ECONOMIC VALUE OF WILDLIFE SANCTUARY: A CASE STUDY FROM THE WESTERN GHATS IN KARNATAKA, INDIA

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ECONOMIC VALUE OF WILDLIFE SANCTUARY: A CASE STUDY FROM THE WESTERN GHATS IN KARNATAKA, INDIA. Goods and services of the ecosystem provided by the natural environment have not been considered in terms of their economic value. There are a number of studies that have estimated the economic value of forest ecosystem services in India, but very few studies have estimated these economic values of other important ecosystem services. Biligiri Rangaswamy Temple Wildlife Sanctuary (BRTWLS) is a unique place as a bridge between the Western Ghats and the Eastern Ghats in Karnataka, India. There are 12,500 *Soligas* (tribal community) living in this area. Non-timber forest products constitute more than 60% of the *Soliga* household income. A number of studies have been conducted in the BRTWLS. However, there is a lack of studies on the economic value. The primary objective of this study is to estimate the value of ecosystem services provided by BRTWLS. This study has used the market price methods for estimating the value of provisioning services and individual travel cost method for estimating the value of recreation services, while the value of carbon sequestration and soil erosion prevention has been estimated based on secondary data. This study has estimated the total annual value of provisioning, regulating and cultural services of BRTWLS at Rs 23.9 million y-1. The findings of the study will be helpful to the local policy makers to increase the entry fee at the BRTWLS, as it provides valuable ecosystem services and reinvests the same in natural capital to achieve environmental sustainability at the local level.

Keywords: Ecosystem services, economic value, brt wildlife sanctuary, travel cost method

NILAI EKONOMI SUAKA MARGASATWA: STUDI KASUS DARI GHATS BARAT DI KARNATAKA, INDIA. Barang dan jasa ekosistem yang disediakan oleh lingkungan alam belum dipertimbangkan dari segi nilai ekonominya. Ada sejumlah penelitian yang memperkirakan nilai ekonomi jasa ekosistem hutan di India, tetapi sangat sedikit penelitian yang memperkirakan nilai ekonomi jasa ekosistem penting lainnya. Suaka Margasatwa Kuil Biligiri Rangaswamy (BRTWLS) merupakan area unik sebagai jembatan antara Ghats Barat dan Ghats Timur di Karnataka, India. Ada 12.500 Soliga (komunitas suku) yang tinggal di daerah ini. Hasil hutan bukan kayu menyumbang lebih dari 60% pendapatan rumah tangga Soliga. Sejumlah penelitian telah dilakukan di BRTWLS. Namun, studi tentang nilai ekonomi masih kurang. Tujuan utama dari studi ini adalah untuk memperkirakan nilai jasa ekosistem yang disediakan oleh BRTWLS. Penelitian ini menggunakan metode harga pasar untuk memperkirakan nilai jasa penyediaan dan metode biaya perjalanan individu untuk memperkirakan nilai jasa rekreasi, sedangkan nilai penyerapan karbon dan pencegahan erosi tanah telah diperkirakan berdasarkan data sekunder. Studi ini memperkirakan total nilai tahunan dari jasa penyediaan, pengaturan dan budaya BRTWLS sebesar Rs 23,9 juta y-1. Temuan studi ini akan membantu pembuat kebijakan lokal untuk meningkatkan biaya masuk di BRTWLS, karena memberikan jasa ekosistem yang berharga dan menginvestasikan kembali modal alam yang sama untuk mencapai kelestarian lingkungan di tingkat lokal.

Kata kunci: Jasa ekosistem, nilai ekonomi, suaka margasatwa, suaka margasatwa kuil biligiri rangaswamy, metode biaya perjalanan

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I. INTRODUCTION

Biligiri Rangaswamy Temple Wildlife Sanctuary (BRTWLS) is a unique place as a bridge between the Western Ghats and the Eastern Ghats in Karnataka, India. BRT wildlife sanctuary has spread over 574.8 km^2 with a very rich biodiversity. According to 2011 Census, there are 12,500 *Soligas* (the tribal community) living in the BRT wildlife sanctuary. Non-timber forest products constitute more than 60% of the *Soliga* tribal household income. Already, a number of studies have been conducted in the BRTWLS, for example, human dependence and ecological impacts, biodiversity conservation and livelihoods (Bawa, Rai and Sodhi, 2011) and extraction of non-timber forest products, assessing biodiversity status, use of traditional knowledge for forest management, ecological sustainability of non-timber forest products, human - wildlife conflict (Karanth et al., 2013), and invasive species (Sundaram et al., 2012). However, there is a lack of studies on the economic value of the BRTWLS. Therefore, this study estimates the economic value of provisioning, carbon sequestration, soil erosion prevention and recreational services of the BRTWLS in Karnataka, India. In addition, better conservation of natural resources can help to achieve Sustainable Development Goals at the local level. (Wood et al., 2017; Veidemane et al., 2019; Yin et al., 2021; Palacios et al., 2021).

There are a number of studies that have dealt with the economics of ecosystem services in India. For example, Verma et al., (2017) estimated the economic value of six tiger reserves at US $ 128 million to US$ 271 million and US $ 344 million to US$ 10.08 billion respectively. Badola et al., (2010) estimated the recreational value of the Corbett Tiger Reserve at US$ 167,619 and the value of carbon sequestration at US$ 63.6 million. Ninan and Kontoleon, (2016) estimated the economic value of 10 ecosystem services and 2 disservices (wildlife damage and forest fire) of the NagarholeNational Park in Karnatakaat between US$13 -148 million.

Manoharan (1996) estimated the value of ecotourism in Periyar Tiger Reserve in Kerala using the contingent valuation and travel cost methods, at Rs 676 per ha. The economic value of recreational services of sacred lake in Sikkim (Khecheopalri Lake) has been estimated at US $ 0.88. million. Many works have been conducted in respect of the Yamuna river Basin. Balasubramanian (2017) estimated the economic value of recreation services at Rs 4.4 million provided by Lalbagh botanical garden based on the travel cost method, while, the value of forest was estimated to Rs 0.93 million for Karnataka (Balasubramanian, 2013).

In the Indian context there are a number of studies that have estimated the economic value of forest ecosystem services (see table 1), but, very few studies have estimated these economic values of other important ecosystem services, for examples Ninan and Kontoleon (2016); Verma et al (2017; Chopra and Kadekodi (1997). Moreover, considering that India accounts for a major global biological diversity, ecosystems like forests, wetlands etc., provide more benefits to human beings. But, the existing economic growth models being followed the world over has increasingly led to the degradation of the ecosystems and their valuable services. Therefore, there is a need for quantification of the economic valuation studies for a better understanding of the importance of the ecosystem services as well as sustainable use of the ecological resources. Moreover, most of the studies focus mainly on the tangible benefits of a very few ecosystem services. But intangible benefits are more important to human well-being (MEA, 2005). Hence, the present study focuses on both the tangible and intangible benefits of the ecosystem services provided by the BRT protected area.

II. MATERIAL AND METHODS

A. Study Area

The BRTWLS is located in the Western Ghats of Karnataka. The altitude of BRT wildlife sanctuary ranges from 600m to 1,800m and the total average annual rainfall is 1,500mm. The present study focuses on the value of

Table 1. Economics of Ecosystem services studies in India

No.	Author	Area	Types of ESS	Methods	Value
1.	Badola& Hussain 2005	Bhitarkanika Mangrove Ecosystem	Provisioning services	Damaged cost avoided approach	$153.74 (per household)
2.	Anneboina& Kavi Kumar 2016	India	Coastal protection, carbon sequestration	Direct market valuation approach	US $ 5.9 billion
3.	Murali, Redpath & Mishra, 2017	Spiti Valley, Indian Trans-Himalaya	Provisioning, regulating and cultural services	Market price method, replacement cost method	US$2,667 per household
4.	Joshi & Negi, 2011	Western Himalaya	Provisioning and regulating services	Market price method, replacement cost method	US$ 74.05US$
5.	Verma, 2007	Uttarakhand	Provisioning services, regulating services	Market price method, replacement cost method	US$$ 0.86 million
6.	Ramachandra, 2016	Karnataka	Provisioning services, regulating services	Market price method, replacement cost method	US$ 1,100.16
7.	Bulov and Lundgren, 2007	Kerala	Recreational services	Travel cost method	$15 billion
8.	Chaudhury, 2006	Chandigarh	Recreational services	Travel cost method and Contingent valuation method	$0.3 million
9.	Chaudhury and Tewari 2010	Chandigarh	Recreational services	Zonal Travel cost method	$1.2 million
10.	De and Devi, 2011	Meghalaya	Recreational services	Travel cost and Contingent valuation	$ 4.8 million
11.	Gera et al 2008	Uttarakhand	Recreational services	Zonal Travel cost method	US $4019
12.	Ninan and Kontoleon, 2016	Karnataka	Provisioning, regulating and cultural services	Market price method, replacement cost method	$ 13.07 million to 147.11 million
13.	Manoharan	Kerala, Karnataka	Recreational services	Contingent valuation method	$ 22.8 million
14.	Nadkarni et al 1994	Karnataka	Provisioning services,	Net Present Value	$0.07 million
15.	Bisht N S (2017)	Mizoram	Provisioning, regulating and cultural services	Market price method, replacement cost method	$ 72 million
16.	Bahuguna and Bisht (2013)	India	Regulating services, value of		US$ 0.9 million
17.	Badola et al (2010)	Uttarakhand	Provisioning, regulating and cultural services	Travel cost, replacement cost	$ 105.2 million
18.	Pandit et al (2015)	Assam	Provisioning and cultural services	Travel cost	US$ 6.2 million
19.	Sinha and Mishra (2015)	Uttarakhand	Provisioning, regulating and cultural services	Market price method, contingent valuation method	Indirect services per hectare US $ 14.4 and direct services US$ 14.11

Sources: Various publications

minor forest products which are produced by the locals such as coffee, fruits and silver wood as provisioning services and carbon sequestration and soil prevention as regulating services while recreation as cultural services. BRTWLS is home to a number of species such as hanuman langur and giant flying squirrel, leopard sandcats in the moist deciduous and evergreen forests, Asian palm civet, sambar deer, chital and wild pig. Tigers and sloth bears are also found in the wildlife sanctuary. BRTWLS has a number of Asian elephants, the density of which has been estimated at 1.7/ km^2. Moreover, BRTWLS has a large density of herbivore species per km2 such as chital (13.96), gaur (5.08), muntjac (3.70), wild pig (5.33), bonnet macaque (6.56),the Hanuman langur (6.34) and the total biomass density is 4,127.82 kg/km^{-2} (Kumara and Rathnakumar, 2010).

B. Provisioning Services

Soliga is one of the predominant tribes in the Western Ghats of Karnataka. *Soligas* are dependent on the forest for their basic requirements such as food, fodder, fiber, fuelwood and other raw materials. After being declared as a wildlife sanctuary, agriculture is the main occupation (coffee, pepper, other cash, and non-cash crops and collection of non-timber forest products being the other vital sources of income for the *soliga* tribe. Fuelwood is an important source of livelihood for *soliga* tribe in BRT hills. For example, as estimated by Shankar et al.,(1998) fuel wood consumption per day is 7,522 kg in the core area (within the legal boundaries) and in the fringe area (corridor); it is 37,043 kg per day. The present study has collected information, based on the interview method, from 148 households spread across four podus (villages). This survey collected both quantitative and qualitative data for the study. Most households are still using fuelwood as a major source of cooking in the study area.

This study used the direct market price method for estimating the value of provisioning services used earlier by some studies, for example, (Ninan and Kontoleon, 2016; Kibria et al., 2017; Costanza et al., 2011). It therefore used the actual price of non-timber forest products, which is fixed by Large Scale Adivasi-Multi Purpose Co-operative societies (LAMP).

C. Carbon Sequestration

The present study has also estimated the value of carbon sequestration in respect of BRTWLS, using the following method (Kibria et al, 2017; Ninan and Kontoleon, 2016; Ninan and Inoue 2013; Xi 2009; IPCC 2000):

$$V_c = Q.P.S. \quad \text{.....(1)}$$

where V_c denotes the service value of carbon sequestration (US$), Q represents net carbon sequestration rate (tC $ha^{-1}yr^{-1}$) and P denotes the international carbon price (India) (US$/tC) and S stands for area of forest in hectare. The social cost of carbon is US$ 86 per tC (Ricke et al., 2018) has been used in this study. Social Cost of Carbon is defined as "the social cost of carbon (SCC) represents the economic cost associated with climate change (or benefit) that results from the emission of an additional tonne of carbon dioxide (tCO_2) (Ricke et al., 2018:895). The present study has estimated the value of carbon sequestration based on Kibria et al., (2017) methods. Particularly, previous Indian studies have used these methods for estimating the value of carbon sequestration, using the social cost of carbon followed by Nordhus (2011) for India at a low discount rate US$ 37.17 (Verma et al., 2017); World Bank (2014) social cost of carbon US$54/tC in (Ninanand Kontoleon, 2016). The present study has used the new value of the social cost of carbon for India US$ 86 per t/C (Ricke et al., 2018). This study has estimated the economic value of carbon sequestration in vegetation (above ground level biomass) and soil organic carbon from BRT wild life sanctuary in Karnataka.

D. Soil erosion

A number of studies have explained the value of soil erosion prevention (Kibria et al., 2017; Ninan and Kontoleon, 2016; Ninan and

Inoue, 2013; Xi 2009). This study has used the following methods of estimating the value of soil erosion prevention by forests:.

$$Vsc = Csr.G \sum Si.D \text{ [here, } D=(di - do)] \quad .....(2)$$

where Vsc denotes the economic value of soil conservation (US$); Csr denotes the cost of sediment deletion per ton (US$); Si stands for area of the respective type of forest in hectare; D is erosion reduction in forest land (t ha-1); G denotes the ratio of amount of sediments present in rivers or reservoirs to the total soil lost; di designates the rate of erosion of broad leaved forest (t ha-1). The present study has used Ninan and Inoue, 2013; Ninan and Kontoleon, 2016 and Kibria et al., 2017) for estimating the value of soil erosion prevention. The economic value of soil erosion prevention includes sediment removal cost and the rate of erosion of broad leaved forest and the rate of erosion of non-forest land (Xi, 2009).

E. Recreational Value

The present study has used the travel cost method for estimating the value of recreational services in the BRT wildlife sanctuary. Travel cost method (TCM) basically refers to an adding of conventional household production function models that the households make the most of utility based on many uses and production decisions. The individual travel cost method implies the assessment of a person engaging of his or her expenditure for non-market goods. Khan (2004) observed that the TCM applied the cost of spending to a non-priced interesting location in order to assume the recreational benefits provided by the site. Therefore, the present study surveyed 125 visitors who were visiting the Biligiri Rangasamy Temple Wildlife Sanctuary. However, a standard econometric model applied to the study observes the number of visitors to the recreational site as functional factors, for example socio economic characteristics such as age, family size, marital status, educational status, household income, travel cost, time spent in the travel to the recreational site and quality of the park. The econometric model is as follows:

$$r_i = \beta_0 + \beta_1 travel\ cost + \beta_2 age + \beta_3 marital\ status + \beta_4 household\ size + \beta_5 educational\ level + \beta_6 D_1 residential\ location + \beta_7 household\ income + \beta_8 D_2 quality\ of\ the\ park + e_i \quad .....(3)$$

The study has used the dependent variable r_i denotes the number of visits by the ***I***th person, his or her, to the recreational site per period of time; *travel cost* implies the total round trip cost from a person residence to and from of the tourism site and includes the opportunity cost of travel time and stay at the park. D_1 denotes 1, if urban dweller, and 0 otherwise, D_2 denotes 1 if the visitor's perception about the site's recreational facilities is good and 0, if bad.

III. RESULT AND DISCUSSION

3.1. Provisioning Services

Local people collect a wide range of non-timber forest products from the BRT wildlife sanctuary. Table 2 and 3 shows the economic value of provisioning services at the household level. The collection of non-timber forest products per season has been estimated at US$ 9,4721 from the sanctuary. Non-timber forest products are available only season-wise, for example, honey is available during the months from March to July. Honey is one of the major non-timber forest products and a major contributor to the household income in the BRT wildlife sanctuary. Honey is available only inside the forest with the frequency of collection being 3 times per season in the study area. More than 50 kg honey is extracted from the forest and they traverse more than 25 km from their home for this purpose. Every non-timber forest product has its own time period to be ready for harvesting, for instance, Shikakai (*Acacia concinna*) is one of the important livelihood sources of the households. The maximum Shikakai harvest takes place in the months of January and February, involving about 10 working days with 50 kg per season

1 This study has estimated per season the economic value of non-timber forest product collection at US $ 9,472 multiplied by three (season= US$ 28,416) per year value of NTFPs of the entire respondent

collected from the forest. Gooseberry is one of the important sources of income for the sample households and is harvested from March to April, involving about 10 working days on the average spent for the collection of each non-timber forest product, working 8 to 10 hours per day. All the non-timber forest products are sold through the LAMP located in the wildlife sanctuary, for example, honey at Rs 170 ($2.46) per kg. This study has found that per hectare value of non-timber forest products is US$ 6.2 from the sanctuary.

The study has estimated that the average annual income from non-timber forest products is between Rs 10,000 and 12,000 (US$ 144 and 173) for the sample households in the BRT wildlife sanctuary. Fuelwood is the main sources of cooking in the sample households. This study has found that 3,715 kg has been collected per annum from the wildlife sanctuary. More than 60% of the household income is received from these agricultural products. Further, only 40% of the households have 2 acres of land and more than 50% of the households do not possess any land for cultivation of agricrops. One of the respondents observed during the household survey that, the total income from non-timber forest products had been reduced as compared to the two previous decades due to weather changes and a number of restrictions enforced by the forest officials in the wildlife sanctuary. The study has also found that a few minor

Table 2. Economic value of provisioning services provided by BRT wildlife sanctuary

Services	Quantity (kg)	US$
Honey	3,583	5,145.75
Pacchi	1,593	34,72.17
Magaleberu	580	147.29
Shikakai (*Acacia concinna*)	1,125	112.97
Paduvanache	220	41.89
Aroleoil	260	35.13
Gooseberry	3,865	412.01
Amla	1,110	60
Fuel wood	3,715	0
Total		9,427.21

Source: Author's calculation

Table 3 Income from silver wood, fruits and coffee in the BRT

Production	Quantity	Amount (RS)
Silverwood	2,810	992,000
Coffee	10,660	1319,750
Pepper	1,611	4,58950
Goava	1,870	11,185
Chakkotta	940	10,150
Lemon	3,005	15,500
Jackfruit	4,450	131,900
Ginger	20	13,500
Banana	800	600
Total		2,953,535

Source: Author's calculation

forest products have been considered in the market through the LAMPS. These services are creating employment opportunities in farming, fisheries, timber harvesting and extraction of building materials (Kettunen, M. and ten Brink, P. eds., 2013). Provisioning services are contributing more than 14.5% of the total income of the households, marginalised households highly benefiting from the forest in Bhitarkanika conservation area, east coast of India (Hussain and Badola, 2010).

3.2. Regulating Services

3.2.1. Carbon sequestration

Carbon sequestration is another important ecosystem service provided by BRTWLS wildlife sanctuary. Moreover, this study is used secondary data for estimating the value of carbon sequestration in the BRT wildlife sanctuary. The secondary data is available only on physical quantity of forest area in hectare for the wildlife sanctuary and we calculated the value of carbon sequestration through the (IPCC, 2000) on net carbon sequestration in logged evergreen forest and semi-evergreen forest (2.65tC ha^{-1} yr^{-1}). The present study has found that the forest in BRT wildlife sanctuary sequesters carbon worth US$ 0.2 million (Table 5).

3.2. Recreation

The value of recreation services has been estimated based on the travel cost method. The present study interviewed 125 tourist visitors to the BRT wildlife sanctuary. The average number of recreational trips (2) and the amounts spent on ecotourism yearly average Rs 1,700 ($24.55). Visitors come from a maximum distance of 1,200 km and a minimum of 20 km to the wildlife sanctuary from their home. Most of the visitors spend a minimum of only 2 hours in the wildlife sanctuary. The total value of recreational services provided by the BRT wildlife sanctuary has been estimated at US$ 0.054 million. This study has also estimated the consumer surplus of visitors. The per capita consumer surplus amounts to Rs 38.24 (US$ 0.05) per visit. Previous studies have used travel cost method for estimating the value of ecotourism in this region, for example, Ninan and Kontoleon (2016) estimated the value of recreational services provided by Nagarhole national park at US$ 0.41 million. Another study Verma et al. (2017) estimated the value of recreational services across various protected areas at US$ 13.8 million.

3.4. Discussion

There are a number of studies that have documented the economic value of ecosystem services across protected areas of India. Already we have discussed in the first chapter services along with the value of many of national parks and wildlife sanctuaries. The present study has found the value of ecosystem services at Rs 23.9 million (US$0.64million), including provisioning services, carbon sequestration, soil erosion prevention and recreational services provided by BRT wildlife sanctuary (see table 5 and figure 1). The previous section has mentioned there is a lack of economic valuation of ecosystem services studies in the region. For example, Ramachandra (2016) estimated the value of provisioning services at Rs 15,171 crore (US $ 1.8 billion) per year provided by Uttara Kannada forest in Karnataka. Carbon sequestration is one of the vital ecosystem services provided by BRT wildlife sanctuary. The value of carbon sequestration has been estimated at Rs 14.4 million (US$0.2 million) from the sanctuary. There is no previous estimation recorded of carbon sequestration in the protected area. For instance, Ninan and Kontoleon, (2016) examined the value of carbon sequestration at US$0.38 million in respect of the Nagarhole national park of the Western Ghats in Karnataka which is located next to BRT wildlife Sanctuary. In addition, Verma et al (2017) estimated the economic value of carbon sequestration in Periyar tiger reserve at US$2.8 million. BRT Soil erosion prevention is another service provided by BRT wildlife sanctuary in the Western Ghats of Karnataka. The present study has estimated

the value of soil erosion prevention at Rs 2.1 million (US$0.03 million). The soil erosion prevention service is very vital for minimizing the sedimentation of rivers (Kibria et al., 2017). Previous studies have estimated the economic value of soil erosion prevention at US$ 0.07 million in respect of Nagarhole national park (Ninan and Kontoleon, (2016). The economic value of sedimentation regulation has been estimated at US$0.2 million in the Periyar Tiger Reserve in the Western Ghats of Kerala (Verma et al., 2017). The present study has estimated the value of soil erosion prevention at US$0.03 million. The earlier studies in India, for example Verma et al. (2017) examined the value of soil erosion prevention across various tiger reserves at US$ 17.9 million. In addition, Ninan and Kontoleon (2016) estimated the economic value of soil erosion prevention at US$ 0.38 million in respect of Nagarhole national park in the Western Ghats of Karnataka. Protected areas play a vital role in generating more income from ecotourism in India. The present study has estimated the value of recreational services provided by BRT wildlife sanctuary, using the travel cost method, at Rs 3.8 million (US$0.03 million). In Karnataka, there are 30 protected areas (National Park, Wildlife Sanctuary etc). BRT wildlife sanctuary is one of the famous spiritual and tourism places in Karnataka. This is the first economic estimation of the recreation services from the wildlife sanctuary. Table 4 shows the regression results of recreational value of BRT wildlife sanctuary. Household size shows a positive and significant relation in respective of those visiting the protected area. In addition, residential location and household income show a negative and significant relation

Table 4. Regression results

Variables	Coefficients (t-statistics)
Intercept	1.444 (2.757)
Travel Cost	-0.013 (-0.115)
Age	-0.115 (-1.148)
Marital Status	0.080 (0.803)
Household size	0.228 (1.936)**
Educational status	-0.082 (-0.864)
Residential location	-0.178 (-1.714)**
Household Income	-0.184 (-1.714)**
Quality of the park	-0.072 (-0.795)
R^2	0.70
F-Statistics	1.097

Remarks: ** 5% level of significance

Table 5. Ecosystem services and their value provided by BRT wildlife sanctuary

Ecosystem services	Total value in Rs (US $)
Provisioning services (Non-timber forest products and production of silver wood, fruits and coffee)	Rs 3.6 million (US$0.05 million)
Recreational services	Rs 3.8 million (US$0.054 million)
Carbon sequestration	Rs 14.4 million (US$0.2 million)
Soil erosion	Rs 2.1 million (US$0.03 million)
Total	Rs 23.9 million (US$0.634 million)

Source: Author's calculations

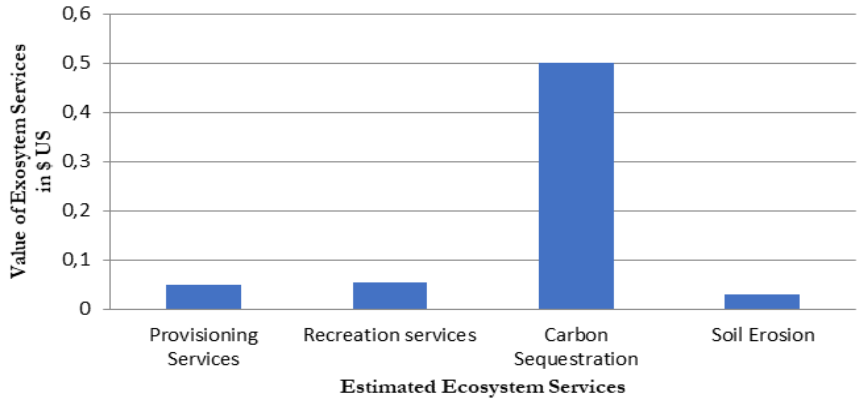

Figure 1. The composition of the values of ecosystem services

to the visit of this area. Table 4 clearly shows that travel cost has a negative association between the number of visits and the location of the wildlife sanctuary. There are a number of studies that have estimated the economic value of ecotourism in respect of other protected areas, for instance, Ninan and Kontoleon, (2016) estimated the value of ecotourism at US$ 0.41 million for Nagarhole national park and Balasubramanian (2017) estimated at US$ 0.2 million provided by lalbagh botanical garden in Bangalore. The economic value of recreational services provided by Dachigam national park in Jammu and Kashmir has been estimated at US$ 3,930,395, using the individual travel cost method (Bhatt and Bhat, 2019). Previous studies have used travel cost method for estimating the value of ecotourism in this region, for example, Ninan and Kontoleon (2016) estimated the value of recreational services provided by Nagarhole national park at US$ 0.41 million. Another study Verma et al (2017) estimated the value of recreational services across various protected areas at US$ 13.8 million.

IV. CONCLUSION

Biligiri Rangasamy Temple Wildlife Sanctuary (BRTWLS) provides a number of eco-benefits to the people. The value of a few ecosystem services is worth about Rs 23.9 million (US$0.634 million)$yr^{-1}$. The value of carbon sequestration is the highest as compared to other ecosystem services in the study area. The present study has only estimated the economic value of four ecosystem services i.e. provisioning, carbon sequestration, soil erosion prevention and recreational services provided by BRT wildlife sanctuary. The study has also found that the Non-Timber Forest Products (NTFPs) has been the vital role to their household consumption and income of the local tribal community. In addition, the protected area is also contributed as a major carbon sequestration by various forest types inside the sanctuary. The result of the study could also help in achieving Sustainable Development Goals (SDGs) at the local level. There are a number of ecosystem services still to be estimated in economic value terms. Moreover, assessing the economic value of ecosystem services would help design entry fee for the wildlife sanctuary as well as create awareness regarding the economics of ecosystem services provided by the protected areas. In addition, investment in natural capital is particularly vital in the protected areas for achieving sustainable development goals at the local level. Further, the allocation of the budget at the state level (TEEB, 2010b) as well as the value of protected areas contributes to national income accounts. This study has a number of limitations, for instance, there are a number of ecosystem services identified in the wildlife sanctuary but due to lack of data, only four ecosystem services have been estimated in terms of their economic value.

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