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A Total Economic Value of Seberuang Ancestral Forest in West Kalimantan - Indonesia: Benefit Transfer Method

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Abstract.

The study of economic resources in ancestral forests continues to develop in line with the emergence agendas of sustainable development goals. In Indonesia, ancestral forests are undergoing a serious alteration of its functions, leading to deforestation, ecological disasters, infectious diseases and social problems. The purpose of this study was to calculate the total economic value of ancestral forest in Riam Batu Village, Sintang Regency, Indonesia by using the benefit transfer method. This study found the Total Economic Value (TEV) of IDR 2.8 trillion per year or equivalent of US $ 189,672,579.00. The largest composition is Indirect Use Value which is equal to 99.62% of TEV while Direct Use Value shares of 0.37%, and the rest is Non Use Value, 0.03%. The TEV is equivalent to 16% of the total GRDP of Sintang Regency which is amounting to IDR 14.7 trillion in 2019, and is almost equivalent to the total GRDP of the agriculture, forestry and fisheries sub-sector which reached IDR 3.1 trillion. This research succeeded in building novelty in calculating isolated ancestral forest area that has not been much taken into account by decision makers in designing development programs and policies.

Keywords: Total economic value; benefit transfer; ancestral forest; indigenous peoples.

1. Introduction

The paradigm of Sustainable development goals (SDGs) puts economic, social and environmental dimensions in harmony, compatible and balance. This new development paradigm is believed to be able to bring prosperity and justice in the life and order of the world community, including indigenous peoples and local communities. In line with it, the study of the economic wealth of natural resources in ancestral territories including ancestral forests continues to develop and promoted. There are four reasons why the economy of indigenous territories is important to discuss. First, the environmentalist perspective looks at the natural resources should not be exploited, because it will change the ecosystem as a whole. Second, the developmentalist perspective holds that nature resources must be used and utilized to overcome poverty and improve the welfare of society. The third is the quasi (combined) developmentalist and environmentalist view, in which economic and environmental interests run proportionately (Saragih, 2001). Fourth, is the importance of proposing a development model, particularly the economic development of indigenous peoples and local communities based on their local wisdom and resources to be prosperous communities (Abafita et al., 2013; Ahmad et al., 2018). Local wisdom that grows and develops in indigenous peoples' communities is an integral part of the process of managing natural resources in a just and sustainable manner (Khan, et al., 2018). In fact, it is the foundation for conservation of nature (Krutilla, 1967). Culture and local wisdom are important conservation pillars since they are not only integrated with the preservation and conservation of natural resources and the environment, but also directly with the economic life of indigenous peoples. This is what makes the economic system of indigenous peoples socially and environmentally friendly (Khan et al., 2018).

The TEV concept has been used extensively to identify and classify the benefits of natural resources. TEV includes not only direct trade value (market) but also non-market value, ecological function, and non-use benefits related to natural resources including forests (Djajadiningrat et al., 2014). TEV consists of use value and non use value. The Use and non-use categories were introduced by John Krutilla in 1967 (Pascual et al., 2010). The use value is distinguished by direct use value and indirect use value (Hawkins, 2003). Environmental valuation using non-market method has developed to various parts of the world. This method developed in the United States in the 1960s and 1970s, in Europe in the 1980s and 1990s it has even become an important field. At the same time developing in Asia, Latin America and Africa (Djajadiningrat et al., 2014). Benefit transfer (BT) method is one of the methods commonly used in the valuation of ecosystem goods and services. Benefit transfer means the use of benefits from one place and time as data to estimate the benefits of actions or studies carried out at other similar places or times (Plumber, 2009).

Ancestral territory is the living space of indigenous peoples whose management uses customary norms. Regulation of the Minister of Home Affairs of the Republic of Indonesia Number 52 of 2014 states that ancestral territory is ancestral land in the form of land, water, and/or waters along with the natural resources on it with certain boundaries, owned, utilized, and preserved from generation to generation and in a sustainable manner to meet the living needs of the community, obtained through inheritance from their ancestors or claims for ownership in the form of common-pool land or ancestral forest. Local wisdom is a form of intellectual creativity of indigenous peoples from generation to generation covering various aspects of life, shaping the culture and spiritual identity of indigenous peoples (Lakshmanan and Lakshmanan, 2014). Anna et al (2018) cited (WIPO, 2017; Simon et al., 2016; Berkes, 2013), elaborated, local wisdom is knowledge, understanding, skills and practices developed, which are sustainable and continue to be carried out from generation to generation in a community, forming their cultural or spiritual identity. In addition, it also refers to the holistic understanding of indigenous peoples towards the world. Local wisdom can be related to the past, but also includes existing community practices, spirituality, morality, ideology, modes of artistic expression, intellectual creativity of indigenous peoples and the way in which knowledge is acquired, is passed on through generations.

Currently, natural forests face a serious threat of deforestation in Indonesia. FWI's study in 3 provinces, North Sumatra, East Kalimantan and North Maluku, shows the rate of deforestation is 240 thousand hectares per year in the 2013-2016 periods. Deforestation rate of 72% in the three provinces are in areas of concession permits: timber (*Hak Pengusahaan Hutan*, HPH), planted industrial timber (*Hutan Tanaman Industri*, HTI), oil palm plantations (*Hak Guna Usaha*, HGU) and mining. These four schemes are the direct causes of deforestation (FWI, 2018).

Table 1. Concessions and Deforestation Rate per Large Island in Indonesia

Island	Areas of HGU and Oher Concessions (Ha)	%	Deforestation rate (Ha)	%
Sumatra	1,632,029.00	2.98	251,000.00	18.72
Kalimantan	4,836,794.00	68.10	528,000.00	39.37
Sulawesi	144,888.00	2.04	247,000.00	18.42
Maluku	26,161.00	0.37	141,000.00	10.51
Papua	463,016.00	6.52	174,000.00	12.98
Total HGU	7,102,888.00	100.00	1,341,000.00	100.0

Source: FWI, 2018 and FWI, 2019

High rate of deforestation in Indonesia is closely related to land-based investment policies for the development of oil palm plantations and other concessions. It can be seen from the distribution of land use permits (HGU) for oil palm plantations and other concessions on major islands in Indonesia (Table 1 above). These permits are generally outside Java. Java is no longer a target for developing land-based concessions. The data shows the rate of deforestation parallels the extent of distribution of these concessions. If the development model based on natural exploitation does not change, the rate of deforestation will remain high. It brings about environmental damages, loss of ecosystems, infectious diseases, social problems and conflicts. Agustiar (2013) indicated in West Kalimantan, economic structural transformation has occurred inevitably, it should wisely take into account the important role of ecosystem including forest.

Previous studies on the economic valuation of indigenous territories using the TEV approach in Indonesia have been carried out by a number of researchers. Halimatussadiah et al., (2018) conducted a study in Kesepuhan

Karang, Banten province. The TEV obtained from two main sources, the economic value of natural resources products and environmental services, indicates total economic value of natural resource products is IDR 29.17 billion/year. Meanwhile, the economic value of environmental services is IDR 7.04 billion/year. The study conducted by Bahruni et al., (2018) for the Kajang Community, South Sulawesi found the TEV of Direct Use Value, Indirect Use Value and Existence Value reaching IDR 73,404,896;/hectare or IDR 60,021,437,201/per year. The economic value of the Kajang ancestral territory without including the weaving culture is IDR 28.92 billion/year. Siyaranamual et al., (2018) conducted a study in Kaluppini Village, South Sulawesi. Based on the results of the TEV, the economic value of the Kaluppini ancestral territory which includes natural resources products and environmental services, the natural resources products are IDR 35.28 billion/year, and environmental services are only IDR 0.31 billion/year. The TEV is IDR 35.59 billion/year. Napitupulu et al., (2018) conducted a study of the economic value of the Saureinu ancestral territory, Mentawai, West Sumatra. Based on the results of TEV, the wealth of the Saureinu ancestral territory from natural resources is IDR. 33.54 billion/year, while for environmental services it is IDR 0.84 billion/year. Anna et al., (2018), the TEV's study of Moi Kelim in Malaumkarta, West Papua. The wealth of the ancestral territory of Moi Kelim Malaumkarta for natural resource products is IDR 7.96 billion/year, the total environmental service value is IDR 159.93 billion/year. In this research, one of the methods used is benefit transfer. Finally, Khan et al., (2018) conducted a study in Riam Batu, Sintang Regency. The focus of the study is on direct use value and indirect use value. The value of natural resource products and environmental services of Riam Batu reaches a total of IDR 38.49 billion/year. This figure consists of the economic value of natural resources products of IDR 27.14 billion/year and the value of environmental services of IDR 11.35 billion/year.

The aims of this study are calculating the TEV of ancestral forest of Riam Batu, comparing the TEV to GRDP and income per capita of Sintang Regency. The findings of the study can provide a basic argument for the legal recognition of the ancestral forest to protect natural and economical assets of the community.

2. Review of Literature

Economists often explain, the exploitation and conversion of forest ecosystems is due to the low value of ecosystem products and services provided by forest ecosystems (Gatzweiler, 2003). Ecosystem services are not accurately quantified and are often not considered by policy makers (Costanza et al., 1997). The important role of valuation is to value ecosystem goods and services in monetary terms as a consideration in formulating a policy, management and protection options as well as being a bridge connecting beliefs to behave and act (Bartczak et al., 2008; Boerema et al., 2017; Hejnowicz and Rudd., 2017).

The study of modern ecosystem services began in the 1970s, framing ecosystem functions benefiting humans as economic services (Braat and de Groot, 2017). Ecosystem function is the capacity of natural processes and their components to provide goods and services to satisfy human beings either directly or indirectly. Natural resources and the environment (ecosystem) have 23 functions, with 4 main classifications, i.e. 1) regulatory function; 2) habitat function; 3) production function; and (4) the information function (Costanza et al., 1997; De Groot et al., 2002). Because of its great function for life, a new paradigm in environmental economics is emerging that the natural environment is natural capital (Barbier and Heal, 2006).

Forest coverage almost reaches 30% of the earth's land, containing 80% of the terrestrial biomass, becoming the habitat for more than half of terrestrial plants and animal species (Morales-Hidalgo et al., 2015). Between 2003 and 2012 an estimated 67 million hectares of forest burned each year, insect pests destroyed 85 million hectares of forest and 142 million hectares of forest were damaged due to various other disturbances (van Lierop et al., 2015). From 1990 to 2015, the world's forests decreased by 3%, from 4,128 million hectares down to 3,999 million hectares (Keenan et al., 2015). Forest Resources Assessment of 2015 data reveals that the trend of afforestation is increasing but forest degradation and loss continues to occur in poor tropical countries (Sloan and Sayer, 2015). Until 2030, forest conversion in the world which is very risky will occur in tropical areas (D'Annunzio at al, 2015).

In fact, healthy ecosystems provide services that are essential for the sustainability of human life (Salzman et al., 2001). Many ecosystem services have economic value because they contribute to well-being and can be scarce but they are not recognized by society (Pimentel, 1997; Editorial, 1999; Brockerhoff et al., 2017). Local wisdom contributes significantly to the solution to the crisis of biodiversity and climate change (United Nations, 2009), furthermore, forests are also landscapes having spiritual significance (Perriam, 2015; Lowman and Sinu, 2017). From the perspective of indigenous peoples, it is a holistic significance. Natural resources and the environment (land and forest) tie relationships with each other, the ancestors, the universe and the Creator.

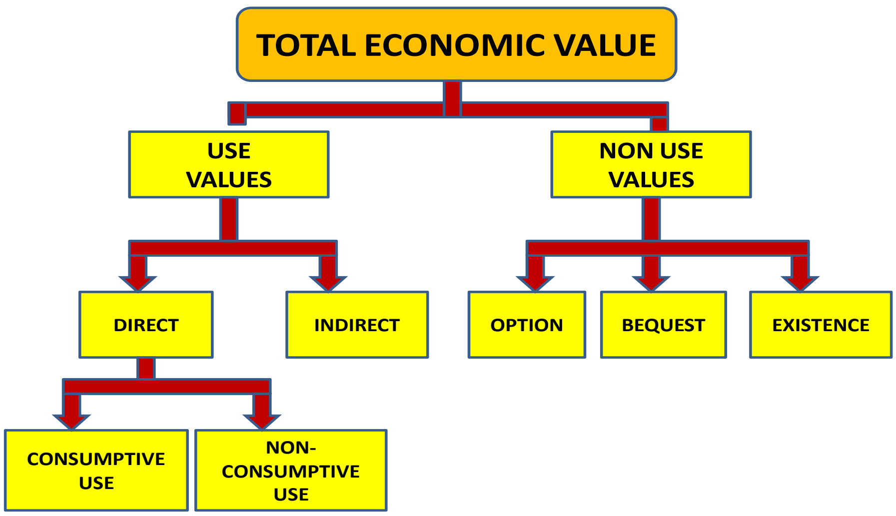
The Iban Dayak of Sungai Utik in Kapuas Hulu states "the land is the mother, the forest is the father and water is the blood". The significance of forest for indigenous peoples is very different from the significance of forest as defined by a globalized world that tends to be technically rational due to the influence of colonialism, imperialism and neo-liberalism (Gonzalez and Kroger, 2020). Forests are a gift that supports life (Deb, 2014). To preserve the services of environmental and natural resources, and avoid worse impacts in the future, studies and models should be created by economists to convince state leaders to take concrete action by providing significant budgets to overcome the risks being faced (Kuusela and Laiho, 2020).

The quantification of ecosystem services value is important for social recognition and ecosystem management at various geographic scales (Villa et al., 2002). The efforts to calculate the value of environmental and natural resources in a landscape have been carried out since the late 1960s. Non-market valuation was even first carried out by Hotelling (1949) when he estimated travel demand. Forest valuation was first carried out by Clawson and Knetsch in 1966 to assess forest recreation (Stenger et al., 2009). Pascual et al., (2010) stated six reasons for valuation to be carried out, they are (1) missing markets; (2) market imperfections and market failures; (3) for some biodiversity goods and services, it is important to understand and appreciate alternatives and their alternative uses; (4) there is uncertainty involving demand and supply of natural resources, especially in the future; (5) governments may prefer to use valuation rather than limiting, managing, or operating market prices to design biodiversity/ecosystem conservation programs; (6) to arrive at natural resource calculations, methods such as Net Present Value, valuation are mandatory.

TEV consists of Use Value and Non Use Value. The use value is further differentiated from the direct use value and indirect use value. Direct use value refers to the direct use of the consumption of resources such as wood, sugar palm, fish, primary agricultural commodities, etc. for both commercial and non-commercial purposes. Meanwhile, indirect use value refers to the value that is enjoyed indirectly such as the function of preventing floods and preventing landslides or the function of forests as carbon sinks (Anna et al, 2018). Another component is non-use value or passive value. This value is not directly related to the actual use of the goods and services produced. Included in the non-use value categories are the Existence value, Bequest value and Option value. Existence value is the value of existence. This assessment is given on the existence or maintenance of certain resources even though the community will not necessarily use them. This value is also called intrinsic value.

The bequest value is defined as the value provided by the current generation by providing or bequeathing resources for future generations. Bequest value is measured based on the willingness to pay the community to preserve it for future generations. Option value is defined as the value provided by the community for the choice to enjoy environmental goods and services and natural resources in the future. Option value is also a maintenance value so that options to utilize it are still available in the future (Anna et al, 2018).

Picture 1. Type of Benefits (Hawkins, 2003) Adapted from Edwards and Abivardi (1998)



Benefit transfer is a monetary valuation of ecosystem goods and services using the benefits from other places and times as data to estimate the benefits of actions or studies conducted at other similar places and times (Plumber, 2009). The BT method has evolved in environmental and natural resources studies due to the needs and demands of policymakers for estimating environmental benefits, particularly non-market benefits (Bartczak et al., 2008; Noel et al., 2009).

Considerable empirical studies on the quantification of ecosystem services have been conducted. Since 2005 it has increased exponentially. Of the 405 studies reviewed, they were scattered in 74 journals in 83 countries (Boerema, et al., 2017). Most studies were regulating services (48%), with the least being provisioning services (26%) and cultural services (26%). The weakness of these studies is, they focus more on one aspect, the ecological side or the socio-economic side. Therefore, they do not describe the functions, benefits and values as a whole. Barbier and Heal (2006) noted, one of the best examples of policy formulation based on the value of a single ecosystem service is the provision of clean water by the Catskill Mountains to New York City.

3. Methodology

This is a descriptive study using a quantitative approach. This study was conducted to determine the Total Economic Value (TEV) of Seberuang Riam Batu ancestral forest with the benefit transfer (BT) method, using the TEV approach with the following formula:

$$TEV = DUV + IUV + OV + EV$$

TEV : Total Economic Value
DUV : Direct Use Value
IUV : Indirect Use Value
OV : Option Value
EV : Existence value

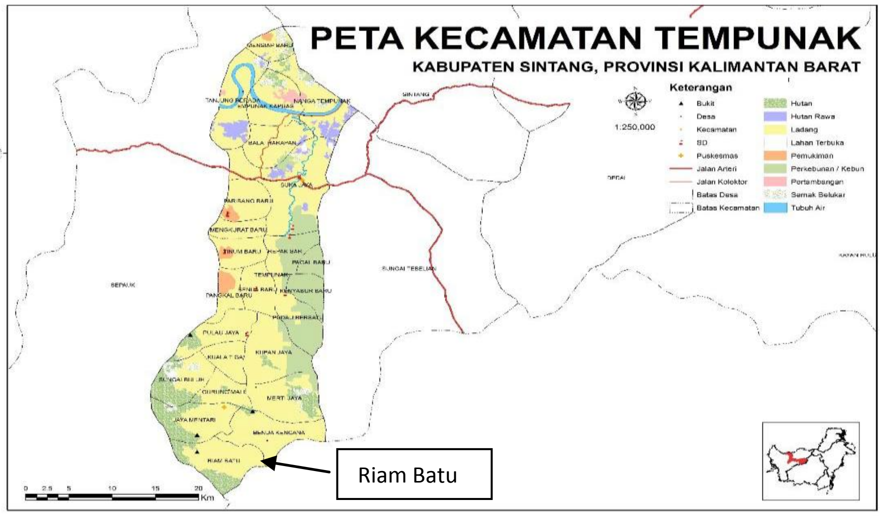
The use of benefit transfer method in this research based on cost-effective and time-effective consideration as in essence, ecosystem valuation is expensive and time-consuming (Colombo and Hanley, 2008; Isaza, 2014). BT has long been used in designing policies and applied environmental studies.

Boutwell and Westra (2013); Smith at al., (2002) in Anna et al. (2018) elaborated, BT is a method that adapts value estimates from previous research for the value of natural resources and environmental services that are the same, but separate, and changing in different sources. The weaknesses of the BT method include high risk of research error, the estimation of the value of the unit quickly unused, and recent research may be difficult to obtain. The advantages are in terms of costs, time, labor, easier adjustment to affected people and most techniques are maintained for the transfer of economic value (Robhati and Kusumawardani, 2016). There are two main forms of BT, 1) The unit transfer method is the simplest method of transferring estimated benefits from research sites, or the average of several study sites, to a policy site; 2) The function transfer method is transferring the benefit function from other studies. The benefit function relates to people's willingness to pay for ecosystem characteristics and the values they arise. This study uses the first form.

This study was conducted in Riam Batu, Tempunak District, Sintang Regency, West Kalimantan Province. Tempunak district geographically is at latitude coordinates 00 09 'NL to 00 26' latitude and longitude at 1110 14 'east longitude to 1110 24. The village with an area of 5,213.36 hectares consists of 3 hamlets: Mulas, Lanjau and Lebuk Lantang, 266 households, with 997 people (511 men and 486 women).

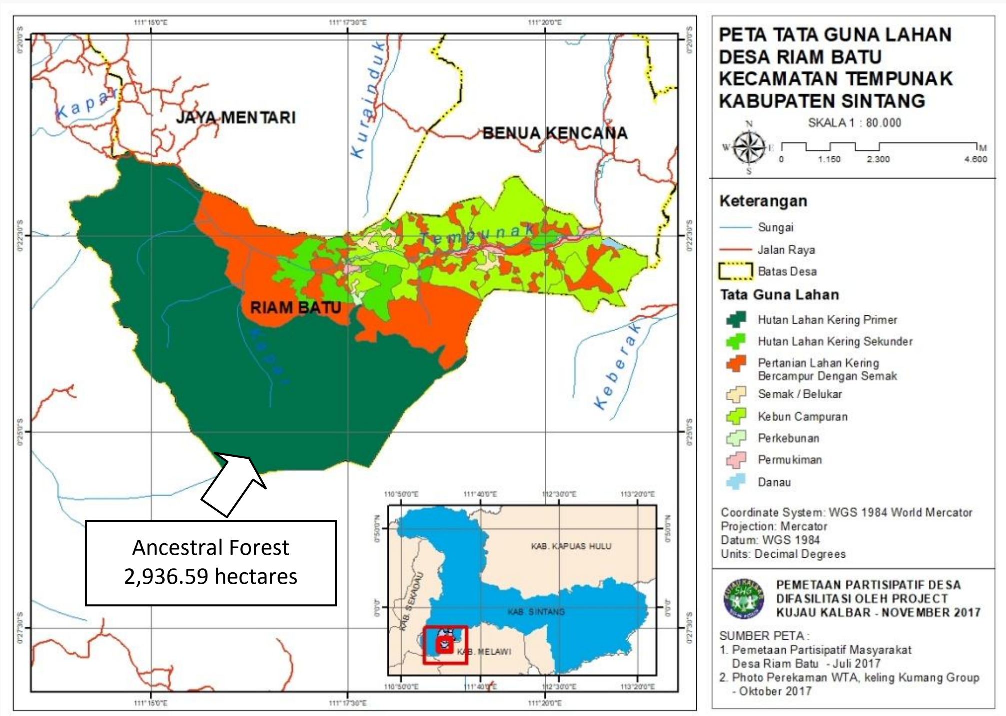
The ancestral territory of Riam Batu consists of 61.03% ancestral forest, 19.13% cultivation area, 12.10% rubber, 6.52% (shorea forest), 0.95% ex settlement (secondary forest) and 0.27% settlement. The main livelihood is as traditional farmers, rubber farmers and forest products takers. The land contours, especially in Mulas and Lanjau, are generally hilly except Lebuk Lantang which is more flat. The educational facility available is primary school in Lanjau. This ancestral territory is rich in natural resources such as wood, tengkawang (shorea), resin, rattan, bamboo shoots, dogfruit, stink bean, mushrooms, game, birds, fishes, vegetables, natural fruits, medicines. The sources of cash income are rubber, chilly, pepper, dogfruit, stink bean, and banana. Customary laws are obeyed by all citizens.

Picture 2. Riam Batu Within the Tempunak District Map



The uniqueness of Riam Batu is Bukit Saran, the highest hill in West Kalimantan, 1,741 meters above sea level. Bukit Saran, apart from being endemic for a number of species, is a sacred place for prayer traditionally. This is where the souls of the ancestors and magical people live. Bukit Saran is a farm hut (langkau uma) of Inai Abang, one of the figures in the legend of *Buah Main* of the Ibanic Dayak group.

Picture 3. Map of Riam Batu Ancestral Forest



In this study, the benefit transfer value used is the BT value from a number of references. Most of the benefit transfer values are taken from a report published by the Food and Agricultural Organization - FAO (2009) in Annex 4 which presents the total economic value (TEV) of Indonesian forests in 2002 in units of US $ per hectare per year as shown in the table below.

Table 2.Total Economic Value (TEV) of Indonesian Forests 2002 (US $/Hectare/Year)

Type of Value	Primary Production Forest	Logged Over Forest (Secondary)	Conservation Forest	Protection Forest
Total Economic Value	**209.44**	**203.07**	**269.47**	**269.47**
Use Value	***199.84***	***195.48***	***252.55***	***251.55***
Direct use value	***109.73***	***93.02***	***135.09***	***135.09***
Timber	60.97	53.67	0	0
Fuelwood	0.16	0.16	0	0
Bon-wood forest products	48.17	38.76	28.47	28.47
Water consumption	0.43	0.43	106.61	106.61
Indirect use value	***90.12***	***101.46***	***116.46***	***116.46***
Soil and water conservation	41.58	40.12	41.58	41.58
Carbon sink	6.57	27.38	5.48	5.48
Flood protection	25.82	24.52	53.26	53.26
Water transportation	5.80	5.80	5.80	5.80
Biodiversity	10.35	4.64	10.35	10.35
Non-use value	***9.59***	***7.59***	***17.93***	***17.93***
Option value	3.40	2.95	7.58	7.58
Existence value	6.19	4.64	10.35	10.35

Riam Batu Ancestral forest is protected forest. Therefore, the benefit of TEV transfer taken is in the protected forest category of FAO (2002). After recalculating, the TEV of Protected Forest per hectare per year is US $ 269.48 instead of US $ 269.47 as stated in the original table. In the table above, there is no transfer benefit value for oxygen provider (O2), so the benefit transfer value for forest as oxygen provider (O2) is taken from Gerakis approach (1974) in Afrizal et al (2010) and Darmawan (2015) which states that every 1 M2 area of forest vegetation can produce ± 50.625 grams of oxygen per day.

The calculation of the value of water production refers to the measurement of the Tempunak river water which receives water supply from this ancestral forest in 2017, by Mr. Gunawan, a micro hydro electric plant expert CV Cihanjuang Bandung. His measurement found that the Tempunak river water discharge in the dry season was 2,500 liters per second while in the rainy season it was 7,000 liters per second, or an average of 4,750 liters per second. In 2017, the average amount of rainfall in Sintang regency was 258.5 mm3 with the largest amount of rainfall occurring in September, i.e. 404.1 mm3 with 19 days of rain in a month. The lowest rainfall in June was 54.6 mm3, with 14 rainy days. According to the Susilo Sintang Meteorological Station, the high intensity of rainfall was mainly influenced by the condition of tropical forested areas and high humidity (Kabupaten Sintang Dalam Angka 2018).

The price per liter of water is counted by referring to the Sintang regency tariff for Class IIA households, the households using 10-20 cubic meters at a rate of 1 cubic of IDR 3,304. The tariff per liter is IDR 3.304; (Three point three zero four rupiah). This provision is regulated in the Regulation of the Regent of Sintang Number: 31 of 2015 concerning the Structure and Tariff of Drinking Water in Sintang Regency. The calculation results are in table 4.

The next is the calculation of wood volume. The wood (timber) is not cut down since it is protected forest. The Ministry of Environment and Forestry also decided it as protected area. For the need of wood value valuation, its volume needs to be calculated. This study only calculates the volume of commercial timber for Class 1 *meranti* type (shorea sp) and commercial timber Class 2 mix as regulated in the Minister of Environment and Forestry Regulation No. P.64/MENLHK/SETJEN/KUM.1/12/2017 Concerning Determination of Benchmark Prices for Forest Products for Calculating Provisions for Forest Resources and Compensation for Stands. So far, no data provided on the potential of this wood in the Melawi KPH XIII (Forest Responsible Board) which supervises the Riam Batu ancestral forest, so the benefit transfer value for calculating the volume of wood refers to the findings of Azham and Bakrie (2014), i.e. Analysis of the Potential to Strengthen the Results of Forest Inventory in KPHP Model Berau Barat, East Kalimantan. Their study took a sample of 45 hectares, finding that the average volume of wood was 177.40 m3/hectare. The average volume per hectare of *meranti* (shoreas sp) species was the largest at 55.93 m3/hectare (Class 1 commercial wood), *medang* (phoebe hunanesis) 13.23 m3/hectare and keruing (dipterocarpus retusus) 12.57 m3/hectare (Class 2 commercial timber). The calculated wood volume is 20 up.

The value per cubic of wood for Class 1 type of *meranti* refers to the Minister of Environment and Forestry Regulation No. P.64/MENLHK/SETJEN/KUM.1/12/2017. The regulation stipulates that Class 1 commercial timber is *meranti* type, the price of medium log is IDR 780,000/cubic. The price of large logs is IDR 810,000/cubic, the average price is IDR 795,000/cubic. Meanwhile, for Class 2 commercial wood originating from the Kalimantan region, the price of Medium Log is IDR 480,000/m3; and the price of large logs is IDR 500,000/m3. The average price is IDR 490,000/m3. The calculation is shown in table 5.

4. Data Analysis

The total economic value (TEV) of Riam Batu ancestral forest is as follows:

A. The TEV of Riam Batu Ancestral Forest Based on Benefit Transfer Calculations according to FAO (2009) Protected Forest Category

Table 3. Total Economic Value of Riam Batu Ancestral Forest Based on Benefit Transfer Calculations according to FAO (2009) Protected Forest Category

N0	Type of Value	Per hectare of forest/year (US$)	Area of Ancestral Forest	Value * Area of Ancestral Forest
	Total Economi Value	**269.48**	2,936.59	**791,352.27**
A	**Direct use value**			
1	Non-wood forest products	28.47	2,936.59	83,604.72
2	Water consumption	106.61	2,936.59	313,069.86
	Sub Total A	**135.08**		**396,674.58**
B	**Indirect use value**			
1	Soil and water conservation	41.58	2,936.59	122,103.41
2	Carbon sink	5.48	2,936.59	16,092.51
3	Flood protection	53.26	2,936.59	156,402.78
4	Water transportation	5.8	2,936.59	17,032.22
5	Biodiversity	10.35	2,936.59	30,393.71
	Sub Total B	**116.47**		**342,024.64**
C	**Non-use value**			
1	Option value	7.58	2,936.59	22,259.35
2	Existence value	10.35	2,936.59	30,393.71
	Sub Total C	**17.93**		**52,653.06**
	A+B+C (US $)			**791,352.27**

B. Oxygen Provider Value (OPV)

The oxygen provider (O2) uses the benefit transfer value according to Gerakis production approach (1974), in Afrizal et al., (2010) and Darmawan (2015) which states that every 1 square meter of forest-vegetated land can produce 50,625 grams of oxygen every day. The calculation is as follows:

- Every square meter of forest vegetated land per day produces : 50,625 grams
- Per hectare per day : 506.25 kilograms
- Per hectare per year : 184,781.25 kilograms
- Total oxygen produced by the forest (2,936.59 hectares) per year : 542,626,770.95 kilograms
- 1 kilogram of oxygen is IDR 4,000; x total production : IDR 2,170,507,083,750.00;

The price of the oxygen refers to the data at the oxygen agency (PT. Papasari) on June 4, 2020 in Pontianak, 1 kg oxygen is IDR 4,000. Total value of the oxygen of Riam Batu Ancestral forest per year is IDR 2,170,507,083,750.00;

C. Water Production Value

Table 4. Calculation of the Water Production Value of Riam Batu Ancestral Forest

N0	Average Volume (Liter)	Unit of Time	HOUSEDHOLD CATEGORY IIA	Price/liter (IDR)
1	4.75	Per second	15,694	3.304
2	285	Per minute	941.64	3.304
3	1,710,000	Per hour	56,498,400	3.304
4	410,400,000	Per day	1,355,961,600	3.304
5	12,312,000,000	Per month	40,678,848,000	3.304
6	**147,744,000,000**	**Per year**	**616,605,696,000**	3.304

D. Wood Volume Value

Table 5. Value of Wood Volume of Riam Batu Ancestral Forest Based on Potential Forest Resources Azham and Bakrie Approach (2014)

Volume of Forest (m3/hectare)	Value
Average Volume of Forest (m3/hectare)	**177.4**
A. Commercial wood Class 1 Category Shorea sp (Meranti)	
1. Average Volume for Shorea sp (Meranti) per hectare	55.93
2. Area of Riam Batu (RB) Ancestral Forest (Hectare)	2,936.59
3. Volume of Shorea sp/hectare x RB Ancestral Forest (hectare)	164,243.48
4. Average price per cubic (IDR)	795,000.00
Total A	130,573,565,566.50
B. Commercial Wood Class 2 (Forest mix)	
1. Average volume of Phoebe hunanesis (Medang) and Dipterocarpus retusus (Kruing) per hectare	25.8
2. Area of RB Ancestral Forest	2,936.59
3. Volume of Phoebe hunanesis (Medang) and Dipterocarpus retusus (Kruing) x RB Ancestral forest area	75,764.02
4. Average price per cubic (IDR)	490,000.00
Total B (IDR)	**37,124,370,780.00**
Total A + B (IDR)	**167,697,936,246.50**

The assumption of 35 years of selective harvesting is in accordance with the applicable regulations in Forest Concession Rights (HPH), with an annual cut of 83.90 hectares, the average value per year is IDR 4,791,369,609.90.

5. Results

The Total Economic Value (TEV) of Riam Batu Ancestral forest is as follows:

Table 6. Summary of Total Economic Value (TEV) of Riam Batu Ancestral Forest

TEV COMPONENTS	VALUE (IDR)	VALUE (USD)	%	NOTE
I. DIRECT USE VALUE (DUV)				
A. Wood				
1. Commercial wood Class 1	3,730,673,301.90	252,456.32	0.13	Per year
2. Commercial wood Class 2	1,060,696,308.00	71,777.79	0.04	Per year
B. Non –wood forest products	1,160,266,266.69	78,515.73	0.04	Per year
C. Water consumption	4,344,783,515.69	294,013.43	0.16	Per year
	10,296,419,392.28	**696,763.28**	**0.37**	**Per year**
II. INDIRECT USE VALUE (IUV)				
1. Soil and water conservation	1,694,551,123.98	114,671.03	0.06	Per year

2. Carbon sink	223,331,853.78	15,112.97	0.01	Per year
3. Flood protection	2,170,557,780.84	146,882.61	0.08	Per year
4. Water transportation	236,373,149.16	15,995.48	0.01	Per year
5. Biodiversity	421,803,907.38	28,543.66	0.02	Per year
6. Water production service	616,605,696,003.24	41,725,981.80	22	Per year
7. Oxigen production service	2,170,507,083,750.00	146,879,180.09	77.44	Per year
	2,791,859,397,568.38	**188,926,367.62**	**99.62**	**Per year**
III.NON-USE VALUE (NUV)				
1. Option value (OV)	308,915,259.30	20,904.43	0.01	Per year
2. Existence value (EV)	421,803,907.38	28,543.66	0.02	Per year
	730,719,166.68	**49,448.09**	**0.03**	**Per year**
TOTAL ECONOMIC VALUE (TEV)	**2,802,886,536,127.34**	**189,672,579.00**	**100**	**Per year**

Note: Conversion to USD is based on the exchange rate as of 3 September, 2020, 1 IDR 14,777.5/US $

6. Discussion

The TEV calculation above shows that;

- Direct Use Value (DUV) of IDR 10,296,419,392.28 or US $ 696,763.28 (0.37%)
- Indirect Use Value (IUV) of IDR 2,791,859,397,568.38 or US $ 188,926,367.62 (99.62%)
- Non-Use Value (NUV) which consists of Option Value (OP) and Existence Value (EV) of IDR 730,719,166.68 or US $ 49,444.09 (0.03%).
- TEV(DUV + IUV + NUV) Riam Batu ancestral forest is IDR 2,802,886,536,127.34/year or US $ 189,672,579.00/year.

Thus, the largest component is IUV, i.e. 99.62%. The biggest contributor to this IUV is the production of oxygen and water. Oxygen and water are very vital components for human life. The TEV value above is 16% of the GRDP of Sintang Regency in 2019, which amounted to IDR 14.7 trillion or almost the same as the amount of GRDP for the agriculture, forestry and fisheries sub-sector which reached IDR 3.1 trillion in 2019.

Forest productivity per hectare is IDR 954,469,822.52 (US $ 64,589.40). The TEV divided by the total population (977 people in 2019), per capita per year is IDR 2,868,870,558.98 or IDR 239,072,546.58 per month (US $ 194,137.75). Compared to the per capita income of the residents of Sintang regency of IDR 35.16 million (US$ 2,379.29) or 2.93 million (US$ 198.27) per month in 2019, the welfare level of the Riam Batu community is far above the average population of Sintang regency.

The Seberuang Riam Batu continues to protect their ancestral forest. Currently, they make use of clean water, micro-hydro power plants and non-timber forest products. Their ancestral forest possesses economic, social, cultural and spiritual values. These values are the pillars of the sustainability of the ancestral forest. In this case, the government policy support is needed that is legal recognition. Through legal recognition, the prevailing customary rules in protecting ancestral forest get affirmation from the State. The recognition also provides legal certainty that the ancestral forest will not change hands to other parties. Internally, the recognition provides the power to prevent it from illegal logging. The management of ancestral forest based on local wisdom has proven effective and substantive. Indigenous peoples are able to manage their resources sustainably. It can be a reference for the state to entrust the indigenous peoples to manage their own ancestral forests.

Since Sintang drinking water company (PDAM) raw water is taken from the Tempunak river, whose water supply comes from this forest, therefore, the community expects there is a benefit sharing policy between PDAM Sintang and Riam Batu community. The benefit sharing expected is a budget allocation annually for village infrastructures, high school and higher education scholarship schemes, health care, access improvement and maintenance from Riam Batu to the main road and a quota to become employees of PDAM Sintang.

7. Conclusion

The TEV of Riam Batu ancestral forest which includes 12 components using the benefit transfer method is IDR 2,802,886,536,127.34 (US $ 189,672,579.00). The largest component is IUV, which is 99.62%. Forest productivity per hectare is IDR 954,469,822.52 (US $ 64,589.40). The TEV divided by total population (977 people in 2019), per capita per year is IDR 2,868,870,558.98 or IDR 239,072,546.58 per month (US $ 194,137.75).

Compared to Sintang regency's residents per capita in 2019 which is IDR 35.16 million (US $ 2,379.29) or IDR 2.93 million (US $ 198.27) per month, the welfare level of the Seberuang Riam Batu is far above the average population of the Sintang regency.

The data shows, the TEV of Riam Batu ancestral forest is enormous. Therefore, it is understandable if the community will not convert it. Consequently, any project may be adopted in this area should take into account the above TEV. The TEV can serve as a basis for the state recognition to protect the ancestral forest. The state recognition provides legal certainty for the community.

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