

Extended benefit cost analysis as an instrument of economic valuated in Petungkriyono forest ecosystem services

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Abstract. Petungkriyono is the last tropical forest in Java and provides biodiversity including rare flora and fauna that must be maintained, managed and utilized in order to give meaning for humanity and sustainability. Services of Forest Ecosystem in Petungkriyono are included such as goods supply, soil-water conservation, climate regulation, purification environment and flora fauna habitats. The approach of this study is the literature review from various studies before perceiving the influenced of economic valuation in determining the measurement conservation strategies of Petungkriyono Natural Forest Ecosystem in Pekalongan Regency. The aims of this study are to analyzing an extended benefit cost of natural forest ecosystems and internalizing them in decision making. The method of quantification and valuation of forest ecosystem is Cost and Benefit Analysis (CBA) which is a standard economic appraisal tools government in development economics. CBA offers the possibility capturing impact of the project. By using productivity substitution value and extended benefit cost analysis any comodity such as Backwoods, Pine Woods, Puspa woods and Pine Gum. Water value, preventive buildings of landslide and carbon sequestration have total economic value of IDR.163.065.858.080, and the value of Extended Benefit Cost Ratio in Petungkriyono is 281.35 %. However, from the result is expected the local government of Pekalongan to have high motivation in preserve the existence of Petungkriyono forest.

Keywords: Economic valuation, natural forest ecosystem, extended benefit cost analysis

1. Introduction

The role of forest resources is very strategic in terms of endurance, food sovereignty for both national protection and security. The biodiversity that is contained in the forest area determines the sustainability of a nation. Various types of flora and fauna and also germplasm effect the macro either micro climate. By maintaining the existence of forest area for minimum 30% from the land area, it is expected to be able as the climate and water regulator.

According to Suparmoko [14], the role of the forest was very unique, due to its great ability to fulfill the needs of human and other living things. Forest had the main function as CO₂ assimilator so the tropical forest in Indonesia is often called as the lung of the world.

White and Heckerberg [15] stated that the loss assessment of the environmental damage was the most important thing in the policy formulation and to prevent the potentially criminal acts and to recover the damaged natural resources.

Economic valuation of forest ecosystem was a complex task, including various factors that were related to conservation area for human welfare, social and political value [12].



Petungkriyono as an icon of Pekalongan Regency had some reasons. **First**, Petungkriyono forest became the function balancer of the ecological area, which was the habitat for some species, including the epidemic species. There were at least 253 species among 4 primate species, including *Owa Jawa*, 63 species of birds, 104 species of butterflies, 41 species of orchids contained 29 epiphyte species and 12 terrestrial species, 19 species of ferns (*pterydophyta*), 4 species of primate and 22 species of trees. Some rare and protected species, such as Lutung Hitam (*trachypithecus auratus*), Surili (*presbytis comata*), Owa Jawa (*hylobates moloch*), Black Eagle (*ichtiaetus malayensis*), Javan Hawks, Julang Mas (*aceros undulatus*), while the plant species was found *Macodes petola*, and *Kantung Semar (nephentes adriani)*. In this area, it also could be found a leopard, big cat, *binturung*, Javanese pigs, deer, and others. That was the reason why it needed to be a guard and protected. **Second**, Petungkriyono particularly had the mystery of the rest of the past culture through archeology sites, between Lingga/ Yoni, Ganesha statue, and *batulumpang* in Telagapakis Village, While Yoni was in Gondang Hamlet Tlogohendro Village, Lingga was in Mudal Hamlet Yosorejo Village Petungkriyono Sub-district. Those sites showed the traces of the history of the past and became liaison between past and present. We surely needed further research about those sites, but at least today we understand that in the past, Petungkriyono and surrounds had various meaning in socio-culture in past. Every site was always equipped with the stories, including the cultural myths. Those myths lived in the social culture of Petungkriyono, including myths to the forest area. People there developed the myth of the region, creating an imagination of forbidden and holy places, and taboo behaviors that were allowed or not allowed to the forest area. Through those myths, people maintained, preserved and guarded the area of Petungkriyono forest. **Third**, the landscape of Petungkriyono was very beautiful, including a dozen of small or big waterfalls, river, and the whole green landscape in it; the area of Petungkriyono forest was about 84% from the wide of sub-district of Petungkriyono so the most part of people's economy was sourced from the forest area. All this time, the economy potency came from the conventional approach of forest area, which was timber and non-timber that was extracted from the forest area. This approach started to be left behind because it had a risk to the changes of area ecology and environmental impact in the upstream areas. The ecological principles became important due to the local government concerned to the efforts to keep the ecosystem of the watershed as a guarantee of agricultural water supply and mitigation of natural disasters. The landscape of Petungkriyono was also a tourism potential to the district as it could bring income to the local people and locally-generated revenue without damaging the ecological function of this area. For example, exotic landscape, such as waterfall (*curug*) of Sibedug, Muncar, Bajing, Lawe, Sokokembang, Sriti and Kutis; the challenging rivers for rafting, such as in Kedung Sipingit and Welo River. There were also natural caves, such as Macan cave, hiking track of Rogojembangan Mountain, Tugu Summit, and Kendalisodo Summit.

The approach of this study was literature review from various studies before perceiving the influence of economic valuation in determining the measurement conversation strategies of Petungkriyono Natural Forest Ecosystem in Pekalongan Regency. In order to analyze the extended benefit cost of economic value in Petungkriyono forest ecosystem services.

2. Research Methods

The method of quantification and valuation of forest ecosystem had four steps of benefits, which were typically recognized as follow [14]:

- (i) Identify the important impact of forest degradation;
To understand the presence and absence of the effects to the environment by an approach of *before and after a projector* by *with and without a project*. For example, for the case of fire woods, it was more precise to use *before and after* because of the differences that can be seen clearly, but if the previous recording condition was absent or unclear so it should use the approach of *with and without a project*. Identification was needed to see the benefits and functions of forest ecosystem especially that was gotten from surrounding people [8].
- (ii) Polluters pay principle;

Quantifying the effect generated. By understanding the value of environmental effect, one of them could be understood a number of pollution charges that would be charged to the pollution creator, it was known as *polluter pay principle*. For example, in the case of deforestation, its negative effect was the loss of forest timber and its product, happened the soil erosion that caused loss of various types of plantations and productivity decreasing, happened the siltation of the river and beach, climate disorder and ecosystem habitats in the downstream area.

(iii) Economic rent with net price;

After identifying the impacts arising due to logging or fire woods, the next step was to measure total or volume of the physical effect. Forest and the logged area were measured for its volume of timber to measure the economic rent per unit as the price of the standing stock. To measure the value of natural resources, it could be used the economic rent approach or so called net price, which was the value that needed to be repaid to the Government as an agent who paid attention to the public interest and maintained the natural resources and environment.

(iv) Extended benefit cost analysis.

The last step of this study was by doing the analysis for the external benefits or external cost that appeared due to the environmental aspect that needed to be counted, so the feasibility analysis was expanded by fulfilling the cost dimension and environmental benefits into the extended economic feasibility.

The method to estimate the natural resources and environment, including: direct observed, indirect observed, indirect hypothetical and direct hypothetical [9]. Those potentials could be seen from total economic value of natural resources. The estimated Variables that could be measured on this research were:

1. Direct Use Value, which was the direct value that could be taken directly from the natural resources, such as: timber, fire-wood, pine gum, fruits, vegetables, bamboo, etc.
2. Indirect Use Value, which was gotten from forest utilization indirectly and was not the result of physical interaction between forest and customers, such as forest ecological function as micro climate controller, protection to the wind and flood, protection to the flora and fauna habitat and biological diversity.
3. Option Value, which was the value that showed someone or individual's willingness to pay for conserving the forest resources for future.
4. Existence Value, which was the value of someone's care to the existence of forest resources, including the value that was given by society for the spiritual benefits, aesthetic and cultural, such as eco-tourism, religious tourism and conservation of local tradition.

The direct benefit was sum up by external benefit (environment) and called as social benefit while the direct cost was sum up by external cost (environment) and called as social cost. To analyze the cost and benefit that had been developed, it was stated as below formula [11]:

$$NPV = \sum_{t=0}^{\infty} \frac{(Bt - Ct)}{(1+i)^t}$$

where:

NPV = Net present value (difference between revenue and expending every year)

Bt = Benefit / t year benefit

Ct = Environment cost of t(external) year

I = Level of Disconto factor

Technique of the survey, to decide the environment value of forest ecosystem, was done using Delphi approach. This approach was according to the statements of the experienced experts and them who had appropriate educational background. This technique was chosen due to the minimum data information, especially related to a specific characteristic of Petungkriyono forest ecosystem.

The scope of this study was limited by the availability of the secondary data that was got by related institutions, i.e. Central Bureau of Statistics, Forestry Department of Pekalongan Regency, Bureau of Watershed Controlling Pemali Jratun, Department of Environment and Forestry of Central Java Province. To calculate the NPV in Petungkriyono forest ecosystem, it was the sum up of these variables, i.e. the amount of timber production and non-timber forest products, people's income and employment opportunity. Furthermore, cost was the data of forest damage, landslide disaster, and drought, and also decreasing amount or even endangered of some types of endemic flora and fauna of typical Petungkriyono.

3. Result

3.1. Characteristics of Petungkriyono Forest Area

Petungkriyono sub district is located 43 Km south side of Pekalongan Regency and it is one of plateaus in Pekalongan Regency with the height 1300 meter above the sea level and the temperature reaches 18-30°C with the extensive area 7.358,523 Ha. From total area, there are 73, 2 % of forest area.

According to characteristics of Petungkriyono area, which most of the area is forest area, it is correlated to the majority of local people is men. Area of Petungkriyono sub district contains of 9 villages and the biggest extensive of State forest area is in Tlogohendro village with 1074.635 Ha, while the most potential people forest is in Soggodadi village with 50 Ha.

Total population on 2016 in Petungkriyono sub district was 12.368 people; contained of 6.246 men and 6.215 women. Ratio of total population between men and women in Petungkriyono sub district were 98.88% in average, so the majority was men although the differences were small. Majority of people's occupation was farmer or in farming sector 50.38%.

3.2. Identification of Economical Benefit in Petungkriyono Ecosystem

According to inventory result of secondary data, it was got the data of Petungkriyono potency that came from forest product of wood, i.e. pine wood, puspa wood and mixture of back wood; while the forest product of non-timber, i.e. pine gum.

The direct use value of forest was got from the benefit of wood for both craftsmanship and fire wood, rattan, animals, dill, vegetables and fruits that could be counted as below (5):

$$ML = MEK (\text{Puspa wood} + \text{Pine wood} + \text{Mixture of Back wood}) + MEGP$$

where:

ML : Direct Value

MEK : Economical Value of (Pine wood + Puspa wood + mixture of back wood)

MEGP : Economical Value of Pine Gum

While for indirect value of forest area, which was water controller, flood preventative, carbon absorber, could be calculated by following formula:

$$MTL = MTL a + MTL b + MTL c$$

where:

MTL : Indirect Value

MTLa : Indirect Value of Water Controller

MTLb : Indirect Value of Flood Preventative

MTLc : Indirect Value of Carbon Absorber

Assumptions used in this research:

1. Felling of forest trees, including woods in Petungkriyono limited productive forest, was only done in certain period of time; Pine woods as commodity had cycle for 50 years so the product that was taken annually was the pine gum. For other forest products, the value was ignored due to there was no supported data.
2. The damage value or environmental impact caused by Hedonic price method, which was by

- emphasizing on the calculation of environmental benefit that attributed to the goods and services, which had market price.
3. According to the data from Perhutani KPH East Pekalongan, the result price for pine woods in 2017 was IDR 931.537; Mixture of back woods IDR 589.034 and puspa woods IDR 408.242. While for production volume of pine gum was 1.5 m³/ tree.
 4. To decide total cost of wood production, it was got by the multiplication between cost of sales and production quantity that was got in certain forest extensive as the research result of Laode (2013). According to data of KPH East Pekalongan 2016, it was known that the standing stocks in Petungkriyono forest were 181.722 m³, with the extensive of terrain were 5388.7 Ha so the value of standing stock per hectare was 33,73 m³/ Ha.

Table 1. The Economic value of Petungkriyono Forest Ecosystems

No.	BENEFIT	COMMODITY	BENEFIT VALUE	COST VALUE
1.	DIRECT USE	a. Mixture of back woods.	2,204,817,289	32.233.203.074
		b. Puspa woods.	3,334,520,656	4.890.909.390,5
		c. Pine woods.	160,719,941,684	40.916.898.170
		d. Pine gum.	937,913,800	234,478,450
		Total Direct Value	167,197,193,429	78.275.489.084,5
2.	INDIRECT USE	a. Water value	4,344,777,500	11,767,400,000
		b. Erroton holder building	11,767,400,000	
		c. Carbon absorber value	69,859,376,235	
		Total Indirect Value	85,971,553,735	
3.	FOREST DAMAGE	a. Forest fire	-	-
		b. Landslide	-	60,000,000
		c. Illegal logging	-	-
	TOTAL		253.168.747.164	89.982.889.084,5

Source:KPH East Pekalongan (2016)

Forests have an important role as a source of foreign exchange and also as a form of natural resource properties. The era of globalization with the accelerated economic growth increases the need for the fields of agriculture, infrastructure, land requirements and other sectors. Human needs increased are giving a positive correlation to the increased pressure on forests. Quantify of Petungkriyono forests in Pekalongan Regency as an effort to support the government's program to realize the green economy in the forestry sector. Method of forest economic calculation in this research was to calculate the extended benefit cost ratio and Total Economic Value (TEV), which consisted of direct use values and indirect use values.

The results showed that the direct use value of forests in Petungkriyono was **IDR 253.168.747.164** which included the value of timber and the value of non-timber, such as pine gum, bamboo, coffee, fruits and vegetables; while the indirect use value was **IDR 89.982.889.084,5** calculated from the value of forest protection, the value of foraging, conservation value, educational value, and recreational value.

3.3. Direct and Indirect Benefit

To analyze the economic value that did not have market price, so it was used *Contingen Valuation Method (CVM)*. CVM was an approach directly to understand how many environmental benefits were by understanding how much someone's desire/ willingness to pay for environmental benefit.

For calculating the Indirect Benefit Value, which was Water Value, it was by using approach of water needs per household. The water needs per household was 1 gallon/ day with the price IDR 3.500/ gallon (10). If total population of Petungkriyono sub district in 2016 was 12.594 people and total household was 3.401, so the cost of water needs in Petungkriyono sub district for a year was IDR 3.500 x 3.401 x 365. Total Water value on Petungkriyono sub district a year was IDR 4.344.777.500. The highest contribution of forest ecosystem TEV derived from indirect use value.

According to the data from KPH East Pekalongan 2016, the value of extensive area of Petungkriyono was 5388,7 while potency of standing stock was 181.722 m³ that contained of 3 types:

1. Commodity plants, such as Pinus Merkusii 2071 Ha, with the volume 172.532 m³ so the average volume per hectare was 83,3 m³/ Ha. Whereas the sale price of Pinus Merkusii was IDR 931.537/ m³.
2. The mixture of back wood of 2960,7 Ha, with the volume 3743,107 m³ so the average volume per hectare was 12,64 m³/ Ha. The sale price of backwoods mixture was IDR 589.034 / m³.
3. Sela puspa plants (*Schiima Wallichii*) was 383,1 Ha with the volume of 8168 m³ so the average volume per hectare was 21,32 m³/ Ha. While the sale price of puspa woods was IDR 408.242 / m³.

Table 2. The Total Cost of Standing Stocks in Petungkriyono Forest

No	Activities	Cost /Ha	Extensive Area (Ha)	Total Value (IDR)
I	Seeds of pine wood, seed distance 3x3	3500x1100	2071	7.973.350.000
2	Planting cost	4.725.081		9.785.642.751
3	Cost of enrichment planting	1.463.286		7.060.246.100
4	Cultivation cost I	1.812.276		6.312.016.568
5	Cultivation cost II	1.236.378		9.785.642.751
	Total			40.916.898.170

No	Activities	Cost /Ha	Extensive Area (Ha)	Total Value (IDR)
I	Seeds of puspa woods, seed distance 3x3	7500x1100	383,1	3.160.575.000
2	Planting cost	4.725.081		1.810.178,5
3	Cost of enrichment planting	1.463.286		560.584.866
4	Cultivation cost I	1.812.276		694.282.935
5	Cultivation cost II	1.236.378		473.656.411
	Total			4.890.909.390,5

No	Activities	Cost /Ha	Extensive Area (Ha)	Total Value (IDR)
I	Seeds of backwoods mixtures	1500 x 1100	2960,7	4.885.155.000
2	Planting cost	4.725.081		13.989.547.317
3	Cost of enrichment planting	1.463.286		4.332.350.860
4	Cultivation cost I	1.812.276		5.365.605.553
5	Cultivation cost II	1.236.378		3.660.544.344
	Total			32.233.203.074

Total cost of standing stocks was IDR 78.041.010.634,5

3.4. Total of Economic Value in Petungkriyono Forest

To calculate the extended net present value, it could be used NPV analysis by reducing the total benefit and cost of ecosystem services in Petungkriyono forest. Formula to calculate NPV was by following (14):

$$\begin{aligned} \text{Economic Value} &= \text{Total Benefit Value} - \text{Total Cost Value} \\ &= (\text{Direct} + \text{Indirect Value}) - (\text{Total Cost Value} + \text{Environment Cost}) \\ &= (253.168.747.164) - (89.868.410.634,5) \\ &= \mathbf{IDR 163.300.336.529,5/ \text{year}}. \end{aligned}$$

3.5. Calculation of The Extended Benefit Cost Ratio

Principle of extended cost and benefit calculation was called as extended benefit cost analysis or well known as analysis of Domestic Product of Regional Gross (PDRB Hijau). The direct cost contained of total cost or cost that needed to be missed, for both direct cost was really missed out and external cost or fixed environmental cost so it was called as social cost.

The estimation of cost and benefits value from forest ecosystem services, then the calculation of Extended Benefit Cost Ratio (B/C) and Net Present Value (NPV) by sum up all the ecosystem benefits for both direct and indirect. The Extended Benefit Cost Ratio in Petungkriyono Forest Ecosystems is 281,35 %. The result concerned that Petungkriyono forest ecosystems worthy compares to other investment.

4. Discussion

The challenges to realize the approach of non-extraction development came from two Acts; First, Acts Number 41 year 1999 about Forestry and Government Regulation Number 72 year 2010 about State Enter IDR rise of Forest. This Act limited the space of local government to the forest area because most of Petungkriyono area was the State Forest that was managed by Perum Perhutani. Second, Acts Number 23 year 2015 about Local Government. This Act took out the authority of Regency Government to create regulation and program to the forest area.

Forests have an important role as a source of foreign exchange and also as a form of natural resource properties. The era of globalization with the accelerated economic growth increases the need for the fields of agriculture, infrastructure, land requirements and other sectors. Human needs increased are giving a positive correlation to the increased pressure on forests.

The usage area of Petungkriyono, according to forest status, was limited as productive forest and protected forest. In the limited status as Productive Forest of State, it was possible to do the productive efforts but needed to pay attention to the natural contour. The limited status as productive forest was possible to do the expansion of forest clearing to be taken the timbers and monoculture efforts in forest area. The implication of this status was by taking the biodiversity in a vulnerable position to the changes of limited productivities. Factually, if we see the satellite imagery or popular technology of google maps, in Petungkriyono and surroundings, now there are more open lands than the dense forest area.

According to the result of the study, it could be seen that total of standing stock in Petungkriyono forest were 181.722 m³ with the extensive area 5388.7 Ha. From those total of standing stocks, it was dominated by standing stocks of pine (*pinus mercurii*) for 95%, and the rest were the mixture of backwoods and puspawoods (*shima wallichii*). From total area of Petungkriyono forest, which were 5388.7% Ha, there were 61.6% as protected forest. So the efforts to save the protected forest area from degradation and exploitation had to be increased.

According to the Acts of Republic of Indonesia No. 41 Year 1999, the conservation area was the forest area that had certain characteristics and had main functions as conservation for flora, fauna and ecosystem, contained of:

1. Area of nature reserve forest.
2. Area of nature conservation forest.

3. Bird Park.

By understanding the characteristics of Petungkriyono forest, which has extended benefit cost ratio in Petungkriyono Forest Ecosystems is 281.35 %. The result concerned that Petungkriyono forest ecosystems worthy compares than other investment so the government must be preferred to have high motivation in preserve the existence of Petungkriyono forest.

Petungkriyono forest area mostly of protected area as source of germplasm, water controller and habitat of flora and fauna, so it would create stronger reasons to increase the status of forest area from limited productive forest to be conservation forest.

But until now, local government of Pekalongan and Provincial Government of Central Java do not follow up the solutions to conserve Petungkriyono forest by increasing the status of forest area, which is by considering a potency of very interesting tourist attraction and promising to gain the revenue of local government (PAD) and increase people's welfare. So, if the status of Petungkriyono forest area had been changed into conservation area, automatically Local Government of Pekalongan would lose authority to manage and get additional revenue from tourism sector.

5. Conclusion

The economic benefit of Petungkriyono natural forest ecosystems services exceed than the economic benefit of commercial timber. The highest contribution of Petungkriyono TEV derived from benefits value of protecting basic good supply, soil water conservation, climate regulation, environment purification and biological habitats.

Forest ecosystems produce both tangible and intangible benefits. Currently those benefits still under-valued causing over exploitation of certain forest benefits. The over exploitation will always happen as long as stakeholders not awared to the valuation of forest ecosystems comprehensively.

References

- [1] Abdillah Rangga Fajar, 2017, Total Economic Value of applied used green line street Model for Tamarindus Indica in Rembang District. *the 2nd International Conference on Energy, Environment and Information System (ICENIS 2017)* Universitas Diponegoro.
- [2] Badan Pusat Statistik. 2016. Kabupaten Pekalongan Dalam Angka Tahun 2015.
- [3] Barbier, E.B. 1994. Valuing Environmental Functions: Tropical Wetlands. *Land Economics* 70(2): 155–73.
- [4] Barbier, E.B. 2007. Valuing ecosystem services as productive inputs. *Economic Policy* 22(49): 177– 229.
- [5] Bishop, T, Joshua. 1998. *The Economic of non Timber Forest Benefits: An Overview* Environmental Economic Programme. London.
- [6] Barbier, E.B., S. Baumgärtner, K. Chopra, C. Costello, A. Duraiappah, R. Hassan, A. Kinzig, M. Lehman, U. Pascual, S. Polasky, C. Perrings 2009. The Valuation of Ecosystem Services. Chapter 18. In: Naeem S., D. Bunker, A. Hector, M. Loreau and C. Perrings (eds.), *Biodiversity, Ecosystem Functioning, and Human Wellbeing: An Ecological and Economic Perspective*. Oxford University Press, Oxford, UK, pp. 248–262.
- [7] Dinas Kehutanan Provinsi Jawa Tengah. 2016. Statistik Kehutanan Provinsi Jawa Tengah Tahun 2016.
- [8] Erfan Noor Yulian, 2011. Valuasi Ekonomi Sumberdaya Alam Taman Hutan Raya Bukit Soeharto di Provinsi Kalimantan Timur. *JPSL Vol. (1) 1*: 38-46 Juli 2011.
- [9] Global Green Growth Institute. 2014, *Extended Cost Benefit Analysis Scoping Paper*.
- [10] Kalitouw Desitha Winda, 2015. *Valuasi Ekonomi Hutan Mangrove di Desa Tiwoho Kecamatan wori Kabupaten Minahasa Utara*. Jurusan Sosial Ekonomi Pertanian Fakultas Pertanian Universitas Sam Ratulangi Manado.
- [11] Khan, K & Khan, M. 2006. *The Encyclopedic Dictionary of Marketing*, Response Books, New Delhi.
- [12] Purwanto, 2013. Valuasi Ekonomi Ekowisata dengan Model Travel Cost dan Dampaknya

- terhadap usaha kecil Pariwisata. *Jurnal JMK* Vol 15. No.1 (89-102)
- [13] Perum Perhutani KHP Pekalongan Timur. 2016. Laporan Hasil Pelaksanaan Evaluasi Potensi Sumberdaya Hutan Tahun 2016.
- [14] Suparmoko, 2006. *Panduan dan Analisis Valuasi Ekonomi Sumberdaya dan Lingkungan (Konsep, Metode Penghitungan dan Aplikasi)*. BPF. Yogyakarta.
- [15] White R and Heckenberg D. 2011. Environmental horizon scanning and criminological theory and practice. *European Journal of Criminal Policy and Research*

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