels for the identified attributes including the level for the status quo are assigned in this stage with the help of experts, literature review and survey. The levels of the attributes must satisfy the characteristics of reliability, feasibility and it has to also elicit the range of respondents preference map (Hanley, 2001).

Stage three: Experimental design selection: in this step different alternative scenarios are developed by using the selected attributes and their levels. Complete factorial design that includes both main effects and interaction effects or fractional factorial design that includes only the main effects can be used in order to determine the number of

combinations or options. Since the complete factorial is very large, mostly fractional factorial is used for choice set determination.

Stage four: Choice sets determination: the options that are determined in the above experimental design step are used to form choice sets. These choice sets can be constructed individually, in groups or in pairs.

Stage five: Development of questionnaire and data collection: the primary data will be collected by using questionnaire. In addition to these the size of the sample should be determined by taking in to account small sample size bias, and financial as well as time constraints.

Stage six: Estimation: The collected data will be estimated by using different estimation techniques like ordinary least square (OLS) and maximum likelihood (ML). Multinomial logit and random parameter logit models are the two commonly used models in choice experiment valuation analysis.

Stage seven: Interpretation and analysis of the results and policy analysis: this is the last step where the estimated results are interpreted and alternative policies are recommended accordingly.

Advantages of Choice Experiment Model

The choice experiment technique of non-market valuation has many advantages over other methods particularly contingent valuation (Blamey et al., 2001). Some of these advantages are the following:

- Choice experiment has the ability to identify the value of each attribute separately by using the above mentioned two models.

- The choice experiment technique of non-market valuation has many advantages over other methods particularly the degree of freedom of respondents by providing multiple choices to elicit their preferences. Therefore it is more informative or it is used to provide broad area of data than other methods of valuation.

- Choice experiment is used to reduce the potential biases of contingent valuation method.

- It reduces various response difficulties such as protest bids, strategic behavior and yeah saying.

Disadvantages

Though choice experiment is widely used in different research areas such as marketing, transport and recently on environmental issues, it has several limitations (Hanley et al., 1998). Some of them are:

- Its cognitive difficulty for respondents in case of multiple attributes and levels, and complex choice sets that increases random errors. Moreover, both learning and fatigue effects may occur as a result of large number of choice sets which may result in irrational choices.

- Choice experiment is sensitive to study design such as the way of selecting the attributes and levels which has significant influence on the preference of respondents and hence on the estimated value of the resources.

2.2. Empirical Literatures

Both choice experiment and travel cost methods were applied by Mesfin (2010) to estimate the value of wetland ecosystem of Wondo Genet recreational site which is one of the most known nature based recreation sites in Ethiopia. This wetland ecosystem is used as a habitat for different fauna and flora. The existence of permanent and hot spring water makes the area one of the important wetland ecosystems of the country. Wondo Genet wetland provides different services to the community like irrigation for agriculture, recreational benefit for both domestic and foreign tourists, supplying of drinking water for the community and their livestock etc. In order to estimate the value of the wetland, four attributes were selected. These were afforestation, quality of recreational services delivered for tourists, general services such as provision of games, and information, and gate fees which is the monetary attribute. In addition to those attributes, the study employed two wetland management scenarios. The survey data was collected from a sample of 192 foreign and domestic visitors. The result from multinomial and random parameter model estimation of the choice experiment showed that all attributes were significant in affecting the probability of choosing alternatives and their signs were similar with the prediction of economic theories and expectations. The visitors' marginal willingness to recreational quality, general services, and plantation of degraded areas were birr 7, birr 2.93, and birr 0.985 respectively. Moreover, respondents estimated compensating surplus were 22 birr, 37 birr, and 44 birr for low impact improvement

scenario, medium impact improvement scenario, and high impact improvement scenarios respectively.

Fetalew (2009) used choice experiment techniques for valuation of Lake Tana fishery and watershed. Three attributes, namely fishing control, lake side plantation and monetary payment were used in the choice experiment model. The result of multinomial and random parameter logit model revealed that all attributes and the socio-economic variables like monthly household income, years of education and family size were significant at one percent level. The estimated marginal willingness to pay for the attributes of fishing control and lake side plantation was birr 15 and birr 50 per month respectively. In addition to these the respondents were willing to pay 57 birr and 97 birr per month for moderate and aggressive improvement scenario respectively.

Birol et al. (2005) conducted a study of valuation of Cheimaditida wetland ecosystem, in Greece. In order to estimate the value of these wetland resources, the researchers applied the choice experiment techniques of valuation. Biodiversity, open water surface area, research and education, retraining of farmers, and payment were the five wetland improvement attributes of the study.

The result of the model indicated that all attributes were highly significant at 1% level and the sign of all attribute coefficients except payment were positive. Similarly the coefficient for alternative constant (ASC) was positive and significant that indicated welfare/utility can be obtained from both hypothetically developed scenarios. Moreover, the most significant attribute was biodiversity which was followed by open water surface and research and educational attributes. The study also applied four alternative wetland

improvement scenarios including the baseline option. These are the status quo, low impact scenario, medium impact scenario, and high impact scenarios. The result of the weighted LCM showed that the total willingness to pay for low impact, medium impact, and high impact scenarios were €419, €846, €644 respectively. Based on the result of cost benefit analysis, high impact scenarios was the most preferred option that maximizes the welfare of the society.

David et al. (2010) conducted a research on the economic valuation of the non use values of the attributes of Lake Kerkini wetland. Lake Kerkini is an artificial lake which is found in Northern Greece. The wetland ecosystem of the lake plays a paramount role to the local as well as the whole population of Greece by providing services like irrigation water, fishing, biodiversity, educational information and training, tourism and recreations. Given these crucial functions, the ecosystem is seriously threatened. According to this study non use values of wetland ecosystem are highly ignored by many environmental conservation and rehabilitations policies. Contingent valuation technique was employed in order to estimate both use and non use values via creating a hypothetical market. The survey was conducted on the 250 sample individuals who were selected randomly from people living around the lake and two towns i.e. Sidiroakastro and Thessaloniki. The respondents were asked to state their willingness to pay and the result of the CVM revealed that respondents were willing to pay an average of 6906.2 Gdr (£15.24) which is a total of 28 billion Gdr (£28.3million) per year for the purpose of lake management.

Carlson et al. (2003) conducted the study on the valuation of wetland attributes by using choice experiment methods in Staffanstorp, Southern Sweden. Four choice sets were

provided for all respondents and were asked to select their best alternative. In order to analyze the collected data, the random parameter logit model (RPLM) was implemented. The results of indicated that all attributes, except for surrounding vegetation and Meadowland, were significant. The willingness to pay for the attributes of biodiversity and walking facilities were $719.75 and $601.41 respectively.

Choice experiment valuation method was applied by Girma G. Selassie (2006) who conducted a research in valuing the benefits from improved quality of Lake Hawassa, Ethiopia. The study identified three main attributes namely Tilapia fish stock, surrounding forest cover, and fishing permit which is the monetary attribute. Three lake management scenarios were implemented and then it tried to value the improvement of the lake quality. Primary data was collected from 200 randomly selected fishermen. Each respondent was asked to choose its most preferred option from given six alternative choice sets. The results of multinomial logit model revealed that the respondent's maximum willingness to pay was found for Tilapia stock. The estimated mean willingness to pay (implicit price) for the improvement of this attribute was 8.83 birr per month. On the contrary the fishermen's willingness to pay for plantation of new trees was very low which was estimated to be 0.56 birr per month. The estimated compensating surplus indicated that fishermen's were willing to pay 31.42, 28.62 and 18.62 birr per month for high impact scenario, medium impact scenario and low impact scenario respectively.

Do and Bennet (2007) conduct a research on estimating the values of wetland biodiversities of Mekong River Delta in Vietnam. The wetland ecosystem of Tram Chin national park which is part of the Mekong River Delta was taken as a case study. A

choice experiment non-market valuation technique was applied in order to estimate the economic values of this wetland ecosystem. Based on the result of the focus group studies, five relevant attributes were found. These are area of healthy vegetation, number of Sarus Cranes, number of fish species, number of affected local households and finally the cost attribute. Four levels for each attribute were determined in consultation with wetland experts. By using these attributes and their levels, twenty-five choice sets with five questionnaire versions were constructed. A total of 900 sample of respondent were selected from three sites by using stratified and systematic sampling techniques. The estimated result of random parameter model revealed that preference heterogeneity among respondents in the attributes of area of healthy vegetation and birds existed. Furthermore all attributes except fish species were significant at one percent level of significance. The result of estimated multinomial logit model showed that the level of income and education had positive relationship with wetland improvement scenarios. In addition to these respondents' willingness to pay for one percent increase in the area of healthy vegetation and for more ten Sarus Cranes were 920 VND (0.06 USD) and 900 VND (0.06 USD) respectively. The aggregated willingness to pay for the wetland management plan was USD 3.9 million which is greater than its cost by USD 0.5 million. This implies the planned management project was feasible.

Dichotomous contingent valuation (DC-CV) method was applied by Seung et.al (2007) in order to estimate the total economic value of the wetland of Woopo, Korea, that asks respondents to accept or reject the proposed level of bid. The survey for the study was based on the response of 540 samples of respondents. However, the responses of the ten interviewees were rejected because of poor information provision. The result of the

before the WTP survey revealed that 85 percents of the respondents valuation of the Woopo wetland were attached or related with the non-use value (i.e. bequest and existence values). The remaining 15 percent of the respondents gave more value for use values of Woopo wetland other than the non-use values. In order to cover the costs of wetland conservation scenarios, annual income tax was selected as a means of payment vehicle. The maximum likelihood estimation result of the dichotomous contingent valuation model showed that all parameters of the model are significant at one percent level of significance. The bid parameter of the model has a negative coefficient which matches with economic theory. Moreover, the estimated mean and truncated WTP were KRW 2,731 and KRW 3,960 per household per year respectively. In addition to these, the annual benefit from the conservation of the Woopo wetland was KRW 19.46 billion and 28.22 billion for mean WTP and truncated mean WTP respectively. This result revealed that the conservation of the Woopo wetland is highly relevant for the society.

Woodward & Wui (2001) conducted a research on economic value of wetland services by using a meta-analysis technique. The panel data for the study was found from the results of 39 related studies on the valuation of wetland resources so as to identify the source of variation in valuing this ecosystem. The result of the Meta analysis revealed that the applied methodology of the study, measurement error or bias, difference in characteristics/services of wetlands, and econometric quality were the main source of variation across the result of wetland valuation studies. As a result of these differences, the study recommended that predicting the value of wetlands on the basis of the obtained actual data or on the result of the previous studies is unrealistic. Therefore, there should be area specific valuation of wetland resources.

A choice experiment technique of valuation was employed by Milon& Scrogin (2006) to evaluate the effects of socio-economic variables and characteristics of wetland attributes on the value of wetland resources. To achieve these two objectives, the study employed three functional and structural attributes. These are Lake Okeechobee water level and timing, and water conservation areas water levels and timing, an Everglades national park and Florida Bay water levels and timing. In addition to these other three social attributes: annual cost per household, restriction on household outdoor and indoor water use and conversion of farmland to wetlands were combined. Three levels for both the ecosystem and socio-economic attributes were specified. Choice sets were formed by excluding the baseline (do nothing) options. By applying fractional factorial method 27 choice sets which were blocked in to two groups were formed. A total of 1680 choices were collected from the 480 sample of respondents. The latent class model result revealed that preferences for wetland ecosystem restoration differ as the function and structure of the ecosystem varies. In addition to these, socio-economic as well as the attitudinal variables of the respondents also influenced the value of these resources.

The above empirical works reveal the existence of various studies on the valuation of wetland ecosystem in different parts of the world. However, to our knowledge, comprehensive studies on valuation of the multi-functions and services of wetland ecosystem have not yet been undertaken in the country in general and Choke Mountain range wetlands in particular. Thus this study is expected to fill this information gap by estimating the value of Choke mountain wetland ecosystem by applying choice experiment valuation method.

CHAPTER THREE

3. DATA AND METHODOLOGY

3.1. Data sources and Sample size

The data for this study was obtained from primary sources. It was collected from a sample of respondents (mainly local farmers) whose livelihoods depend directly or indirectly on the resources of Choke Mountain by means of questionnaire. By taking into account the time and financial resources required for data collection and to minimize the bias from small sample, the sample size for this study was limited to 250 respondents.

Even though the range of Choke mountain wetland ecosystem is found in eight woredas of East Gojjam Zone, the largest proportion (in area coverage) of the mountain is found in Senan woreda. In addition to this, Senan woreda is the nearest woreda relative to others which is important for time and financial resources. Due to these reasons Senan woreda was selected as target population purposefully. From the total of sixteen kebeles of Senan woreda, mt. Choke ecosystem is found only in five kebeles. These kebeles are Dangulie, Abezaze Woybeyegn, Shewa Kedanemeret, Tamawit Gedelbet and Telesamo. Natural resources and tourism development cooperatives/associations were formed in all of these five kebeles. Therefore the total sample size was allocated proportionally to their respective cooperatives of these five kebeles. Furthermore, the respondents were selected via simple random sampling from the members of these cooperatives in each kebele. The data were collected via face to face (in-person) interview with the selected local farmers. In order to collect the data, five enumerators were employed and a short

training on how to conduct the interview was given to them. The survey was conducted on March 2012 for two weeks.

Based on the information gathered from the local communities such as farmers, kebele development agents (DAs), concerned woreda and zonal offices, and different literatures on valuation of wetlands (e.g. Teferi, 2010; Birol, 2006), a total of four attributes including the payment attribute were selected. Among these attributes three of them were qualitative and the fourth was quantitative with different levels. These were biodiversity, availability of water, and recreational facilities. Three levels, four levels, and three levels including the levels for status quo were determined for the attributes of biodiversity, availability of water and provision of recreational facilities respectively. The last attribute is monetary payment/cost and was identified with four levels.

3.2. The choice experiment model specification

There are numerous stated preference techniques for non-market valuation of environmental resources, including the contingent valuation method, contingent rating, contingent ranking and paired comparison. However, choice experiment model is relatively more efficient than the above mentioned methods of valuation in valuing the multi- functional environmental resources such as wetland ecosystems. The reasons include choice experiment has the advantages of providing a richer data set, reduction of strategic bias, and benefit transfer potential, framing effect control and context flexibility (Bennett and Blamey, 2001). It consists of a family of survey-based methodologies for modeling preference for goods, where goods are expressed in terms of attributes they possess (Hanley et. al., 2001). In choice modeling respondents are provided with various

alternative descriptions of the good with different attributes and levels and asked to choose their best alternative. Therefore, in this study choice experiment modeling was applied for valuing the multiple goods and services provided by wetlands.

The foundation for choice experiment model is the Luce and McFadden theory of random utility (Luce, 1959; McFadden, 1974) and Lancaster's consumer choice model (Lancaster, 1966). According to these scholars the total utility derived from the consumption of a good is the sum of two components. The first is the observable component whose value depends upon the attributes and characteristics of the good and the second component is the unobservable error component which is assumed to be independently identically distributed (Lancaster, 1966).

Assuming the error terms of the resulting utility function are independently and identically distributed, a multinomial logit (MNL) model can be developed in order to derive the value of compensating surplus (Morrison et al., 1999).

By using choice experiment, the indirect utility function of an individual i from alternative j is decomposed in to the following observable and stochastic variables (Louviere, 2000):

$$\mathbf{Uij=V\ (Z_j,\ S_i)\ +E} \quad \text{.....} \quad \mathbf{1}$$

Where i -stands for an individual

j- the alternative scenario which is chosen by individual i

Z- indicates attributes of wetland

S- represents the socio-economic characteristics of an individual

V- deterministic/observable component of the utility function

E - unobserved/random component which is not correlated with the observable part by assumption

U_{ij} is the utility (or net benefit or wellbeing) that person i obtain from choosing alternative j. V_{ij} is the systematic, observable component of the latent utility which is the function of both the attributes of the alternative and the socio-economic characteristics of the individual. ε_{ij} is the random component of the latent utility associated with option j and consumer i. Because of the random component, it is impossible to understand and predict preferences perfectly. This leads to the following expression for the probability of choosing alternative i.

$$\boldsymbol{P(i/Cn) = P(Ui > Uj) = P(Vin + \varepsilon in > Vjn + \varepsilon jn)} \text{ ….....2}$$

Where, $\mathbf{C_n}$ is the set of all possible alternative scenarios

Furthermore the systematic component of the utility function can be expressed by using vector of explanatory variables and their coefficients as follows.

$$\mathbf{V_{in} = \beta' x_{in}} \text{……..……..……3}$$

Equation (3) again can be used to write the probability that consumer n will choose option i in terms of systematic and error components which is used to estimate the values of vector of parameters (βs) in the following way:

$$\mathbf{P\ (i/C_n) = P\ [(\beta' x_{in} + \varepsilon_{in}) > P\ (\beta' x_{jn} + \varepsilon_{jn})]\ ,\quad \forall\ j \in C,} \text{ ……..……4}$$

Assuming the consumer of this non- marketable environmental resource is utility maximizer, he/she chooses option *i* from option j in the choice set C_n if and only if the probability that the systematic and random components of option *i* is greater than the systematic and random components of option *j*. To estimate the choice probabilities using Multinomial Logit (MNL) model, it is assumed that the random components are independently and identically distributed (IID), with the implication that alternatives are independent from irrelevant attributes (IIA). Given the assumption of the above IID Gumble distribution of the random component (type I extreme value) and independence between alternative scenarios and individual attributes, the probability of choosing alternative scenario i in MNL equation has the following representations.

$$\mathbf{P\ (i) =}\ \frac{\mathrm{e}\boldsymbol{xp^{\lambda\beta xi}}}{\sum \boldsymbol{exp^{\lambda\beta xj}}} \quad \textbf{……..……..5}$$

Where, λ is the scale parameter.

The scale parameter (λ) is inversely related with the variance of the error terms of utility function which implies that the higher the scale parameter the lower the variance of the error term and hence the higher the model fits. Unlike in separate sample, it is impossible to get the value of the scale parameters from a single sample and its value is assumed to be one (Alpizar et al., 2001). The above probability equation can be estimated by using multinomial logit model regression which is based on the independence of irrelevant alternative (IIA) assumption.

However, when the IID assumption is violated which is realistic, MNL regression might yield biased results. Therefore, other estimation techniques/models such as nested logit, mixed logit or random parameter logit (RPL), latent class models and multinomial probit can be employed (Boxall and Adamowicz, 2001). These models have the advantages of introducing respondents' preference heterogeneity as independent variables in explaining the probability of choice. These models have been widely applied in estimating the total economic values of wetland resources (Birol *et al.,* 2005).

3.2.1. Random parameter logit model (RPL)

Standard multinomial logit model has two main problems (Alpizar et al., 2001). First the model assumes no correlation among the unobserved disturbance terms i.e. it is based on the assumption of independence of irrelevant alternatives (IIA) which is not always realistic. This problem comes as a result of the IID assumptions of the model. The second problem of the MNL model specification is that it doesn't take in to considerations the taste variation of individuals. However, the random logit model provides a simple way to generalize the multinomial logit model-to permit the utilities of each alternative to be correlated (Cameron and Trivedi, 2005).

By relaxing the assumptions of conditional logit model, the random utility function in the random parameter logit model will take the following form (Birol et al., 2005):

$$U_{in} \equiv V_{in} + \varepsilon_{in} \equiv Z_i (\beta + n_n) + \varepsilon_{in} \quad \text{.....6}$$

Where respondents n receives utility U choosing alternative i from a choice set C. Utility is decomposed in to a non- random component (V) and stochastic term (**ε**); and the

indirect utility is assumed to be a function of the choice attributes Z with parameters β (and socio-economic characteristics, if they are included in the model) that may vary across respondents by a random component n_n due to preference heterogeneity. Thus, the probability of choosing alternative i in each of the choice sets will have the following form (Birol et al., 2005)

$$\boldsymbol{P = \frac{e^{Zin(\beta+\eta n)}}{\sum_e Zjn(\beta+\eta n)}} \quad \textbf{.....7}$$

As noted by Birol (2005), since the random parameter logit model does not require the IIA assumption, the stochastic part of utility may be correlated among alternatives and across the sequence of choices via the common influence of η_n. Moreover, it is indicated that in terms of overall fit and welfare estimates, random parameter logit model is superior to conditional logit model and it is also used to account variations in tastes across populations. Thus the general form of the choice experiment in random parameter model is:

$$\textbf{Vij} = \textbf{ASC} + \sum \boldsymbol{\beta_k Z_k} + \sum \boldsymbol{\beta_m Sm} \textbf{……..……8}$$

Where ASC is alternative specific constant that captures effect of any attribute that are not included in the choice specific attributes or it captures the status quo bias. K is the number of attributes and m is the number of socio-economic characteristics of the respondent. Since socio-economic factors are constant for any individual, it can only enter as interaction terms with the attributes or alternative specific constant.

3.2.2. Implicit Price (Part worth)

Implicit prices for wetland attributes are the estimations of the WTP of respondents for an increase in the attribute of concern, given that everything else is held constant. Implicit prices are determined using the following formula:

Implicit price (Part worth) = - ($\beta_{\text{non-market attribute of wetland}}/\beta_{\text{monetary attribute}}$)…….……9

Where, β are the estimated coefficients of the attributes in the multinomial or random parameter logit model. In addition to the estimation of values of individual attributes, the compensating surplus relating to a change in overall conditions can be also estimated by using the following formula:

Compensating surplus = - ($1/\beta_{\text{monetary attribute}}$) ($V_0$-$V_i$)……..10

Where, V_0 is the value of the indirect utility associated with the status quo.

V_i is the indirect utility associated with different alternative improvement scenarios or plans with their specific levels of the attributes. β is the estimated coefficient for monetary attribute.

3.2.3. Specific Equation for Choice Experiment Method

The collected data from respondents were entered in to the Limdep8.0 NLogit4.0 econometrics software in order to estimate both the multinomial and random parameter logit models. In the multinomial logit model two different multinomial functions were estimated. The first model is the basic multinomial logit model which is the function of the attributes of wetland ecosystems alone. The second model is called the extended

multinomial logit model that includes the interactions of the socio-economic variables with the ASCs in addition to the attributes. In both multinomial logit models, three indirect utility functions for the respective three alternatives were derived. These were utility function for status quo option, plan1 and plan2. The specification for these utility functions and hence the basic multinomial logit model is the following.

Model 1: Basic MNL Model

In the basic MNL model the utility function is assumed be linear and has additive form. It is the functions of attributes of the alternatives and the alternative specific constant (ASC). The utility function of the basic model would take the following general form:

$$\mathbf{V_i = ASC + b_1 Biodiversity + b_2 Availability\ of\ water + b_3 Recreational\ facility + b_4 Payment} \quad \mathbf{\ldots\ldots 12}$$

Where: ASC = 0 for status quo option and one for plan1 and plan2. In addition to this b_1, b_2, b_3 and b_4 are the coefficients associated with each of the four attributes, i.e. improvement in biodiversity, availability of water, recreation quality facilities and monetary payment respectively. The three specific utility functions for those three alternative scenarios can be represented as:

$$\mathbf{V_1 = ASC1 + b_1 Biodiversity + b_2 Availability\ of\ water + b_3 Recreational\ facility + b_4 Payment}$$

$$\mathbf{V_2 = ASC2 + b_1 Biodiversity + b_2 Availability\ of\ water + b_3 Recreational\ facility + b4Payment}$$

$$\mathbf{V_0 = b_1 Biodiversity + b_2 Availability\ of\ water + b_3 Recreational\ facility + b_4 Payment}$$

Where: V_1, V_2, V_0 were denoted as the utility for alternative one, two and the statusquo respectively. ASC1 and ASC2 are two alternative specific constants for plan 1 and 2. According to Bennett and Blamey (2001) the two ASCs for improvement plans are constrained to be equal, because of a generic format and an experimental design that was close to orthogonal were used to develop the choice sets and hence we included one common alternative specific intercept for the two alternatives that imply changes**.**

Model 2: Extended MNL Model

The above basic multinomial logit model is estimated based on the assumption of preference homogeneity i.e. it assumed that preferences are homogeneous across individual respondents. But this is not always realistic. Rather preferences are heterogeneous across individuals and such heterogeneity need to be accounted through interacting socioeconomic variables with either attributes or ASCs and use them as independent variable in the utility equation so as to have unbiased estimates (Birol et al., 2005). However, due to a possible multicollinearity problem, all possible interaction between the socio-economic characteristics and attributes should not be included. Moreover, it has to be recognized that they cannot be introduced separately in the model. Because respondent's characteristics do not vary across alternatives, "Hessian singularities" arise in the model unless the socio-economic characteristics are introduced as interactions with either the attributes or the ASCs (Bennett and Blamey, 2001). Six socioeconomic variables age, distance from the mountain, family size, income, education, and sex were included in this extended model as interactions with the ASCs which enable to capture the influence of the variables on the probability of the respondent to choose either plans. The specification of this model is given as follows:

$$V_i = ASC + b_1 Biodiversity + b_2 Availability\ of\ water + b_3 Recreation\ facility + b_4 Payment + \lambda_1 ASCi*AGE + \lambda_2 ASCi*FAMSZ + \lambda_3 ASCi*INC + \lambda_4 ASCi*EDUS + \lambda_5 ASCi*SEX + \lambda_6 ASCi*DSKM \quad (13)$$

3.2.4. Definitions of Variables in the Choice Experiment Method

ASC: this represents alternative specific constant and takes value 1 for the attributes with changes (improvement plan 1 and improvement plan 2 in the choice sets) and 0 for the base (status quo) option.

Biodiversity: this attribute refers to the number of fauna and flora species and their habitats in the ecosystem. Improving the levels of these ecosystems in quantity as well as in quality has multi-dimensional importance and it has an expected positive sign in relation to the utility of the respondents.

Availability of water: This attribute stands for the availability of water for domestic consumption (for both humans and animals drinking), irrigation of crops etc. Availability of water is expected to have a positive relationship with the utility of the farmers.

Recreational facilities: it represents the recreational/tourism facilities that are used to increase the flow of local as well as foreign tourists to the mountain. This recreational facility includes availability of improved infrastructure (such as road, water, and electricity), provision of tourists resting facilities like hotels and lodges etc. The improvement of this attribute is expected to enhance the wellbeing of the local community and the domestic and foreign tourists as well.

Monetary payment: it is the amount of money that is collected annually from the households in order to improve and manage the wetland ecosystem of mt. Choke. Its

coefficient is expected to be negative since an increase in the price of the alternative will be expected to reduce the utility of the respondents.

AGE: it is the respondent's age which is measured in years. Generally, a positive relationship is expected between a person's age and the choice of improved environmental plans. This is because the person's interest in environmental improvement is expected increase as he/she becomes older.

FAMSZ: is the total number of people in the respondent's household. A negative relationship is expected between family size and the probabilities of choosing improved environmental plans.

INC: this is the annual income of the respondents. Since income reflects the ability to pay, a positive relationship is expected.

EDUS: this represents respondent's educational level in years of education. More years of education would generally be expected to lead to a better understanding of the importance and benefits of wetland ecosystem improvements. Therefore, a positive relationship is expected between educational status and the choice of improved environmental plans.

DSKM: it shows how far the farmers are from the Mountain Choke wetland ecosystem. It is expected to have a negative sign, i.e., the further the farmer is from it, the lower the willingness to pay for the improvement of the area and.

SEX: This variable represents the sex of the respondent. It is included in the study as a dummy variable, where 1 is for male and 0 for female. This relationship is indeterminate a priori.

3.3. Design of Choice Experiment

3.3.1. Description of Attributes and Levels

Attributes are determined by taking in to account the respondent's, in this particular case farmer's, characteristics and their capacity. When the number of attributes is too many, it is difficult for farmers to choose from many choice sets. On the contrary too few attributes has the disadvantage of being unable to explain the value of the ecosystem very well because of small data base. On the bases of the above reasons and in consultation with various experts and local residents around mt. choke, four attributes including the payment attribute were determined. In addition to this the selected attributes should be relevant to the problem being analyzed, credible and realistic, capable of being understood by the sample population, and relevant for policy making process (Bennett and Blamey, 2001). After attributes were identified and defined, the level of each attribute was determined.

Biodiversity is the first attribute that was used in this study. Biodiversity is the number of fauna and flora species and their habitats. The level of both fauna and flora species and their habitats is degraded at alarming rate in the Choke Mountain because of many factors. The unprotected nature of Mt. Choke ecosystem has aggravated the unprecedented rates of biodiversity loss that resulted in the extinction of many fauna and

flora species. This is because of the given opportunity for local communities to use these defenseless resources for different activities such as for agricultural land expansion, fire wood, wood for construction, grazing of animals etc. Because of these factors the wetland ecosystem of mt. Choke and its recreational potential is under threat. Therefore, guiding the existing land use practice based on practicable land use planning that takes in to account the suitability of the ecosystem process for different uses is essential. On account of this, improving the level of plant and animal species (level of biodiversity) was taken as one attribute with two levels: the improvement of fauna and flora species and their habitat at a medium level (improving by 25%.) and improvements in both quality and quantity of fauna and flora species at a high level (improving by 50%).

Availability of water is the second attribute used in this study. Mt.Choke is the source of many rivers (especially for tributaries of river Blue Nile) and springs which are used for domestic consumption (drinking water for both animals and plants) and irrigation of different crops. However, the water level of many of the rivers is reducing and many springs which are very important to the local community as well as the region have disappeared particularly in the dry seasons of the country. Therefore, improving the availability of water in the region via improving the wetland ecosystem of the mountain was taken as one attribute with three levels included: Water is available in two of the four seasons of the year, water available in three of the four seasons of the year and water available in all four seasons.

Recreation facilities were taken as the third attribute in the study. Even though Mt. Choke has the potential to be one of the tourist destinations of the country, the area is not obtaining the expected level of tourists as well as the revenue generated from them. As a

result of this the community around the area in particular and the region as a whole is not the beneficiary of this great opportunity. There are a lot of factors responsible for this. The main factors are the unavailability of almost all types of recreational facilities such as infrastructure (road, clean water, and electricity), no transportation services, no resting facilities (hotels and lodges), no information provision etc. The site has failed to provide even one of these facilities. Therefore, providing such recreational services is likely to be a highly relevant attribute and it has taken with two levels.

The last relevant attribute for this study is the monetary payment (cost) which is the annual payment for improvement and management of Mt. Choke wetland ecosystem via improving the level of biodiversity, availability of water and recreational quality attributes. The description of attributes and levels is found in table 2.

Table.2 Description of attributes and levels used in Choice experiment

Attributes	Description of Attributes	Levels of Attributes
Biodiversity	The numbers of common and endemic fauna and flora species as well as their habitats in the site.	**A) Low (status quo)**: the current number of both fauna and flora species and habitats in the mountain wetland ecosystem are very scarce and many species of the ecosystem are destroyed. **B**) **Medium**: the improvement and management of fauna and flora species and their habitat at a medium level (improving by 25%.) **C) High:** the improvement and management of fauna and flora species and their habitat at a high level (improving by 50%).
Water Availability	Availability of water for domestic use, livestock watering, grazing, and irrigation of crops. It is measured in terms of the number of seasons with water.	**A) Status quo**: Water is available once in the Year/in summer. **B)** Water is available in two of the four Seasons of the year. **C**) Water is available in three of the four seasons of the year. **D)** Water is available in all four seasons of the year.
Recreation/Tourism facilities	Choke mountain ecosystem has the potential to be the destination for both local and foreign tourists. Therefore, the development of recreational quality of the site such as infrastructure, hotels (lodges), resting facilities, information facilities etc are crucial in order to attract tourists. The local community can obtain benefits from these improvements directly or indirectly including creation of new job opportunities.	**A**) **Status quo**: There are no facilities such as road, clean water, electricity etc. in the area. **B**) Infrastructural development such as road, electricity, and clean water only **C)** Infrastructural development such as road, electricity, clean water, provision of resting facilities such as of hotels and lodges and provision of general services like information provision etc.
Monetary payment (cost)	Annual payment for the enhancement and management of Mt.Choke wetland.	**A**) **Status quo:** birr 0, no payment **B)** birr 25 **C)** birr 50 **D)** birr 75

The selected attributes have direct use, indirect use and non-use characteristics. For instance the attributes of water supply and recreation/tourism facilities have direct use and indirect use values respectively. Even though the non-use value of the attribute of biodiversity is high, it has also direct use and indirect use characteristics.

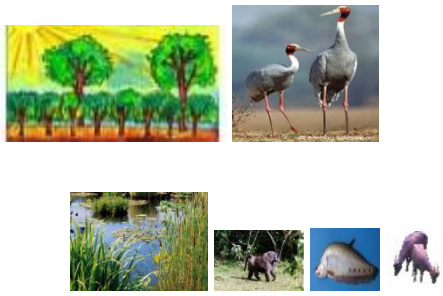
Given the above mentioned attributes and levels, choice sets are determined by using experimental design methods (Louviere, 2000).

3.3.2. Experimental Design

After the relevant attributes and attribute levels were identified, the next step is construction of choice sets via experimental design. Choice sets were formed by using different levels of the attributes. The combination of different levels of attributes yields different alternative scenarios and then choice sets. In this study four attributes are used: biodiversity, availability of water, recreation facilities, and monetary payment. Excluding the status quo, the attributes of biodiversity and recreation facilities have two levels each while the attributes of availability of water and monetary payment have three levels each. The number of wetland management scenarios that can be generated from four attributes, 2 with four levels and two with 3 levels was 144 (i.e.$4^2*3^2=144$).This full factorial design may lead to very large combinations which could not be practicable and it is more than the respondents could be expected to cope with. In such cases, there is a need to choose a subset of possible combinations (fractional factorial) to be included in the choice set. Based on this, from one hundred forty four possible combinations, six optimal choice sets were created using SAS in orthogonal design method using the OPTEX procedure. Thus each respondent was asked to complete six consecutive choice sets with three alternatives

(options)-two with different combinations of attribute levels and one the status quo. Since the respondents were farmers, choice sets were supported with different pictures in order to illustrate the level of the attributes. One sample choice set that was provided to respondents is the following.

Choice set one: Choose your favorable management scenario

Attributes	Plan 1	Plan 2	Status quo
Biodiversity	High: (improved by 50%) 	Medium:(improved by25%) 	Few plants and birds 
Water availability	Water is available in all four seasons of the year. 	Water is available during two of the four seasons of the year. 	Water is available only once in the year/in summer. 
Recreation facilities	Infrastructural development (road, water and electricity) only. 	Infrastructural development, construction of hotel and Lodges and information provision. 	There are no facilities 
Monetary payment	Birr 75	Birr 25	Birr 0, no payment

3.3.3. Questionnaire development

Developing the questionnaire involves preparation of general and choice experiment questions that was provided to the respondents. The questionnaire for choice experiment was classified in to four parts. The first part includes questions about socioeconomic status of the respondents. These typically include the respondent's age, gender, household income, marital status, occupation, number of dependents, and educational attainment. This is followed by questions on general perceptions and observations of respondents about the Mt. Choke wetland ecosystem. These questions focus on respondent's attitude and their observation with regard to the Mountain.

The next part of the questionnaire consists of the choice experiment questions. There are six choice sets with three options each. Before the choice experiment exercises, the choice scenario description was presented to the respondents. The description was about features of Mt. choke wetland ecosystem, about the attributes and their levels and the payment vehicle. This description was aided with pictures that could explain the attribute levels in all options. Then the choice sets were presented to them. Choice experiment questions were followed by follow up questions designed to explore the motivations behind respondent's choices and understanding the reasons whether respondents were or were not willing to pay for the proposed hypothetical programs. These questions are important to identify protest responses that are responses of people that did not engage in the trade off exercises. Follow up questions are further aimed at explaining respondents views of the hypothetical programs they evaluated. These questions help for assessing the credibility and meaningfulness of the choice experiment exercises. A full description of the questionnaires and scenarios is provided in the appendix.

CHAPTER FOUR

4. EMPIRICAL RESULTS AND DATA ANALYSIS

4.1. Descriptive Statistics

Three main sets of data were collected from a sample of 250 respondents via questionnaire. The first data set includes the socioeconomic and demographic characteristics of the respondent such as income, age, sex, educational status, distance from the mountain and family size. The second data set focused on the general perceptions and observations of the respondents (in this particular case farmer) about the Choke Mountain Wetland Ecosystem. The third data set contains the choices of the respondents for different hypothetical improvement scenarios of Choke Mountain. The data was first coded and entered into the LIMDEP8.0 NLOGIT4.0 Econometrics Software for estimation and analysis.

The results of the descriptive statistics as it can be seen from table 4.1 revealed that male and female respondents consisted of 70 percent and 30 percent of the total respondents respectively. The mean age of the respondents was 41 years. More than 90% of the respondents are married. The average family size of the respondents was 5 and the values varied between a minimum of 1 and a maximum of 9. Since all the respondents were farmers most of them are illiterate i.e. unable to write and read. The maximum and the minimum years of education were 5 years and 0 years respectively. According to the survey result, all of the respondents generate their income from mixed farming (agriculture and livestock rearing) and their average annual income was calculated as 13917.8 birr. Farming is the only source of income for farmers.

Table 4.1 Descriptive Statistics

Variable	Mean	Std.Dev.	Minimum	Maximum
SEX	.708	.415	.000	1.000
FAMSZ	5.358	1.507	1.000	9.000
EDUS	.272	.809	0	5
INC	13900.5	6583.86	3080	43680
DSKM	2.347	1.339	.250	6
AGE	40.952	11.329	22	70.000
MAR	.907	2.872	.000	1

4.2. General Perception and Observation of Mt. Choke Wetland Ecosystem

In the second part of the questionnaire, information about the general problem of the mountain, the current recreational facilities problems, and their suggested solutions was collected.

4.2.1. General Factors for the Degradation of Choke Mountain

The respondents were also asked about the current status of Mt.Choke and to rank the severity of the most important problems that have threatened the area. These questions were made to better understand the perceptions of farmers regarding the problems of the mountain. Accordingly, 93 percent of the respondents agreed on the extreme degradation of the Mt.Choke wetland and the extinction of many animal species such as Ethiopian Wolf (Red Fox) and many plant species like Koso and Ameja etc. Most of the respondents claimed that both the farmers and the government are responsible for such

degradation. They mentioned that limited attention of the government to the area gives free right for the whole member of the community to use and over exploit the resources. They also suggested that the government should intervene so as to protect the mountain and maintain the sustainability of different resources for future generations. The ranked major problems of the mountain with their frequency and percentage of responses can be looked at in table 4.2.

Table 4.2 Current major problems of Choke Mountain

	Agricultural expansion		Resettlement		Deforestation		Over grazing of animals	
Degree	freq	%	freq	%	freq	%	freq	%
1st	**67**	26.7	15	6.0	40	15.9	**128**	51
2nd	128	51	15	6.0	15	6.0	92	36.7
3rd	15	6.0	40	15.9	**180**	71.7	15	6.0
4th	40	15.9	**80**	71.7	15	6.0	15	6.0
total	250	100	250	100	250	100	250	100

Source: Computed from survey data

There are several factors that are affecting the choke mountain wetland. Among these factors overgrazing of the area was ranked as most severe problem which was reported as the most frequent problem by majority of the respondents (i.e.51% of the respondents).

This is because the livelihoods of the farmers around the mountain highly depend on mixed farming i.e. agriculture and livestock rearing. This implies that too many cattle are using the mountain as a source of grass and water which resulted in over degradation of the resources in the site. The second major problem ranked by respondents was agricultural land expansion in the wetland resources of the mountain. As a result of these, many square kilometers of the mountain have been converted in to agricultural land. Consequently, the area coverage of the mountain is reducing from time to time. Resettlements and deforestation problems were ranked as third and fourth respectively. These are because farmers are using the forests of the mountain for construction of houses and fuel wood etc.

4.2.2. Problems of Recreational Facilities of Choke Mountain

Choke Mountain has many resources that have to be visited by both domestic and foreign tourists. The Marvelous landscape of the mountain, the existence of common and endemic plant and animal species, and the suitable agro-ecological zone i.e. cold moist temperate (Wurch in Amharic) throughout the year are some of the recreational resources of the mountain. Even though the mountain has the above mentioned resources that have to be visited, the flow of foreign and domestic tourists to the mountain is highly limited. Therefore, respondents were also asked to rank the severity of the major problems about the recreational facilities of the mountain so as to get reasons for the above critical problem. Their response can be seen in table 4.3.

Table 4.3 Problems of Recreational Facilities of Mt.Choke

	Problem of infrastructure such as road, water and electricity		Absence of resting facilities such as hotels and lodges		Security problems around the mountain		Lack of advertisement by government about the site	
Degree	freq	%	freq	%	freq	%	Freq	%
1st	**188**	**74.9**	0	0	0	0	45	17.9
2nd	0	0	**150**	**59.8**	0	0	100	39.8
3rd	62	24.7	60	23.9	31	12.4	**105**	**41.8**
4th	0	0	40	15.9	**219**	**87.3**	0	0
Total	250	100	250	100	250	100	250	100

Source: Computed from the survey data

Problems of infrastructure such as road, clean water and electricity were ranked as first obstacle of tourists by three-quarter of the respondents. Even though the area has a great potential of recreational resources, there is no standardized road that connects the mountain even with the nearest cities of Debre Markos and Bahir Dar. It is obvious that without the existence comfortable roads, flows of both local and foreign tourists to the mountain are very limited. There is no clean water for tourists. Electric power supply in

rural areas is a common problem of the country in general and the Mt. Choke recreational site in particular. Since the mountain is far from cities and towns, resting facilities for tourists are welcome. So that inexistence of resting facilities for tourists such as hotels and lodges services was ranked as the second problem of recreational facilities of the mountain. Lack of advertisement by the government about the potential resources of the mountain was ranked as the third problem that affects the number of tourists negatively. Instability in the area is relatively a less severe problem.

4.3. Results and Discussion

Six choice sets were provided for each of the 250 samples of respondents. Therefore, 1500 choices were elicited from this sample size and coded according to the level of the attributes. For the attributes of biodiversity, at a high level improvement (50 percent improvement) was coded as 2 and code 1 was used for a medium level improvement (25 percent improvement). For availability of water attribute, accessibility of water in the four seasons of the year, three seasons of the year and two seasons of the year were coded as 3, 2 and 1 respectively. The attributes of recreational quality, infrastructural development such as construction of roads, provision of clean water and electricity service, and provision of hotels and lodges service were coded as 2. Infrastructural development such as road, water, and electricity alone was coded as 1. The levels for monetary attributes (i.e. 0, 25, 50, and 75 birr) were entered directly. The status quo alternative scenario levels were coded as 0 for all attributes. LIMDEP8.0 NLOGIT4.0 was used to estimate the two multinomial logit models (basic and extended MNL models) and the Random Parameter Logit Model. The estimates for the basic and extended

multinomial logit models are presented in tables 4.4 and 4.5 while estimates for the random parameter logit model are presented in table 4.6.

4.3.1. Multinomial Logit Models

Table 4.4 Results of the Basic Multinomial Logit model

Variables	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
ASC	.539	.104	5.187	.020**
BBIO	-.294	.216	-1.366	.000***
BRECREAN	.215	.119	1.820	.000***
BWATER	1.231	.063	19.645	.000***
BFEE	-.008	.003	-3.065	.000***
Log-likelihood				-860.234
R-sqrd				.378
Number of observations				1500

*** Significant at 1% level, **significant at 5% level

The result of the above estimated basic multinomial logit model revealed that all attributes namely biodiversity, water availability, recreational facility and monetary attribute are highly statistically significant at 1 percent level. The attributes of water availability and recreational facility have the expected positive sign. Even though the

expected sign for biodiversity attribute was positive, it has a negative sign which is also contrary to the results of other valuation studies (e.g., Birol et al., 2006; Despina, 2010).

This implies that an improvement of biodiversity from the status quo level reduces the utility of the respondent. In other words it reduces the probability of choosing the improvement scenarios over the status quo. This is perhaps because currently the livelihood of these communities highly depends on the choke mountain resources. They are using the mountain resources for various purposes including for grazing of animals, as a source of agricultural land, fuel wood and wood for construction. Therefore, improving the level of both plant and animal species (i.e. biodiversity) in quantity as well as quality in the mountain requires protecting the area from any illegal community intervention. Consequently, farmers expected that such policy change will reduce their current consumption of the resources of the mountain. The forgone benefits of biodiversity protection in terms of increased agricultural or livestock production, or the cutting and sale of forest products loom large to the local population. They gave more value for the current consumption rather than the future importance of biodiversity. Due to these reasons their utility is negatively related with the level of biodiversity attribute. Another possible explanation for the negative relationship is due to the 'limited awareness' or 'lack of understanding' or 'information failure' of farmers about the values particularly the indirect use and non-use values derived from biodiversity attribute. Undervaluation or focusing only on the extractive and commercial values of natural ecosystems is the other reason for the 'irrational' uses of these resources.

The estimated coefficient of the remaining two attributes i.e. availability of water and recreational facilities have the expected positive sign. This positive sign implies that an

increase in the levels of these attributes increases the probability of choosing improved scenarios. In other words, the farmers (respondents) gave more weight for the availability of water in the mountain. In addition they gave more value for the improvement of recreational facilities such as infrastructural development like construction of roads, provision of clean water and electricity and construction of hotels and lodges. This may be because the local community can obtain benefits from the improvement of these recreation facilities directly or indirectly. For instance new job opportunities can be created and there may be various forward and backward market linkages like supplying their agricultural outputs via easily accessible market and getting industrial products like fertilizer, quality seeds and electricity etc. Therefore, an improvement in water and recreational facility attributes increases the probability of choosing the improved alternative scenario with higher level of these attributes, other things keep constant. The sign of monetary attribute is negative as expected and significant at 1 percent level which is consistent with economic theory. This result indicates that, other things held constant, the higher the payment level in the alternative scenario, the less preferred it is by respondents.

The alternative specific constant has positive sign and it is significant which implies that there is welfare improvement as we move away from status quo.

Table 4.5 Results of Extended multinomial logit model

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
ASC	.071	.420	2.546	.050**
BBIO	-.295	.216	-1.366	.000***
BRECREAN	.216	.119	1.820	.000***
BWATER	1.233	.063	19.643	.000***
BFEE	-.009	.003	-3.078	.000***
BASC*FAMSZ	.010	.055	.188	.850
BASC*DSKM	-.002	.002	-.109	.000***
BASC*EDUS	.008	.118	.072	.094*
BASC*INC	.128	.159	.808	.054**
BASC*AGE	.007	.007	1.021	.067*
BASC*SEX	-.136	.200	-.686	.492
Log-likelihood				-858.748
R-sqrd				.398
Number of observations				1500

*** Significant at 1%; significant at 5%; significant at 10%

The extended model was estimated by using the data on wetland attributes and the interactions of individuals' socioeconomic and demographic characteristics with the alternative specific constant (ASC). The coefficients for the wetland attributes including monetary attributes in the extended model are similar with the coefficients of the basic model in both sign and magnitude. The coefficient for interactions of ASC with the socio-economic co-variants of distance from the mountain is significant at 1 percent level

and has the expected negative sign. The further the respondent is from the Choke Mountain, the lower the probability of choosing improvement plans with changes in the wetland attributes. This is because the nearest farmers are highly dependent on the resources of the mountain and hence they are willing to pay for the improvement of the mountain particularly for the changes in the attributes of water availability and recreational facilities. In addition to this the coefficient of interaction of ASC with income of the respondents are positive and significant. This because willingness to pay and ability to pay for improved plans increases as income level improves. Years of education and age of the respondents are positive and significant at 10 percent level. This implies that as years of education increases, the probability of choosing the wetland improvement alternatives increases, ceteris paribus. This is due to the fact that education can increase the awareness of respondents about the importance of environmental resources for the local community as well as the country as a whole. Similar argument holds for the coefficients of interaction of ASC with age of the respondent. However, the interaction of the coefficient of ASC with the sex and family size of the respondent have negative and positive sign respectively. But the coefficients of both factors are insignificant even at 15 percent level which implies that they are not important.

According to Birol et al. (2005), the overall explanatory power of the model could be assessed using McFadden's Pseudo R^2. When the value for Pseudo R^2 is between 0.2 and 0.4, the model is said to be good fit (Birol et al., 2005; Bennet and Blamey, 2001). The estimated values of R^2 for the above basic and extended multinomial logit models are .38 and 4.0 respectively which is adequate.

4.3.2. Random Parameter Logit Model

The standard multinomial logit model has two basic problems (Alpizar et al., 2001). Its first problem is because of the assumption of the independence of irrelevant alternatives (IIA) which may not hold. The IIA property which is the result of IID assumption states that the ratio of choice probabilities between two alternatives in a choice set is unaffected by other alternative changes in that choice set. That means if we add or remove new alternative plans over the existing one, it will not affect the choice probability of the first alternatives. Even though the observed heterogeneity can be incorporated in to the model by interacting the socio-economic characteristics with the attributes or alternative specific constants, multinomial logit model does not take into account the taste variation or unobserved heterogeneity among individual respondents. This is the source of the second problem of multinomial logit model. Because of these two main problems of multinomial logit model, Random Parameter Logit model is used in order to incorporate the unobserved heterogeneity and to relax the IID assumption. Since the difference matrix was negative definite, the Hausman test is not conducted to find out whether the IIA assumption is violated in the multinomial logit model. However, a result of the random parameter logit model, which addresses these two problems with the multinomial logit model, is reported in table 4.6.

Table 4.6 Results of Random Parameter Logit Model

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
ASC	.628	.342	1.836	.021
BIO	-.387	.227	-1.703	.000***
RECREAN	.291	.132	2.206	.000***
WATER	1.257	.066	19.041	.000***
FEE	-.008	.003	-2.428	.000***
Log-likelihood				-859.231
R-sqrd				.47
Prob [chi squared > value]				.000
Number of observations				1500

*** Significant at 1 % level

The estimated result of the random parameter logit model revealed that the sign and significance level of the coefficients is similar with the result of multinomial logit models. But there is slight improvement in the magnitudes of coefficients for the attributes of biodiversity and recreational facilities. All attributes are significant at 1% level. Moreover the explanatory power of the random parameter logit model which is given by the level of pseudo R^2 is better. In particular, the R^2 in the random parameter logit model is 0.47, while the corresponding value in the multinomial logit model is

0.396. Therefore there is improvement in the model fit with the use of random parameter model for the collected data set.

4.3.3. Estimation of Marginal Willingness to Pay

The marginal willingness to pay or 'the implicit price' or 'the part worth' is the marginal rate of substitution between wetland attributes and the monetary attribute (Bennett and Blamey, 2001). It is the rate at which respondents are willing to pay for the improvement of an attribute. The value of the implicit prices of different attributes revealed the relative importance of the attributes for the society. The implicit prices are calculated as the ratio of the coefficients for the attributes of Choke mountain wetland ecosystem in random parameter logit model to the estimated coefficient of the monetary attribute. The results are reported in table 4.7.

Table 4.7 Estimates of Marginal Willingness to Pay (in birr) for the attributes

Attributes	MWTP in birr	Standard error	P[|Z|>z]
Biodiversity	- 48	2.558	0.000***
Water availability	155	0.579	0.000***
Recreational facilities	36	0.242	0.000***

As noted above, because of lack of awareness about the benefits of biodiversity attribute and expectation of negative future consumption from improvement policy change, respondents are not willing to pay for the improvement of the same. However, the implicit price for the water availability attribute is the highest valued and it is significant at 1% level. Consequently, respondents are willing to pay about birr 155 annually for an increase in the level of water availability, ceteris paribus. As well, respondents are willing to pay 36 birr annually for an increase in the level of recreational facilities from the status quo level, other things being constant. The respondents' marginal willingness to pay for the availability of water attribute is higher than recreational facilities. Thus, the respondents gave more value to the availability of water than biodiversity and recreational facility attributes. According to few elder respondents' legend, about 15 and 20 years ago rain as well as water was available in the area full of the year. There was even glacier (ice) at the peak of the mountain. However, currently the area is highly vulnerable to drought and water is becoming highly scarce from time to time except in summer season. This may explain why farmers gave more attention to this attribute relative to others.

4.3.4. Estimation of Welfare Measures

Choice experiment method of valuation has the advantage of estimating the value of various alternative scenarios from one set of choice data (Bennet and Blamey, 2001).The difference between the utilities of the individuals that could be obtained from the status quo option and improved alternative scenarios is what economic welfare measures focus on. Economic welfare measures or compensating surplus can be estimated by using the estimated coefficients of the attributes in the random parameter model (which is more

explanatory relative to standard multinomial logit model) and the levels of the attributes in the different alternative scenarios. The estimated coefficients and levels of attributes are used to estimate the indirect utility functions. By subtracting the value of the improved alternative options (V1 and V2) from the value of the statusquo (V0) and multiplying the difference by the negative inverse of the coefficient of the monetary attribute yields the economic surplus (Bennett and Blamey, 2001). In short it can be estimated by using equation (10) presented earlier which is shown below.

CS = {(-1/Bm) (V0-Vi)}, Where Vi =V1 and V2; and Bm is the coefficient for monetary payment attribute

In order to compute the economic welfare (benefits), three hypothetical alternative scenarios with their attribute levels were created. These are low impact improvement scenario, medium impact improvement scenario, and high impact improvement scenario. The description of these three improvement scenarios with their attributes and levels are the following.

Current situation/Status quo

- No improvement in biodiversity.
- Water is available in one season of the year.
- No provision of recreational facilities.

High impact improvement scenario

- Biodiversity is managed at high level (improves by 50%).
- Water is available in the four seasons of the year.

- There is infrastructural development and provision of hotels and lodges services.

Medium impact improvement scenario

- Biodiversity is improved at a medium level (improves by 25%).
- Water is available in four seasons of the year.
- Infrastructural development, provision of hotel and lodges services.

Low impact improvement scenario

- Biodiversity is improved at medium level (improves by 25%).
- Water is available in two seasons of the year.
- Infrastructural developments alone.

Estimates of willingness to pay for the three scenarios are presented in table 4.8.

Table 4.8 Estimates of compensating surplus

Alternative improvement scenarios	Willingness to pay (WTP) per year for each scenario (in birr)
High impact improvement scenario	444
Medium impact improvement scenario	490
Low impact improvement scenario	143

The estimated result revealed that there is welfare change due to an improvement from the status quo situation. The respondent's willingness to pay (compensating surplus)

increases as we improve the status of Mt.Choke wetland ecosystem particularly the attributes of water and recreational facilities. Respondents are willing to pay birr 444, birr 490, and birr 143 annually for high impact, medium impact and low impact scenarios respectively. The respondent's willingness to pay for the high impact scenario is lower than the WTP for medium impact management scenario. This is due to differences in the level of biodiversity attribute. When the level of conservation and management for biodiversity improves from low to high, willingness to pay reduces from birr 490 to birr 444. This result again confirms the respondent's unwillingness to pay for biodiversity improvement and management plans. In addition to these, the overall annual economic welfare (or the aggregate willingness to pay) so as to achieve, conserve and improve the stated attributes in the low impact scenarios, medium impact scenarios, high impact scenarios are birr 18,885,867, birr 64,713,810, and birr 58,638,636 respectively. This value of the Choke mountain wetland ecosystem could be considered as the lower bound. If other international contributions of the mountain such as supply of water for down streams countries (e.g. Sudan and Egypt and) and its role in global climatic stabilization etc. are taken in to account in the valuation study, its value become beyond the above figure.

Therefore, the environmental policy makers can use this valuable information as a relevant input to do a cost benefit analysis, a tool for decision makers in different alternative improvement programmes or projects of Mountain Choke wetland ecosystem.

4.4. Results of the Follow up Question

Six follow up questions that best describe the reason why they made their choices in answering the choice set exercises were presented to the respondents. The responses of respondents are presented table 4.9.

Table 4.9 Results of follow up questions

Follow up questions	Percent of response
I found that the improvement of biodiversity attribute was relevant and chose the highest level of it.	11.35
I chose the alternative that has the highest level for recreational facility attribute.	29.75
I found that the improvement of availability of water attribute was relevant and I chose the option with the highest level of the same.	42.5
I chose the status quo option since I haven't the ability to pay for the improvement.	0 .86
All attributes were important then I chose the highest levels of an alternative whatever the payment level.	2.23
I chose the cheapest alternative.	13.3

Source: Computed from the survey data

Almost all respondents have answered the follow up questions. About 42.5 percent of the respondents replied that they gave top priority for the highest level for the attributes of availability of water. About 11 percent of the respondents replied that the improvement in biodiversity attribute was relevant and choose the alternative that includes the highest

level for this attribute. The other 0.86 percent of the respondents chose the status quo options whatever the levels of the attributes since they are unable to pay for future costs of improvement. About 13 percent of the respondents chose the cheapest plan whatever the levels of the attributes. About 2 percent of the respondents replied that they made choice with the highest level of all attributes whatever the payment level. About 30 percent of the respondents found that the attributes of recreational quality was important and gave top priority for the highest level of this attribute and chose the alternative with the highest level of this attribute.

CHAPTER FIVE

5. CONCLUSION AND POLICY RECOMMENDATION

5.1. Conclusion

The Choke Mountain range whose peak is approximately 4070m above sea levels is found in East Gojjam, Ethiopia. The most remarkable feature of the mountain is the existence of more than 3386 km^2 of various wetland resources ranging from Sedge Swamps to seasonally flooded grasslands. The mountain is also used as the water tower of Upper Blue Nile (Abay in Amharic). More than 56 tributary rivers of the Abay originate from this mountain. In addition to these about 225 springs and streams are also found in this area (Teferi, 2010). Furthermore, the mountain has a great potential in its recreational resources. For instance, the existence Marvelous landscape of the mountain, the four stepped mountains (Arat Mekeraker in Amharic) with surprising setup, and much unique and common biological diversity and the interesting agro-ecological zone (Wurch in Amharic) are some of the resources.

However, this mountain range is degraded and a number of species are threatened. The continued loss and degradation of wetlands of the mountain and their functions have reached critical levels due to various factors like the public good nature of the mountain and hence absence of enforceable property rights, lack of understanding about the multitude values of wetlands, the expansion of poverty in the area, ever mounting population pressure, overgrazing, and failure of intervention by government. As a result of these problems, 607 km^2 of seasonal wetland with low moisture and 22.4 km^2 open water of Choke Mountain have been lost within the last 20 years (Teferi, 2010). Many

animal and plant species were also extinct. The other main problem that fueled the degradation of the mountain is the inexistence of studies on the valuation of the multidimensional benefits of wetlands of the mountain which lowers the awareness of the society about the importance of these resources. To our knowledge, a comprehensive study on welfare valuation of wetland ecosystem of the choke mountain has not yet been undertaken. Therefore, to fill this gap, choice experiment valuation method was applied by using four attributes namely biodiversity, water availability, recreational facilities and monetary attribute.

Primary data was collected from a sample 250 respondents with six choice sets each and hence 1500 observations. Two multinomial logit models and a random parameter logit model were estimated by using LIMDEP8.0 NLOGIT4.0 econometric software. The result of the models revealed that all attributes are significant at 1% level and they have the expected positive sign except biodiversity attribute. In addition to these the estimated marginal willingness to pay showed that respondents (farmers) gave more value for the attributes of water availability followed by recreational facilities. Finally the results from estimated welfare measures under different scenarios indicated that the welfare (wellbeing) of the society improves while there is improvement in the different attributes of Choke Mountain. Farmers are willing to pay birr 444, birr 490, and birr 143 annually for high impact, medium impact and low impact scenarios respectively. This result confirms the indispensability of the mountain to the welfare of the society. Therefore, the government needs to take measures to improve the aggregate welfare by making improvements in Choke mountain wetland ecosystem.

5.2. Policy Recommendations

Given the vital role that Choke Mountain Wetland Ecosystem plays to both the society of the region and millions of others, farmers are willing to pay for the improvement of the mountain particularly for the attributes of water availability and recreational facilities. This implies that the government can generate income from the farmers so as to improve, enhance and manage the mountain via improving the attributes of the mountain. However, the results of the survey showed that respondents are not willing to pay for the improvement of biodiversity attribute. This is perhaps because of the expectation of the farmers about the negative effects of the policy change on their current consumption of the resources of the mountain and their limited awareness about the multi- functions and services provided by these resources. Therefore, Governmental and Non-Governmental Organizations (NGO) need to implement mass awareness programme for popularization of the importance of biodiversity in the Choke mountain wetlands and its role in the sustenance of human civilization. The area could then be protected from any illegal intervention of the society for sustainable improvement and utilizations of the mountain resources. The mountain could be one of the national parks of the country. In addition to these there should be infrastructural developments so as to improve the flow of domestic and foreign tourists to the mountain and hence raise the revenue that is needed from this sector. Moreover, the government should introduce the mountain via different mass media like TV, radios, and news papers etc. to improve the information of the society about the area. Furthermore, the renaissance dam of the country which is under construction will be affected by the degradation of Choke Mountain wetland ecosystem in two ways. Since many of the tributaries of the river Abay originate from this mountain,

the supply of water will be reduced as long as solution is not provided for this highly threatened ecosystem. Secondly the existence of rapid soil erosion in the degraded part of the mountain increases soil sediments on river Abay and then in the Dam. Consequently, the government will incur huge extra cost to clean these soil sediments. Therefore, conservation and management of Choke Mountain is vital even for the dam. Finally the environmental policy makers have to give recognition for functions and services derived from Choke Mountain Wetland in their resource planning, management and economic decision making with regard to all national and state programmes, policies and activities. This leads to the use of the Choke Mountain in a manner that enhances prospects and sustainable development at local, regional and country level.

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APPENDIX

ADDIS ABABA UNIVERSITY
DEPARTEMENT OF ECONOMICS

CHOICE EXPERIMENT QUESTIONAIRE PREPARED FOR THE BENEFICIARIES OF Mt. CHOKE RANGE WETLAND ECOSYSYTEM, UPPER BLUE NILE BASIN, ETHIOPIA

Name of the interviewer: _____
Date of interview: _____
Code of the interviewee: _____

Hello. My name is_____ [interviewer name]. This interview is designed by Mr. Getnet Berhanu who is studying at Addis Ababa University. At this time he is doing a research on the economic valuation of Mt.Choke range wetland ecosystem for his MSC in economics. You are requested to give information on your perception and observation about Choke mountain wetland ecosystem and to select your most preferred wetland management options. The information you provide will be very crucial in order to estimate how much the ecosystem is valuable to the region and it also help the community to have common understanding about the problems of the area. In addition to this it is used for policy makers so as to make appropriate and informed policy about the area. Information you provide will be kept strictly confidential and will not be given to others.

Woreda:_____,Kebele_____
Village/Got/:_____
Household Head Name: _____

PART ONE: SOCIO-ECONOMIC FEATURES OF THE RESPONDENTS

1.1. Age of the respondent? _____years

1.2. Sex of the respondent?

1. Male 2. Female

1.3. Marital status?

1. Married 2.Single 3.Divorced /Separated 4. Others (please specify)

1.4. How many members does your household have including you? _____

1. How many of them are children (those less than 15 years)? _____
2. How many of them are adults (15-65 years)? _____
3. How many of them are elders (those higher than 65 years)? _____

1.5. Have you attended formal education? 1. Yes 2. No

1.6. If your answer is yes for question no. 1.5, what are your years of education? __ Years

1.7. Which one represents your yearly household income?

Source of income	Measurement	quantity	Unit price(birr)	Total income
1.Total production in the last crop year	quintal	Teff		
		Wheat		
		Sorghum		
		Potato		
		Barely		
		Others		
2.Livestock(cow, oxen, horses, donkey)	number			
3. Sheep	number			
4. Hen	number			
5. Goat	number			
6.Other Off farming sources	_____			
Total				

PART TWO: GENERAL QUESTIONS

(Respondents observation, perception and attitude about Mt.Choke wetland ecosystem)

2.1. How many kilometers/meters your home is far from the mt. choke wetland ecosystem**? _____**

2.2. For what purpose are you using mt. Choke wetland ecosystem? (Rank them in order benefits. Six is the maximum rank)

1. Consumption from Plants and animals that are found in the mountain_____
2. Source of drinking and irrigation water_____
3. Recreational importance_____
4. Educational, research and cultural contribution_____
5. As a source of agricultural land_____
6. For grazing of animals_____
7. Others (please specify)_____

2.3. The Mt.Choke range wetland ecosystem has been extremely degraded and many plant and animal species have disappeared. Do you_____?

1. Agree 2. Disagree

2.4. If your answer for question number 2.3 is agree, what are these species that are disappeared extinct?

Animals	Plants
1._____	1._____
2._____	2._____
3._____	3._____

2.5. Can you mention some wetland areas or any other water body that are disappeared/degraded or decreased in area coverage)

1. _____
2. _____
3. _____

2.6. What do you think are the major factors for the degradation of this ecosystem? (Rank the problems in order of severity. Four is maximum rank)

1. Deforestation_____
2. Agricultural expansions on wetland resources_____
3. Resettlements_____
4. Climate change/global warming_____
5. Other factors (please specify)_____

2.7. Who is the responsible body for these problems? (Multiple choices is possible)

1. Farmers 2. Government 3. Both farmers and government 4. Other peoples (please specify)

2.8. Do you think that Mt.Choke has the potential to be one of the recreational sites of the region?

1. Yes 2. No

2.9. If you answer is yes for the above question, what are the resources that are used to attract tourists and then provide different services?

1. _____
2. _____
3. _____

2.10. What are the current problems of tourists? (Rank them in order of severity. Four is the maximum rank)

1. Problem of infrastructure such as electricity, road and water___
2. Absence of resting facilities such as hotels and lodges_____
3. Security problems namely guards_____
4. Lack of advertisement about the site by government_____
5. Others_____

2.11. What measures do you think should be taken so as to improve Mt.Choke wetland ecosystem in quantity (area coverage) as well as quality? (multiple choices are possible)

1. It should be protected area from grazing of animals and free for humans.
2. It should be protected from humans and free for animals only.
3. It should be protected totally from both animals and humans destructive activity.
4. Plantation of new trees in the degraded areas of the mountain.

5. Others (please specify)

2.12. Are you interested to contribute for the costs to be incurred so as to improve this mountain?

1. Yes 2.No

PART THREE: CHOICE EXPERIMENT SCENARIOS

I would now like to ask you to think about alternative management plans of the government so as to improve, enhance and manage the wetland ecosystem of Mt.Choke.

These management plans relate to the improvement of the level of biodiversity (plants, animals and their habitats), availability of water and recreational facilities in the area. You have to consider the level of the attributes (assume they are independent) while revealed you preferred choice. Bear in mind you will incur costs if you preferred the two alternative management plans (plan 1 and plan 2) in order to carrying out these measures. For the status quo/baseline/do nothing option there is no extra cost, but there is low level of biodiversity, availability of water, and recreational facilities in the area.

Suppose the government has an intention to take measures that could mitigate the problem of the mt. Choke wetland ecosystem and assure the development, conservation and sustainable use of the resources of the area. In order to accomplish this, there are fundamentally three areas where the government plans to improve the environmental quality of the mountain and its services.

A) Biodiversity: most of the biological diversities (biodiversity) like fauna and flora species, ecosystems (or landscape and habitats) and functions in the mountain are heavily threatened. Even most of these species are disappeared. As a result of these the local community in particular and the country in general has been lost the crucial direct and indirect benefits which are obtained from these resources such as fuel wood consumption, input to production of farming materials and medicine, construction of houses, and for recreation, flood control, reduce global warming etc Currently almost all animal species except few birds and reptiles and many of the plants in area are degraded. By taking into account these serious problem the government has been designed measures for biodiversity protection and restoration in the area. To improve the number of fauna

and flora species, the plan uses various programs such as protecting the area from agricultural expansion and over grazing, new plantations of the degraded area, implementations of soil conservations techniques etc The plan has two main alternatives biodiversity management scenarios. The first option is improving the level of plants animals and their habitat at medium level (improving by 25%).The second scenario is improving these resources at high level (improving by 50%). Now I would like to ask you to tell me which situation you prefer?

B) Availability of water: the second vital resource which is highly affected in the area is availability of water in volume or quality. It is obvious that mt. Choke is the water tower (Yeweha Guan) of upper Blue Nile. Many tributaries of upper Blue Nile such as, Cheye, Suha, Gedeb, Muga, Temcha, Bogena, Lah, Sedie, Teme, Azuari, Teza, Dechet, Yeda and many other springs are mainly originated from this mountain. Therefore, it is possible to say the life of millions including Egypt and Sudan is depending on this resource. However, the availability of water in the area is highly fluctuating. Especially during the seasons Bega, several rivers are drying and the water volume of many of them is highly reduced. In addition to these many of the streams (springs) are dried in every Bega seasons and many of them are disappeared. Consequently water which is used for different purpose like human and animal drinking, irrigation of crops, fishing, electric power generation, recreational use etc is becoming highly fluctuating and scarce in different parts of the area. Since these water resources of the area has multi-dimensional economic development effects including the ongoing Renaissance Dam, the regional government in collaboration with the federal government has planned to improve the availability of this resources mainly through restoring the ecological functions of the mountain like covering the degraded area of the mountain with trees (afforestation) and improving the wetlands of the area in quality as well as quantity. The plan embraces three main alternative scenarios. The first scenario is focused on making water accessible for the society for two seasons of the year (Keremet and Meker). The second alternative plan is improving water availability to three seasons of the year (Keremet, Meker, and Tseday). Improving the availability of water in year round (Keremet, Meker, Tseday and Beleg) is the main objective of the third alternative scenario. Now I would like to ask you to tell me which situation you prefer?

C) Recreational/tourism facilities: Choke Mountain has the potential to be the destination of many domestic and foreign tourists just like other areas of the country. However, the area is till idle and the community of the region as well the country is not benefiting from these resources. Many reasons can be mentioned for this problem. Currently different recreational/ tourism facilities such as infrastructural development (road, water, electricity), and resting facilities like lodges and hotels are totally absent in the area. Therefore, the government has been proposed plans so as to obtain the recreational benefits of the ecosystem by improving the recreational qualities of the area. These plans have two main possible alternatives. The first plan is focused on infrastructural development i.e. road, water, and electricity. The objective of the second alternative scenario is improving the availability of resting facilities such as hotels, lodges and information provision in addition with the development of infrastructures. Now I would like to ask you to tell me which situation you prefer? Please mark the preferred alternative as if it is the only choice you make and feel free to go back and change your previous choice

Thus, in order to implement these programs, annual income tax will be chosen as a means of payment vehicle. The government will collect money from the society via appropriate tax rate on annual basis for the next five years. The sample choices set are shown in the following tables.

Choice Set One

Attributes	Plan 1	Plan 2	Status quo
Biodiversity	High: a lot of improvements in both quality and quantity of fauna and flora species and their habitat (improving by 50%)	Medium: some improvement in both quality and quantity of fauna and flora species and their habitat (improving by 25%)	Low: the current number of species and habitats in the ecosystem is very small; even many species of the ecosystem are destroyed.
Water availability	Water is available in all four seasons of the year	Water is available during three of the four seasons of the year	Water is available only in one of the four seasons of the year
Recreation facilities	Infrastructural development such as road, electricity, and clean water, in the area	Infrastructural development such as road, electricity, and clean water in the area	There are no facilities such as road, clean water, electricity, hotels and lodges, provision of general services like information provision etc. in the area
Monetary payment	birr 75	Birr 50	Birr 0, no payment
I would prefer (please put tick mark)			

Choice Set Two

Attributes	Plan 1	Plan 2	Status quo
Biodiversity	High: a lot of improvements in both quality and quantity of fauna and flora species and their habitat (improving by 50%)	Medium: some improvement in both quality and quantity of fauna and flora species and their habitat (improving by 25 %)	Low: the current number of species and habitats in the ecosystem is very small; even many species of the ecosystem
Water availability	Water is available in all four seasons the year	Water is available during two of the four seasons of the year	Water is available only in one of the four seasons of the
Recreation facilities	Infrastructural development such as road, and electricity, clean water, in the area.	Infrastructural development such as road, electricity,clean water, construction of hotels and lodges and provision of general services like information provision etc. in the area	There are no facilities such as road, clean water, electricity, hotels and lodges, provision of general services like information provision etc. in the area
Monetary payment	Birr 75	Birr 25	0, no payment
I would prefer (please put a tick mark)			

Choice Set Three:

Attribute	Plan 1	Plan 2	Status quo
Biodiversity	High: a lot of improvements in both quality and quantity of fauna and flora species and their habitat (improving by 50%)	Medium: some improvement in both quality and quantity of fauna and flora species and their habitat (improving by 25 %)	Low: the current number of species and habitats in the ecosystem is very small; even many species of the ecosystem are
Availability of water	Water is available in all four seasons of the year	Water is available during three of the four seasons of the year	Water is available only in one of the four seasons of the year
Recreational facilities	Infrastructural development such as road, electricity, clean water, construction of hotels and lodges and provision of general services like information provision etc. in the area	Infrastructural development such as road, electricity, and clean water, in the area	There are no facilities such as road, clean water, electricity, hotels and lodges, provision of general services like information
Monetary payment	Birr 25	Birr 50	Birr 0, no payment
I would prefer(please put a tick mark)			

Choice Set Four

Attributes	Plan 1	Plan 2	Status quo
Biodiversity	Medium: some improvement in both quality and quantity of fauna and flora species and their habitat (by 25 %)	Medium: some improvement in both quality and quantity of fauna and flora species and their habitat (by 25 %)	Low: the current number of species and habitats in the ecosystem is very small; even many species of the ecosystem are destroyed
Water availability	Water is available during three of the four seasons of the year	Water is available during two of the four seasons of the year	Water is available only in one of the four seasons of the year
Recreation facilities	Infrastructural development such as road, electricity, and clean water, in the area.	Infrastructural development such as road, electricity, clean water, construction of hotels and lodges and provision of general services like information provision etc. in the area	There are no facilities such as road, clean water, electricity, hotels and lodges, provision of general services like information provision etc. in the area
Monetary payment	Birr 50	Birr 25	Birr 0, no payment
I would prefer (please put a tick mark)			

Choice Set Five

Attributes	Plan 1	Plan 2	Status quo
Biodiversity	High: a lot of improvements in both quality and quantity of fauna and flora species and their habitat (by 50%)	High: a lot of improvements in both quality and quantity of fauna and flora species and their habitat (by50%)	Low :the current number of species and habitats in the ecosystem is very small; even many species of the ecosystem
Water availability	Water is available in all four seasons of the year	Water is available in all four seasons of the year	Water is available only in one of the four seasons of the year
Recreation facilities	Infrastructural development such as road, electricity, and clean water in the area.	Infrastructural development such as road, electricity, clean water, and construction of hotels and lodges and provision of general services like information provision in the area	There are no facilities such as road, clean water, electricity, hotels and lodges, provision of general services like information provision etc. in the area
Monetary payment	birr 75	birr 25	Birr 0,no payment
I would prefer(please put tick mark)			

Choice Set Six

Attribute	Plan 1	Plan 2	Status quo
Biodiversity	High: a lot of improvements in both quality and quantity of fauna and flora species and their habitat (improving by 50%)	Medium: some improvement in both quality and quantity of fauna and flora species and their habitat (improving by 25 %)	Low: the current number of species and habitats in the ecosystem is very small; even many species of the ecosystem are
Availability of water	Water is available in all four seasons of the year	Water is available during two of the four seasons of the year	Water is available only in one of the four seasons of the year
Recreation qualities	Infrastructural development such as road, electricity, clean water, construction of hotels and lodges and provision of general services like information provision etc. in the area	Infrastructural development such as road, electricity, clean water, construction of hotels and lodges and provision of general services like information provision etc. in the area	There are no facilities such as road, clean water, electricity, hotels and lodges, provision of general services like information provision etc. in the area
Monetary payment	Birr 25	Birr 25	Birr 0, no payment
I would prefer(please put a tick mark)			

Part four: Follow up Questions

Which of the following statement can briefly explain why you choose this situation?

1. I found that the improvement in biodiversity attribute is relevant and chose the alternative with highest level of this attribute.
2. I choose the status quo options whatever the levels of the attributes since I haven't the ability to pay for cost of improvement.
3. I choose the alternative with the highest level of all attributes whatever the payment level.
4. I found that the attributes of recreational quality is important and chose the plan with the highest Level of such attribute.
5. I choose the cheapest plan whatever the levels of the attributes.
6. I found that the availability of water attribute is important and thus gave priority for choice with the highest level of this attribute.

THANK YOU FOR ANSWERING OUR QUESTIONS!

Declaration

I the under signed, declare that this thesis is my original work and has not been presented in other Universities; all sources of materials used have been duly acknowledged.

Name: Getnet Berhanu

Signature: _____

Date of submission: June 2012

This thesis has been submitted for examination with the approval of university advisor

Name: Dr. Alemu Mekonnen

Signature: _____

Date of submission: June 2012

JUNE, 2012

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