Recreation Use Value of

Wondo Genet Wetland Ecosystem - Ethiopia

Mohammed Ali

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Recreation Use Value of Wondo Genet Wetland Ecosystem – Ethiopia

By

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Abstract

Wondo Genet Resort Hotel is one of the most well-known nature-based recreation sites in Ethiopia. The main attractions of the site includes: the hot spring water for bathing and swimming; the forested landscape, streams, birds and other wildlife in the surrounding; and the cafeteria, bar and bedroom services. The attractive quality of the site for many of the users is its nature-based resources. The natural ecosystem of the area can be described as wetland which can be categorized under fresh water or geothermal springs or streams and creeks category according to RAMSAR, (1971) classification of wetland types.

Over the past decades, considerable conversion of the natural ecosystem into other land uses mainly to agriculture, settlement and plantation has occurred; and recurrent occurrences of fire and illegal overexploitation of timber has been going on in the sub-catchment, where the recreation site is part of the area suffered by the impacts. The value of the site in terms of its recreation service to society and how this service is being affected by the prevailing land use practices in the surrounding is not known. The primary objective of this study was to estimate the recreation use value of the site, and connected to it, the main site quality attributes for visitor attraction is identified and the possible impact of the native forest disappearance in the sub-catchment to the wetland ecosystem service is highlighted based on findings of other studies.

To estimate the recreation use value of the site, single site travel cost model was applied. Application of truncated count data models for consumer surplus estimation per single recreation visits to the site on average resulted in 184 birr and 271 birr for daily and overnight visitors, respectively. Accordingly, the aggregate consumer surplus is estimated as 18 million Birr and 1.5 million Birr for daily and overnight domestic visitors respectively; which amounts in total to around 20 Million Birr per year (equivalent to USD$ 2.2 million per year).

The primary recreation attraction of the site is its water based services and its natural landscape with its birds and other wildlife contents. Over 88% of the total respondents had their main interest in bathing, swimming and in the landscape scenery for making their visit to the site. Other site attributes mountain trekking, bird or other wild animals watching, photographing, cafeteria, bar and bed room services are preferred lesser in their order. The impact of the above mentioned native vegetation conversion practices in the sub-catchment to the wetland ecosystem of the site can be for the most part negative according to inferences from other studies.

The result of this study indicates that even the conservative estimate of the economic value of recreation benefit from the site is very big and it also indicates that the domestic recreation demand to the site is high. Therefore, it can be suggested that guiding the existing land use practice based on practicable land use planning that takes in to account the suitability of the land for its different uses and to its role in maintaining the ecological system in the sub-catchment is essential.

Key words: recreation, economic value, Wondo Genet, resort hotel, travel cost, wetland, hot spring, swimming, bird watching

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Dedication

This Work is dedicated to my late father Ali and
to my mother Iysha

Table of contents

List of Tables

List of Figures

Introduction

Nature-based recreation is one of the many ecosystem services that benefit humans. Ecosystem services are defined as, “the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life” (Daily, 1993). The Millennium Ecosystem Assessment (MA) identified four types of ecosystem services namely: provisioning services such as food and water; regulating services like regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services that include recreational, spiritual, religious, and other nonmaterial benefits (MA, 2005).

Ecosystems - the complex system of plant, animal, fungal, and micro-organism communities and their associated non-living environment interacting as an ecological unit (MA, 2005)- undertake physical, chemical and biological actions derived by energy flow that gives rise to the functioning of the ecosystem and provision of its services (Daily, 1993). Ecosystem services are, therefore, provided as a “by-product of the functioning of ecosystem”, where the resource bases of an ecosystem i.e. its structure or composition is the bases for its functioning (Dasgupta, et al 2000 p. 342)

Observed ecosystem functions are conceptualized as ecosystem goods and services when human values are implied in them (De Groot et al., 2002). Therefore, according to De Groot et al. (2002), the concept of ecosystem goods and services is inherently “anthropocentric” i.e. human beings as valuing agents enable the translation of basic ecological structures and processes into value-laden entities. Human survival depends on the provision of these nature’s services. They are also bases for economic development. They fulfil basic human needs by themselves directly such as food, water supply, and also used as means of production and ingredients in the production process of various items that fulfil human wants (Daily, 1993).

However, as humans use of ecosystem goods and services become continually increasing over time, it is resulting in depreciation and causing irreversible change to the environment at any of the spatial scales considered (Daily, 2000). This is true in the case of Ethiopia where demand for agricultural land use, wood fuel production, and commercial land use activities like timber extraction, cash crop production, and mining is causing habitat destruction and loss of species of the natural ecosystem (UNESCO, 2004)

It is argued, “although there are many causes of tropical deforestation and forest degradation, an important cause appears to be an undervaluation of forests by markets and governments” (Kramer et al, 1995, P.VII). Many services provided by forests such as biodiversity conservation, recreation, watershed protection, purification of water, support to local people livelihood are not traded in markets, hence these values to society are often ignored in evaluating the alternative uses of the resources base, and in computing conventional GDP (MA, 2005; Kramer et al, 1995; Belcher, 2005).

The implication of such failure in recognizing the full values of natural system to their management is discussed by Mogaka et al, (2001) as:

Underestimation and misrepresentation of forest values has implications for economic and development policies ….. Because the forest sector is perceived to have such a low value it is accorded little emphasis by economic planners and policy-makers, and little thought is given to ensuring that broader economic conditions are supportive of community involvement in sustainable forest management. In many cases, macroeconomic and sectoral policies in Eastern and Southern Africa have actually provided economic disincentives to communities becoming involved in sustainable forest management (Mogaka et al, 2001 p. 22).

This has particular relevance to Ethiopian forest management context. The contribution of forest sector to GDP of Ethiopia is considered to be low, for example in 1986 and 1987 it was estimated to be 1.9% (Million, 2001A). The author further stated citing EARO (1998) that "If direct consumption of commodities such as fuel wood and charcoal and the indirect contributions of forests to watershed management and soil conservation as well as that of forest products utilized in other manufacturing and construction activities are considered in the calculation, the contribution of forestry to the total GDP and agricultural GDP will be much higher amounting to about 10% and more" (Million, 2001A, p.2).

Complementary to the above statement, Girma (1998) indicated that 75-90% of Ethiopia's rural population requirement for traditional medicine, especially medicinal plants for their primary health care, is derived from forests and woodland. Honey production, bee wax, foodstuff, fodder production and other cultural benefits derived from forest and woodland is enormous (Girma, 1998; Million, 2001; Gemedo-Dalle et al 2005). Biomass fuel covers 95% of the total energy supply of the country out of which 77% being derived from woody biomass (Alemneh, 2003). Watershed protection, biodiversity conservation and recreation services of forest ecosystem are additions to those estimated benefits.

As a reflection of the poor recognition of the role that ecosystem services play to society, forest resource management in Ethiopia is characterized by insufficient funding to the sector. Only a fraction of the revenue that the sector generates are allocated back to forest management effort (Million, 2001B), consequently protected area management in Ethiopia is "chronically under funded" (IRIN, 2002). A report from Forestry Outlook Studies in Africa (FOSA) stated that "… [In Ethiopia] present forest management fails to achieve the protection and conservation objective of the State" (Million, 2001B p. 15). Although, in recent years encouraging steps has been taken at the national level such as formulating forest policy and decentralizing forest administration to the regional States, at the practical level this brought little change to the ongoing alarming forest destruction (Million, 2001B).

Among the reasons that may contribute to the discrepancy between the level of ecosystem service enjoyed by people and the low value/attention attributed to them is primarily because these ecosystem services are not traded in the market and their economic value not readily known. This under-valuation could lead to inefficient allocation of the resource stock, its depreciation unaccounted and uncompensated for those affected, ultimately resulting in loss of welfare to forest-dependent communities and to society at large (Mogaka et al, 2001).

Within this broad natural resource valuation problem, this study addressed a specific case of ecosystem service for recreation at Wondo Genet sub-catchment in Ethiopia. The recreation site is primarily nature-based but developed to suite for visitors use. The study site is better described as a wetland ecosystem since permanent water availability characterizes the area and hot spring water is the attractive quality of the site in providing the recreation service (see photo 1 & 4 below). Though, there is no precise definition to what constitutes a wetland, because of their diverse nature and difficulties in defining their boundaries (Turner et al, 2000), the RAMSAR Convention definition, widely accepted internationally, defined wetland as: “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 metres” (Ramsar, Iran, 1971). According to the RAMSAR definition and its classification of wetland, the study site can be grouped in to the categories of Freshwater Springs, Geothermal Springs or Permanent Streams and Creeks wetland category (Photo 1& 4).

Photo 1: The left photo showing a marsh area below the hot spring; and the right photo showing a small water fall from a stream just by the swimming pool. *Photos by Tadele and Hussen*

Wetlands are highly productive and valuable ecosystems with a range of ecological, social and economic functions (Dixon and Wood, 2003). A large number of down stream communities benefit from Wondo Genet wetland ecosystem. Water related benefit people obtain from it includes provision of fresh water for drinking, household and livestock use; irrigation for agricultural crops; and the ecosystem as a whole provide nature-based recreation service to a wide range of users from local visitors to international tourists. These services are generally believed to be tremendous, but no study has been made to assess the significance of them to the welfare of the respective users.

On the other hand, land use practices that are believed to impact the wetland ecosystem negatively are widespread. According to Dixon and Wood, (2003) many wetlands are fragile and transient ecosystems, easily prone to degradation through the actions of natural processes and exploitative human interventions. The most conspicuous problems affecting the wetland ecosystem at the study area which may have detrimental impact on the quality and quantity of water related services include:

- deforestation of the sub-watershed for cultivation and settlement including on steep up hill slopes of the springs and the associated use of chemical compounds such as fertilizer and pesticide.
- stream sides are becoming devoid of vegetation and cultivation extending up to stream bank slopes;
- conversion of native vegetation cover to exotic plantation at close proximity to spring water sources and along the water courses (see photo 5 below)
- uncontrolled livestock grazing, where livestock directly graze at the water source swamps in the forest, and along the water courses.
- recurrent fire on the uphill slope of the water sources and streams in the sub-catchment and,
- uncontrolled waste disposal.

The impacts these land use practices on wetland services is not studied specifically in the study site. But available scientific evidence suggests that these land use activities can generally cause deterioration in quality and quantity of water supply from a catchment. This may have implication on the quality of the site for recreation. The study area is known for its attractive qualities for recreation. Many domestic and foreign recreation users come to visit the area mainly for bathing and swimming in naturally hot spring water, to watch birds and enjoy the beautiful landscape scenery and hotel services. In general the value of the site in terms of its recreation service to society and how this service is being affected by the prevailing land use practices in the surrounding is not known. Therefore, it is important to understand the public demand for the recreation service of the area, so that the information can be used while designing natural resource management objective in the sub-catchment.

Objective of the study

The primary objective of this study was to assess the recreation use value of Wondo Genet Resort. In addition the study endeavoured to:

- Identify the site quality attributes of Wondo Genet Resort that contribute in attracting visitors and
- Highlight the possible impact of the prevailing land use practice in the sub-catchment on the wetland ecosystem through literature review.

Economic valuation of ecosystem services: Background

Economic valuation methods

Economic value is a measure of what the maximum amount an individual is willing to forego in other goods and/or services in order to obtain some other goods and/or services (Arrow et al, 2000). For goods and services that can be sold at the market, the value of the good or the service concerned is easily referred from its price in the competitive market (Heal, 2000). However, environmental goods and services that are not traded in the market such as amenity, watershed services etc; market prices are unavailable for measuring their economic value. Economic valuation techniques are therefore employed to estimate the economic value of these non-marketed environmental goods and services (De Groot et al., 2002; Pigola et al, 2004; Heal, 2000). Main economic valuation techniques are described in Appendix A as summarized by Pigola et al, (2004).

The need for economic valuation of ecosystem services

Lambert, (2003) discussed the view that "nature has an intrinsic value, that it is our long-term life support system and this is enough reason to protect it." According to the author, while this is a right reasoning the reality that most natural resources are facing in the world is different from this thought.

The reality is natural systems are being converted to other land uses on the bases of mostly short term financial gain rather that their long term value to society (Daily, 1997). In natural resource use decision making process, non-marketed values of nature's services assigned too little or zero value in the cost benefit analysis of the resource use decision due to absence of market data and their public good nature (Turner et al, 1998), at least in developing countries like Ethiopia. This has led to favour conversion of natural systems into other land uses. Millennium Ecosystem Assessment Report, 2005, concluded that:

> *Most resource management decisions are most strongly influenced by ecosystem services entering markets; as a result, the nonmarket benefits are often lost or degraded. These nonmarket benefits are often high and sometimes more valuable than the marketed ones.*

In this case, as Barber et al, (1997) explained, ecosystem goods and services must be given a quantitative economic value if their continued supply is to be chosen over the inefficient alternative uses.

From the other direction, loss of environmental resources is an economic problem, because lost or degraded ecosystem services affect human welfare (Barber et al, 1997). For efficient decision making all the values (including non-marketed services) that are gained and lost under each resource use option need to be carefully evaluated (Barber et al, 1997). Under these circumstances the need to economic information about environmental good and services is described by Daily as:

> *At a time when ecosystem services becoming increasing[ly] scarce, there is an urgent need for systematic characterization of ecosystem services – locally, regionally, and globally – in biophysical and economic terms. Incorporation of their value into decision making process will require both developing ways to estimate their social value and developing institutional mechanisms through which that value can be realized* (Daily, 2000; p. 334).

Defining ecosystem benefits/value

The value of ecosystem is described by the concept of total economic value framework. The framework disaggregates the value of ecosystems into direct and indirect use values and non-use values. Millennium ecosystem assessment, (2005) described the components of total ecosystem values as follows.

Direct use values are derived from ecosystem services that are used directly by humans. They include the value of consumptive uses, such as harvesting of food products, timber for fuel or construction, medicinal products, and hunting of animals for consumption; and value of non-consumptive uses, such as the enjoyment of recreational and cultural amenities like wildlife and bird watching, water sports, and spiritual and social utilities that do not require harvesting of products.

Indirect use values are derived from ecosystem services that provide benefits outside the ecosystem itself. Examples include the natural water filtration function of wetlands, which often benefits people far downstream; the storm protection function of coastal mangrove forests, which benefits coastal properties and infrastructure; and carbon sequestration, which benefits the entire global community by abating climate change.
Option values are derived from preserving the option to use services in the future, which may not be used at present, either by oneself in which case it is named option value or by others or heirs named by bequest value.
Non-use values refer to the value people may have for knowing that a resource exists even if they never use that resource directly. This kind of value is usually known as existence value or sometimes passive use value.

What is measured in economic valuation

In Economics, the concept of value relates to the change in human welfare. Economic value of ecosystem service relates to the contribution the service makes to human welfare, where human welfare is measured in terms of each individual's own assessment of his or her well-being (Bockstael et al, 2000).

Value is expressed in economic terms when an individual makes tradeoffs while choosing between two alternative states. The tradeoffs can be described usually in terms of the amount of money the individual is willing to pay or accept compensation for the change involved between the alternatives. Depending on the situation the tradeoffs can be described either in compensating variation or equivalent variation (more in Bergstrom, 1990)

Therefore, in economic valuation of ecosystem services the aim is to estimate individuals' willingness to pay or accept compensation for a defined change in the provision or loss of the ecosystem service. Usually, consumer surplus is used as an approximation to the compensating and equivalent variation measures since the latter two are not empirically observable (Bergstrom, 1990) in revealed preference valuation methods.

Measure of economic value is subjective in nature that depends on the experience, taste, and wealth/income of individuals and on the availability of substitute goods to the item under valuation as well as on the amount supplied and demanded of the particular good or service (McDonald, 2002; Heal, 2000). Therefore, "… the monetary valuation of an ecological resource tells us little about its [ecological] capacity or potential" (Straton, 2006 P. 410).

Possible application of economic valuation

Economic valuation studies are being increasingly used in guiding resource management decisions. The area of application includes the following according to Navrud and Pruckner, (1997) and Grafton et al. (2004).

Cost-benefit analysis: Economically evaluating projects and policies that involve non-marked environmental item, and/or externality. This involves the valuation of the environmental good and/or the externality.

Environmental damage assessment: In the case of environmental damage, determination of compensation for the affected involves the valuation of environmental benefits lost because of the damage.

Regulatory analysis: Developing standards for environmental quality as in the case of air pollution, for example, requires the valuation of costs and benefits of the regulatory action and balancing of marginal benefits and marginal costs of the control measures for economic efficiency.

Land use planning: land use planning that takes into account multiple uses of the land, such as for timber harvesting and amenity, requires the valuation of the benefits from the different uses and design optimal management plan so as to produce maximum benefit.

Natural resource accounting: Traditional measures of economic well-being as measured by GNP do not capture the depreciation of environmental or natural resource stocks or changes in the value of non-market resources from the environment. New approaches to national accounting namely green accounting or natural resource accounting, requires the use of environmental valuation techniques.

In terms of ecosystem service context, Pigola et al, (2004) discussed that valuation can help in:

- Determining the value of the total flow of benefits from an ecosystem.
- Determining the net benefits or costs of interventions that alter ecosystem conditions.
- Examining how the costs and benefits of ecosystem conservation are distributed. Help to identify who is loosing and who is benefiting from projects that influence ecosystem, thereby helping to design compensation measures.
- Identifying potential financing sources for ecosystem conservation. This involves the establishment of payment schemes for using environmental services to help financing of ecosystem conservation.

Challenges in Economic valuation

According to Arrow et al, (2000), given the complexity of ecological system and its nonlinear behaviour it is difficult to know clearly the way how exploiting or damaging one service influence the functioning of the other and how they respond to changes. This is one of the sources of uncertainties in valuation studies (Arrow et al, 2000).

In making tradeoffs in the allocation of land and other resources to competing human activities, usually the marginal value of the resource under the different alternatives is needed. In the case of ecosystem service for example, how much flow of ecosystem service is enjoyed from a unit hectare of forest is difficult to determine and attach corresponding marginal economic value (ESA, 1997)

When the interest of the future generation is considered; how should future benefits be valued, in economic, cultural, or other terms and how such value of future generations is represented in today's decision making table is generally not clear (Daily, 2000).

Despite the challenges, estimates of the economic costs and benefits of changes in ecosystem services can be useful for decision making (MA, 2005; ESA, 1997). Often comparison of relative values is sufficient – that is weighting the economic benefits of a particular development project with the economic benefits supplied by the ecosystem that would be altered or destroyed, measured over a time period of interest to subsequent generations (Daily, 2000).

As MA (2005) expresses, well-designed valuation studies can show how much ecosystem services are worth; can inform resource management decisions with information about the economic benefits of alternative management options; help to identify who benefits and loses from ecosystems services maintenance or its conversion; and help to design payment mechanisms among the stake holders for financing of ecosystem conservation.

Materials and Methods

Study site

The study was conducted at Wondo Genet Resort hotel, one branch of the Wabe Shebelle Hotels enterprise. It is located in Awassa Woreda of Sidama zone at about 7^0 6' N and 38^0 37' E, and East of Wondo Wosha town. The area lies at the base of a mountain range escarpment where the low-lying rift valley, part of the East African Great Rift, changes to its adjacent high land. The hotel was established in 1964 and had been used as recreation site for the then royal family until 1975. It was by then the area given its current name "Wondo Genet" by Emperor Haile Sillassie, in its translation meaning *Wondo Paradise,* used to describe the beautiful panorama of the natural area and its rich endowment of natural resources that include forests, wildlife and ample water flow from streams and springs of fresh water and geothermally hot water.

After 1975 its administration was transferred to the then Hotels Corporation and now the resort hotel is a subsidiary of the Wabe Shebelle Hotels Enterprise that falls under the jurisdiction of the Tourism Commission. Wondo Genet Resort Hotel constitutes 54.4 ha area of land and possesses 40 bed rooms, restaurant and bar, swimming pools and some artefact collection of the then royal family according to Ato Tadese, the hotel manager. The attraction of Wondo Genet recreation site is still based primarily on its naturally endowed resources namely the hot spring water along side the perennial stream flow that forms nature's unique beauty which visitors enjoy with. Additional glamour of the site is the attractive landscape scenery created by the surrounding forest covered hilly topography containing diverse plant and animal species of tourist importance. Moreover, standard services in restaurant, bar and bedroom characterize the resort hotel (photo 2 and 3).

Among the many flora and fauna at Wondo Genet sub-catchment, it has been shown that 118 bird species, out of which 7 endemic, 3 inter-African migrant and 6 intercontinental migrant species could be observed from part of the sub-catchment (Sim, 1979); though the current status is not known.

Currently, bird species encountered by bird watchers at the site include the following: Silvery-cheeked Hornbill, White-cheeked Turaco, Yellow-fronted Parrot, Black-headed Forest Oriole, Golden-backed Woodpecker, Red wing Starling, Grosbeak Weaver, Mountain Wagtail and Black roughing Swallow (Remote River Expeditions, 2007).

Many tree species were found in the remaining forest which is found mostly at the valley pockets and on the escarpment of the mountain range. Mersha (2002) identified many tree species in certain part of the forest among which *Podocarpus falcatus*, *Olea Europea*, *Milliettia ferruginea*, *Juniperus Excellsa*, *Syzygium Guineense, Cordial Africana, Aningeria adolfi-friedericii, and Prunus africanus* etc are some of the species found of which some are endangered species in the country.

Among wild animals, Mountain Nyala (*Tragelaphus buxtoni*) which is becoming locally extinct (Gessesse & Kleman 2007), Colobus monkey, Anubis baboon and Minellik's Bushbuck, are some of the wild animals at the site which visitors may encounter with, of which some of them are endemic species.

Photo 2: The above two photos show a portion of the surrounding landscape of the recreation site. The Swimming pool and the hot spring (shown in photo 4 below) is located at the foot of the hill in the right photo. The left photo shows the top of the hotel cafeteria and bar. *Photos by Tadele & Hussen*

Photo 3: Photo showing part of the hotel compound, some of its bedrooms (at the far distant in the photo) and visitors parking cars. *Photo by Tadele & Hussen*

Photo 4: The upper left photo shows visitors taking shower before going to swimming and the lower left photo shows visitors swimming in the pool. Geothermally hot water is supplied for the use from an upland hot spring shown in the right photo. *Photos by Mohammed Ali.*

Methods

To identify site qualities that attract visitors, interview has been conducted to identify and rank the site quality attributes that are considered as reasons for their visit of the site.

To estimate the economic value of the recreation site, single site travel cost model is applied.

Single Site Travel Cost Model (TCM) - theoretical overview

Recreation use value of a site to its users can be estimated by applying the travel cost method which originally proposed by Harold Hotelling in 1949 (Ward and Beal, 2003). Since the price of accessing a recreational site is most of the time zero or very small that do not reveal the real value users attribute to the recreation site, the individual's travel costs, including the costs of travelling and accessing the site, accommodation as well as their opportunity cost of time can be used as surrogate prices to approximate the nonexistent market price of the recreation service (Ward and Beal, 2000). TCM measures only recreation use value of the site, not non-use values such as intrinsic value, existence value, option value, or bequest value of a recreation site. The way we measure economic value of recreation sites is discussed by Freeman (2003) as the sum of the willingness to pay for the recreation services of all the users.

Freeman (2003) discussed that, since the compensated demand curve for visits at the site cannot be observed directly, the usual practise is to use the ordinary demand curve for visits to the site. The demand curve represents number of trips taken to the concerned recreation site in a given period of time as a function of travel distance/cost of visitors. This is due to the property of decreasing frequency of trips of visitors to a recreation site as the travel distance increases from the site (Ward and Beal, 2000); i.e. distance to site or cost of accessing the recreation site and number of visits made to the site are complementary.

To establish the demand curve, first a demand function describing the relationship between the number of trips taken to the site as a function of travel cost, site quality and demographic variables will be established. Then the demand curve will be established at assumed increment of travel cost evaluated at average values of all other variables considered in the demand function (Ward and Beal, 2000). Then the established visitation demand curve is used to estimate the consumer surplus for individual visitor. The aggregate consumer surplus of all visitors is used to approximate the economic benefit of the recreation site (Freeman, 2003; Ward and Beal, 2000)

It is generally assumed in TCM that there is separability between recreation and non-recreation market good consumption for an individual involved in recreation (Grafton et al, 2004)

Single site recreation demand model: the following model is adapted from Freeman (2003). Assuming an individual who make visits to a particular site, he/she makes a number of visits with in a given time period. Then utility from the site visit can be described as:

max: $u(Z,r,q)$ (1)

Subject to:

Monetary constraint, $M + P_w*t_w = Z + c * r$ (2)

Time constraint, $t_t = t_w + (t_1 + t_2) r$ (3)

Where

Z = the quantity of the numerary whose price is 1,

r = number of visits to the recreation site,

q = environmental quality at the site,

M = Exogenous income

P_w = wage rate

c = monitory cost of a trip

t_t = Total discretionary time,

T_w = hours worked,

T_1 = round trip travel time, and

T_2 = time spend on site

r and q are complements in the utility function. The monitory cost of a trip to a site has two components: the admission fee (fee), if exists, and the cost of travel as the product of per kilometre cost of travel (p_d) and round trip distance (d).

The full price of a visit to a site (p_r) is given by,

$P_r = c + p_w * (t_1 + t_2) = fee + p_d * d + p_w *(t_1 + t_2)$ (4)

Substituting the time constraint equation into the monitory budget constraint gives:

$M + p_w * t_t = Z + p_r * r$ (5)

Maximizing u (Z, r, q) subject to equation 5 yields the visitor's demand function as:

$r = f (p_r, M, q)$ (6)

Equation (4) shows the full price of a visit consists of four components namely: the admission fee, the monitory cost of travel, the time cost of travel and cost of time spent at the site (Freeman, 2003).

Underlying assumptions in the above model include:

- The wage rate is the relevant opportunity cost of time given the individual is free to choose the number of hours to work at a given wage.
- All visits entail the same amount of time spent on the site
- There is no utility or disutility derived from the time spent travelling to the site
- Each trip to the site is for the sole purpose of visiting the site.
- There are no substitute sites
- Individual's choice of where to live is independent of preferences for recreation visits

However, when certain of the assumptions are violated depending on the circumstances under which a study is made, they can be relaxed with appropriate treatment of the assumption being violated.

Since opportunity cost of time is evaluated at one third of the wage rate. The full price of accessing the site is given by:

$P_r = c + (p_w/3)*(t_1 + t_2) = fee + p_d * d + (p_w/3)* (t_1 + t_2)$ (7)

Finally in equation 6, since site quality does not vary within the study period, and all visitors are supplied with the same level of quality; site quality is constant and can be dropped from the model (Ward and Beal, 2000):

$r = f (p_r, M,)$ (8)

Apart from the price of accessing the recreation site and income of the visitor, a set of demographic variables (X) and price of substitute site (Ps) can be added as shifters in the demand function (Parsons, 2003). And the working model can be expressed as:
$r = f (p_r, M, X, Ps)$ (9)

Procedures followed

In recreation value estimation for a site, the aim is first to establish the recreation users demand curve for their visitation of the site and then to estimate the average consumer surplus users benefit at the average cost of accessing the site – a proxy for price of accessing the site. Therefore, variables relevant to form the recreation demand function includes cost of accessing the particular site, cost of access to a substitute recreation site and other demographic variables such as age, gender, income etc of users that are believed to influence the recreation consumption of users. In order to collect information about these variables of the recreation demand function a survey was conducted. A survey questionnaire was developed after studying a sample of questionnaires used in previous studies. The draft questionnaire enriched by advices from researchers and finally the questionnaire was tested on potential respondents before applied to collect the real data.

The field survey was carried out from October 2006 to January 2007. In the first two weeks a test survey was made to learn about potential respondents' reaction, questions clarity, and to make sure that the questionnaire format helps to capture the variables needed.

Sample selection

Day time and overnight visitors were sampled separately. Day time visitors refers to those visitors who visit the site and return back on the same day, while overnight visitors spend at least a night at the study site.

Overnight visitors were sampled at the reception in the hotel. Since the number of overnight visitors in a day is known before they arrive, it was possible to randomly select samples according to their reservation number. Depending on the number of overnight visitors per day, variable number of samples was chosen. For less than 15 overnight visitors per day five samples were taken and for more than 15 overnight visitors per day up to ten visitors were randomly chosen for the survey. For majority of the overnight visitor samples their arrival was not predictable, some arrive in the evening after interviewers left the place; therefore, questionnaires was put for them through the receptionist and were asked to return it back to the receptionist after completing.

For day time visitors, it was difficult to randomly select samples because it was not clearly known at the beginning of the day how many visitors would come to the site on that particular day. As suggested by Parsons (2003) to address such a sampling problem, sample selection following a given interval of arriving visitors was adopted. Therefore, roughly expecting about 100 to 150 visitors per day on weekends, based on previous experience, selecting sample at every 15th arriving visitor was made at the thicket office to the swimming pool. To comply with random selection procedure, every day when the survey began the first respondent from the first arriving 15 visitors was selected at random then afterwards selection continued following the regular interval. For small to medium size survey it is commonly taken a sample of 300 to 500 usable data points (Ward and Beal, 2000). It was hoped to obtain 300 to 400 usable observations.

Sampling was done from 10 am in the morning to 6 pm in the afternoon on everyday except on Tuesday and Wednesday. The swimming pool is cleaned and refilled every Wednesday, so that it was known from experience that not much daily visitors come on Monday through Wednesday.

Estimating visitors cost of accessing the study site

The cost of accessing the study site for visitors consists of the round trip transportation cost, entrance fees and accommodation costs in the case of overnight visitors. Visitors used different modes of transportation; namely public transport, their own cars or rented cars. For those who used public transport, the public transportation fares were used.

Those who used private or rented cars, to estimate respondent's round trip transportation expenses average automobile running costs of 1.09 birr per kilometre was used. Information about average automobile running cost in Ethiopia was not directly available. UNDP (2002) indicated that automobile fuel consumption increases by one-fourth in Ethiopia. Having this guideline, fuel consumption of automobiles in other countries was consulted. As indicated by the study of eight developed countries automobile fuel consumption by Espey (1996), 9 litters per 1oo kilometre fuel consumption of automobile was taken as the average. The American Automobile Association (AAA), (2007) estimate of US $0.089 per mile average gas cost of running small cars; and most small vehicles fuel consumption rate in the range of 60 km per gallon according to Vehicle Certification Agency (VCA) of UK (http://www.vcacarfueldata.org.uk/), translates into approximately 0.09 litter per kilometre.

The above rate is then increased by one-fourth as indicated by UNDP (2002). The corrected automobile fuel consumption rate used was 0.116 litres per kilometre. Then this was multiplied by the average diesel and petrol cost of 6.805 birr per litter to estimate the fuel cost of running a car in Ethiopia. Maintenance cost of US $0.03, and cost of tyre US $0.004 per kilometre of running small car (AAA, 2007) were considered, assuming that these costs do not at least overestimate the Ethiopian case. In total automobile running cost was estimated to be around 1.09 birr per kilometre equivalent to around USD $0.12. The value includes only variable cost of running a car; it does not include fixed costs such as insurance cost, and different car ownership costs; presumably reasonable to ignore such costs since these fixed costs by themselves may influence little the recreation trip decision. Then the respondents' cost of travel would be his/her share of the transportation cost among the number of visitors transported by the car. In the case of rented car, the respondent's share of the rent was added together with the shared car running cost.

Respondents who employed visits to another recreation site on the same trip were identified. Visitors who made single destination trips to the study site, their full expenses of travel were used. For respondents who made visits to other sites on their same trip to the study site, it was tried to identify which site was their primary destination in their trip by asking a question:

If you visited or have a plan to visit other sites than Wondo Genet during this recreation trip, please indicate which site was your primary destination?

From 89 respondents, that account 26% of the total respondents' data used in the analysis, who employ visits to other sites on their trip, 49% of them indicated that their primary destination was the study site. These visitors, who chose the study site as their primary destination indicated in a follow up question that they would make the trip to the study site even in the absence of the other visited sites on their way to or from the study site. This suggests that for these respondents their visit to the other sites could be treated as "incidental consumption," according to Parsons and Wilson (1997) which complements the recreation trip to the study site. According to Loomis et al. (2000) and Parsons and Wilson (1997), counting these complementary recreation consumption in the recreation demand model increases the value of the primary recreation site, however, the increase in value is not statistically significant in their study. Therefore, respondents who made visits to other sites as described above, their round trip travel expenses, ignoring the additional benefit from their incidental visits, were considered here.

For respondents that chose another recreation site as their primary destination, or chose the study site jointly with other sites (Parsons and Wilson, 1997), only the incremental travel expenses from their primary destination to the study site was considered which is an approach practised by for example Kerkvlier et al. (2002). 51% of the 89 respondents were treated this way.

Expenses of respondents at the site include entrance fee and payments for different services like guided walks through the forest, campfire, and fees to use camera etc. Payments made for group activities were apportioned by the number of members in the group to know the share of the respondent's cost. For overnight visitors, rent for bed room[2] was considered, but expenses for food and drinks were not included, because food and drinks were assumed to be regular expenses which could occur even if visitors were not on the particular recreation visit - an approach followed by Navrud and Mungatana (1994).

Opportunity cost of time spent during the recreation visit should also be included as part of the travel cost. For visitors who were able to freely exchange work time to

[2] It is assumed visitors came to the site primarily for nature-based recreation services, not for luxury hotel facility. The study considered all quality attributes of the site including its hotel facility as recreation attractions of the site in their totality. More can be found in the section "Site Quality Attributes" about site quality preferences of visitors.

recreation time, their opportunity cost of recreation time can be evaluated at their wage rate (Freeman, 2003). When work time is a fixed hours per week, and visitors can not exchange between work and recreation time, the opportunity cost of time spent on recreation is usually evaluated at some fraction of the wage rate (Parsons, 2002). In this study most visitors visited the site on weekends, and during the survey it was tried to get the opinion of the visitors about their opportunity cost of recreation time. A question 'How much income has you lost because of using your time to this recreation trip?' Except a few of the respondents all replied that they did not lose any income.

However, even if time spent on recreation is not used in the alternative to generate monetary income, it is considered time as a scarce resource for the household and its value should be incorporated in the recreation demand function (Bockstael et al, 1987; Wilman, 1980). Therefore, this study evaluated the respondent's opportunity cost of time spent on the recreation trip at one-third of the individual wage/income rate following studies by Chen, et al. (2004); Navrud and Mungatana (1994); Kerkvlier et al. (2002) among others. For overnight visitors 8 hours in every 24 hours of their stay at the recreation site was counted in calculating their opportunity cost of time. A sensitivity analysis is presented that assume zero opportunity cost of visitors' recreation time in Table 7.

Data Analysis

Data generated based on on-site sampling of visitors according to Individual Travel Cost method have the following characteristics:
The dependent variable is number of trips taken by visitors and independent variables are travel cost to the site, demographic variables of visitors, costs to substitute sites, and quality of the site. The dependent variable, number of trips taken by visitors, is a count observation with values in the domain of non-negative integers. Therefore a count data model was used to establish demand function for trips taken by visitors. Poison and binomial distributions are applied to represent the dependent variable distribution.

Since the data collected were from visitors who made at least one trip to the site, people with zero trip (non participant to recreation and those people who did not make their trip during the sampling period were not included in the sample). Observation was made from the subset of the general population. Therefore, zero value of the dependent variable was not observed in the sample, rather its value started from one. Hence the range of values of the dependent variable was truncated at zero. For this reason truncated count data models was used for analyzing the data.

The observed sample values may be highly variable that the variance of the dependent variable is more than the sample mean; an effect known as over dispersion of the dependent variable - number of trips in this case.

Taking into account all the above characteristics of the data, appropriate models for this kind of data are truncated Poisson or truncated binomial regression (Creel and Loomis, 1990). For comparison Ordinary Least Squares (OLS) estimates, and standard Poisson and standard negative binomial models were tested to see if result from this study show similar pattern of parameter estimate with those studies which compare the performance of the above model specifications.

Recreation trip demand function – count data models

Given the count nature of the dependent variable, the basic count data model to establish recreation demand function is a Poisson regression. The variable number of trips taken by a person in a period of time is assumed to be generated by a Poisson process. The following equations 1 to 9 below are adapted from Ovaskainen et al. (2001) and Creel and Loomis (1990), unless other sources are stated. The probability of observing an individual take (y) number of trips in a period of time is given by the Poisson probability distribution:

$$\Pr(Y = y) = \frac{\exp(-\lambda)\lambda^{y}}{y!} \qquad (1)$$

Where, y = 0,1,2,…; and λ is the expected number of trips = E(Y), which is taken as equal to the variance of the random variable = Var (Y).

I.e., E(y) = λ = Var (Y) (2)

The expected number of trips (λ) is assumed to be a function of the variables specified in the recreation demand function.

For each respondent in the sample all the independent variables are known, and the probability of observing the number of trips actually taken by the respondent is given by equation (1). For each respondent in the sample it is possible to construct the probability of observing each respondent's actual number of trips taken. The likelihood of observing the actual pattern of visits made by all respondents in the sample is then the product of the individual respondent's probability given by (Parsons, 2003):

$$L(\beta / Y, X) = \prod_{n=i}^{N} \frac{\exp(-\lambda_i)\lambda_i^{y_i}}{y_i!} \qquad (3)$$

Where, individual respondent is denoted by i = 1, ... , N, so y_i is the number of trips taken by respondent i. Therefore, the parameters β, which determines the value of λ are chosen to maximize L through a process of iteration. The log-likelihood function for the above Poisson process of recreation trip events is given by:

$$\ln L(\beta / Y, X) = \sum_{i=1}^{N} [y_i X_i^{'} \beta - \exp(X_i^{'} \beta) - \ln y_i!] \qquad (4)$$

However, this likelihood function assumes a sample obtained from the general population, which means including those who did not take recreation trips. It assumes 0 number of trips observation are included in the sample. However, this is not the case in on-site sampling at a recreation site, in which case sample values does not include 0 number of trips, rather it begins from one since each respondent has made at least one recreation trip to the study site (Figure 1).

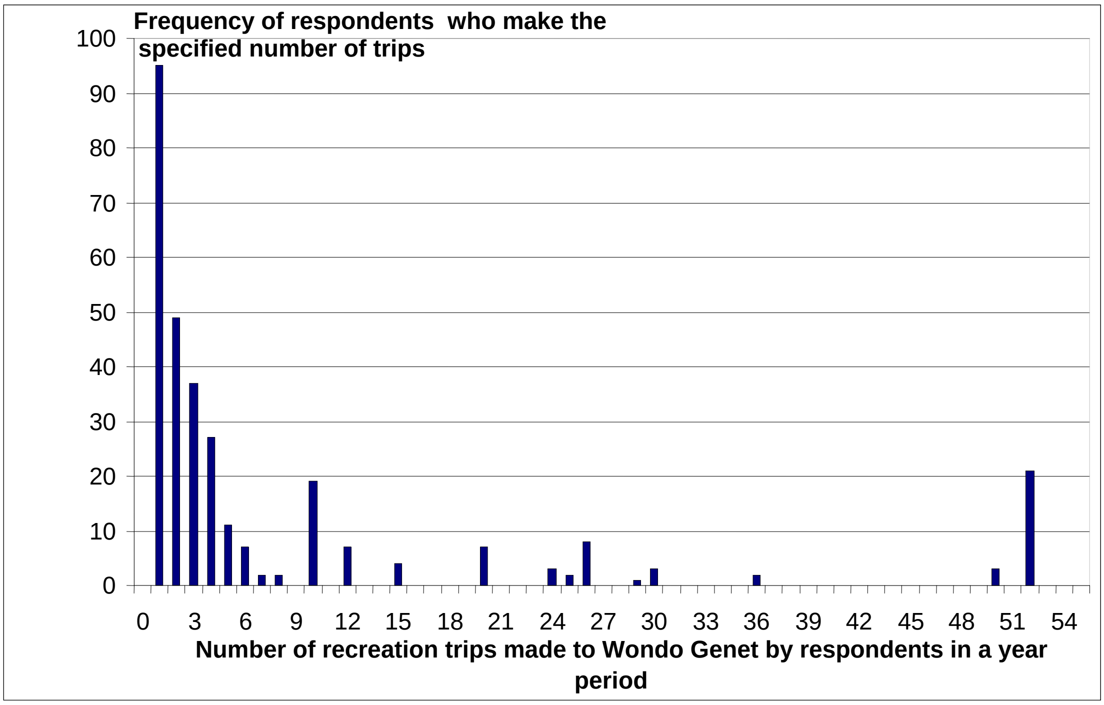

Figure 1: Distribution of the recreation trips variable based on sample respondents data[3]

Therefore, the above equations have to be corrected to account the truncated value of the dependent variable at 0 value. In this case the conditional probability of observing y is:

$$\Pr(Y = y / Y > 0) = \frac{\exp(-\lambda)\lambda^{y}}{y!}\left[\frac{1}{1-\exp(-\lambda)}\right] \qquad (5)$$

Conditional mean = variance = E(y/X, Y>0) = $\lambda\left(1 - F_p(0)\right)^{-1}$ (6)

Where, $F_p(0) = f_p(0)$ the probability density in the Poisson distribution for y = 0.

However, the Poisson probability distribution restricts the variance of the sample to be equal to the mean value. This restriction on the Poisson distribution is not appropriate for data that exhibit over dispersion (higher variance than the mean), where this is the case for the recreation trip data of this study. Therefore, negative binomial distribution that allow the variance to vary from the mean of the dependent variable is found to be an appropriate distribution to derive the demand function of recreation trips and to measure welfare estimates (Ovaskainen et al, 2001; Gomez and Ozuna, 1993). Failure to account over dispersion in recreation trip data causes biased parameter estimate especially when the mean number of trips is low (Creel and Loomis, 1990). The negative binomial probability distribution is given by:

[3] On-site sampling may include more frequent visitors than those less frequent users; the effect this might have is believed to be small in this study given the large number of respondents with the smallest number of trips to the study site. Also Ovaskainen et al, 2001, showed that accounting the effect brought no significant change to the welfare estimate.

Prob (Y= y) = $\left(\dfrac{\Gamma(y+1/\alpha)}{\Gamma(y+1)\Gamma(1/\alpha)}\right)(\alpha\lambda)^{y}(1+\alpha\lambda)^{-(y+1/\alpha)^{-1}}$ (7)

Where, y = 0,1,2,…; Γ represents the gamma distribution and α denotes the dispersion parameter where the rate of dispersion according to Green (1995) is given by:

$$\frac{Var(y/X)}{E(y/X)} = 1 + \alpha * E(y/X)$$

Mean and variances are;

$E(y/X) = \lambda = \exp(X\beta)$

$Var(Y/X) = \lambda(1+\alpha\lambda)$

Truncated binomial probability,

Prob (Y= y/Y>0) = $\left(\dfrac{\Gamma(y+1/\alpha)}{\Gamma(y+1)\Gamma(1/\alpha)}\right)(\alpha\lambda)^{y}(1+\alpha\lambda)^{-(y+1/\alpha)}\left[1-F_{nb}(0)\right]^{-1}$ (8)

Where, y = 1, 2,…, $F_{nb}(0) = f_{nb}(0)$ = probability density of y = 0 in the negative binomial distribution.

Variance $Var(y/X) = E(y/X)(1+\alpha * E(y/X))$

Conditional mean, E(Y/X, Y>0) = $\lambda(1-F_{nb}(0))^{-1}$

To estimate the parameters of the recreation trip demand function in the above count data models LIMDEP econometric software was used.

Usually λ takes a log-linear functional form in recreation demand function.

$$\ln(\lambda_i) = \beta_1(TCW_i) + \beta_2(SUSBS\_TC_i) + \beta_3(INCOME_i) + \beta_4(AGE_i) + \beta_5(GENDER_i) + \beta_6(HIGHAABVE_i) + \beta_7(OTHERVIS_i) + \beta_8(SELFEMPE_i) + \beta_9(GOVEMP_i) + \beta_0$$

(9)

Which is equal to $\lambda = \exp(X\beta)$ in matrix form.

Where, X represents the vector of the independent variables; and β is a vector of the independent variables coefficient. Key to abbreviations of the variables is presented in Table 5.

Measuring Welfare

The benefit users obtain from visiting the study site is estimated using consumer surplus at average values of the independent variables in the estimated recreation trip demand function. According to Creel and Loomis, (1990) and also Hellerstein and Mendelsohn, (1993) the consumer surplus (CS) for the semi-log functional form recreation trip demand curve is given by:

$CS = -\frac{\bar{Y}}{\beta_{Tcw}}$, where β_{Tcw} is the coefficient of the price variable in the recreation trip demand function, and $\bar{Y}$ is the predicted number of trips at average values of the independent variables.

For the linear functional form:

$$CS = -\frac{\bar{Y}^2}{2*\beta_{Tcw}}$$

Result and Discussion

From a total of 482 sample visitors, 72% of them provided usable information for the recreation demand function. During the survey it was learned that the survey faced a problem with foreign tourist respondents guided by touring company or travel agents. These respondents could not indicate their travel expenses specific to the study site. This is because such visitors made a lump sum payment at the beginning of their visit to a touring company or agent for their whole visit of the many destinations in the country that may include this study site. During the visit the tour company serves them in their visits of the different destinations taking care of all expenditures for the group it is managing at the particular tour trip. In this arrangement it was difficult to know on the site the individual visitor's cost of accessing the study site separately from the group of other sites visited in their itinerary.

Clearly, the multi-destination nature of foreign tourists visit, and the particular way of organizing their visit with the tour company or agents, make the single site travel cost model difficult to apply for valuation of a single recreations site by such foreign visitors in this study. Therefore, the study is forced to concentrate on assessing the recreation demand of domestic users to the study site which still constitutes the important component of the total users of the site.

Therefore, the majority of the non used responses, 66 of the 93 were those from tourists guided by touring agents. The resulting 348 usable data were obtained from 310 daily visitors and 38 overnight visitors. 22 foreign visitors who came to visit the site without the service of touring agents were included in the data set. Five of them were overnight visitors.

Site quality attribute for the recreation use of the study site

One of the objectives of the study was to identify the study site attributes that attract visitors. The site attribute categories shown in Table 1 were listed in the survey question and respondents were asked to indicate and rank their choice of attribute that made them visit the site. In classifying the site attributes into the listed categories, each category of attribute was not independent of the other in the respondent's choice. Therefore, respondents knew that they could give the same rank to more than one of the attribute classes listed, if they have same level of interest in more that one category of site attribute.

Table 1: Percentage of interested respondents and their mean rank to the site attribute classes.

Site attribute categories	% of respondents interested in the attribute from 397 sample	Mean rank
Hotel (bar, cafeteria, and bed room) services	24.4	3.9
Bathing and/or swimming	94.0	1.41
Landscape scenery	87.9	1.5
Mountain Trekking	49.4	2.7
Bird or other wild animals watching	41.8	2.7
Photographing	45.1	2.9
Royal family artefacts	17.4	3.2
Social interaction	1.3	3.4
Fruit supply	0.5	3.5

Table 1 show the percentage of respondents interested in each attribute class and the mean rank of the attribute category as given by those interested respondents. The ranking was out of seven and a total of 397 respondents answers were used for each site attribute category.

It was evident that 94 % of the total respondents were interested in bathing and swimming facility of the recreation site with their mean rank of 1.4 in their preference to swimming among other attributes of the site. Eighty eight percent of the total respondents were interested in the landscape scenery with their mean rank to it 1.5 among the other site attributes. Mountain trekking, bird or other wild animals watching, and photographing on the site attracted about 50%, 42%, and 45% of the total respondents respectively with their mean rank to these attributes around 2.7.

The remaining site attributes namely the cafeteria, bar and bed room services attracted 24% of the respondents, royal family artefacts attracted 17% of the respondents and rest attributes attracted few respondents with a mean rank to these attributes indicating the least priority given to them in visitors' choice compared to the other nature-based site attributes. Figure 2 below also illustrates the same pattern of visitors choice over the site quality attributes of the site. Therefore, it can be concluded that the main attraction of the recreation site for visitors to come to the site is its water based recreation facility and the scenic beauty of the natural landscape with its biotic contents in the ecosystem.

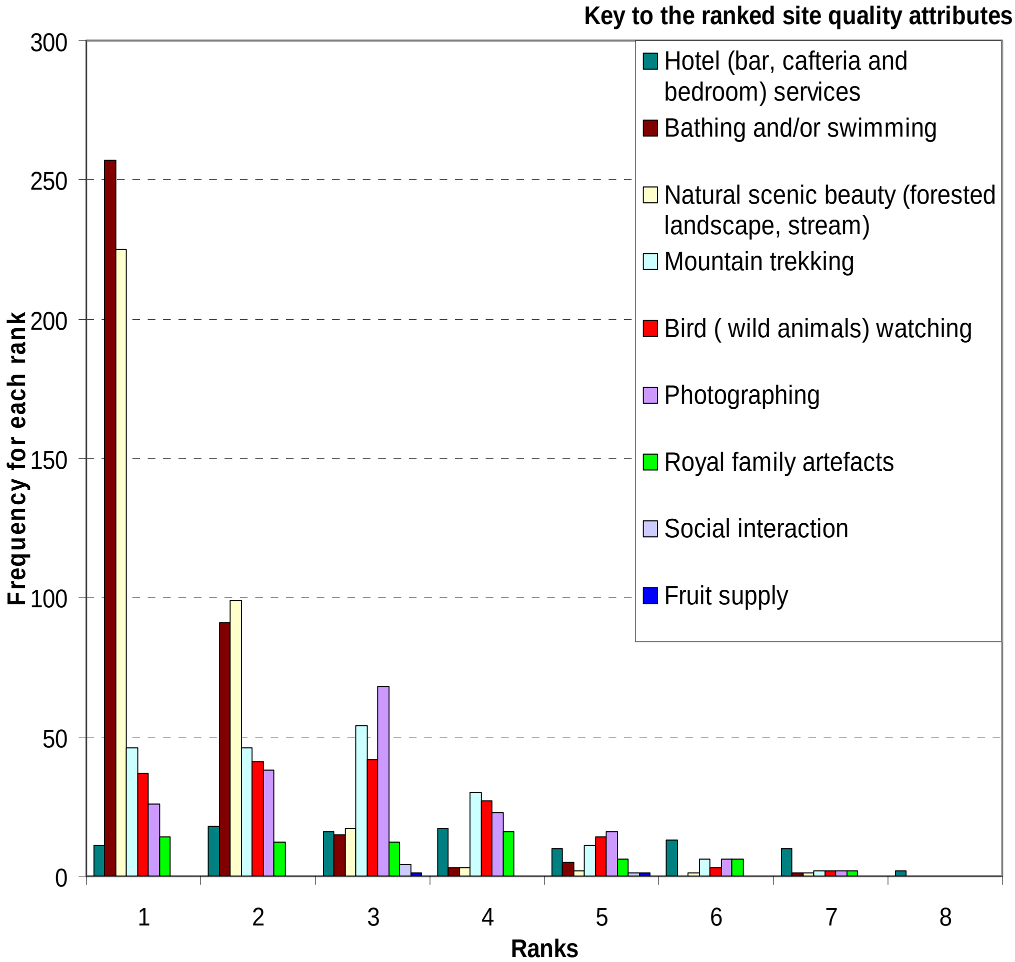

Figure 2: Actual number of respondents who choose and rank each attributes class

Recreation demand function

As shown in the Table 2, the majority of the respondents were male probably a reflection of the general uneven participation rate between male and female. In terms of education about 93% of all respondents completed high school or had higher education. In terms of employment, 82% of the total respondents were employed and were fairly distributed in every of the employer classes. Unemployed and student visitors accounted to 17% of the respondents. Age wise, less than 35 years of age visitors dominated. More detailed descriptive statistics of the variables used in the recreation demand model is presented in Tables 3 and 4 while the key for abbreviation used in these tables is provided in Table 5.

Table 2: Summary of demographic information of respondents whose response used in the recreation demand function.

	Class	%[1]	Age Class (years)	%[1]
Gender	Female	12.9	15-19.9	7.2
	Male	87.1	20-24.9	19.5
			25-29.9	25.6
Education	No education	0.9	30-34.9	23.9
	Primary school	5.4	35-39.9	9.8
	High school	38.8	40-44.9	7.8
	College	23.0	45-49.9	3.7
	University	31.9	50-54.9	1.1
			55-59.9	0.3
Employed by	Government	25.6	60-64.9	1.1
	NGO	14.4	65-69.9	0.0
	Private	27.0	70-74.9	0.6
	Self-employed	15.8	75-79.9	0.0
	Other (Unemployed, students	17.2	80-84.9	0.0
Other information		Numbers		
	Daily users	310		
	Overnight users	38		
	Domestic visitors	326		
	Foreign visitors	22		

%[1] = percentage of 348 respondents

Table 3: Descriptive statistics for variables used in the trips demand function – day time users

Variable	mean	Median	Std.Dev.	Minimum	Maximum	cases
TRIPS	8.95	3.00	14.21	1	52	310
TCW	127.44	71.13	269.34	9.45	4237.2	310
SUBS_TC	157.79	113.65	224.02	32.33	3561.02	310
INCOME	28967.70	15000.00	78512.20	2500	4.05E+06	310
AGE	31.00	28.00	9.03	18	73	310
SEX	0.88	1	0.33	0	1	310
HSCHOOLA	0.93	1	0.26	0	1	310
SELFEMP	0.15	0	0.36	0	1	310
GOVEMP	0.27	0	0.36	0	1	310
PUBTRANS	0.52	1	0.50	0	1	310
OTHERVIS	0.21	0	0.41	0	1	310

Table 4: Descriptive statistics for variables used in the trips demand function – overnight users

Variable	Mean	Median	Std.Dev.	Minimum	Maximum	cases
TRIPS	3.21	2	3.63	1	16	38
TCW	617.16	504.44	570.01	87.84	3095.76	38
SUBS_TC	488.43	412.14	436.85	36.56	2301.2	38
INCOME	40736.80	21000	74653.40	2500	1.05E+06	38
AGE	34.32	33	9.56	18	63	38
GENDER	0.97	1	0.16	0	1	38
HSCHOOLA	0.97	1	0.16	0	1	38
SELFEMP	0.21	0	0.41	0	1	38
GOVEMP	0.13	0	0.34	0	1	38
PUBTRANS	0.21	0	0.41	0	1	38
OTHERVIS	0.63	1	0.49	0	1	38

Table 5: Key to the abbreviations used for the variables in the demand function

Abbreviations	Description of the variable represented
TRIPS	Number of recreation trips made by the respondent to the study site in the past one year
TCW	The respondent's cost of accessing the study site (Wondo Genet recreation site)
SUBS_TC	The respondent's cost of accessing the substitute recreation site
INCOME	Annual household income of the respondent
AGE	Age of the respondent
GENDER	Dummy variable = 1, if respondent is male; otherwise 0
HSCHOOLA	Dummy variable = 1, if respondent attained High school education or above; otherwise 0
SELFEMP	Dummy variable = 1, if respondent is self employed; otherwise 0
GOVEMP	Dummy variable = 1, if respondent is Government employed; otherwise 0
PUBTRANS	Dummy variable = 1, if respondent used public transport for the current trip; otherwise 0
OTHERVIS	Dummy variable = 1, if respondent visited other recreation site during the trip; otherwise 0

Initially about 16 independent variables expected to have an influence on the trip demand function were included in the model. Relevant variables that help to explain the number of recreation trip taken to the study site were identified based on the significance of each variable in the model. Marital status, number of children, employment status, and daily or overnight visits were among the variables which were not significant in the truncated negative binomial model (TNBN).

The presence of these variables in the TNBN model improved the log likelihood function from -917.54 to only -916.2. Log likelihood ratio test, Chi square value of 2.68 for the dropped variables confirmed the null hypothesis that the dropped variables had no effect in predicting number of trips in the model at 99% probability. Therefore, their removal had no significant effect in the model in predicting the dependent variable. However, even if not significant in the trip demand function, independent variables such as income, age, etc, that were believed important to report their performance were retained in the model. Finally eleven independent variables including the constant term were used to form the recreation demand function to the study site.

Table 6: Recreation trip demand function model output

Variables	Ordinary Least square (OLS)	Standard Poisson	Standard negative binomial (NbN)	Truncated poison (TP)	TNBN
Constant	3.109	1.291***	1.509***	1.280***	-0.231
	(0.731)	(9.695)	(3.851)	(9.296)	(-0.147)
TCW	-0.0313	-0.0058***	-0.0038***	-0.0071***	-0.0050***
	(-4.874)	(-20.901)	(-10.797)	(-20.929)	(-7.171)
SUBS_TC	0.0357***	0.0050***	0.0041***	0.0052***	0.0055***
	(4.032)	(15.245)	(8.009)	(14.240)	(5.334)
INCOME	-4.7334E-06	-2.17849E-06 ***	1.00907E-06	-1.68627E-06**	3.04709E-06
	(-0.343)	(-3.962)	(1.254)	(-2.714)	(1.795)
AGE	-0.0320	-0.0041	-0.0152	-0.0037	-0.0343*
	(-0.396)	(-1.664)	(-1.865)	(-1.460)	(-1.992)
SEX	2.3763	0.2812***	0.3308	0.2828***	0.5880
	(1.151)	(4.267)	(2.339)**	(4.187)	(1.757)
HSCHOOLA	0.7987	0.2488***	0.2198	0.2957***	0.1612
	(0.294)	(3.592)	(0.800)	(4.188)	(0.233)
SELFEMP	7.9167***	0.6907***	0.7025***	0.6965***	1.0622*
	(4.049)	(15.229)	(3.973)	(15.153)	(2.220)
GOVEMP	-0.8673	-0.1357**	-0.0235	-0.1527***	0.1620
	(-0.531)	(-2.691)	(-0.171)	(-2.963)	(0.539)
PUBTRANS	3.4701	0.4922***	0.3938	0.5006***	0.5337
	(2.283)**	(9.995)	(3.254)***	(9.712)	(1.885)
OTHERVIS	-1.6701	-0.1361*	-0.3087*	-0.0836	-0.6134*
	(-0.915)	(-1.967)	(-2.031)	(-1.136)	(-2.081)
Alpha			1.048***		17.969
			(7.808)		(0.694)
Over dispersion		3.157		1.770	
(Pseudo) r square [1]	0.174	0.243	0.658	0.258	0.697
Log likelihood		-2288.84	-1034.300	-2242.466	-917.540
Restricted log L. at intercept		-3023.458	-3023.460	-3023.458	-3023.458
chi square	66.720***	1469.230***	3978.32***	1561.984***	4211.836***
cs/per trip	132.97	171.5071707	260.2980413	140.2640611	200.9153704

[1] = R square for Ols, MacFaddin's Pseudo r square for the rest models involving maximum-likelihood estimation

Values in the brackets ( ) refers to the ratio of the coefficient to its standard error.

Coefficients marked by: * , ** and *** are significant at 10%, 5% and 1% α levels respectively

Table 6 continued ….

	Daily users TNBN	p - value	overnight users TNBN	p - value
Constant	0.005		1.074	
	(0.003)	0.997	(0.000)	1.000
TCW	-0.0054***		-0.0037	
	(-7.283)	0.000	(-1.125)	0.261
SUBS_TC	0.0048**		0.0050	
	(2.734)	0.006	(1.285)	0.199
INCOME	6.25305E-06		-1.75094E-06	
	(1.867)	0.062	(-0.156)	0.876
AGE	-0.0328		-0.0434	
	(-1.801)	0.072	(-0.829)	0.407
SEX	0.4093		2.6440*	
	(1.151)	0.250	(1.978)	0.048
HSCHOOLA	0.2178		-1.4660	
	(0.315)	0.753	(0.000)	1.000
SELFEMP	1.1965*		0.2982	
	(2.189)	0.029	(0.433)	0.665
GOVEMP	0.2637		-1.1028	
	(0.823)	0.411	(-0.709)	0.478
PUBTRANS	0.5650		-0.1953	
	(1.874)	0.061	(-0.227)	0.820
OTHERVIS	-0.7238**		0.1319	
	(-2.342)	0.019	(0.150)	0.881
Alpha	15.281		0.842	
	(0.784)	0.433	(0.963)	0.336
Over dispersion				
Pseudo r square	0.702		0.363	
Log likelihood	-841.780		-66.070	
Restricted log L. at intercept	-2827.717		-103.657	
chi square	3971.874***	0.000	75.1732***	0.000
cs/per trip	184.2241492		270.9821477	

Values in the brackets ( ) refers to the ratio of the coefficient to its standard error.
Coefficients marked by: * , ** and *** are significant at 10%, 5% and 1% α levels respectively

Based on the TNBN model output, chosen to be the appropriate model for this data for reasons discussed below; the cost of accessing the recreation site (TCW), which is a function of the distance from the visitor's residence to the recreation site, on-site expenses and recreation time cost has shown negative sign, while the cost of accessing a substitute site (SUBS_TC) has got a positive sign in the trip demand function as generally expected according to demand theory. Both TCW and SUBS_TC were significant at 1% level.

AGE and OTHERVIS were significant only at 10% level and had shown negative sign; meaning older aged visitors consumed less number of trips to the study site than younger ones, and visitors who made multiple site visits on their trip also consumed less number of trips than those who did not make multiple site visit.

The rest variables in the demand function namely, GENDER, HSCHOOLA, SELFEMP, PUBTRANS, indicated a positive sign. SELFEMP was significant at 10% level, the rest were not. Gender being male, education being high school and above, Employment being self employed, and as means of transportation using public transport; each had shown to increase recreation trip consumption to the recreation site. SELFEMP was found to influence recreation trip consumption more than other variables as indicated by having higher coefficient in the trip demand function, while amount of household income (INCOME) of a visitor had minimal influence for his/her recreation trip consumption as shown by its small coefficient in the demand function. Income was not also statistically significant at 10% level. Such insignificant income variable in other recreation demand study was observed for example in Shrestha and Loomis, (2003) and Kerkvliet et al, (2002).

Overall, the ability of the independent variables in the demand function in predicting number of recreation trips taken to the study site was significant. The outcome of the log likelihood ratio test; Chi square value of 4211.82 rejects the null hypothesis of zero effects for all explanatory variables in the model at 1% level.

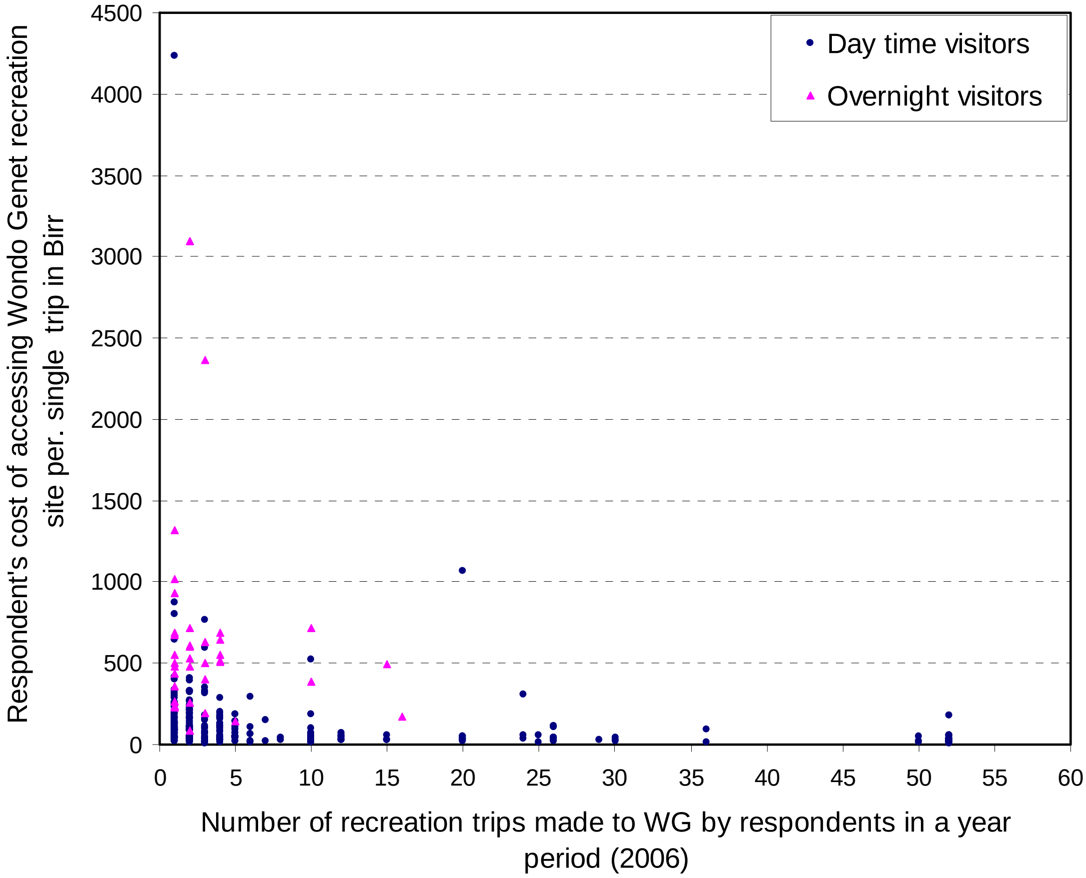

Figure 3: Graph showing the relation between numbers of recreation trips made by individual respondents to the study site against their cost of making the trip

As shown from the graph above (Figure 3), the cost of accessing the recreation site and the number of recreation trips made to the study site had shown a predictable pattern.

It is known at the beginning that for recreation trips demand curve based on on-site sampled data; OLS, standard Poisson and standard negative binomial models yield biased estimates for the recreation demand functions (Creel and Loomis, 1990; Ovaskainen et al, 2001). As expected based on previous studies OLS did not fit well the data as shown by its low r-square value of 0.17. The Standard Poisson and standard negative binomial models resulted in lower coefficient to the travel cost variable in the recreation demand function and consequently yield higher consumer surplus value when compared to their respective truncated models. This is as expected based on previous study results. Candidate models for estimating the correct welfare measure are, therefore, truncated Poisson (TP) and truncated negative binomial models (TNBN).

Looking at model outputs from TP and TNBN, variable coefficients from the TP model are more significant and t-values for the coefficients are higher (in absolute terms) when compared to the coefficients in the TNBN model. The value of the dispersion parameter in the TP model 1.77 and the non zero alpha value of 17.9 in the case of the TNBN suggests that the dependent variable is over dispersed, which means the variance of the variable is greater than its mean. This reminds that the assumption of equality between the variance and the mean of the variable in the Poisson model is violated.

In this case, when the dependent variable is characterized by over dispersion, it is known that the Poisson model underestimate the standard error of the parameter estimates leading to higher t-value for the estimates resulting in seemingly more significant variable coefficients (Gomez and Ozuna, 1993, Creel and Loomis, 1990). In this case welfare measures, significance level tests and confidence interval estimation using the Poisson regression model output is no longer valid (Heinzl and Mittlbock, 2003; Gomez and Ozuna, 1993; Creel and Loomis, 1990). Therefore, the negative binomial model results are used to estimate the welfare measure, as the model is praised to be the generally applicable model for count data analysis. The observed pattern of higher coefficient to the travel cost variable and consequently the lower value of consumer surplus in the case of the Poisson model when compared to the negative binomial model in the presence of over dispersion is consistent with the results obtained by the above cited authors.

For a recreation visit with different duration of stay at the recreation site, the correct way to calculate the welfare measure is to form a separate recreation trip demand curve for the different groups according to their duration of stay at the recreation site (Ward and Beal, 2000).

Consumer surplus was measured for the day time and overnight visitors from their respective separate recreation trip demand function. Therefore, consumer surplus per single trip of 184 birr and 271 birr for day time and overnight users respectively was obtained. However, the recreation trip demand function for overnight users was based on relatively small number of samples (38 respondents) compared to the day time users (310 respondents); therefore, it may be reasonable to assume all visitors have similar duration of stay at the recreation site. In the latter case the consumer surplus per trip for day time and overnight visitors combined together was found to be 200 birr. Fortunately, the weighted average of the two separate consumer surplus estimates for day time and overnight visitors was 194, close to the value when two visitor groups are combined together. Therefore, the weighted average value can be used to compare the result with other results and to aggregate the consumer surplus measure for all users of the site.

In comparing this study result with other results, it is important to note that travel cost study results differ among other factors due to the type of recreation activity being valued, the approaches followed in sampling and travel cost estimation, and the econometric methods applied in estimating welfare measures and, of course, the preferences of the users (Smith and Kaoru, 1990). It is difficult to find travel cost valuation studies conducted at similar sites in Ethiopia or elsewhere. To make comparisons to those made in Europe and America may be unfair for the fact that wide socioeconomic circumstances exists among users of this study site and those in the other studies. However, based on at least the similarity of the method applied it may be possible to see where the results of this study lay.

Navrud and Mungatana, (1994) estimated consumer surplus per domestic visitor per annum to Nakuru national park, Kenya, for wild animals viewing from US $68 to $85. A study by Ovaskaine et al, (2001), of valuing forest recreation sites near Helsinki in Finland reported consumer surplus per single trip visited to be around 70-72 Fim, where 1 Fim was equivalent to $0.2 at the time of their study.

The result reported in the present study is higher than those values obtained in the above studies. Among the different possible reasons for the variation, probably the nature of the service being valued may be one. The service that this study deals with is connected to water based recreation while those above studies are either visits to a national park for wildlife viewing or visits to a forested land. It can be presumed that users may likely to have made frequent visits to a swimming pool than to a national park or to a forest. Other water based recreation studies which involve consumptive fishing, crabbing, etc. indicated higher benefits up to US $72 per trip (Walsh, et al, 1988).

Liston-Heyes and Heyes (1999), reported £10.8 to £13.28 consumer surplus per recreation trip of daily visitors from visiting Dartmoor National park in South-west of England. A meta-analysis of 77 TCM studies is USA indicated a mean consumer surplus per visit of US $25.24 (Smith and Kaoru, 1990). In Welish et al. (1988), the net economic value per day for swimming based on 11 studies in USA was indicated to be on average US $22.9. The consumer surplus estimate in this study, the weighted average of the daily and overnight visitors of 194 birr/trip, equivalent to USD $ 21.5 according to August 2007 exchange rate, seems in agreement with the above reported results. However, important to note, among other differences, that this study was made at a time where car fuel cost is comparatively at a higher rate than it was during the time those cited results obtained. Therefore, even if the figures seem comparable, the value this result represents is in fact lower than the current value of those other results. Overall, the result this study show is within the ranges that other travel cost study results indicate, and therefore it can be regarded as plausible.

Sensitivity Analysis

The reported figure is based on available practice of estimating recreation site use value as discussed in the preceding sections, but depending on different possible considerations the sensitivity of the reported figure to different assumptions is presented in Table 7. If the value of time spent during the visit is ignored, consumer surplus per trip is reduced by 11%; if only the round trip travel time is considered leaving the time spent on the site, CS/trip decreased only by 4%. Evaluating the recreation time by 100% wage rate increases the CS/trip only by 25%. If automobile fuel consumption per unit distance is reduced by 25% from that used in the analysis, CS/trip will be reduced by 14%. If the assumption of no substitute to the study site prevails CS/trip increases by 281%. This suggests that variation in the wage rate in treating recreation time does not have a large influence to the welfare measure but assumption about the substitute site matters considerably.

Assumptions	Wage rate decreased by 33% (Opportunity cost of recreation time = 0)	Only travel time, ignoring onsite time, evaluated at 33% wage rate	Full wage rate (wage rate increased by 67%)	Fuel consumption rate decreased by 25%	No substitute site in the demand function
Effect on CS/trip	-11%	-4%	+25%	-14%	+281%

Table 7 Sensitivity analysis for the consumer surplus measure under different possible assumptions

Respondents' comments about service at the study site

Here I will try to summarize the comments made by respondents about the recreation service at the study site. It can be understood that the management of the hotel made possible for users to benefit from the site, which otherwise wouldn't have been possible. On the other hand, visitors buy the services. Keeping all the good quality services in mind, respondents pointed out things they were dissatisfied with during their travel to the site or during their stay at the recreation site.

Number one problem every respondent mentioned was the poor road condition and poor transportation service from Shashemene town to the study site. This part of the road is for the most part poorly maintained and respondents said that it was extremely difficult to drive on. Some said they wouldn't come again on that road as it was by then. Particularly the part of the road from Wosha town to the study site is severely eroded creating deep ruts on the road that automobile hardly cross over it (Photo 5), though certain maintenance efforts were made by the hotel administration's own initiative, according to Ato Tadesse, the problem is beyond their capacity. Those respondents who used public transportation, they described the service from Shashemene to the study site as it is very difficult because vehicles offering transportation service on that route overload passengers far more beyond the available sits. Even transportation service is unavailable for the last three kilometres from Wosha to the recreation site, where visitors who use public transport had to walk on foot to the resort.

Photo 5: It shows erosion forming a rut on the road from Wosha town to Wondo Genet resort. *Photo by Mohammed Ali.*

It has been described that price of food and drinks at the recreation site is so expensive and unaffordable for most domestic users. On top of that, some of the respondents said that, the hotel administration demanding a fee to be paid for using one's own packed food is unreasonable. Unavailability of fast food shops near the swimming pool is a problem as they mentioned.

Many complained about existing changing rooms. Respondents said, 'the ones available now are not actually rooms since each one does not properly cover someone inside it'. A locker to safely put one's property is not available as demanded, they said.

Another problem mentioned was the poor toilet facility by the swimming pool. They said only two toilet rooms one for men and one for ladies in such a place with many visitors is not sufficient. The ones available are 'so poor and traditional' said a respondent.

Boys from the local community used to guide guests through the forest and get paid for their service. In the process, the race among the many boys to give the service creates stress on the part of the visitor and some times these guides are said to ask for higher payment than is appropriate. Recently, this has been resolved since the hotel administration made the boys to organize themselves and properly offer their service.

It has also been described that proper resting facility around the swimming pool is lacking. Some respondents were unhappy about congestion of the swimming pool. At certain time, especially on weekends, many visitors came at a time, consequently the pools became crowded.

Some visitors who know the recreation site in previous times mentioned that they felt sad because they observed the site is losing its naturally attractive quality because of degraded land cover and ongoing land conversion. The habit of waste disposal, generally including the wider community, is not cognizant of the environmental consequences of improper waste disposal.

Some facts about land use impacts on water related services of a catchment (Review from literature)

Apart from presenting the benefit people enjoying from Wondo Genet recreation site, it will be also meaningful if the possible impact of existing land use practices to the wetland ecosystem is mentioned. However, it is not to deal with all aspects of the intricate social and biophysical process affecting the wetland ecosystem; but only the possible impact of existing land use practices on the quality and quantity of water output from the sub-catchment and its implication to the recreation service of the wetland is the theme of the topic. The following bulleted conclusions in this section were made by Dudley and Stolton, (2003) in their World Bank published report based on synthesis of scientific information about the relationship of land use and water supply from a watershed. Results or explanation from other sources included as supplements to each of the conclusion by Dudley and Stolton, (2003).

- *Some natural forests (particularly tropical mountain cloud forests and some older forests) increase total water flow, although in other cases this is not true and under young forests and some exotic plantations net water flow can decrease*

Forests affect amount of water output from a catchment through its effect on interception of rain fall, its own use of water for transpiration and through its effect on the soil properties of the land. Since forests expend much water in transpiration, the presence of forest decrease water output from a catchment except cloud forest and mature forest. The effect of mature forest in reducing water yield is believed to be minimal because of its relatively low rate of transpiration when compared to young growing forests and its compensating effect through improved soil permeability to enhanced water infiltration (Bruijnzeel, 2004; Andreassian, 2004).

Afforesting an area has an effect of decreasing available water from a catchment. The extent of water flow reduction in a catchment following afforestation /reforestation depends on the type of species established or the type of species replacing the original forest. Generally, afforesting with coniferous forest is known to cause the most reduction in a catchment water flow followed by deciduous hardwood, then by brush and last by grass cover (Bosch and Hewlett, 1982; Bruijnzeel, 2004). In Ethiopia, a study by Fetene & Bake, (2004) at Munessa Shashemene Forest Industry Enterprise concluded similar effect of higher annual water use of coniferous species than that of broad leaf species.

Afforestation decreases base flow, shorten the flow duration of an ephemeral stream (Andreassian, 2004). In the Mae Thang watershed in Thailand afforestation program led to water shortages down stream, which resulted in seasonal closure of water treatment plant and lower availability of water for irrigation (Chomitz and Kumari, 1996 cited in FAO, 2001). Large scale Pine plantation in the Fiji Islands is reported to have resulted in a reduction in dry season flow of 50 – 60%, putting the operation of Hydro-electric plant and drinking water supply at risk according to FAO, 1987 as cited in FAO, (2001).

Conversely, deforestation increases water flow from a catchment, since no interception of rain fall water by vegetation and no water used for transpiration. However, the water gain in the catchment following deforestation decreases with time as new vegetation establishes on the site (Bruijnzeel, 2004). The impact of forest conversion on the base (dry season) flow from a catchment can have two ways to follow depending on the land management after forest clearance.

When after forest clearance bare soil is continued to be exposed to intense rain fall, compaction by overgrazing or machinery, the disappearance of soil faunal activity, increased area occupied by impervious surfaces such as roads and settlements; in this case rainfall infiltration opportunities into the ground gradually reduced, resulting in pronounced increase in storm runoff during rainy season that may seriously impair the recharge of the soil and ground water reserves that feed springs and maintain base flow. In a catchment under such land use, dry season flow decreases and the duration of intermittent stream flow shortened (Bruijnzeel, 2004).

On the other hand, if soil surface characteristics after clearing are maintained sufficiently to allow the continued infiltration of (most of) the rainfall, then the reduced evapotranspiration associated with forest removal will show up as increased dry season flow (Bruijnzeel, 2004).

❖ *Well managed natural forests almost always provide higher quality water, with less sediment and fewer pollutants, than water from other catchments*

The type of land use in a catchment affects the quality of water through its influence on:

1. Sedimentation

Sediment entering the stream system because of improper upland management acts both as a physical and chemical pollutant. Physically, sediment loaded in water (turbid water) limit sunlight penetration into the water that makes aquatic biotic activity negatively affected and their habitat damaged (Kiersch, 2001). Sedimentation also fills up downstream water bodies and reduces reservoir capacity and causes extra water treatment measures in case of drinking water. Chemical pollution of sediment includes adsorbed metals and phosphorous, as well as hydrophobic organic chemical (FAO, 1996, cited in Kiersch, (2001)).

Forests control soil erosion and protect downstream sites from sedimentation. Forests are checkers of soil erosion. However depending on the type of erosion prevalent on an area such as surface erosion, gully erosion, and mass movement, the ability of forest cover in controlling each type is different (Bruijnzeel, 2004). The role of forests in protecting surface erosion is largely because of understory vegetation and ground surface litter and the ability of the soil to infiltrate more water. Understory vegetation and litter layer on the surface protect the soil from raindrop impact which otherwise would cause splash erosion with its high impact energy. The permeable forest soil structures by allowing more rain water to infiltrate in to the ground reduces runoff there by reducing surface erosion. The root network of plants produces a stabilizing effect on the ground and generally protects shallow mass movement of soil on steep slope (Bruijnzeel, 2004).

The median surface erosion rates in tropical forest is reported to be 0.3 ton/ ha/year and the maximum 6.2 tones/ha/year, while conversion to other land use that involve the removal of surface litter layer and repeated disturbance by burning, frequent weeding or overgrazing dramatically increased the median erosion rates to 53 tones/ha/year and the maximum value up to 183 tones/ha/year (Bruijnzeel, 2004)

Soil erosion is generally severe in Ethiopia. As a result sedimentation becomes a problem at downstream sites and water bodies. Studies in the rift valley lakes region of Ethiopia, the same basin where Wondo Genet is located, indicated that sedimentation is severely affecting lakes Abaya and Chamo (Aulachew, 2006), lake Langano (Legesse and Ayenew, 2005), and Awassa. In the northern part of Ethiopia water reservoirs at farmers' fields are shown to be loosing 100% of their dead storage capacity within less than a quarter of their expected life time with sedimentation rates on average reaching 20000 t/km^2/year on catchments without vegetation cover while those on a vegetated catchment receive sedimentation at a lower rate of 1900 t/km^2/year (Tamene, et al, 2006).

The following summary numbered from 2 to 7 is made from Kiersch, (2001) unless other sources are indicated.

2. Nutrients and organic matter

The chemical content of surface and ground water can be altered as result of change in land use in a catchment. Deforestation can lead to high nitrate concentrations in water due to decomposition of plant material and reduced nutrient uptake by vegetation. Nitrate concentrations in runoff in deforested catchment can be 50 times higher than in a forested control catchment over several years (See below for more under "*Riparian Zones as Nutrient Filters").*

Agricultural activities can lead to increased nitrogen concentrations into water bodies through fertilizer application, manure from livestock, municipal sewage and aeration of the soil. It can be major source of Phosphate pollution in water bodies that may eventually cause eutrophication in lakes.

3. Pathogens

Bacteriological quality of water can be affected through land use change. Grazing in riparian vegetation or waste influx from livestock production can increase pathogenic bacteria concentration in surface water and create health concern for down stream water users.

4. Pesticide and other persistent organic pollutant

Pesticides and other toxic organic compound applied in any land use activity, in forestry or agriculture can find their way into water bodies and cause both acute and chronic toxic effects to humans and animals. Many pesticides are transported in association with suspended matter, therefore any measure that help slow down erosion and sedimentation may helps to hold down the transport of these pollutants.

5. Heavy metals

Mobility of heavy metals in the soil from anthropogenic and geologic origin can be influenced by land use. Heavy metals in the soil may be transferred into water bodies by erosive forces. Directly from livestock manure and sludge from sewage treatment, heavy metals can enter in to water bodies.

6. Change in thermal regime

The thermal regime of surface water can be affected by land use practices. In small streams, removal of riparian vegetation can cause temperature increase in the water (thermal pollution). Tail water discharge from irrigated lands may cause a rise in temperature of the receiving stream. A temperature rise leads to induce oxygen solubility, which can negatively affect the biological activity in the water as well as the self cleaning capacity of the stream.

7. Salinity

Depending on the climatic and geologic factors in an area, irrigation and drainage activities may cause increased salinity of surface and ground water through evaporation and the leaching of salts from the soil. Ground water extraction can cause intrusion of seawater into aquifer, and causing salinization of ground water.

Spatial and temporal scale of land use change impact on hydrologic regime and water quality

According to Kiersch, (2001) the impact of change of forest land to other uses in a catchment on hydrologic regime and sediment yield is inversely related to the spatial scale of observation. Impact of forest cover on average flow rate, pick flow, base flow and ground recharge is clearly observable at smaller spatial scale up to hundreds of km^2 watershed area; where as the effect at greater spatial scale becomes less observable. Kiersch (2001) summarizes the spatial dimensions of land use effects on catchment hydrologic regime and water quality (Table 8).

Table 8: Summary of spatial dimensions of land use effects on catchment water supply

Impact	Basin size in Km^2						
	0.1	1	10	100	1000	10000	100000
Average flow	×	×	×	×	-	-	-
Peak flow	×	×	×	×	-	-	-
Base flow	×	×	×	×	-	-	-
Groundwater recharge	×	×	×	×	-	-	-
Sediment load	×	×	×	×	-	-	-
Nutrients	×	×	×	×	×	-	-
Organic matter	×	×	×	×	-	-	-
Pathogens	×	×	×	-	-	-	-
Salinity	×	×	×	×	×	×	×
Pesticides	×	×	×	×	×	×	×
Heavy metals	×	×	×	×	×	×	×
Thermal regime	×	×	-	-	-	-	-

Legend: × = observable impact; - = no observable impact

As the above table shows, some impacts like pollution by pesticides and by heavy metals and salinization can affect a greater spatial scale of a watershed up to hundred thousands km^2 areas. But land use effects on pathogens and influence on thermal regime are observable at smaller spatial scale.

In terms of temporal scales, according to Kiersch, (2001), time of observing land use impact varies widely ranging from less than a year in the case of bacterial contamination to hundreds of years in the case of salinization. Generally, as Kiersch, (2001) indicated, the time it takes to restore an aquatic system (if at all possible), after impacted by an adverse land use activity, is much longer than the time it takes for an impact to appear.

Role of Riparian Forest in Agricultural Landscape

The following summary about role of riparian vegetation in agricultural landscape is drawn from a review of scientific literature on the subject by Naiman and Decampus (1997), unless other sources are indicated.

Riparian refers to biotic communities on the sides of streams and shores of lakes; and the riparian zone encompasses the stream channel between the low and high water marks and that portion of the terrestrial landscape from the high water mark toward the uplands where vegetation may be influenced by elevated water tables or flooding and by the ability of the soils to hold water. Vegetation outside the zone that is not directly influenced by hydrologic conditions but that contributes organic matter (e.g. leaves, wood, dissolved materials) to the floodplain or channel, or that influences the physical regime of the floodplain or channel by shading, may be considered part of riparian zones.

Riparian forests are at the interface between the aquatic and the surrounding terrestrial environment composed of plant communities with specialized and disturbance-adapted species within a matrix of less-specialized and less-frequently disturbed upland forest. They play a key role in regulating the aquatic-terrestrial linkages and undertake biogeochemical processes. The function of the riparian zones in the landscape includes both physical functions and ecological functions.

Physical Functions

Control Mass Movements of Materials and Channel Morphology: Stream banks devoid of vegetation are often highly unstable and subject to mass wasting. Major bank erosion is 30 times more prevalent on non-vegetated stream banks than on vegetated ones. Riparian vegetation also modifies sediment transport either by physically entrapping materials, which is mostly important in relatively low gradient environments, or by altering channel hydraulics. Alteration of channel hydraulics is accomplished by roots or by large woody debris in the channel at low flows, where as this is done by stems at high flows. All provide physical structure that slows water, decreases stream power, and holds materials in place.

Wood in Streams and Riparian Zones: Depending on the size of woody debris piles, their position in the channel, and geometry, they can resist and redirect water currents, causing the erosive power of water to become spatially heterogeneous, thereby creating a mosaic of erosional and depositional patches in the riparian corridor. Woody debris also results in longer water residence times and can act as a temporary storage of materials. Woody debris provides habitat for fish and macro invertebrates within the stream channel. On exposed cobble bars, most seedling germination and survivorship are associated with woody debris, which provides a protective and relatively moist, nutrient-rich microenvironment. Woody debris also provide protection for small mammals and birds; the diversity and abundance of small mammals such as shrews, voles, and mice are significantly greater in areas with woody debris accumulations, while several bird species preferentially use woody debris for perching and feeding.

Micro climate: Riparian forests exert strong controls on the microclimate of streams. Stream water temperatures are highly correlated with riparian soil temperatures, and strong microclimatic gradients appear in air, soil, and surface temperatures and in relative humidity.

Riparian zones as ecological corridors: Riparian zones, as networks distributed over large areas, are key landscape components in maintaining biological connections along extended and dynamic environmental gradients

Ecological Functions of Riparian Zones

Sources of Nourishment for organisms: Riparian vegetation supply organic matter and nutrients to aquatic organisms and help to maintain the aquatic ecological system.

Riparian Zones as Nutrient Filters: In agricultural watersheds, riparian vegetation play important role in controlling non-point sources pollution to stream water from sediment and nutrient through mechanisms of physically trapping sediment and adsorbed pollutants, up taking of nutrient by vegetation and microbes, and denitrification processes.

Positive relationship exists between presence of riparian vegetation, stream biotic integrity and stream water quality. For example, Anbumozhi, et al. 2005, has shown result of watershed studies from Japan, Indonesia, and India, where nutrient concentrations in riparian land use stream sites are far below the average nutrient concentration measured at agricultural land use stream sites. Osborne and Kovacic, (1993), in their review of published studies, indicated that forest vegetated buffer zones with 30-50m in width reduced nitrate concentration in surface runoffs by 79-98%, while grass buffer with width of 4.6-27m reduced nitrate concentration by 54-84%. The same study showed Forest vegetated buffer strips with 16-50m in width reduced phosphorus concentrations in surface waters by 50-85%, while grass buffer strips, dimension as above, and reduced phosphorus concentration by 61-83%.

Habitat provision: Most riparian zones are covered with a variety of woody vegetation from shrubs serving as refuges for small mammals to trees offering nesting and perching sites for birds. Also, enhanced productivity and food quality in the riparian zones sustained herbivory, and fallen woody debris provides stability for terrestrial as well as aquatic invertebrate communities. Riparian forests act as refuges in adjacent areas and, in some cases, as corridors for migration and dispersal.

Kasangaki, et al. (2006), in a catchment in Uganda, show that high biotic diversity and better water quality are associated with forested stream sites. Benstead et al. (2003) in Eastern Madagascar; Roth, et al. (1996) in Michagan streams showed the presence of forest buffer around a steam associates with high in-stream biotic diversity in the agricultural landscapes.

Land use influences on stream ecosystems

A summary of the impact of land use on stream ecosystem is made from reviews made by Allan, (2004) and Wohl, (2006), and is presented in the table at appendix B.

- *Protection within watersheds also provides benefits in terms of biodiversity conservation, recreational, social and economic values*

Wetlands are known for their diverse flora and fauna, particularly for rare plants and migratory bird species (Gren, et al, 1994), which makes them to be the only single group of ecosystems to have their own international convention (Turner, et al, 2000). Wetlands have been described as "biological supermarkets" because of the extensive food webs and rich biodiversity they support (Mitsch & Gosselink, 2000). Best managed forestry practices for timber production can also be combined with objective of water supply services of a watershed forest (Foster, et al. 2005; Stuart and Edwards, 2006)

- *Impacts of forests on security of supply or mitigating flooding are less certain although forests can reduce floods at a local headwater scale*

With regard to flood, forested area usually register a lower frequency and rate of peak flow for smaller and medium size storms (FAO & CIFOR, 2005). For large basins and large storms, however, other geological and climatic factors are more important than the presence of forests in influencing floods (FAO & CIFOR, 2005).

- *As a result of these various benefits, natural forests are being protected to maintain high quality water supplies to cities*

Over all, it is accepted that well managed forests in a watershed provides better quality water (Achouri, 2002; FAO & CIFOR, 2005). Managing watershed properly is the cheap way of supplying drinking water (Ernst, et al, 2004). The cost of treating water for drinking negatively related to the amount of forest in a watershed from which the water comes (Ernst, et al, 2004; Postel and Thompson, 2005)

Studies from 27 US water suppliers indicated that treatment costs for drinking water derived from watersheds covered at least 60% by forest were half of the cost of treating water from watersheds with 30% forest cover, and one-third of the cost of treating water from watersheds with 10% forest cover (Postel and Thompson, 2005)

According to the World Bank study by Dudley and Stolton, (2003); about a third of world major cities (33 of 105 studied) obtain their drinking water supply from forest protected area, and there is a growing trend among cities to acquire more land to protect around their water source for clean water supply.

Conclusion

The attractions of Wondo Genet recreation site are based primarily on its naturally endowed resources that include: the hot spring water, stream water flow and the attractive scenery of the landscape attributed to its vegetation cover and richness in many bird species of interest to visitors. Therefore, it can be understood that the above resource facilities of the recreation site are products of the ecological functioning of the ecosystem in the landscape, and therefore are subject to influences by activities that occur beyond the hotel precinct. The main attractions of the site are public good in their nature.

The total number of visits to the site was estimated to be 49,000 visits at day time in 6 months from September, 2006 to February, 2007. For the whole year it can be extrapolated to 98, 000 day time visits. Number of overnight visits from September 2005 to August 2006 included 5,340 visits by foreigners and 6, 876 visits by domestic visitors. If the above pattern of overnight visitation to the site is assumed to be the same as that during the year of this study, aggregate users benefit from the recreation site is estimated to be 18,032,000 Birr for day time visitors and 1,863,396 birr for overnight domestic visitors, excluding visits by foreign overnight visitors. Both day time and overnight domestic visitors benefit from Wondo Genet recreation site together amounts to about 20 Million Birr per year, equivalent to USD$ = 2.2 million at the current exchange rate.

The recreation use value of the site indicated above mainly refers to domestic users, therefore, the true recreational use value of the site is believed to be higher than the reported figure if uncounted recreation benefits to foreign visitors, and the contribution of visitors to the hotel and other local small business profit is considered. The result obtained in this study indicated that there exists a very high public demand for the recreation service of the site as manifested by the high number of visitors and their high economic value that they attach to the recreation site. The high recreation demand of domestic users of the site can indicate a case where there exists high need for nature based recreation facilities even in least developed countries like Ethiopia.

The study also indicates that travel cost valuation study can be applied to generate useful economic information about recreation sites in Ethiopia. Though, the method is subject to its common limitation to entertain multiple site visitors in its single site model, particularly to those international tourists, the method can be extended to evaluate the recreation use value of the set of recreation sites together for the international tourists as practised for example by Maille and Mendelsohn (1993).

The recreation service of the site extends to society who is beyond the boundary of the catchment, signifying that the wetland ecosystem service has a national significance in terms of its recreation service. Apart from its recreation service considering its other services such as water supply to down stream community and to population of neighbouring towns to a total of around 200,000 users (Gessesse & Kleman 2007), the role the catchment forest plays as a place of practical training and research for the natural resource education at Wondo Genet College, and water supply to irrigation based agricultural production (Gessesse & Kleman 2007) – these all simply confirms the immense societal value of the wetland ecosystem.

Beneficiaries from the wetland ecosystem service, so far, made no tangible contribution for the sustainable management of the ecosystem as one can read it from the landscape, except currently ongoing efforts through DOITAR program of SIDA supported action research program by Wondo Genet College of Forestry. Due to the public good nature of the resources involved for recreation at the site, no one dared to invest on their maintenance.

Given the available evidences about the impact of land use on catchment water supply services and the continued degradation of the mountain forest cover along with its biotic contents such as birds and other wildlife (Gessesse & Kleman, 2007) which has direct contribution to the recreation service at the site; it is evident that the wetland ecosystem and its recreation service is under threat; unless urgent measures to reverse the situation is taken. Further Gessesse & Kleman, (2007) indicated that during the past 30 years a number of streams dried up and water flow from the catchment has substantially decreased.

Particular attention should be given to the conversion of native forest cover to plantation forest particularly at areas close to water sources. For example, the *Cupressus luisitinica* stand established at close proximity to the spring (see photo 6 below) might influence spring water output. At the recreation site measures should be taken to properly dispose its sewage off the stream in environmental friendly way and due care should be taken to ensure that sewage from existing toilet facility is not contaminating surface or ground water. The hotel management should also be sensitive to customers needs at the site.

Photo 6: The photo shows a clear cut area of *Cupressus lusitinica* plantation a few meters away from the hot spring at its up slope and it borders the stream at its down slope. *Photo by Mohammed Ali*

Some ways to consider to maintain the wetland ecosystem

Although the scope of the objectives in this study does not enable to come up with recommendation of particular strategy that may solve the above natural resource degradation problem at the study site, the following measures can positively contribute for the maintenance of the wetland ecosystem.

Guiding the existing land use practice based on practicable land use planning that takes in to account the suitability of the land for its different uses and to its role in maintaining the ecological system in the sub-catchment is essential. In this context it seems worthwhile to further investigate possibilities to dedicate the remaining hill slope and valley pocket natural system in to a park, to be managed by the community; as such a use may enable to utilize the potential of the area for increased economic benefit of the proximate interested groups, at the same time helping to maintain nature based recreation centre in the human dominated landscape.

Natural resource management objective in the sub-catchment should integrate the maintenance of the resource bases involved in the recreation service of the wetland ecosystem.

Further efforts should also be made:

- To encourage the use of riparian buffers along streams crossing cultivated lands, and reduce disturbance around springs and streams in the forest.
- To monitor the status of ecosystem services supply from the catchment in response to biophysical and social dynamics in the area.
- To understand the economic role of ecosystem services from the catchment to society, with due emphasis in the pattern of benefits and costs distribution among the different groups of users and its implication on sustainable management of the ecosystem.

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Appendix

Appendix A: Main economic valuation techniques

Methodology	Approach	Applications	Data requirements	Limitations
Revealed preference methods				
Production function; also known as 'change in productivity'	Trace impact of change in ecosystem services on produced goods	Any impact that affects produced goods	Change in service; impact on production; net value of produced goods	Data on change in service and consequent impact on production often lacking
Cost of illness, human capital	Trace impact of change in ecosystem services on morbidity and mortality	Any impact that affects health (e.g. air or water pollution)	Change in service; impact on health (dose-response functions); cost of illness or value of life	Dose-response functions linking environmental conditions to health often lacking; underestimates, as omits preferences for health; value of life cannot be estimated easily
Replacement cost (and variants, such as relocation cost)	Use cost of replacing the lost good or service	Any loss of goods or services	Extent of loss of goods or services, cost of replacing them	Tends to overestimate actual value; should be used with extreme caution
Travel cost (TCM)	Derive demand curve from data on actual travel costs	Recreation	Survey to collect monetary and time costs of travel to destination, distance travelled	Limited to recreational benefits; hard to use when trips are to multiple destinations
Hedonic pricing	Extract effect of environmental factors on price of goods that include those factors	Air quality, scenic beauty, cultural benefits	Prices and characteristics of goods	Requires vast quantities of data; very sensitive to specification
Stated preference methods				
Contingent valuation (CV)	Ask respondents directly their WTP for a specified	Any service	Survey that presents scenario and elicits WTP for specified services	Many potential sources of bias in

	service			responses; guidelines exist for reliable application
Choice modelling	Ask respondents to choose their preferred option from a set of alternatives with particular attributes	Any service	Survey of respondents	Similar to those of CV; analysis of the data generated is complex
Other methods				
Benefits transfer	Use results obtained in one context in a different context	Any for which suitable comparison studies are available	Valuation exercises at another, similar site	Can be very inaccurate, as many factors vary even when contexts seem 'similar'; should be used with extreme caution

Source: Pigola et al, (2004).

Appendix B: Mechanisms by which land use influences stream ecosystems

Allan, (2004) and Wohl, (2006) made the following summary from their review of studies on the impact of land use on stream ecosystem.

Environmental factor	Effects
Sedimentation *	Increases turbidity, scouring and abrasion; impairs substrate suitability for periphyton and biofilm production; decreases primary production and food quality causing bottom-up effects through food webs; in-filling of interstitial habitat harms crevice-occupying invertebrates and gravel-spawning fishes; coats gills and respiratory surfaces; reduces stream depth heterogeneity, leading to Wood decrease in pool species
Nutrient Increases *	autotrophic biomass and production, resulting in enrichment changes to assemblage composition, including proliferation of filamentous algae, particularly if light also increases; accelerates litter breakdown rates and may cause decrease in dissolved oxygen and shift from sensitive species to more tolerant, often non-native species
Contaminant pollution *	Increases heavy metals, synthetics, and toxic organics in suspension associated with sediments and in tissues; increases deformities; increases mortality rates and impacts to abundance, drift, and emergence in invertebrates; depresses growth, reproduction, condition, and survival among fishes; disrupts endocrine system; physical avoidance
Hydrologic alteration *	Alters runoff-evapotranspiration balance, causing increases in flood magnitude and frequency, and often lowers base flow; contributes to altered channel dynamics, including increased erosion from channel and surroundings and less-frequent over bank flooding; runoff more efficiently transports nutrients, sediments, and contaminants, thus further degrading in-stream habitat. Strong effects from impervious surfaces and storm water conveyance in urban catchments and from drainage systems and soil compaction in agricultural catchments
Riparian clearing/ canopy opening *	Reduces shading, causing increases in stream temperatures, light penetration, and plant growth; decreases bank stability, inputs of litter and wood, and retention of nutrients and contaminants; reduces sediment trapping and increases bank and channel erosion; alters quantity and character of dissolved organic carbon reaching streams; lowers retention of benthic organic matter owing to loss of direct input and retention structures; alters trophic structure
Loss of large woody debris *	Reduces substrate for feeding, attachment, and cover; causes loss of sediment and organic material storage; reduces energy dissipation; alters flow hydraulics and therefore distribution of habitats; reduces

	bank stability; influences invertebrate and fish diversity and community function
Altered fire regime **	Alteration can involve suppression of fires that results in less frequent, more intense fires, or increase in fire frequency associated with land clearing; in either case, fires increase water and sediment yield to streams, with resulting changes in sediment dynamics, stream geometry and stability, and aquatic and riparian habitat
Riparian grazing **	Concentration of wild or domesticated grazing animals in the riparian zone reduces riparian vegetation and, together with animal trampling of banks, decreases bank stability and increases sediment yield to channel, resulting in aggradation, wider and shallower stream geometry, loss of aquatic and riparian habitat, and altered water chemistry (higher water temperatures, excess nitrogen)
Transportation corridors (railroads, roads) **	Unpaved roads, traction sand and gravel used during winter on paved roads, cut slopes above and fill slopes below roads and railroads, and changes in surface and subsurface runoff and through flow that increase mass movements all increase sediment yield to streams; contaminants from road surfaces enter streams in solution or adsorbed to fine sediment; transportation corridor can eliminate riparian corridor, constrict stream, or restrict lateral channel mobility in narrow valleys
In-channel structures (check dams, grade-control structures, culverts) **	Creates segmented longitudinal profile; alters sediment dynamics; bed and bank stability; interrupts longitudinal movement of nutrients and aquatic organisms; alters passage of flood waves

Sources: those marked in the table by * are from Allan, (2004) those by ** are from Whol, (2006).

Appendix C: Survey Questionnaire [4]

This survey is designed to estimate the recreation use value of Wondo Genet ecosystem. The information you would supply to this questionnaire will help us to know how much the site is benefiting recreation users. In this regard we appreciate your help in completing this questionnaire honestly, and for returning back the completed form. In answering the questions, every answer from you to each question is valuable for the study. In cases when you do not remember exact figures, your best approximate estimate is more helpful than not answering to such a question. Please, do not place your name anywhere in this form, so that your information will be kept anonymous.

When you have answered all items please return the completed form back to us or to the hotel staff at the thicket office or to the staff at the hotel bar.

If you have any question about this survey, please contact us at the site or call by the number:

I. Travel information

1. Where is your place of residence? ___________________

2. If you live out side of town or city, what is the name of the nearest town to your residence? ________

3. How many recreational trips to Wondo Genet have you taken in the past one year from today? ___ trips

4. What is the place of departure for your current trip to Wondo Genet? _______________

5. What means of transportation did you use to get to Wondo genet recreation site for this trip? Select from the following list, and supply other requested information for your choice

   ☐ Your own car; if so, what is the number of people who came with you for the visit? ____persons

   ☐ Public transport; if so, what is the total round trip cost you paid? _____ Birr

   ☐ Rented car; if so, what is the cost that you paid for the rent? _______ Birr. Did you pay for cost of fuel additional to the rent you indicated above ? ☐ Yes ☐ No

[4] This format is designed for domestic recreation users; it is slightly modified to foreign visitors but basically seeks for similar type of information.

☐ Other means of transport used; ____________________. Its cost _________ Birr

6. How long time it take to you to reach to Wondo Genet (one way) ___ Hours, and/or _____ minutes

7. Have you visited other recreation sites on your way to or from Wondo Genet recreation site?

   ☐ Yes ☐ No. If you answered yes, please, answer the following questions labelled A, B and C

A. List all other sites you visited on your way to or from Wondo Genet and indicate the time you spend at each site visited.

Name of site visited	Time spent at the site
_____________________	________ hours
_____________________	________ hours
_____________________	________ hours
_____________________	________ hours

B. When you leave your home for the trip which site was your primary destination?

____

C. Assume you had known earlier at the time of planning your trip that these other sites on the way to or from Wondo Genet were not available for you to visit during your trip, would you still undertake your trip only to Wondo Genet? ☐ Yes ☐ No

II. On-site information

8. How long time do you spend at Wondo Genet recreation site? ____ Hours; if you stayed full day(s) _____days (12 hours day time) and/or; _____ nights

9. In which recreational activities do you participate during your stay at Wondo Genet recreation site? Mark all activities that you take part in during your stay at the site.

   ☐ In door bathing ☐ Swimming ☐ Bird watching

   ☐ Mountain trekking ☐ Camp fire ☐ other wild animals watching

   ☐ Picture recording (Photo or motion picture) ☐ Other (mention) ___________

10. How much is your expenditure for recreational activities that you took part or would like to take part during your stay at the site?

Indoor bathing fees, ____________ Birr
Swimming fees, __________ Birr
Payment for guide in the forest, ___________ Birr
Payment for photographer service, _________ Birr
Fee to do camp fire, _________ Birr (please indicate number of persons in the group, __________ persons)
Fees to use your own packed food. ____ Birr (indicate number of persons in the group, _________ persons)
Fees to use camera (To record pictures: photo and/or motion pictures) _______ Birr

Accommodation, including food and/or drinks expenditure at the site _____ Birr
Other expenditures (please indicate their cost and what they are for) ________ ___

11. How much is your typical total trip cost on average to Wondo Genet site for recreation in a single trip; including hotel services, if you used? _____________ Birr

12. What makes you come and visit Wondo Genet recreation site? Mark that apply to you from the following list; and rank each of your choice starting from 1 assigned to your best reason to visit Wondo Genet. It is possible to give the same rank for different items of your choice.

Rank

- ☐ Hotel restaurant, bar and bed room services ______________
- ☐ Swimming and bathing services ____________________
- ☐ Naturally green landscape beauty ____________________
- ☐ Mountain trekking and site seeing____________________
- ☐ Bird and wild animals watching __________________________
- ☐ To have pictures of the area and of you at the site ________
- ☐Others attractions, please indicate ___________________ ______

13. Which other recreational site(s) offer(s) to you the same level of satisfaction obtained from visiting Wondo Genet? If there is (are) any, mention its (their) names ____

14. What unique quality/qualities that you think Wondo Genet recreational site offers to you? If you think any, indicate here
____

15. What makes you feel uncomfortable or unhappy during your recreation trip to Wondo Genet? List all
____

16. Which days you used/do you use for your recreation visits to Wondo Genet, including days of travel? Indicate the name of the days______________________________

17. Did you give up wage, salary income or other income of any kind while making your recreation trip to Wondo Genet? ☐Yes ☐ No. If your answer is yes, how much income did you give up because of the recreation trip? ________Birr

18. Please indicate how many recreation trips have you made to the following recreation sites for the last one year

Recreation site	Number of trips
Abjata or Shalla	
Langano	
Sodere	
Rift Valley park	
Awassa Lake	
If other site visited , indicate here ______________	____________

III. Information about you

19. Are you male or female? ☐ Male; ☐ Female

20. How old are you? Put a mark at the range that include your age: ☐ 15- 20; ☐ 20-25; ☐ 25-30; ☐ 30-35; ☐ 35-40; ☐ 40-45; ☐ 45-50; ☐ 50-55; ☐ 55-60; ☐ 60-65; ☐ 65-70; ☐ 70-75; ☐ 75-80;

21. What is the highest education level you completed? ☐ No education attained ☐ Some primary school; ☐ Primary school completed ☐ High school; ☐ College; ☐ University ☐ Other ___________

22. What is your occupation? ____________

23. Employed by: ☐ Government ☐ NGO ☐ Private employer ☐ Self-employed, ☐ Other, ________

24. Are you married? ☐ Yes☐ No
If you have family, what is the number your children? ______ .

25. What is your approximate income? Put a mark at the range that contains your income level. Use both columns below

Household monthly salary income after tax in Birr (It includes your spouse's salary when applicable) Mark your choice with (√) at the blank space	Your annual household ***income from other source**** all together (after tax) in Birr (excluding the salary) Mark your choice with (√) at the blank space
0 ----------	0 ----------
< 500 ----------	< 5,000 ----------
501 – 1,000 ----------	5,001 - 10,000 ----------
1,001 –1,500 ----------	10,001 - 15,000 ----------
1501 – 2,000----------	15,001 - 20,000 ----------
2,001 – 2500 ----------	20,001 - 25,000 ----------
2501 – 3,000----------	25,001 - 30,000 ----------
3,001 –3500 ----------	30,001 - 35,000 ----------
3501 – 4,000 ----------	40,001 - 50,000 ----------
4,001 – 4500----------	50,001 - 55,000 ----------
4501 – 5,000 ----------	55,001 - 60,000 ----------
5,001 – 5500 ----------	60,001-70,000----------
5501– 6,000 ----------	70,000-80,000----------
6,001 – 7,000 ----------	80,001-90,000----------
7,001 – 8,000 ----------	90,000-100,000----------
8,001 – 9,000 ----------	100,000-500,000----------
9,001 – 10,000 ----------	500,000-1,000,000--------
10,000 – 15,000----------	More than 1,000,000-----
15,001 – 20,000----------	* ***Income from other sources***
More than 20,000 ---------	can refer to income from over time employment, from private business, from farm and/or animal production, etc.

Thank you very much!