

## Original Paper

# Economic Valuation of Ecosystem Services Provided by Dellanj Forest Using Contingent Valuation Methods

Hamdon A Abdelrhman<sup>1,2</sup>, Tasneem A Almaleeh<sup>1</sup> & Inaam Mohammed Mahmoud elshareef<sup>1</sup>

<sup>1</sup> University of Kordofan, Faculty NATRES, Dept. Of Forestry and Range Sciences Elobeid, Sudan

<sup>2</sup> Research Associate Interim: Techno Economic in Biocomposite, Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor, Malaysia

Received: October 16, 2022      Accepted: November 1, 2022      Online Published: November 5, 2022

doi:10.22158/jepf.v8n4p58

URL: <http://dx.doi.org/10.22158/jepf.v8n4p58>

### **Abstract**

*This study was conducted at Dellanj Forest in South Kordofan State, during the period 2021/2022. This paper aims to quantify the economic value of ecosystem services in Dellanj forest. Data of this analysis were collected using interview for respondents visited the Dellanj forest for one week, monthly and in holidays), 120 questionnaires were distributed to the respondents contains different questions concerning the ecosystem services provided by Dellanj forest. To supplement the primary data, the secondary data, key Informants were used in this analysis. Also, the study followed framework of ecological assessment in quantifying forest ecosystem services and management, the data analysis using statistical Package for Social Sciences. The results revealed that, regarding sex, age, education and occupation of respondent visiting Dellanj forest, 50.8% of respondent were female and the rest of them are male; 34.2% of respondents; in study area their education status was reach and studied until university. The results of the forest visits season indicated that , most of respondent visited the forest four times a month, this represented by 38.3% followed by 3 and 2 times which indicated by 25.8 and 24.2 respectively. Also, the investigation revealed that, there are four main ecosystem services provided by Dellanj forest ecosystem they were recreation, watershed protection, flooding protection and soil erosion. The results depicted that all the choices of payment which presented by the researcher to forest visitors displays positive responds from the interviewees. In addition, the respondent analysis resulted that, the flooding and soil erosion are the main services which provided by Dellanj forest and that indicated the importance of the Dellanj forest to population of Dellanj and the visitors as well. The study concluded that, the four ecosystem services which provided by Dellanj forest are very crucial for the communities resided around the forest and visitors that stated in the mount of ecosystem services payment by the respondents. The study recommended that, the value of ecosystem services must include*

*as environmental extension messages to decision makers and community for conserving Dellanj forest. Also, the economic value of the other service provided by forest need to be investigated to rise the value of Dellanj forest ecosystem and its indirect values.*

### **Keywords**

*Dellanj forest, economic value, ecosystem services and benefits transfer*

## **1. Introduction**

The valuation of economic is still a progressing science as mentioned by researchers. For numerous goods and services, the market provides prices that are good reflections of the values by society places on that good or service. For other goods and services, market prices either do not exist or only capture a small part of the total value. For example of such goods and services included endangered species and beautiful views. It is regularly helpful to disaggregate any environmental impact into individual components of value in order to simplicity in the undertaking of analysis. The Total Economic Value (TEV) approach is a suitable method to conducting this and would be imply in this study in order to estimate the whole economic benefits that the people receives (Muñoz et al., 2021). In addition any good or service is contain of diverse features; lead to the ideas behind the TEV approach, whereby some of which are concrete and simply quantified, whereas others may be more complicated to measure. The sum of all of these modules is known as the total value. The breakdown and terminology for the components of TEV differ slightly from every quantifying and estimation, but normally include (i) use value; and (ii) non-use value. Hence, each value is frequently subdivided into extra categories (Horlings et al., 2020). Moreover, the use value is simply estimated the cost of environmental resources to the individuals who use them. Or else, use value arises from human's direct or indirect exploitation of wetlands goods and wetland services, respectively (Kornatowska, 2018). This value constitute of three different modules, These which concerning with the direct value also known as extractive, consumptive, or structural use value, derives from goods which can be extracted, consumed, or directly enjoyed such as wood derived from forest (Kornatowska, 2018). In the context of a forest, for example, extractive use value would be derived from timber, from harvest of minor forest products such as fruit, herbs, or mushrooms, and from hunting and fishing. In addition to these directly consumed goods, direct use values can also be non-consumptive. For example, people who enjoy hiking or camping in the same forest receive a direct use value, but do not actually "consume" any of the forest resource. Similarly, in a coral reef direct use values can include the harvesting of shells and catching of fish, or the non-consumptive use of the reef by scuba divers. Besides, the direct use values from cultivation of palm oil on peatland are palm oil, palm log, wood products, research and etc. (Horlings et al., 2020). Non-extractive use value or functional value is another name for indirect use value. This kind of values derives from the services the environment provides. For instance, wetlands frequently filter water, improving water quality for downstream users, and national parks provide opportunities for recreation (Resende et al., 2017).

## 2. Methodology

### 2.1 Study Area

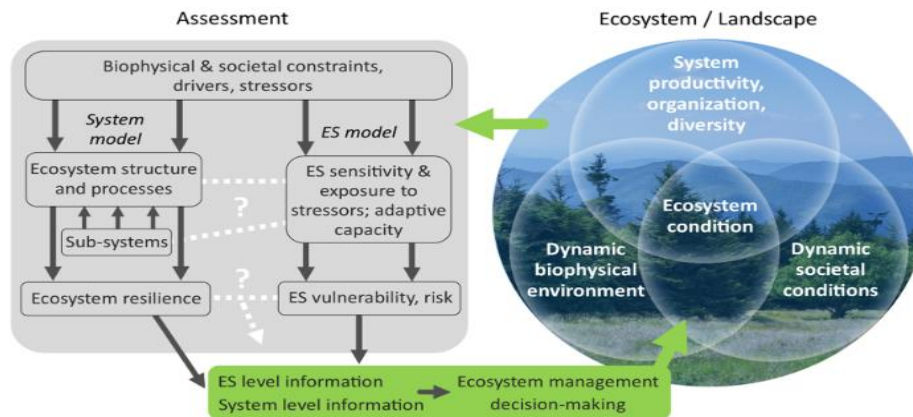
The study was conducted at Dellanj Locality in South Kordofan State showed in figure1. The state lies between latitudes 9 °and 12 °N; longitudes 27 °and 32 °E., and covering an area of 13.44 million ha (Bello, et al., 2016). Vast areas of the state are covered with hill catena intersected by seasonal watercourses, valleys and depressions where fertile alluvial soils deposition occurs seasonally. The main soil type is verticals, so-called cracking clays, in addition to sandy clay soils, locally known as gardud, which has a hard crust that hastens water runoff. Sandy soils characterize the northern parts of the State. The mean annual rainfall ranges from 350 mm in the north to 850 mm towards the southern boundaries of the state (Bello et al., 2016).



**Figure 1. South Kordofan State and Its Localities (Dellanj Locality)**

### 2.2 Method Tools

Data were collected using close ended questionnaire interviewed the visitors daily, for one week, monthly and in holidays), 120 respondents were subjected to different questions regarding the ecosystem services of Dellanj forest. To supplement the primary data, the secondary, Key Informants were used in this analysis. Also, the study followed framework of (Pomara and Lee, 2021) for ecological assessment in quantifying forest ecosystem services and management which showed in Figure 2.



**Figure 2. Ecological Assessment in Quantifying Forest Ecosystem Services and Management**

### 2.2 Contingent Valuation Method (CVM)

The method which obtains wide attention from some economists is the contingent valuation method which consider as a hypothetical/direct method. It utilizes survey techniques to ask community about the values they would put on environmental resources if they were needed to pay for them. The CVM asks people directly to state their preferences concerning environmental resources and by doing so can theoretically capture both use and non-use values.

As shown by (Getzner, 2010), there are three steps in CVM and they are as follows:

- 1) Presentation of the hypothetical market and the scenario under which the good or service is offered
- 2) Questions for the respondents to elicit his/her willingness to pay (WTP)
- 3) Questions for the respondents to relate his/her WTP to the socio-economic and demographic characteristics

To set up the hypothetical market is the first step in applying CVM which it will expose to the respondents during the interview. It means that firstly, we have to define the population of respondents whose values are to count, to define and describe the item to be valued and to determine the mechanism (termed payment vehicle) by which the respondents would pay for the item. Mitchell and Carson (Hjerpe & Hussain, 2016) also claim in their study that a thorough explanation of the hypothetical market should be made and the market must clearly set what are the good/service being valued, the market structure under which the good/service is to be provided, what the substitutes available are, and the method of payment. In order to ensure that the kind of questions asked work well, so the questionnaire should be pre-tested. This could be the wording or the ordering of the questions which can influence the answers given in the questionnaire (Hjerpe & Hussain, 2016).

Once the first steps are complete, the next stage of in CVM is to elicit values from respondents. A numerous of alternative techniques or methods are available to elicit WTP or WTA responses. The oldest and most commonly used elicitation technique is the iterative bidding game, followed by the payment card technique, then take-it-or-leave-it approach, and the last technique is open-ended

question. After we estimate the mean of WTP/WTA and analyze the determinants of WTP/WTA, then we require to evaluate how successful is the CVM at the final step. Thus, by looking at several indicators for instance the amount of protest bids, the understanding level between the hypothetical market respondents, and comparing the result with other studies, we can easily evaluate the successfulness of the CVM using all these ways (Bamwesigye et al., 2020).

### 3. Results and Discussion

#### 3.1 Socio Demographic Analysis of Respondents

Table 1 explains sex, age, education and occupation of respondent in Dellanj locality which used to conduct the study of contingent valuation method to value the ecosystem services provided by Dellanj forest, the analysis depicted that 50.8% of respondent were female and the rest of them are male; 34.2% of respondents in study area their education status was reach and studied university, lastly 25.8 of respondents in Dellanj locality they practice farming system as main occupation.

**Table 1. Socio-demographic Characteristics of the Respondents (N = 120)**

Factors		Frequency	Percentage (%)
<b>Sex</b>	Male	59	49.2
	Female	61	50.8
<b>Age</b>	30-40	24	20.0
	40-50	54	45.0
	50-60	32	26.7
	60 and above	10	8.3
<b>Education status</b>	Illiterate	37	30.8
	Primary	22	18.3
	Secondary school	20	16.7
	University	41	34.2
<b>Occupation</b>	Farm	31	25.8
	Employee	20	16.7
	Student	4	3.3
	Teacher	11	9.2
	Trader	16	13.3
	House wife	10	8.3
	Not able to work	2	1.7
	Self-employment	19	15.8
	Army	7	5.8

### 3.2 Seasons and Period of Visits to Dellanj Forest

The analysis of the results in Table 2 indicates the suitable season of visiting the forest is an autumn which represented by 91.7 respondent as depicted in Table 3, this may lead and indicate that, the respondent enjoying the forest at the rainy seasons. Also, the study resulted that most of respondent visited the forest four times a month, this represented by 38.3% followed by 3 and 2 times which indicated by 25.8 and 24.2 respectively.

**Table 2. Seasons and Period of Visits to Dellanj Forest**

<b>Factors</b>		<b>Frequency</b>	<b>Percentage (%)</b>
<b>Season which the respondent visit forest</b>	Winter	5	4.2
	Autumn	110	91.7
	Summer	5	4.2
<b>number of visit to the forest per month</b>	1	10	8.3
	2	29	24.2
	3	31	25.8
	4	46	38.3
	5	3	2.5
	6	0	0.0
	7	1	0.8

### 3.3 Willingness to Pay for Dellanj forest Ecosystem Values

The results which shows in Table 3 illustrated the willingness to pay for provide services by Dellanj forest ecosystem. The results depicted that all the choices of payment which presented by the researcher to forest visitors displays positive responds from the interviewee. Also most of the respondents' intent to pay as high as they can as showed in Table 3, this resulted in their awareness by the forest ecosystem services provided. Also the result depicted that the respondent concerning with the four ecosystem services provided by the forest they are recreation, soil erosion, flooding protection and watershed protection According to Horlings et al. (2020) Valuation of ecosystem services plays a role in signing the scarcity and quality of ecosystem services and considered as essential for communicating the economic value and scarcity of nature services provided by the forest. Also the monetary values plays roles in conserving the forest services.

**Table 3. Willingness to Pay for Dellanj forest Ecosystem Values**

Factors		Frequency	Percentage (%)
<b>Recreation</b>	30000	56	46.7
	50000	33	27.5
	80000	31	25.8
	30000	45	37.5
<b>Watershed protection</b>	50000	43	35.8
	80000	32	26.7
<b>Flooding</b>	30000	39	32.5
	50000	40	33.3
	80000	41	34.2
<b>Soil erosion</b>	30000	44	36.7
	50000	36	30.0
	80000	40	33.3

### 3.4 Dellanj Forest Ecosystem Values

The results of the investigation which showed in Table 4 display the Dellanj forest ecosystem values, the view of respondents show that all the four ecosystem services which provided by Dellanj forest are very crucial for their survival, that mentioned in the amount of ecosystem services payment as showed in Table 4. In addition, the respondent analysis resulted that, the flooding and soil erosion are the more ecosystem services which provided by Dellanj forest and that indicated the importance of the Dellanj forest to the community of Dellanj and the visitors as well in preserving the city from the disasters of heavy rainy season and strong runoff which happen during the rainy season (Hjerpe & Hussain, 2016), in their Econometric analysis proposed that, the respondents have strong preference for forest conservation management, including both preservation and ecological restoration depending on their socioeconomic characteristics, e.g., gender, age, place of residence, household income. Also their findings recommended that the result of willingness to pay is helpful to forest managers in the preparation of resource management plans consistent with maximization of total economic value of forest ecosystem services.

**Table 4. Dellanj Forest Ecosystem Values**

Forest Ecosystem	Values/SDG*
Recreation	5810000
Watershed protection	6060000
Flooding	6450000
Soil erosion	6320000

\*(1USD=572SDG)

#### 4. Conclusions and Recommendation

The valuation of economic of forest ecosystem services is still a progressing science as mentioned by many scientists, the investigation of Dellanj forest ecosystem value estimation concluded that, the suitable season of visiting Dellanj forest is an autumn season, this may indicate that, the visitors enjoying the forest at the rainy seasons. Also, the study concluded that most of community visited the forest four times a month, that proof, they were preferably visited the forest in the holidays. The analysis display Willingness to pay to measure the importance of the Dellanj forest ecosystem values, the study concluded that there were four ecosystem services provided by Dellanj forest and are very crucial for community survival. The flooding and soil erosion as ecosystem services are the main amenities which provided by Dellanj forest. The study recommended that, the value of ecosystem services must include as environmental extension frequently messages to decision makers and community to set rules for conserving Dellanj forest. Also, the economic value of the other service provided by forest need to be investigated to rise the value of Dellanj forest ecosystem and its indirect values.

#### Acknowledgement

The author would like to thank RUFORUM and Master card for their financial support for this study. Also, researchers would like to gratitude the faculty of Natural Resources and Environmental studies for their support.

#### References

- Abdel Raouf Suleiman Bello, & Hassan Abdelnabi Allajabou. (2016). Factors affecting Forests' uses in South Kordofan State of Sudan. *International Journal of Advanced Research*, 4(6), 1963-1970. <https://doi.org/10.21474/IJAR01/690>
- Bamwesigye, D., Hlavackova, P., Sujova, A., Fialova, J., & Kupec, P. (2020). Willingness to pay for forest existence value and sustainability. *Sustainability*, 12(3), 891. <https://doi.org/10.3390/su12030891>
- Getzner, M. (2010). Economic and cultural values related to Protected Areas-Part 1: Valuation of Ecosystem Services in Tatra (PL) and Slovensky Raj (SK) national parks. *Der öffentliche Sektor*, 36(1).
- Hjerpe, E. E., & Hussain, A. (2016). Willingness to pay for ecosystem conservation in Alaska's Tongass National Forest: a choice modeling study. *Ecology and Society*, 21(2). <https://doi.org/10.5751/ES-08122-210208>
- Horlings, E., Schenau, S., Hein, L., Lof, M., de Jongh, L., & Polder, M. (2020). Experimental monetary valuation of ecosystem services and assets in the Netherlands. Wageningen University & Research, The Netherlands, 100.



- Jantzen, J. (2006). The economic value of natural and environmental resources. *Institute for Applied Environmental Economics, Nedherland*.
- Kornatowska, B., & Sienkiewicz, J. (2018). Forest ecosystem services–assessment methods. <https://doi.org/10.2478/ffp-2018-0026>
- Masiero, M., Pettenella, D., Boscolo, M., Kanti Barua, S., Animon, I., & Matta, R. (2019). *Valuing forest ecosystem services: a training manual for planners and project developers*. Food and Agriculture Organization of The United Nations.
- Muñoz-López, J., Camargo-García, J. C., & Romero-Ladino, C. (2021). Valuation of ecosystem services of guadua bamboo (*Guadua angustifolia*) forest in the southwestern of Pereira, Colombia. *Caldasia*, 43(1), 186-196. <https://doi.org/10.15446/caldasia.v43n1.63297>
- Pomara, L. Y., & Lee, D. C. (2021). The Role of Regional Ecological Assessment in Quantifying Ecosystem Services for Forest Management. *Land*, 10(7), 725. <https://doi.org/10.3390/land10070725>
- Resende, F. M., Fernandes, G. W., Andrade, D. C., & Náder, H. D. (2017). Economic valuation of theecosystem services provided by a protected area in the Brazilian Cerrado: application of the contingent valuation method. *Brazilian Journal of Biology*, 77, 762-773. <https://doi.org/10.1590/1519-6984.21215>
- Wu, S., Hou, Y., & Yuan, G. (2010). Valuation of forest ecosystem goods and services and forest natural capital of the Beijing municipality, China. *Unasylva*, 61(1), 28-36.