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# Total Economic Value in Investment Analysis

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***Abstract***

*Forest ecosystems are often defeated in decisions about investment and economic development. There is a very wide gap between policy makers and development investment on the one hand and environmentalists on the other hand, who see the forest ecosystem from the perspective of ecology and environment. The first party considers that forest ecosystems have a low value, while the second party often shows very fantastic figures about the economic value of forests. From the second party's point of view, the first party could be ignorant or having a short-term interest; while from the first party's point of view, the second party loves to produce the figures that are too good to be true. As a result, the total economic value of ecosystems is not only ignored as a consideration in investment decisions, but the total economic value of ecosystems has been seen as a boring scientific joke. Why did the gap occur and how to close the gap will be discussed in this paper. Economic valuation of ecosystem needs to be done more realistically so that the results are more plausible before policy makers. On the contrary, policy makers need to be aware that once a species vanished it never goes back.*

*Keywords: ecosystem, goods and services, value, trade-off, double counting*

***Abstrak***

*Ekosistem hutan sering dikalahkan dalam keputusan tentang investasi dan pembangunan ekonomi. Ada kesenjangan yang sangat lebar antara pembuat kebijakan dan investasi pembangunan di satu sisi dan pecinta lingkungan di sisi lain yang melihat ekosistem hutan dari perspektif ekologi dan lingkungan. Pihak pertama menganggap bahwa ekosistem hutan memiliki nilai yang rendah, sedangkan pihak kedua sering menunjukkan angka yang sangat fantastis tentang nilai ekonomi hutan. Dari sudut pandang pihak kedua, pihak pertama adalah pihak yang kurang memiliki pengetahuan tentang hutan atau memiliki kepentingan jangka pendek, sedangkan pihak kedua sering memamerkan angka-angka nilai hutan yang terlalu fantastis. Akibatnya , nilai ekonomi total ekosistem tidak hanya diabaikan sebagai pertimbangan dalam keputusan investasi, tetapi nilai ekonomi total ekosistem telah dilihat sebagai lelucon ilmiah yang membosankan. Mengapa kesenjangan terjadi dan bagaimana untuk menutup kesenjangan akan dibahas dalam makalah ini. Valuasi ekonomi dari ekosistem perlu dilakukan secara lebih realistis sehingga hasilnya lebih masuk akal di mata para pembuat kebijakan. Sebaliknya, pembuat kebijakan perlu menyadari bahwa sekali suatu spesies hilang tidak pernah kembali.*

*kata kunci: ekosistem, barang dan jasa, nilai, trade-off, penghitungan ganda*

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## Introduction

The main motivation for writing this article came from two sources. First, I have encountered a number of "research" for master thesis and even doctoral dissertation on the topic of total economic value of ecosystems, especially forest ecosystems, which I consider still contains many weaknesses. Often the economic value generated is too spectacular to be trusted by people with common sense. If I say that my wife just bought a hair dryer that costs me Rp25 trillion, then I am pretty sure no one wants to know more about what I have said and very likely society will say that I am hallucinating. Things like this is what often happens in the economic valuation of forest ecosystems. Valuation figure were too spectacular to arouse people's curiosity, but ridicule. One source of total economic value of forest ecosystems that are too huge is double counting (Dixon & Sherman 1991; Jansson *et al.* 1999; Farber *et al*. 2006; Rönnbäck *et al*. 2007; Fisher *et al*. 2008; Boyd & Krupnick 2009). Second, I have observed many government decisions at the expense of forest ecosystems that are difficult to be understood by foresters. Why do governments choose non-forestry investment, whereas the total economic value of forest ecosystems is higher than the alternative options? Various reasons have been thought to be the cause of the

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government's decision that are difficult to be comprehended, such as ignorance, short-term interests, and so forth.

This paper is an attempt to bridge the gap between view point of researchers, who love to produce amazing figures and of the government officials, who love to use the word of development while what they doing is actually a destruction. To reach this goal, the rest of the paper is organized in 5 sections, they are definition and criterion, total economic value, investment decision, caution, and conclusion. Section of definition and criterion discusses key terminologies frequently used in ecosystem valuation and criterion used to make decision. Section of total economic value presents the total economic value of ecosystems, especially forest ecosystems, in regular as well as alternative way. Section of investment decision basically presents how to use total economic value in decision making of investment. In section of caution, I warn you to be very careful in producing and employing total economic value in investment decision.

## Definition

Before moving any further, there are 3 terms whose meaning needs to be agreed, namely ecosystem services, economic value, and efficiency:

1 The Millennium Ecosystem Assessment (2005) defines ecosystem services as "the benefits people obtain from ecosystems." This is a very broad definition which is still difficult to operate and does not provide guidance in the valuation of ecosystem (Fisher *et al.* 2008). In order to be more operational, Turner *et al*. (2008) defines ecosystem services as "the aspects of ecosystems consumed and/or utilized to produce humanwell-being." Still, Daily (1997) defines ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life.

2 Economic value is measured by the most someone is willing to give up in other goods and services in order to obtain a good, service, or state of the world. Simply, it is often referred to as "willingness to pay (WTP)." The payments people are willing to accept (WTA) in the way of compensation for environmental damage is another measure of economic value that is related to WTP. For better measure, WTP is supposedly defined on the Hicksian demand curve - the relationship between quantity demanded and price while keeping the user's utility level constant (Munasinghe 2001). However, for practical purposes the commonly estimated demand function is the Marshallian one, which shows the relationship between quantity demanded and price while keeping the user's income level constant. The consumer surplus can also be used to measure the value of ecosystem goods and services (Krieger 2001). For the environmental goods and services, which are available at no cost, consumer surplus is the area under the demand curve. But, for goods and services that are produced at a cost then the more appropriate definition of the economic value is total surplus, which comprises producer and consumer surplus. However, it is not always easy to do and amixed measure often cannot be avoided (Costanza *et al*. 1997).

3 Efficiency is not a terminology that is absolute because it is always relative to a criterion. A criterion for economic efficiency is the value. A change that adds value is called efficient changes and vice versa changes that reduce the value referred to the changes which is inefficient. An investment can lead to these changes that have implications for the value achieved. Information about the total economic value of ecosystems to improve policy and decision-making in natural resourcemanagement (Fisher *et al.* 2008).

## Criterion

An activity proposed by one or more economic actors, such as mining companies or government, will be beneficial or detrimental to some members of the society. What criteria should be used to accept or reject the proposed activity? Activity in question may change the economic parameters and also the quality and quantity of the environment that could potentially change the social welfare, get better or worse. Within the framework of welfare economics, the criteria commonly used are *Pareto criterion*. However, this criterion is deemed not very useful because it is often not met in practice and therefore need to be relaxed into *test compensation* (Bishop *et al*. 2008).

In *compensation test*, the value for the parties who benefit are different from the value for the parties harmed by the proposed activity. For those who benefited, the value of the proposed activity is the WTP so that the proposed activities are implemented. WTP, added up across all winners, measures the maximum compensation winners would be willing to pay losers. For the aggrieved party, the value of the change is the minimum compensation they need to erase the loss suffered. This is called the willingness to accept (WTA). WTA summation of all patients is the amount of compensation to be paid by the party that wins. If the aggregate WTP is greater than the aggregateWTA, then the activity can proceed and the public will become more prosperous. Conversely, if the aggregateWTP is less than the aggregate WTA.

## Total Economic Value

I tried to keep this paper simple and easily understood by the readers who are interested in doing research or using total economic value of ecosystem. More complete and detailed discussions of the total economic value of ecosystems can be found in papers written by Costanza *et al*. (1997), Pearce (2001), de Groot *et al*. (2002), Plottu and Plottu (2007), and also textbooks written by Bateman *et al*. (2003), Turner *et al*. (2008), and Singh and Shishodia (2007) to name very few.

Let us start with a forest ecosystem that is relatively not much disturbed. An ecosystem consists of goods and various processes to produce goods and services that flow out of the ecosystem. To get to the consumer, some types of goods produced by ecosystems have entered the market and have prices ($x_1$ and $x_2$), but some other types of goods flow directly to consumers without entering the market and have no price ($x_3$, $x_4$, and $x_5$). Both types of goods are important for human welfare. While $x_3$ and $x_4$ can still be enjoyed by the owner of the ecosystem, $x_5$ is not used at all by the owner of the ecosystem. The owner of ecosystems uses information on

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output prices and input prices to make decisions about these ecosystems to achieve its objectives. Figure 1 shows the relationship between an ecosystem and the owners who benefit from it.

What is the total economic value of ecosystems as shown in Figure 1? Ecosystem valuation can be a difficult and controversial task, and criticism is often addressed to the economists who love to put a price tag on any goods and services. I do not want to be criticized unnecessarily. I would like to share the difficulty with you. Actually, economists need help to improve the basic idea of the valuation of ecosystem. Let us assume that $x_{1t}$, $(p_{1t}, w_t)$ and $x_{2t}$ $(p_{2t}, w_t)$ are 2 goods produced by ecosystems that can be sold in the market or exchanged for other goods or services at time *t*, while $x_{3t}$ and $x_{4t}$.

Further, I will focus on two goods or services only, ie, good 1 and good 3. The difference between the two goods or services is that good 1 is producedwith a cost, while good 3 is produced by ecosystem without cost to the human. At time t, the market for goods 1 is as shown in Figure 2. The area under the demand curve and above the supply curve is the surplus at time *t*, denoted by $S_{1t}$, as shown in Equation *[1]*.

$$S_{1t} = \int_0^{\bar{x}_1} (p_{1t}(x^*_{1t}, p_{-1t}, m_t) - p_{1t}(x_{1t}, w_t))dx \quad [1]$$

If the ecosystem is managed properly and last forever, then the economic value of goods 1 is as shown in Equation *[1]*($v_1$) as shown in Equation *[2]*.

$$V_1 = \sum_{t=0}^{\infty}(1+\delta)^{-t}S_{1t} \quad [2]$$

where δ is the discount rate. Furthermore, if there are *n* goods similar to good 1, then the economic value of all goods are as shown in Equation *[3]*.

$$V = \sum_{j=1}^{n} V_j \quad [3]$$

Nowlet us turn to good 3. The situation is shown in Figure 3. In the meantime, consumers of ecosystem services here are limited to the owner of the ecosystem. The inclusion of non-owner consumers will be discussed later. Because the available quantity is much greater than the demanded quantity, then economic theory says that prices will decline. In the case of good 3, its price is zero, meaning that good 3 can be consumed for free by the communities surrounding the ecosystem. Can we say that the good 3 does not have economic value? It is just an illusion (Pearce 2001). To avoid this illusion, prices and values should not be confused.

Say by using contingent valuation methods or other methods, we can construct the WTP, represented by $p_{3t}(x^*_{3t}, p_{-3}, m)$ curve, as shown in Figure 3. Then we can calculate the consumer surplus for good 3 at time *t*, denoted by $S_{3t}$ as shown in Equation *[4]*.

$$S_{3t} = \int_0^{\bar{x}_s} p_{3t}(x^*_{3t}, m)dx \quad [4]$$

Summing over *k* goods and services similar to good 3 across the time yields as shown in Equation *[5]*.

$$H = \sum_{j=1}^{k}\sum_{t=0}^{\infty}(1+\partial)^{-t}s_{jt} \quad [5]$$

The 2 groups of goods and services contribute asmuch as *V+H* to the total value of the ecosystem in Figure 1. It is not all yet, because many ecosystem services or ecosystem values have not been taken into account. In the ecosystem itself various processes take place, such as soil formation, and pollination by insects. However, since many services are not enjoyed by the community then the value of the services are not to be considered as part of total economic value (Hein 2010). Let us assume that the remaining value is *R* then the total economic value of ecosystems is *H* + *V* + *R*. Let us call it

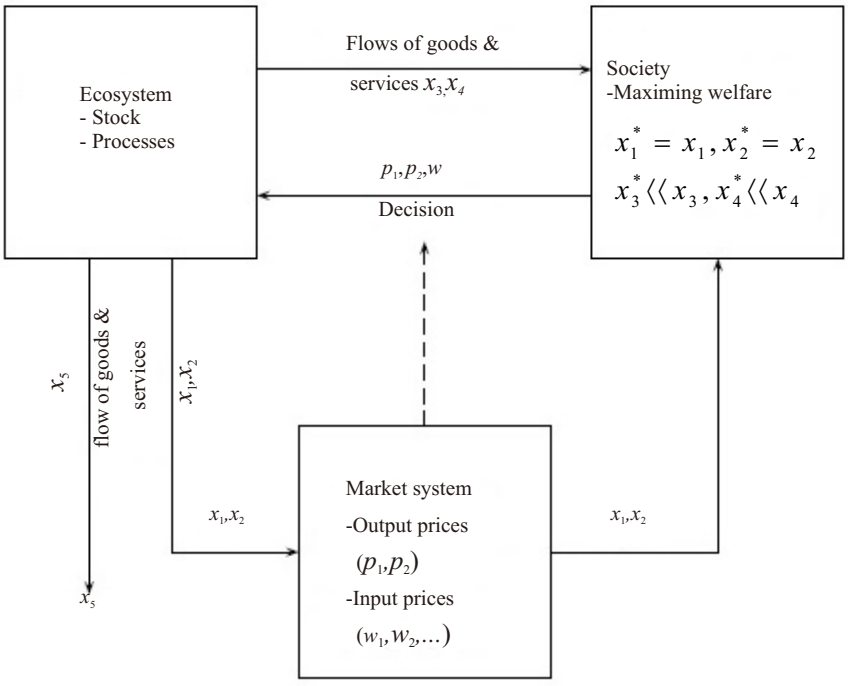


Figure 1 Ecosystem, goods, and services.

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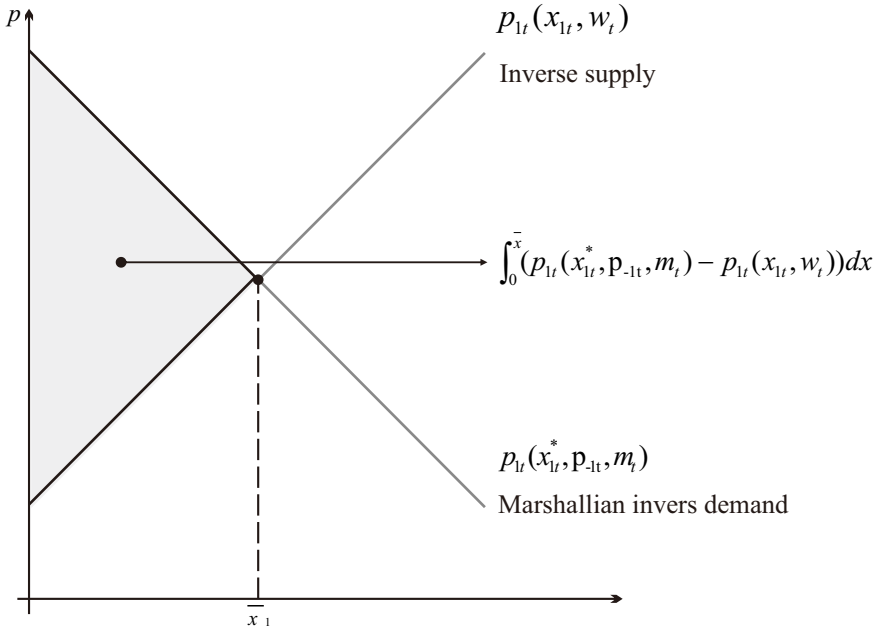


Figure 2 Market of good 1 at time *t*.

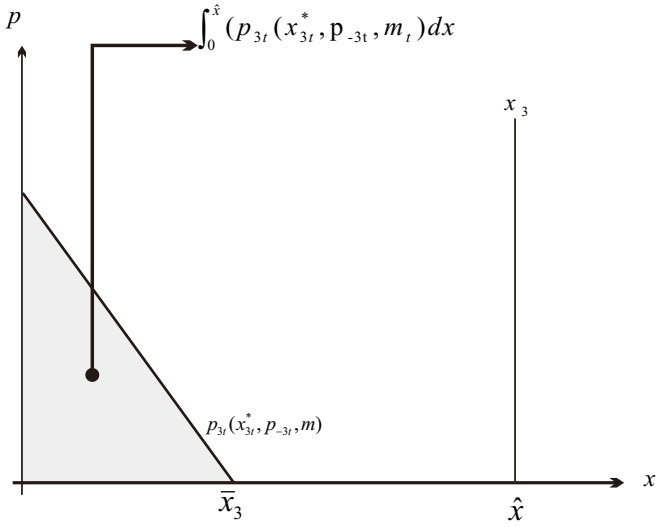


Figure 3 Supply and demand for goods 3 at time *t*.

initial total economic value of the ecosystem, denoted by $W_1$.

How to decide whether to accept or reject a proposed investment that alter ecosystems by using information on the total economic value of ecosystems? As mentioned previously, an action is deemed efficient if these activities improve social welfare,while an act is considered inefficient if these activities reduce social welfare. For example, through conventional calculations of net benefits of the proposed investment is *B*, but the total economic value of the ecosystem changes from $W_1$ to $W_2$. An example is when the flow of good 3 falls (Figure 4).

The decision was taken after comparing social welfare in two different circumstances, namely the initial conditions and conditions with the investment in question. The decision rule can be written as follows:

$$\text{If } W_1 - W_1 \begin{cases} \leq B, \text{ then accept the proposed investment} \\ > B, \text{ then accept the proposed investment} \end{cases}$$

When $W_1 - W_2 \leq B$ then the question that remains is how to provide compensation to the aggrieved party by the related investment. Conversely, if what happened is $W_1 - W_2 > B$ but the government approved the investment in question then the economy will experience inefficiencies. Is the problem solved? No, not yet. In fact, we are facing the global community who wants to participate one way or another in making decisions on our resources.

Now, let us cover consumers of ecosystem services who are not the owner of the ecosystem. Les us assume that these non-owner consumers have a much higher income that

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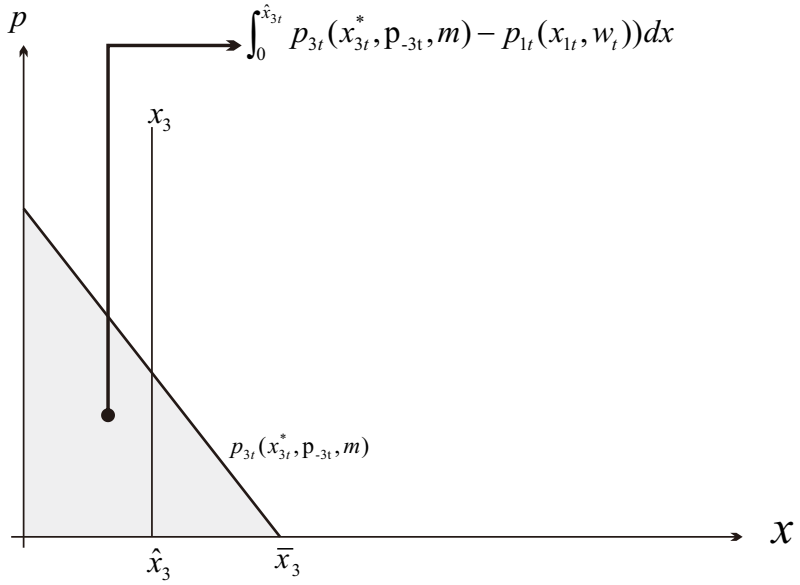


Figure 4 A fall in the supply of good 3 at time *t* due to a project.

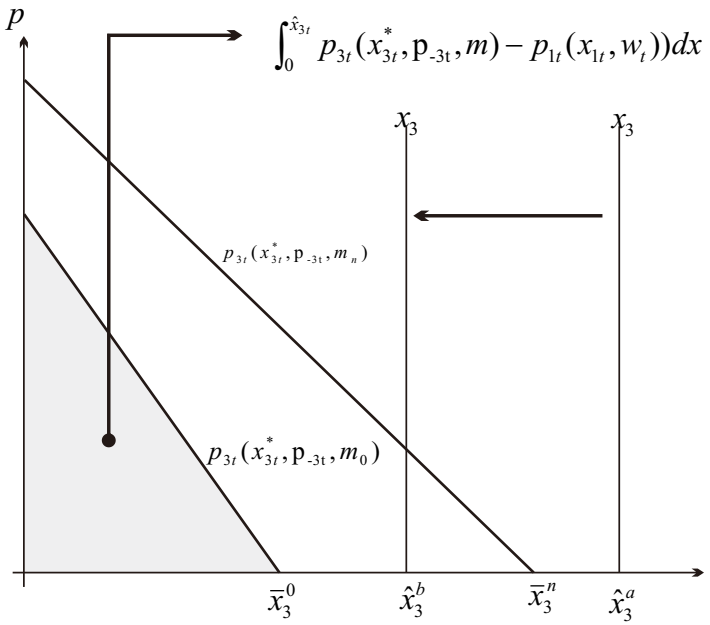


Figure 5 A change in consumer surplus: owner versus non-owner of ecosystem.

implies having a higher WTP, which is indicated by $p_{3t}(x^*_{3t}, p_{-3t}, m_n)$ curve. Indexes of *o* and *n* on income *m* represent owner and nonowner respectively. Initially, the quantity of ecosystem services supplied ($\bar{x}_3^{\bar{a}}$) exceeds the maximum quantity of ecosystem services demanded by either owner or nonowner. For both groups of consumers, price of the ecosystem services is zero. Next, let assume that an investment bemade by the owner of the ecosystem resulting in a decrease in the supply of ecosystemservices to ($\bar{x}_3^{\bar{b}}$) as shown in Figure 5.

As we can easily see, the quantity supplied ($\bar{x}_3^{\bar{b}}$) is less than the maximum quantity demanded of the nonowner consumers ($\bar{x}_3^{\bar{n}}$). Now, the nonowner consumers are willing to put a positive price on the ecosystem services, while their welfare falls. However, it is not the case for the owner consumers, the quantity available freely is stillmuch larger than the maximum quantity they desire. As a result, there is a difference in the point of view on the investment between the owner consumers and nonowner consumers. The investment is extremely desired by the owner consumers but it is strongly rejected by the nonowner consumers.

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## Caution

There are several cautions that must be adhered to regarding ecosystem valuation, but I will mention only two, one is for assessors of economic value of ecosystem and the other is for decision makers. The assessors should maintain the credibility of the valuation by avoiding too spectacular figures. In this way, decision makers will be easier to understand and accept the advice given by the assessors. On the contrary, decision makers should be more careful in making decisions that alter the ecosystem. Ecosystems are very complex systems, so information about them is never complete. Incompleteness of information can contribute to making highly fatal decisions leading to irreversible impacts. However, as part of the academic world, I will more highlights some issues to be considered by the assessors, which generally involve scientific work.

The situation as shown in Figure 3 can result in gaps between the values provided by ecosystems as a result of the calculations of experts and the value that is really enjoyed by the communities surrounding ecosystem. The problem will grow increasingly complicated and difficult to understand when the beneficiaries of ecosystem services is much broader than the party entitled to make decisions on the ecosystem (Figure 5). The assessors should carefully define who the consumers of the ecosystem services are. The more consumers involved, the greater the total economic value of ecosystems that will be obtained.

The main consideration of decision makers is not how much the value of total services that may be provided by the ecosystems they have, but what is the value of ecosystem services that they can enjoy. This phenomenon is demonstrated by the tendency of owners of forest ecosystems to choose oil palm plantations rather than to maintain the forest ecosystem. Ecosystem services are essential for human life, but the importance of ecosystem services can not be directly translated into economic value (Heal 2000). I disagree on the statement made by Costanza *et al*. (1997) that "if the forest offered nonmarketed, aesthetic, existence, and conservation values of $70, those receiving this nonmarket benefit should be willing to pay up to $70 for it." It is a sort of fallacy, but the opposite is correct.

Research on the total economic value of ecosystems is of course closely related to the use of quantitative methods. However, to achieve reliable results, researchers of the total economic value must be able to get away from purely quantitative approach. Costanza statement that I quoted above is an example of the use of quantitative approaches that are too excited. Ecosystem values submitted by the researchers is the value from the perspective of the researchers, not the value of ecosystems in the view of people who live in and own that ecosystem (see Smith 1983; Bryman 1984; Howe 1992). Qualitative approach is useful to maintain the validity of benefit transfer methods, which are often used in economic valuation of forest ecosystems (Brouwer & Spaninks 1999). In summary, studies the total economic value of ecosystemshould combine quantitative and qualitative approaches in a balanced manner.

I still doubt whether or not the WTP obtained through contingent valuation method or other methods is independent of the level of abundance of natural resources. In economic theory, the abundance of goods should not affect WTP. But, in reality, I do not believe that society will provide a high WTP when they live in an environment that has abundant natural resources. It is very difficult for a person to imagine or pretend to live in water scarce environment when indeed the person is currently living in an environment rich in water resources. In other words, the consumer's preferences are affected by the resource abundance. Therefore, we need to be alert to the possibility of bias when estimating the WTP of the ecosystemservices that have nomarket price.

Relationship of the 2 types of goods and services produced by ecosystems may be neutral or tradeoff. In the case of neutral relations, ecosystem owner does not face any difficulty in making decisions to achieve its objectives. But, when the relationship is a tradeoff, then the owner of the ecosystemhave to do an optimization. For example, because the hydrological functions of ecosystems is highly dependent on vegetation cover, then increase the extraction of timber will reduce the value of the hydrological function. A failure in taking into consideration the tradeoff will result in a double counting. An optimization of the goods or services that have market prices is relatively easy to do. In many cases that I found, the total economic value of ecosystems is obtained by summing the value of each type of goods and services, regardless of whether there is a trade off between those goods and services.

Economic valuation of an ecosystem is a difficult job, but it seems an easy one. As a result, many students are stuck in his thesis research. The easiest and cheapest way out is to use the benefits transfer. The most commonly used data is the one found in the article by Costanza *et al*. (1997). Data on tropical forests also exist in the paper. The data is used to represent all kinds of tropical forest. We all know that tropical forests in the highlands differ from tropical forests in the lower plains, tropical forests in Borneo is different from the tropical forest in Sulawesi. It is impossible that a single number fits to all kinds of tropical forest.

## Conclusion

If extinction is symbolized by the " black" color then I can say that "once a species goes black, it never goes back." Valuation of ecosystem services should be more realistic in providing information on the total economic value of ecosystems, while decision makers should be more careful in taking decisions pertaining to the ecosystem.

## References

Azqueta D, Sotelsek D. 2007. Valuing nature: From environmental impacts to natural capital. *Ecological Economics* 63(1): 22–30. http://dx.doi.org/10.1016/j.ecolecon.2007.02.029.

Bateman IJ, Lovett AA, Brainard JS. 2003. *Applied Environmental Economics: A GIS Approach to Cost-Benefit Analysis*. Cambridge: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511493461.

Bishop RC *et al*. 2008. Integrating economics and ecological assessment. In: Stahl Jr.RG, Kapustka LA, Munns JrWR, Bruins RJF, editors. *Valuation of Ecological Resources:*

*Integration of Ecology and Socioeconomics in Environmental Decision Making*. FL: Society of Environmental Toxicology and Chemistry (SETAC), Pensacola.

Boyd J, Krupnick A. 2009. The definition and choice of environmental commodities for nonmarket valuation. Discussion Paper RFF DP 09-35, Resources for The Future, Washington, DC.

Brouwer R, Spaninks FA. 1999. The validity of environmental benefits transfer: further empirical testing. *Environmental and Resource Economics* 14:95–117. http://dx.doi.org/10.1023/A:1008377604893.

Bryman A. 1984. The debate about quantitative and qualitative research: a question of method or epistemology? *The British Journal of Sociology* 35(1):75–92. http://dx.doi.org/10.2307/590553.

Costanza R *et al*. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387: 253–260. http://dx.doi.org/10.1038/387253a0.

Daily GC. 1997. Introduction: What are ecosystem services? In: Daily GC, editor. *Nature's Services: Societal dependence on natural ecosystems*. Washington DC: Island Press.

de Groot RS, Wilson MA, Boumans RMJ. 2002. A typology for the classification, description and valuation of ecosystemfunctions, goods and services. *Ecological Economics* 41(3): 393–408. http://dx.doi.org/10.1016/S0921-8009(02)00089-7.

Dixon JA, Sherman PB. 1991. Economics of protected areas. *Ambio* 20(2): 68–74.

Farber S *et al*. 2006. Linking ecology and economics for ecosystem management. *BioScience* 56(2):121–133. http://dx.doi.org/10.1641/0006-3568(2006)056[0121:LEAEFE]2.0.CO;2.

Fisher B *et al*. 2008. Ecosystem services and economic theory: Integration for policy-relevant research. *Ecological Applications* 18(8): 2050–2067. http://dx.doi.org/10.1890/07-1537.1.

Hannon B. 2001. Ecological pricing and economic efficiency. *Ecological Economics* 36(1):19–30. http://dx.doi.org/10.1016/S0921-8009(00)00212-3.

Heal G. 2000. Valuing ecosystem services. *Ecosystems* 3(1): 24–30. http://dx.doi.org/10.1007/s100210000006.

Hein L. 2010. *Economics and Ecosystems: Efficiency, Sustainability and Equity in Ecosystem Management*. Edward Elgar, Cheltenham: Edward Elgar Publishing Ltd. http://dx.doi.org/10.4337/9781849806770

Howe KR. 1992. Getting over the quantitative-qualitative debate. *American Journal of Education* 100(2):236–256. http://dx.doi.org/10.1086/444015.

Jansson S, Folke C, Rockström J, Gordon, L. 1999. Linking freshwater flows and ecosystem services appropriated by people: The case of the baltic sea drainage basin. *Ecosystems* 2(4): 351–366. http://dx.doi.org/10.1007/s100219900085.

Krieger DJ. 2001. *The economic value of forest ecosystem services: A review*. Washington DC: Wilderness Society.

Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-being: Synthesis*. Washington DC: Island Press.

Munasinghe M. 2001. Implementing sustainable development: a practical framework. In: Cleveland CJ, Stern D I, Costanza R, editors. *The Economics of Nature and the Nature of Economics*. Cheltenham: Edward Elgar Publisher Ltd. http://dx.doi.org/10.4337/9781843761419.00016.

Pearce DW. 2001. The economic value of forest ecosystems. *EcosystemHealth* 7(4):284–296. http://dx.doi.org/10.1046/j.1526-0992.2001.01037.x.

Plottu E, Plottu B. 2007. The concept of total economic value of environment: A reconsideration within a hierarchical rationality. *Ecological Economics* 61(1):52–61. http://dx.doi.org/10.1016/j.ecolecon.2006.09.027.

Rönnbäck P *et al*. 2007. Ecosystem goods and services from swedish coastal habitats: Identification, valuation, and implications of ecosystemshifts. *Ambio* 36(7): 534–544. http://dx.doi.org/10.1579/0044-7447(2007)36[534:EGASFS]2.0.CO;2.

Singh K, Shishodia A. 2007. *Environmental Economics: Theory and Applications*.New Delhi: Sage Publications India Pvt Ltd.

Smith JK. 1983. Quantitative versus qualitative research: An attempt to clarify the issue. *Educational Researcher* 12(3):6–13. http://dx.doi.org/10.3102/0013189X012003006.

Turner RK, Georgiou S, Fisher B. 2008. *Valuing ecosystem services: the case of multifunctional wetlands*. London: Earthscan.