Analysis

Low-income fishermen's willingness-to-pay for fisheries and watershed management: An application of choice experiment to Lake Tana, Ethiopia

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ABSTRACT

In this paper, choice experiment was applied for valuation of Lake Tana's fishery and watershed. Two attributes — fishing control and lake side plantation — were identified as relevant attributes for the choice experiment. A monetary attribute — payment for fishing permit was also included. Multinomial and random parameter logit models were used for estimation. All the attributes included were significant factors in affecting the probability of choosing an alternative scenario. The results suggest that fishermen were more concerned about fishing control as reflected by the higher value they give to fishing control than lake side plantation. Household income, years of education, and family size were found to be significant. The economic welfare measures we calculated for two scenarios show that fishermen were willing to pay 57 birr (US$5.3)) per month for a moderate improvement scenario and 93 birr (US$8.6) per month for an aggressive scenario for the two attributes.

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1. Introduction

Overfishing and wetland degradation are important environmental problems especially in developing countries. These problems are reflected in Africa among other things through collapse of African cyprinid fisheries and complete disappearance of lakes (de Graaf, 2003; EPA, 2008). Lake Tana of Ethiopia is an area where problems of overfishing of some species and wetland degradation are observed. With a surface area of 3150 to 3500 km^2 Lake Tana is the largest lake in Ethiopia found in North West highlands of the Amhara Region (Berhanu et al., 2001; Fig. 1). It accounts for about 50% of the total inland fresh water in Ethiopia and is a major source of the Blue Nile River.

Lake Tana and its surrounding wetlands provide a lot of benefits for the dwellers around it. It is home of various fauna and flora (including being habitat of endemic fish species), provides transportation for tourists, and increases quality of life for the residents. Moreover, it is an important source of livelihood for the fishermen. The wetland around the lake supports the livelihood of inhabitants. It provides water, is the basis for agricultural activities (farming, and cattle raring), offers fuelwood and other socioeconomic services.

The lake has a potential fish yield estimate of 15,000 metric tons per year on average. But the average annual catch is only about 1500 metric tons of fish (Lake Tana Fishery Resource Development Project, 1997). Socioeconomic factors contribute to this poor performance of the

fishery industry in the lake. There is selection of fish species for consumption purposes. Some species (like Barbus and Tilapea) are more preferred to others (like catfish) for cultural and religious reasons. Moreover, a large number of the fishermen are poor and use traditional equipments for fishing which limit their catch levels. Despite this low level of exploitation, there is a threat in the decline of abundance and even extinction of some endemic species. The endemic large Barbus species is one that faces such a problem reflected, for example, by a sharp decline of the species due to unregulated over fishing at the spawning grounds (de Graaf, 2003). Moreover, de Graaf emphasized that the future of Lake Tana's Barbus species and its fisheries might follow the same path of collapse of other African cyprinid fisheries unless protective measures are taken soon.

Furthermore, loss of the surrounding wetland and plant coverage due to agricultural expansion, greater silt inflow into the lake, experiences in using inappropriate equipments (small mesh size gill nets) and methods (using poisonous substances like 'Birbira') are major causes that could lead to decline and even extinction of endemic fish species as well as collapse of biodiversity. Expanded commercial gill net fisheries at the river mouths along with watershed degradation will cause severe fishery and biodiversity loss of the lake unless the resource is managed and regulated effectively. Because of such fear of biodiversity losses and sustainability of the lake, researchers have given great emphasis to fishery regulation and watershed management in the lake (Ayalew et al., 2007; de Graaf, 2003). The property right structure reflects the problem of the commons discussed in the literature (Baland and Platteau, 1996; Gordon, 1954; Hardin, 1968; Ostrom, 1990; Stavins, 2011) and unless Lake Tana's fishery is

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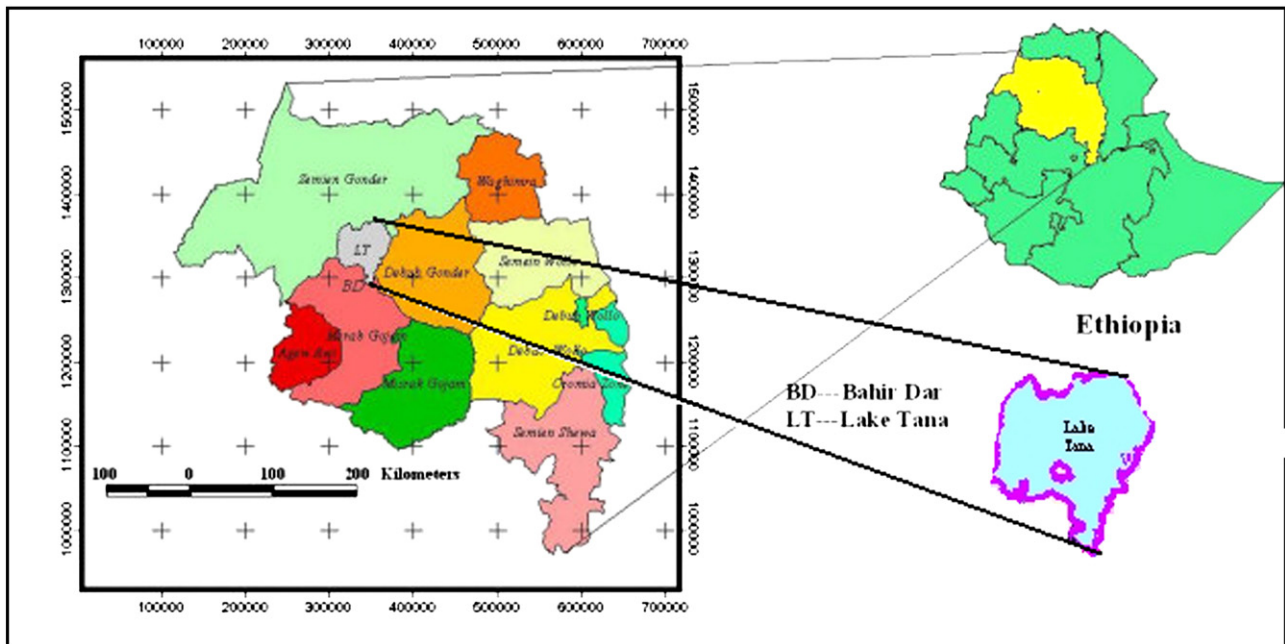
Fig. 1. Location of Lake Tana, Ethiopia.

regulated properly as a common pool resource, mismanagement could lead to overexploitation and "the tragedy of the commons" (Baland and Platteau, 1996).

The biological behavior of fish in the lake in particular and the lake ecosystem in general have been studied by biologists. Such studies note that watershed degradation and hence siltation and sedimentation problems along with pressure of fishing in spawning grounds at the river mouths are the major threats for the sustainable utilization of the lake and the fishery resource (Ayalew et al., 2007; de Graaf, 2003; Eshete, 2003; Nagelkerke, 1997; Sibbing et al., 1998; and Wudneh, 1998).

For implementation of fishery regulations and investments on sustainable utilization of the lake's resources, the preferences of the society (especially of the fishermen) must be taken into consideration. No valuation of fisheries and watershed management of Lake Tana has been conducted previously to the best of the authors' knowledge. The general objective of the study is to understand the preferences of fishermen for the different attributes of Lake Tana using choice experiment method. The specific objectives are to estimate the marginal willingness to pay of an individual fisherman and the welfare implications of improvements in some attributes of the lake and its surroundings and to identify socioeconomic factors that affect the utility of individuals for improvements of the lake's attributes. We find that even low-income-fishermen are willing to pay to protect fisheries and the surrounding wetland of the lake. Given that application of choice experiment for environmental valuation in developing countries is limited (Bennett and Birol, 2010a,b), we believe that this study also contributes to this limited but growing literature.

2. Valuation Method and Empirical Model

2.1. A Brief Note on Valuation Method Used

The stated preference approach to valuation enables estimation of the value of environmental goods and services which are not traded or are not closely related to any market goods and services. In such situations, people cannot 'reveal' their willingness to pay for these goods and services (Alpizar et al., 2003). The most widely used method in stated preference approaches is the contingent valuation method (CVM). However, due to criticisms of CVM, other methods have

been developed and used — one of which is choice experiment. As Alpizar et al. (2003) note, in addition to the well known contingent valuation method, choice experiment (CE) is a very important tool for valuing non-market environmental goods. Birol et al. (2005) also note that for the valuation of the benefits generated from multiple characteristics and functions of environmental goods, CE is the most appropriate method from a range of non-market valuation techniques. One particular reason for choice of CE as opposed to CVM in this study is the possibility that we can estimate marginal willingness to pay for specific attributes and make comparisons among them. An additional advantage of using CE as opposed to CVM is minimization of strategic bias due to the complexity of formulating strategic responses across multiple choice sets (Bennett and Birol, 2010a).

The technique of choice experiment is based on Lancaster's characteristic theory of value (Lancaster, 1966) and random utility theory (Birol et al., 2005; Hanley et al., 1998; List et al., 2006; and McFadden, 1974). Choice experiment is a structured method of data generation which needs designing choice sets that help to infer the factors influencing choice. In choice experiment, respondents are offered a hypothetical market setting in which the attributes (and their levels) of environmental goods are presented using alternatives. Monetary values (prices) are included as one of the attributes. Individuals are, then, asked to choose their most preferred alternative from several alternatives in a given choice set. Choice experiment is a relatively recently developed method of valuation in the family of stated preference methods. However, its application has become frequent in environmental valuation especially in developed countries (e.g., see Adamowicz et al., 1994, 1998; Bennett and Blamey, 2001; Birol et al., 2005; Carlsson et al., 2003; Hoyos, 2010; Jin et al., 2006).

As is the case with the CVM, there are a number of challenges associated with the application of choice experiment in developing countries (Adamowicz and Whittington, 2010; Whittington, 1998). In a recent review of studies on the application of the choice experiment method in developing countries, Bennett and Birol (2010a,b) note that applications of this method are still scarce in developing countries. Their recent review of such work also suggests the importance of applying the method to inform policy while noting also the need to be careful in the application of the method. Based on such review of studies, they also provide a list of issues to be considered in an attempt to provide a