



## Research article

# Estimating visitors' willingness to pay for a conservation fund: sustainable financing approach in protected areas in Ethiopia



Sintayehu Aynalem Aseres<sup>a,b,\*</sup>, Raminder Kaur Sira<sup>b</sup>

<sup>a</sup> Department of Tourism Management, Madda Walabu University, Ethiopia and PhD. Scholar at School of Management Studies in Punjabi University, India

<sup>b</sup> School of Management Studies, Punjabi University, India

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## ABSTRACT

An increasing number of protected areas (PAs) are being established in many countries to conserve and preserve the wildlife species and to maintain earth's ecological balance, but in emerging economies such as Ethiopia, PAs are currently confronted with inadequate conservation funding that makes it tough to protect the remaining biodiversity. PAs, therefore try to use other financial means such as ecotourism to subsidize their financial shortage and nourishes the nexus between conservation and development. Estimation of visitors' willingness to pay (WTP) would be useful to craft strategies to strengthen the self-financing capability of PAs and hence realizing environmental and livelihood goals. In this study, the visitors' WTP for the proposed conservation fund in the context of Bale Mountains National Park (BMNP) was estimated using a contingent valuation method. The finding indicated that 75% of visitors were willing to pay a conservation fee. The mean WTP was estimated to be US\$7.40 for foreign visitors and US\$1.00 for domestic visitors. The finding suggests that the implementation of conservation fee in addition to the existing entry fee helps to improve the long-term sustainable financing of PAs.

## 1. Introduction

The primary purpose of PAs is conserving and preserving the remaining worlds' flagship species and maintaining the earth's ecological balance (Dudley et al., 2010). Despite PAs are less commercialized, they also contribute to the sustainable development goals, especially in developing countries through tourism (Agyeman et al., 2019; Tseng et al., 2019; Ma et al., 2019; Stronza et al., 2019). Scholars (e.g. Nyaupane and Poudel, 2011; Stone and Nyaupane, 2016; Taczanowska et al., 2019) have argued that through the alternative income hypothesis, there are clear connections between ecotourism, local people, and conservation. Ecotourism is a lubricant to strengthen the linkage between conservation and communities' livelihood based on the notion that the needs of local people and the conservation goals can be reconciled (Boley and Green, 2016; Mathis and Rose, 2016; Ma et al., 2019). Despite the conflicted relationship between livelihoods and conservation goals, as a neo-liberal approach to sustainable development, it is argued that ecotourism is touted as a promising route for generating economic incentives, especially for those minority groups or local people and

supporting biodiversity conservation simultaneously (Ramírez and Santana, 2018; Vannelli et al., 2019).

Ecotourism can play a crucial role in conservation-development nexus (Mathis and Rose, 2016; Boley and Green, 2016; Stone and Nyaupane, 2016). Through ecotourism development, PAs can generate alternative sources of revenue. Since many PAs are established in more remote regions, the economic role of ecotourism to local people is straightforward, while simultaneously appreciating the local culture and maintaining the environmental purity (Stronza et al., 2019; Ma et al., 2019). Therefore, developing sustainable tourism initiatives is critically important to increase the positive linkage between local people, livelihood, and conservation (Nyaupane and Poudel, 2011; Hunt et al., 2015; Stone and Nyaupane, 2016). However, global biodiversity and ecosystem services are now rapidly declining due to different challenges at local and global scales of either natural or anthropogenic factors (Rani et al., 2019; Wang et al., 2019; Savage et al., 2020). Since the 1970s, wildlife species and their ecological habitats have been degraded, especially in developing countries (Riggio et al., 2019; Pedroso and Kungu, 2019) and this critically affects the future opportunity to develop ecotourism sector in PAs.

\* Corresponding author.

E-mail address: [sinaynalem2007@gmail.com](mailto:sinaynalem2007@gmail.com) (S.A. Aseres).

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Increasing human population and its consequences such as agricultural land expansion, cattle ranching, hunting, and poaching are the critical cause of biodiversity losses (Larson et al., 2016; Williams et al., 2016; Wei et al., 2018). Especially, the conversion of PAs into other conventional land-use options has also been noticed worldwide (Riggio et al., 2019; Huntley et al., 2019), which become even more critical in developing countries such as Ethiopia. In Ethiopia, the conservation–development conflicts are increasingly becoming acute problems for the future sustainable existence of PAs. For example, Sod ash factory in Abijata-Shalla National park, Ethio-Djibouti railway and geothermal power construction in Awash National Park, and Kuraz Sugar Factory in Omo and Mago National Parks are some of the conservation–development conflicts observed today in PAs in the country.

Lack of adequate conservation funding is a critical impediment for effective PA management (Baral et al., 2008; Larson et al., 2015; Wilson et al., 2016; Getzner et al., 2018; Martin et al., 2018). PAs, particularly in developing countries are increasingly linger to public funding. As some scholars (e.g. Ly et al., 2006; Togridou et al., 2006; Emerton et al., 2006) noted, government subsidies are neither adequate nor feasible to generate sufficient conservation funding. Conservation stakeholders are insisting on the government to increase the allocation of conservation budget but it seems unattainable in low-income countries such as Ethiopia (Eagles, 2003; Buckley, 2003; Whitelaw et al., 2014). As a result, local people are neither compensated for the opportunity costs that they trade-off for biodiversity conservation and nor incentivized to adopt sustainable land-use practices (Weaver, 2013; Ma et al., 2019). As alternative revenue options, an entry fee has been placed to access the PAs (Thapa et al., 2017; Schuhmann et al., 2019). However, as pointed out by Maynard et al. (2019) and Lundberg et al. (2019), an entry fee is insufficient to compensate the opportunity costs of conservation.

Many of the newly established PAs in Ethiopia are undervalued, and in most other PAs across the country, foreign tourists pay an average entry fee of \$4.14, which is critically less than the global average entry fee of \$20, and the neighboring countries' such as Kenya (\$40.18) and Tanzania (\$43.72) (see Zyl et al., 2019). Because the total revenue generated in PAs is inadequate, realizing the environmental and socio-economic objectives has not been successful. This would pose a practical policy implication to develop alternative market-based conservation mechanisms, e.g., linking the ecotourism sector with the direct payment schemes (Whitelaw et al., 2014; Wearing et al., 2019; Taczanowska et al., 2019). Through market-based conservation approaches, PAs generate much-needed conservation funding and further provide incentives for local people (MEA, 2005; Wunder, 2005; Reid-Grant and Bhat, 2009). Since the East Africa region, including Ethiopia, has been recognized as a biodiversity hotspot and home to many endangered wildlife species, the notion of adopting market-based conservation approaches (e.g., payments for ecosystem services, tourism charges, users' fee, and bioprospecting) is compelling to increase the sustainable financing of PAs in the region (Riggio et al., 2019; Huntley et al., 2019; Pedroso and Kungu, 2019). Therefore, charging a viable users' fee and securing adequate conservation funds are critically prioritized where PAs are underfunded (Thur, 2010; Waldron et al., 2013; Lee et al., 2019).

Visitors are one of the beneficiaries of PAs in terms of participating in different activities, e.g., trekking, wildlife safari, birding, fishing, hiking, camping, and trophy hunting but equally, they induce environmental damages or costs (Ramírez and Santana, 2018; Schuhmann et al., 2019; Tchakatumba et al., 2019). Theoretically, the costs of conservation can be proportionally distributed to the environmental benefits received (Honey, 2008; Ma et al., 2019) whereby the beneficiaries pay for the ecosystem service they consume as enlightened by the theory of the 'Beneficiaries Pays Principles' (Wearing et al., 2019; Casey and Schuhmann, 2019). However, in practice, inadequate conservation funding is highly associated with the ecosystem service market failure due to some free-rider goods and services, and a lack of defined monetary system in estimating those ecosystem services and goods (MEA, 2005; Miteva et al.,

2012; Muradian, 2013). It is environmentally rational to charge fair and reasonable fees on visitors and other beneficiaries to trade-off the negative environmental externalities (Buckley, 2003; Nyaupane et al., 2009; Spenceley et al., 2017). In this regard, the valuation of non-market environmental values has been a major research topic in environmental economics (Hanemann, 1989, 2001). Particularly, the WTP approach is widely applicable in developing fair and equitable users' fees to access the PAs (Witt, 2019).

Several authors (e.g. Schutgens et al., 2018; Murphy et al., 2018; Nie et al., 2019; Lee et al., 2019; Casey and Schuhmann, 2019) suggest policy implications for countries either to introduce a new entry fee or to increase the existing fee to generate adequate conservation funding based on the WTP approach. However, beyond this, alternative means of conservation funding have been overlooked in the existing literature. Particularly, a review of the conservation funding literature (e.g. Eagles, 2003; Emerton et al., 2006; Baral et al., 2008; Gelcich et al., 2013; Adamu et al., 2015; Pedroso and Kungu, 2019) showed that studies were inadequate in developing countries such as Ethiopia regarding estimating visitors' WTP for the additional conservation fund to improve the long-term sustainable financing of PAs. This study, therefore aimed to bridge this gap by examining visitors' WTP for supporting biodiversity conservation in the context of BMNP in Ethiopia using a contingent valuation method (CVM). In addressing the ongoing biodiversity degradation due to inadequate conservation funding, this study provides key policy and management implications to develop alternative sustainable financing tools and restructure the existing PAs' pricing policy in the country.

## 2. Literature review

### 2.1. Economic valuation of protected areas

The taxonomy that is understood as 'total economic value' is classified as use-values and non-use values (Pearce and Moran, 1994). The use-values are goods or services or outputs, which are derived from PAs, particularly the provisioning ecosystem services (MEA, 2005). The use-values can be either direct use-values, which refer to goods or services that are used directly such as fishing and timber extraction, or indirect use-values, which are indirect functioning benefits, e.g., viewing wildlife species, habitats, and biodiversity. The use-values can also be option values, which will be used at a future date (Ahmed and Gotoh, 2006). On the other hand, non-use-values include situations in which individuals are not currently using the goods or services but they want to see the conserved PAs and preserved for future generations, i.e., existence values and bequest values (Pearce and Moran, 1994; Martin-Lopez et al., 2008).

Ecotourism is most often considered as a direct use-values of PAs but in principle, it should be non-consumptive (Whitelaw et al., 2014; Boley and Green, 2015) and may influence the other values, e.g., visitors in post-trip are more aware of its existence and, therefore, would be more willing to pay for supporting the conservation of the existence values of PAs and want to retain for future generations (Martin-Lopez et al., 2008). In this scenario, ecotourism, which is considered as non-use-values and categorized as cultural ecosystem services, is part of the non-market goods and services (MEA, 2005). The valuation of non-market goods and services informs policymakers to predict the economic impact of ecosystem services and estimate the monetary values of all economic benefits that are associated with the PAs (Hanemann, 2001). The approach in valuing non-market environmental goods and services is mainly contingent on people's preferences for changes in the state of their environment (Haab and McConnell, 2002; Hackett, 2006). The environmental values can be estimated from the perspective of the observed behavior or actual choice, i.e., revealed preferences and hypothetical behaviors, i.e., stated preferences or discrete choice of an individual preference (Hanemann et al., 1991; Ahmed and Gotoh, 2006; Freeman et al., 2014).

## 2.2. Contingent valuation method (CVM)

A CV method is a widely applicable stated valuation technique used to elicit both the use and non-use-values of the PAs (Carson, 2000; Hackett, 2006). It is a survey-based technique often used to place monetary values on non-market environmental goods and services (Carson et al., 2001). CVM is inquiring information about individual preferences, demands, or WTP for direct hypothetical scenarios (Bateman and Langford, 1997). The purposes of the method are, therefore, to estimate an individual WTP for changes in the quantity and quality of goods and services (Hanemann, 2001; Haab and McConnell, 2002; Hackett, 2006). Despite the improvements that have occurred in a CV method design, elicitation formats, data analysis techniques, and report style, the practicality of the method is still more complex and ubiquitous (Arrow et al., 1993) due to several limitations and biases, which affect the validity and reliability of the measurement scales. For example, individual responses relying upon a hypothetical scenario, respondents may have less awareness of the proposed valuation and change of interests, and other biases associated with the selection of eliciting formats and the type of payment vehicles used (Carson, 2000). The researchers should, therefore be cautious about these potential biases and try to control by employing a good survey design, maintaining the adequacy of samples, developing a well-narrated hypothetical scenario, and employing appropriate eliciting formats and payment vehicles (Togridou et al., 2006; Baral et al., 2008; Han et al., 2011; Mach et al., 2020).

In CV studies, different elicitation formats such as the payment card approach, open-ended questions, bidding games, and dichotomous choices (either single or double-bounded) are commonly used based on different valuation perspectives (Arrow et al., 1993). The payment card, which has been recommended as a preferred approach to avoid the starting-point bias and effective to estimate the maximum amount an individual would pay to conserve or maintain environmental quality (Schutgens et al., 2018; Casey and Schuhmann, 2019; Haefele, 2019), was chosen in this study. Equally, the choice of appropriate payment vehicles, e.g., user fee, entrance fee, surcharge tax, lump-sum payment, or conservation fee is a significant factor in estimating WTP (Lundberg et al., 2019; Gordillo et al., 2019). Therefore, as realistic, far-reaching, and voluntary basis (Gelcich et al., 2013; Malinauskaite et al., 2019), a conservation fee was chosen in this study.

## 2.3. Previous valuation studies

In recent times, several studies have examined the WTP for different purposes and implications, especially in conservation and ecotourism literature. For example, Baral et al. (2008) have elicited tourists' WTP for increasing entry fees using a CVM for the case of the Annapurna conservation area (ACA) in Nepal. The authors found that a significant number of visitors would be willing to pay \$69.2 for an increasing entry fee, which potentially generates about \$1.3 million per year. Thur (2010) conducted a CV study among scuba divers who visited Bonaire National Marine Park and found positive WTP. In Nigeria, for the case of the Yankari game reserve, Adamu et al. (2015) conducted a CV study using a double-bounded dichotomous-CV approach to estimate visitors' WTP for the entry fee. The study showed that visitors would be willing to pay an estimated amount of \$3.4, with potential revenue of \$53, 283 per year. Another similar CV study by Kaffashi et al. (2015) estimated a mean WTP value of \$1.6 for domestic and \$3.2 for foreign visitors for the entry fee to access the National Elephant Conservation Center in Malaysia. Through the application of a double-bounded dichotomous-CV survey, Witt (2019) has estimated a mean WTP of tourists ranging from \$15.7 to \$25.83 for an increased entry fee for the case of Mexican PAs. Lee et al. (2019) used a choice experiment method to examine the preferences and WTP of divers, fisheries, and site visitors for the Kenting coral reef and estimated a mean WTP ranging from \$10.55 to \$ 18.48 for increasing entry fee.

As vividly indicated in the literature explained above, ecotourism brings economic support for the improvement of conservation areas through generating revenue from entry fees. It has also been observed that fair and equitable entry fee is the opportunity that helps to secure the required amount of conservation funding (Buckley, 2003; Thapa et al., 2017; Spenceley et al., 2017; Taczanowska et al., 2019). However, entry fees are generally underutilized and the opportunities have not been effectively used, especially in countries with limited funding for conservation (Schuhmann et al., 2019). Therefore, alternative means of sustainable funding for conservation are critically required. Some scholars (e.g. Togridou et al., 2006; Baral et al., 2008; Buckley and Mossaz, 2018) suggest options for generating additional funding sources such as conservation trust fund, donations, privatizations, and levying users' taxes. Because implementation of a new pricing policy may affect the visitation trend and consequently result in the decline of tourism income (Buckley, 2003; Casey and Schuhmann, 2019), the application of alternative pricing policy should rely on the analysis of acceptability, i.e., preferences and WTP (Thur, 2010; Murphy et al., 2018).

In the context of Mexico, Casey et al. (2010) recommend to implement additional conservation fee. The authors indicated that tourists would be willing to pay an estimated value of \$57.93 conservation fee. Getzner et al. (2018) also suggest additional means of conservation financing for supporting wildlife species and their habitats in Croatia. Using a payment card CV method, Schutgens et al. (2018) estimated the mean WTP value of \$59 per trip for the conservation of Snow Leopard in ACA in Nepal. The other CV study by Pedroso and Kungu (2019) suggest the implementation of green tourism fund for the restoration of the upstream ecosystem of Masai Mara National Reserve in Kenya. The authors used a payment card approach to estimate the wildlife tourists' WTP, which was \$41.6, with a total potential annual revenue of \$3.5 million. Similarly, Lundberg et al. (2019) applied a payment card approach to assess visitors' willingness to donate to support conservation. Taking a case study of Caribbean Marine PAs, Schuhmann et al. (2019) estimated tourists' WTP ranging from \$36 to \$52 per visit for the conservation fees.

However, still literature show a notable research gap regarding estimating visitors' WTP for the conservation fund to ensure the long-term sustainable financing of PAs. Studies, especially, concerning how to increase sustainable financing of PAs to effectively conserve and manage the wildlife species and their ecological habitats, while simultaneously supporting local economic development are needed. In many underfunded PAs, particularly in Ethiopia and other East African Regions, empirical researches are still inadequate (Riggio et al., 2019). Despite more PAs being established in the region, many wildlife species are wiped-out due to lack of conservation financing coupled with other critical challenges discussed above (Wei et al., 2018; Huntley et al., 2019). On the other hand, the presence of flagship species attracts considerable international donors for supporting the conservation measures and opening-up future ecotourism development simultaneously (Pedroso and Kungu, 2019). This can be considered as a big opportunity for generating funds from the multi-country WTP for the conservation and management of outstanding global biodiversity hotspots in the region such as BMNP. This study can, therefore, bridge this gap by examining visitors' WTP for the proposed conservation fund from developing countries' perspective to mitigate the ongoing biodiversity crisis.

The other objective of the study was to explore the effects of different factors, which are related to the respondents' socio-demographic, economic backgrounds, and environmental attitudes and perceptions on the WTP to improve PA management. In this regard, of course, there is plenty of studies, which examines the determinants of WTP. For instance, Baral et al. (2008) and Schutgens et al. (2018) model WTP as a function of bid amount, visitors' satisfaction, number of nights spent in the destinations, and the use of guides. Other studies (e.g. Choi and Fielding, 2013; Hultman et al., 2015; Rodella et al., 2019; Nie et al., 2019) showed that an individual WTP can be influenced by his/her age, gender, education, and income. Particularly, WTP can also be a function of the previous visit and visit preferences (Kamri et al., 2017), participation in environmental

issues and knowledge of ecotourism and conservation (Han et al., 2011; Sadikin et al., 2017; Lundberg et al., 2019), and the level, and type of ecotourism activities, trekking, and nationality (Platania and Rizzo, 2018; Murphy et al., 2018). The present study, therefore examined the effect of attitudes towards conservation and ecotourism, environmental concern, and visit characteristics, besides the socio-demographic variables to provide a comprehensive model of visitors' WTP.

### 3. Methods

#### 3.1. Study area

The study was conducted at BMNP, located in the southeastern part of Ethiopia (Figure 1). The area of the park is 2,150 km<sup>2</sup>, which comprises spectacular scenery, mountains, sweeping valleys, dramatic escarpment, and a wide expanse of forest, and grassland (Aseres and Sira, 2020). In 1970, the park was established for the protection of the endangered species of mountain Nyala (*Tragelaphus buxtoni*) and Ethiopian wolf (*Canis simensis*) (Hillman, 1988). Since 2009, the park has been enlisted as 'global biodiversity hotspot' and was a nominee for world heritage status (<http://whc.unesco.org/en/tentativelists/5315/> accessed on November 2018). The park has also been recognized as a center of high endemism, particularly home to diversified species, including plants (of 1321 plant species, 163 are endemic and of the 1000 known medicinal plant species in Ethiopia, the park harbors 40%), mammals (of 80 species, 20 endemic), bird species (of 300 species, 16 endemic) Bale Mountain National Park (BMNP), 2017.

The ecosystem of the park is also considered as water catchment areas for the downstream countries such as Somalia and Kenya. Currently, the park is identified as an international in-situ conservation area but lack of adequate sustainable financing systems, coupled with other human-induced impacts as a result of struggling for the sake of fulfilling their basic needs, have jeopardized the park's biodiversity and ecosystem (Aseres and Sira, 2019). Because of the park's diversity of life, it has been promoted as "one park, many world" and potentially it has been considered as outstanding global ecotourism site Bale Mountain National Park (BMNP), 2017 but tourism is seasonal. Figure 2 shows that since the

beginning of 2014, visitors' flow has been decreasing due to factors mainly associated with political instability in the country (Aseres and Sira, 2020). As a result, the ecotourism revenue generated from entry fees has been dramatically declining. Despite an entry fee is the indispensable source of conservation funding (Buckley, 2003; Buckley and Mossaz, 2018), the revenue collected from the entry fees were neither adequate nor feasible to reduce the rate of biodiversity losses in BMNP and other PAs in Ethiopia.

#### 3.2. Samples

The CV survey was conducted among visitors who visited the national park from September 2017 to 2018, considering both peak season (November to January) and off-season (March to September). Students and those who were under 18 years old were not included in the survey. Because the sampling frame is not known (Baral et al., 2008), using probability sampling techniques was not practical for conducting visitors' survey (Aseres and Sira, 2019). Consistent with the study by Casey and Schuhmann (2019), respondents were, therefore intercepted based on their convenience. The sample size was framed using Yamane (1967) formula, which is given in Eq. (1) by considering the planned annual visitors' number in 2018, which was estimated to be 10, 000 (Bale Mountains National Park Office, 2018). However, as the trend shows (see Figure 2), the number of visitors is subject to seasonality. Bearing this into consideration, the 10% non-response rate was added (Pedroso and Kungu, 2019).

$$n = \frac{N}{1 + (N(e^2))} \quad (1)$$

where  $n$  is the sample size ( $n = 384$ ),  $N$  is the annual visitors' number ( $N = 10, 000$ ),  $e$  is the precision level ( $e = 0.05$ ), or taking a 95% confidence level. Because the majority of overnight visitors are usually staying at Goba Wabishebele hotel and Bale Mountains Lodge, the two sites were selected as accessible interception points but day-trippers or domestic visitors were intercepted at park office after completed their trip and before checking to exist. The data collection process was carried out over 140 days, with 3 days randomly selected per week to intercept the

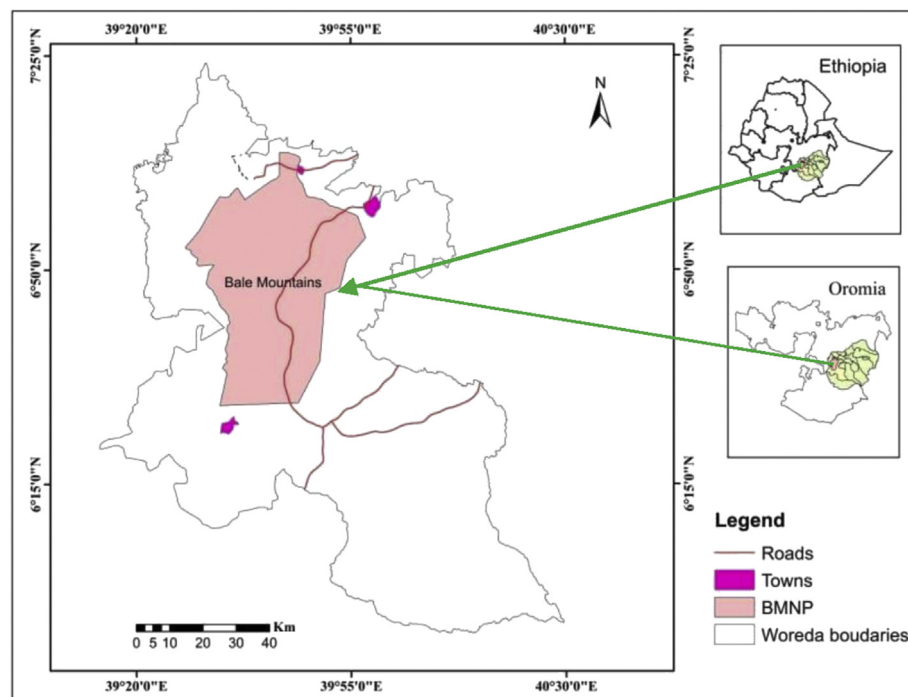


Figure 1. The location of BMNP.



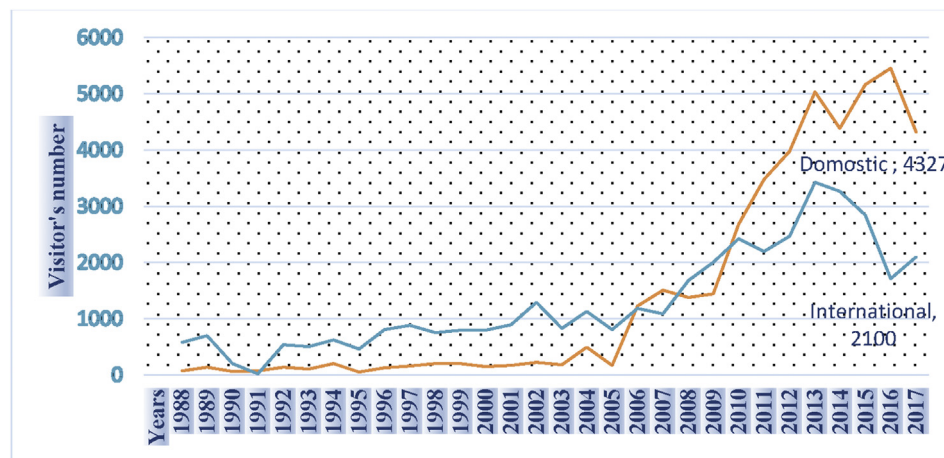


Figure 2. Annual visitors' number from 1988 to 2017 (Source: Aseres and Sira, 2020).

Table 1. Contingent valuation scenario.

Bale Mountains National Park (BMNP), which was established in 1970, is the largest and most important protected area in Afromontane habitat in the whole of Africa. It is home to high levels of species richness and endemism with more than 1,650 plants, 78 mammals, and 278 bird species. The park has been recognized as a "global biodiversity hotspot" and "potential ecotourism site" and since 2009, the park has been a nominee for the UNESCO world heritage site. However, BMNP and other PAs in the country lack sufficient conservation funding. Therefore, in addition to the current entry fees, conservation fund needs to implement to increase the self-financing of PAs in the country. The conservation fund will be collected through charging conservation fees on divers' beneficiaries of the park's ecosystem like you.

Recognizing the proposed conservation fund program, would you be willing to pay a conservation fee? YES No

If No: why?

If Yes: why?

If your answer is "Yes", how much you would pay in US dollar per trip?

Foreign visitors: \$0, \$3.3, \$4.3, \$5.4, \$6.5, \$7.6, \$8.7, & \$9.8 and others \_\_\_\_\_

Domestic visitors: \$0, \$0.5, \$0.7, \$0.9, \$1.1, \$1.3, \$1.4, & \$1.6, and others \_\_\_\_\_

required number of visitors. Of the total visitors who were accessible in the interception sites ( $n = 423$ ), 389 observations were obtained, 24 visitors declined the survey, and 10 visitors provided incomplete responses.

### 3.3. Survey design

The survey questionnaire was divided into three parts. The first part of the questionnaire was designed to collect the socio-demographic background and visit characteristics of respondents. The second part was presented to collect the visitors' environmental concerns and attitudes towards conservation and ecotourism. The last part of the questionnaire presented the WTP questions (see Table 1). Since CVM is employed to measure the WTP for the proposed conservation fund and to explore the factors affecting visitors' WTP, a hypothetical scenario was developed to provide sufficient information about the purpose and type of valuations, and to mitigate a hypothetical bias (Baral et al., 2008; Casey and Schuhmann, 2019). The respondents were asked whether they would be willing to pay a conservation fee and for those who were willing, a list of bid prices was presented using a payment card approach and asked them to choose their maximum amount from the lists.

Based on the amount of the current entry fee, bid prices, including the protest bid (0) were given, i.e., domestic visitors (\$0, \$0.5, \$0.7,

\$0.9, \$1.1, \$1.3, \$1.4, & \$1.6 and foreign visitors (\$0, \$3.3, \$4.3, \$5.4, \$6.5, \$7.6, \$8.7, & \$9.8). The bid prices were given in local currency (i.e., 27.6 Ethiopian currency = ~\$US1), taking the average exchange rate of the year (National Bank of Ethiopia, 2018). The bid prices were initially proposed through focus group discussions with the park authorities. A pre-test was conducted among 30 randomly selected visitors to avoid biases such as starting point, strategic, and payment vehicle biases (Baral et al., 2008; Han et al., 2011). Consistent with the recommendation by Baral et al. (2008) and Wang and Jia (2012), follow-up open-ended questions were asked to investigate visitors' reasons for both positive and negative willingness to pay for the proposed conservation fund. Based on the guidelines of the National Oceanic and Atmospheric Administration (NOAA) for CV studies, a face-to-face interview was used for only WTP questionnaire (Arrow et al., 1993). Other sociodemographic sections were filled by visitors independently. The survey was administered in Amharic (the official language of Ethiopia) and English languages.

### 3.4. Econometric model

As noted above, CVM was used to measure the maximum WTP that respondents would contribute to the proposed conservation fund. In line with the previous CV studies (e.g. Baral et al., 2008; Han et al., 2011; Murphy et al., 2018), a binary logit model was chosen to estimate the parameters because of the ordinary least square regression violates the assumption of normality when the response variable is categorical (Schutgens et al., 2018). The respondents were asked about their opinion whether they were willing to pay ( $WTP_i=1$ ) or not willing to pay ( $WTP_i=0$ ) for the proposed conservation fund (Hanemann, 1989; Field, 2009). In a logistic regression model, independent variables are, therefore predicting the probability of an event occurring (Berry and Feldman, 1985). The logistic probability model is given in Eq. (2), where,  $e$  is the natural logarithm,  $\alpha$  is the constant,  $\beta_1, \dots, \beta_n$  are the coefficients,  $x_1, \dots, x_n$  are the vector of the explanatory variables (see Table 2), and  $\varepsilon$  is the error terms.

$$p(y_i) = \frac{1}{1 + e^{-(\alpha + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_n x_{ni} + \varepsilon_i)}} \quad (2)$$

Therefore, the probability of visitors' WTP, i.e.,  $p(WTP_i=1)$  or  $p(WTP_i=0)$  and the mean WTP are estimated in the study using the following equations.

Model-1: foreign visitors

$$WTP_i = \frac{1}{1 + e^{-(\beta_0 + \beta_1(GEN_i) + \beta_2(AGE_i) + \beta_3(MAST_i) + \beta_4(EDU_i) + \beta_5(INC_i) + \beta_6(NNA_i) + \beta_7(ENMEM_i) + \beta_8(SAT_i) + \beta_9(ATT_i) + \beta_{10}(ENCON_i) + \varepsilon_i)}} \quad (3)$$

**Table 2.** Variables included in the Model.

Variables	Description and measurement
AGE	Age category of respondents.
GEN	The respondents' gender (dummy variable: 1 = male and 0 = female).
MAST	Respondents marital status (dummy variable: 1 = single = & 0 = otherwise).
HHS	Number of persons in household.
EDU	Respondent's level of education.
INC	Respondent's average monthly income.
NNs	The number of nights that respondents spent in the destination.
ENMEM	Dummy variable of environmental membership (1 = yes & 0 = no)
SAT	Visitor satisfaction towards overall park visit, which is measured using 5-point likert scale, 1 = not at all satisfied to 5 = very satisfied.
ATT	Respondents' attitude towards conservation and ecotourism, which is measured using 5-point likert scale, 1 = low to 5 = high.
ENCON	Respondents' level of environmental concern measured with 7 items using 5-point likert scale, 1 = completely disagree to 5 = completely agree.
WTP	Binary dependent variable: 1 = yes and 0 = no.

Model-2: domestic visitors

$$WTP_i = \frac{1}{1 + e^{[-\beta_0 + \beta_1 (GEN) + \beta_2 (AGE) + \beta_3 (EDU) + \beta_4 (INC) + \beta_5 (HHS) + \beta_6 (SAT) + \beta_7 (ATT) + \beta_8 (ENCON) + \epsilon_i]}} \quad (4)$$

$$\text{Mean WTP} = \frac{\sum_{i=1}^n WTP_i (BP_i)}{\sum_{i=1}^n WTP_i} \quad (5)$$

The mean WTP was estimated using Eq. (5), which was previously used by [Pedroso and Kungu \(2019\)](#) for estimating visitors' WTP for the green tourism fund for the case of Masai Mara Reserve, where  $n$  is the number of respondents who were willing to pay,  $BP_i$  is the chosen bid prices in the  $i^{th}$  respondents, and  $WTP_i$  is the estimated respondents' probability of WTP from the binary logistic model in Eqs. (3) and (4). The values of the probability ( $WTP_i$ ) varies between 0 and 1, which means a value of  $WTP_i$  close to 1, visitors are more likely to be willing to pay, but

$WTP_i$  value is close to 0 means that visitors would less likely be willing to pay for supporting the proposed conservation fund and 0.5 was considered as a cut-off value ([Field, 2009](#)).

## 4. Results

### 4.1. Descriptive statistics

A total of 389 valid responses were collected from the intercepted respondents. Of which, foreign visitors represented 75% and the majority

**Table 3.** Visitors' sociodemographic and Visit characteristics.

Items	Characteristics	Results (%)	Characteristics	Results (%)
Visitor category	Domestic visitors	25%	<b>Purpose of visit</b>	
	Foreign visitors	75%	Wildlife Viewing	35%
Gender	Male	54%	Birding	32%
	Female	46%	Trekking	23%
Age	18–24	16.2%	Education and research	10%
	25–50	55.8%		
	51–64	27.2%	Visit satisfaction	3.66 (1.43)
	65 and above	0.8%	Number of nights	2.13 (1.23)
Marital status	Single	41.1%	Environmental membership	0.28 (0.45)
	Married	58.9%	Attitude towards conservation	3.75 (1.39)
Education	High school	17.4%	Environmental concern	3.63 (1.41)
	College/TVET	15.2%		
	BA degree	15.7%		
	MA and above	51.7%		
Income	<\$500	24.6%		
	\$500-1500	7.5%		
	\$1501-2000	13.4%		
	\$2001-5000	21.3%		
	\$5001-7000	9%		
	>\$7000	24.2%		
Household size	<2	53%		
	2–4	41%		
	5 and above	6%		

**Table 4.** Distribution of payment card responses.

Card amount (\$)			Count	Percent	Card amount (\$)			Count	Percent	$\chi^2$
Foreign visitors	0 "No"	70	23.9	Domestic visitors	0 "No"	26	27	0.396*		
	3.3	21	7.2		0.5	11	11.5			
	4.3	22	7.5		0.7	25	26			
	5.4	13	4.4		0.9	7	7.3			
	6.5	36	12.3		1.1	4	4.2			
	7.6	29	9.9		1.3	9	9.4			
	8.7	45	15.3		1.4	3	3.1			
	9.8	57	19.5		1.6	11	11.5			
	Total	293	100		total	96	100			
Current entry fee = \$3.3				Current entry fee = \$0.5						

\*  $\chi^2$  (chi-square value) is not significant at 1%, 5%, and 10% level of significance.

of them were from the United Kingdom and the USA. Others (25%) were domestic visitors. This result appears to be inconsistent with the average official visitors' arrival. On average, the domestic visitors accounted for 52%, including students, and foreign visitors represented 48% and the majority of them were from Europe and America ([Ethiopian Wildlife Conservation Authority \(EWCA\), 2018](#)). Because the educational trip was higher in the park during the data collection period and students were excluded from the survey, the majority of respondents were foreign visitors during the interception period. Of the 389 respondents, 54% were male and most of the respondents (55.8%) were found in the age category of 25–50 years. Regarding education, 67% of respondents had a Bachelor's degree and above, and 17.4% had completed high school. In terms of monthly income, 24.6% earned less than \$500, and 24.2% of respondents earned more than an average income of \$7000. The majority of respondents (53%) had a family size of fewer than 2 individuals and 41% had a family size of 2–4 (see [Table 3](#)).

The payment card responses are summarized in [Table 4](#). The result revealed that 293 (75%) were willing to pay a conservation fee, but others, 70 (24%) foreign visitors, and 26 (27%) domestic visitors were not willing to pay a conservation fee due to different reasons, which are presented in [Table 5](#). As indicated in [Table 4](#), zero WTP indicates the protest bid or "No" responses. All the zero WTP were not included further in the estimation. The most maximum WTP of foreign visitors was \$9.8, with 57% responses, whereas \$0.7 was the most frequently chosen card amount with 26% responses by domestic visitors. However, given different card amounts, foreign visitors were more willing than domestic visitors though this difference is not statistically significant ( $p > 0.05$ ) [Table 4](#).

As shown in [Table 5](#), among those who were willing to pay (293), 41% of respondents want to conserve the ecosystem and support the local community; 31.7% of respondents need to see the existence of the park, particularly to preserve the endangered wildlife species and to retain the option values of the park in the future; 15% of respondents were also

willing to pay for the proposed conservation fund to maintain the park's sustainability and believed they would visit again. Others (10.2%) were willing to pay because they believed that the proposed conservation fee is affordable. On the other hand, of those who refused (96), most respondents (44.8%) assumed that the existing entry fee is sufficient; 31.3% of respondents believed that funding is the responsibility of the government, and 13.5% of respondents could not trust that the fund would be used for park conservation. Only a few respondents (10.4%) declined the additional conservation fee because they were not satisfied with their overall visit.

#### 4.2. Parameter estimation

Some assumptions, e.g., linearity relationship between the outcome and predictor variables, the normality of the residuals, and homoscedasticity are not necessarily problems in the logistic regression model ([Long, 1997](#)) but cautious to assumptions such as the nature of outcome variable, independency of each observation, less multicollinearity among the continuous predictors, and the linearity relationship between continuous predictors and log odds. All these assumptions were tested and checked by the model appropriateness. The results were interpreted based on the regression coefficients and standard error (S.E) ([Wang and Jia, 2012](#); [Casey and Schuhmann, 2019](#)). The diagnostic test such as Hosmer-Lemeshow goodness of fit statistic was carried out to test the model fitness ([Hosmer et al., 2013](#)) and the result shows that the model fits the data, i.e., for model-1 ( $p > 0.05$ ) and model-2 ( $p > 0.05$ ). In line with [Salkind \(2010\)](#), the result of the omnibus test of the model coefficient indicates that the model shows significant improvement, i.e., model-1 ( $p < 0.05$ ) and model-2 ( $p < 0.05$ ) [Table 6](#).

The log-likelihood test also indicates the goodness of fit of the model by checking the prediction power of the model based on Cox & Snell  $R^2$  and Nagelkerke  $R^2$ , but based on the recommendation by [Allison \(2014\)](#), the Nagelkerke  $R^2$  was used in the study, and 44.5% of the outcome

**Table 5.** Reasons for WTP.

Reasons for positive WTP	Results
To reduce overcrowding of visitors into the park	6 (2%)
It is not expensive, I can afford it	30 (10%)
I concern for its sustainability, so I have an opportunity to visit again	44 (15%)
I want to support the conservation measures and the local community	120 (41%)
I want to see the existence of the park and the preserve the wildlife species	93 (32%)
Reasons for negative WTP	
I already pay enough through entry fee	43 (45%)
Low ecotourism service quality, therefore, not interested to pay	10 (10%)
I don't believe the money will be used for conservation of the park	13 (14%)
Funding the conservation of the park is the responsibility of the government	30 (31%)

Table 6. Regression results.

Variables	Model-1: Foreign visitors (N=293)		Model-2: Domestic Visitors (N = 96)	
	Coefficient	S.E	Coefficient	S.E.
Gender (1)	-.357	.351	.145	.874
Marital status (1)	-.420	.226*		
Age	.020	.342	-2.752	1.77
Education	.090	.125	1.075	.662
Income	.612	.148***	.844	.416**
Household size			.404	1.049
Number of nights	-.252	.141*		
Environmental membership (1)	.643	.387*		
Visit satisfaction	.301	.143**	2.792	.99***
Attitude towards conservation	.123	.128	1.404	.662**
Environmental concern	.162	.028***	.155	.073**
Intercept	-4.642	1.412***	.9050	3.773**
Mean WTP	\$7.4 (ETB = 202.9)		\$1 (ETB = 26)	
Total aggregate WTP (Mean WTP × total visitors number)	\$16, 650/year		\$5, 250/year	
Likelihood-ratio	$\chi^2 = 103.29, p < 0.05$		$\chi^2 = 147.828, p < 0.05$	
-2Log-likelihood (Nagelkerke -R <sup>2</sup> )	44.5%		69.7%	
Goodness of model	$\chi^2 = 6.374, p > 0.05$		$\chi^2 = 6.554, p > 0.05$	
Overall prediction percentage	85.3%		87.5%	

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , and \* $p < 0.1$ .

variable was explained in model-1 and 69.7% in model-2. In the first model, monthly income and environmental concern ( $p < 0.01$ ), and visit satisfaction ( $p < 0.05$ ) had a strong positive effect on the WTP. Environmental membership ( $p < 0.1$ ), marital status, and the number of nights ( $p < 0.1$ ) had less effect on the WTP. However, age, gender, education, and attitude were insignificant. In model-2, income, attitude towards conservation and ecotourism, and environmental concern showed a positive effect on the WTP ( $p < 0.05$ ). Visit satisfaction had a strong positive effect on the WTP ( $p < 0.01$ ), but visitors' WTP was not influenced by other variables such as gender, age, education, and household size. Based on the number of willing visitors, the mean WTP for a conservation fee was estimated to \$7.40 for foreign visitors and \$1.00 for domestic visitors per trip, with estimated annual aggregate revenue of \$21, 900 Table 6.

## 5. Discussion

In the context of PAs in Ethiopia, particularly, a globally recognized biodiversity hotspot and harbor to a range of unique and flagship wildlife species, the BMNP was a focus of this research paper. The study followed a payment card-CV approach to elicit visitors' WTP and to examine the factors affecting the WTP. The result indicates that 75% of visitors were willing to pay a conservation fee for the proposed conservation fund. This finding is consistent with other findings in different case studies around the globe (e.g., Baral et al., 2008; Lal et al., 2017; Sadikin et al., 2017; Ji et al., 2018). The non-use values or conservation and preservation of endangered wildlife species and their sensitive habitats was the primary objective of the WTP estimation in the study. Most visitors were willing to pay a conservation fee for the intention of supporting the park's conservation projects and, therefore, hoping to visit the park again and preserve the endangered wildlife species for the future generation. This implies that visitors would prioritize the non-use values of the PAs, i.e., option values and existence values. Parallel to this study, the same results were found by other researchers (e.g. Togridou et al., 2006; Han et al., 2011; Murphy et al., 2018; Schutgens et al., 2018; Pedroso and Kungu, 2019).

The analysis of reasons for negative WTP also indicates that PA authority and management bodies need to show prolific assurance to secure the proposed conservation funding and to develop appropriate, trustworthy, and transparent fund management systems to avoid any

suspicion by individual users who are financially willing to support the conservation measures. This conforms with the finding by Wang and Jia (2012), which showed that a significant number of visitors would not be willing due to lack of trust that the fund would be used to the conservation purpose. As noted by some authors (e.g. Kareiva and Marvier, 2003; Waldron et al., 2013; Larson et al., 2015), inadequacy of conservation spending and increased rates of biodiversity imperilments have a direct causal effect relationship. One of the possible reasons for limited budget allocation in developing countries is associated with a low level of economic development (Stone and Nyaupane, 2016). Consequently, ecotourism could be a good option to generate sustainable conservation funding through charging users' fee. The finding indicates that levying a conservation fee can generate significant conservation funding to halt biodiversity losses. In the study, the mean WTP was estimated to \$7.40 for foreign visitors and \$1.00 for domestic visitors per trip. This result shows that foreign visitors were willing to pay 2.3 times the current entry fee and 1.8 times the current entry fee for that of domestic visitors.

The finding noticed that proportionally, domestic visitors were less willing to pay for the conservation of PAs than foreign visitors even though statistically insignificant. The difference might be because of sampling errors or beyond this due to socio-demographic and income differences among foreign and domestic visitors. As noted by Ahmed et al. (2007), Baral et al. (2008), and Ji et al. (2018) domestic visitors were less willing to pay to support environmental conservation and management due to factors associated with low awareness and education. Multiplying the mean WTP by the total visitor arrivals per year provides an aggregate estimation of total revenue for the proposed conservation fund. As discussed above, the total number of visitors to the park was 10, 000 in 2018, of which, 3000 were foreign visitors and 7000 were domestic visitors. Based on those visitors who were willing (293 or 75%), annual aggregate revenue was estimated to \$21, 900 for the conservation fund, but assuming that a conservation fee could be implemented for all visitors, estimated revenue of \$29, 200 per year could be generated in BMNP and over \$226, 973 revenue could be generated in all PAs of the country, taking a rough estimation of total visitors' number in 2018 (domestic visitor = 54, 412, foreign visitors = 23, 319) (Ethiopian Wildlife Conservation Authority (EWCA), 2018). This result, therefore indicates that PAs can generate additional revenue through charging conservation fees. In addition to government subsidies and other funding sources such as bilateral and multilateral aid, and



donations, estimating WTP has been part of the PA management tool to develop incentive-based conservation, especially designing market-based payments to ensure the sustainable financing system of PAs (MEA, 2005; Wunder, 2005).

The result shows the application of WTP to develop alternative self-financing mechanisms to reduce the current financial crises of many PAs in Ethiopia and other developing countries. Indeed, charging fair and equitable entry fee can help, on one hand, to generate conservation funding, on the other hand, to reduce the environmental impairment associated with overcrowding visitors in the PAs (Schuhmann et al., 2019). However, the current result unfolds that since the existing entry fee is critically low across PAs in Ethiopia, the estimation of visitors' WTP helps to generate additional finance sources. However, levying an additional conservation fee may impede the trend in park visitation (Baral et al., 2008) because visitation is income elastic (Wang and Jia, 2012; Casey and Schuhmann, 2019). In the current study, visitors were informed in a hypothetical scenario that the collected fund would be allocated for the conservation and management of PAs in addition to the current entry fee. As the result vividly shows, most visitors would be willing to pay a higher amount than the current entry fee. In support of other similar findings (e.g., Thur, 2010; Murphy et al., 2018; Wang et al., 2019; Casey and Schuhmann, 2019), the finding unfolds that visitors understood the hypothetical scenario and willing to pay for the proposed conservation fund without significantly decreasing their overall tourism demand despite the need to develop fair and equitable PA pricing policy.

The finding also showed that some socio-demographic variables, particularly income and other variables such as visit satisfaction, environmental attitude, and environmental concern had a positive effect on the WTP of visitors to support the conservation funding. Income had a strong positive effect on the WTP of visitors to support the conservation funding. This indicates that visitors with a higher income would be more willing to pay a conservation fee than the low-income earners (see also Platania and Rizzo, 2018; Murphy et al., 2018; Nie et al., 2019). The result confirms that visitation is income elastic and the demand for ecotourism is highly affected by the propensity of household income and the nation's wealth. As noted by Thur (2010) and Casey and Schuhmann (2019), the demand for biodiversity conservation raises with increasing nation's wealth to allocate more budgets for the conservation of PAs. The finding unfolds that the more concerned visitors would be more willing to pay than the less concerned visitors. This result was consistent with the finding by Opacak and Wang (2019) but inconsistent with the finding by Pedroso and Kungu (2019), which noted that environmental consciousness, behaviors, and awareness of individual users could not affect the WTP.

The relationship between environmental attitude and WTP was explored in the studies by Choi and Fielding (2013) and Hultman et al. (2015). The authors found a positive relationship between peoples' environmental attitude and their WTP. However, attitude towards conservation and ecotourism did not affect the WTP of foreign visitors but had a strong positive effect on the WTP of domestic visitors. Han et al. (2011) and Schutgens et al. (2018) showed that foreign visitors would not be influenced by their attitude to pay extra amount for the conservation of PAs. Nonetheless, because responses are entirely based on a hypothetical scenario, analyzing peoples' attitudes towards conservation and ecotourism is useful for CV studies (Lundberg et al., 2019). The result also demonstrated a positive effect of satisfaction on the WTP. Therefore, enhancing visitors' experience and satisfaction in PAs is critically important (see Pedroso and Kungu, 2019; Aseres and Sira, 2019). As the result shown that foreign visitors who spent a few nights would be more willing to pay than visitors who spent more nights. It is clear that the longer the stay in the destination, the higher the expenditure, the less likely visitors would pay extra money for conservation funding (Lal et al., 2017; Ji et al., 2018; Lee et al., 2019). The finding shows that there was a less significant difference between members and non-members of environmental organizations on the effect of WTP a conservation fee. This might be due to the effect of environmental membership overridden by

other more significant variables such as income, satisfaction, and environmental concern.

The result also shows that younger people are found to be more WTP to provide economic support for nature conservation. This result is consistent with the findings by Platania and Rizzo (2018) and Witt (2019) but inconsistent with the findings by Opacak and Wang (2019) and Pedroso and Kungu (2019). Gender and household size had no significant effect on WTP. Baral et al. (2008) support this result but the inconsistent result was revealed in the findings by Nie et al. (2019). The marital status of the respondents was a less important factor, but the negative coefficient indicates that unmarried people may have more willingness to support the conservation measures because they visit more PAs than married people (Wynen, 2013). Although education was not significant in the model, the positive coefficient shows that WTP was positively influenced by education, which implies that increasing the number of years studying would increase the likelihood of visitors' WTP. The same result was also revealed in the studies by Witt (2019) and Pedroso and Kungu (2019). Education and awareness has a positive consequence on personal maturity and will help to increase one's knowledge and could ultimately have an impact on the positive environmental thinking of a person (see Opacak and Wang, 2019; Rodella et al., 2019; Lundberg et al., 2019).

## 6. Conclusion and implications

This research paper contributes to the existing non-market valuation literature in estimating visitors' WTP using a CVM to support the improvement of management and conservation of PAs, especially where the conservation funding is inadequate. The study provides insights on the application of WTP in sustainable financing to develop market-based conservation approaches in developing countries to reduce the ongoing biodiversity losses and preserve the iconic wildlife species. The study also provides an empirical investigation of the effect of different factors, which helps to model visitors' WTP. The study argued that conservation funding is critically low in PAs in developing countries such as Ethiopia. Many of the PAs are undervalued and the entry fee is, therefore not a panacea in achieving conservation-development goals. Therefore, the estimation of visitors' WTP for the proposed conservation fund is a framework, which can help to conservationists, policymakers, and PA management in considering alternative financing mechanisms beyond the implementation of entry fees to generate adequate conservation finance and nurtures positive linkage among ecotourism, conservation, and local inhabitants.

As Wang and Jia (2012) noted, PAs are touted as an effective refuge site for the world's remaining biodiversity. However, PAs in low-income countries such as Ethiopia, particularly in BMNP, except for the limited conservation budget through government subsidies and NGOs' donations, there is no well-established sustainable financing system to achieve their environmental and societal goals. Therefore, this study examined the feasibility of developing alternative sustainable financing and proposed the implementation of fair and equitable conservation fees at the national level to increase parks' revenue. The implementation of a conservation fee at national level helps to generate revenue, which adequately covers the operating costs for the conservation of PAs. Correspondingly, some portion of the revenue may also be allocated towards benefiting the local community, especially those who claimed ownership rights over some lands of the PAs and principally conserve the PAs. The result, therefore, stressed that the economic return from ecotourism should not leak from the local economy and should support the conservation measures in PAs by scheming ecotourism into more market-based conservation tools such as the direct payment schemes. It is reasonably important to note that a neoliberal economic approach, especially implementing direct payment approaches such as charging beneficiaries' fees, can generate adequate funding for effective PA management. As noted by Engel et al. (2008), instigating beneficiaries' pays principle, e.g., charging fair and equitable users' fees are enormously

acknowledged in balancing the demand and supply in the provision of ecosystem services and the costs and benefits associated with biodiversity conservation. In this regard, the study, thus provides a policy implication on restructuring the existing pricing policy, especially in setting fair and adequate entry fees to access PAs.

Moreover, this research paper could be a good reference for further valuation research in wildlife sanctuaries, biosphere reserves, and control hunting areas in Ethiopia and other developing nations. However, the study is subject to sampling and scope limitations. Because visitors flow was drastically dropped in the country during the data collection period, only 399 respondents were intercepted from BMNP though the sample size was fairly met the assumption of sampling adequacy in CV studies (see Calia and Strazzera, 2000). Therefore, it would be important for further valuation studies to consider an adequate sample size by taking many PAs as case studies to improve the generalization of the results and its implications. Although the study contributes to the existing valuation literature by estimating the WTP of visitors for the proposed conservation fund, future studies need to continue to estimate the WTP of other beneficiaries in different PAs in Ethiopia. The effect of some of the socio-demographic factors was found to be less important to model visitors' WTP and the outcome variable, which was explained by model-1, was less than 50% for the case of foreign visitors. This is an interesting topic for further studies in modeling the WTP by considering other variables, which were not included in the current study such as cost of travel, distance from the park, prior visit experience, and use of guides to improve the model's fitness.

## Declarations

### Author contribution statement

S. A. Aseres: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

R.K. Sira: Contributed reagents, materials, analysis tools or data; Wrote the paper.

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### Competing interest statement

The authors declare no conflict of interest.

### Additional information

No additional information is available for this paper.

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