Forest Management in Lower Kinabatangan Sabah, East Malaysia: Cost-Benefit Analysis

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Abstract: Sabah is known in the world with its nature and biodiversity. In fact, one of the contributions of tourism sector in Sabah is the uniqueness of the nature and wildlife. Unfortunately, the developments of agriculture, particularly for oil palm cultivation cause so many negative impacts to environmental imbalance, especially in fragile areas such as Lower Kinabatangan. Because of that, Lower Kinabatangan need for a balanced approach to reduce the negative effects due to the clearing of forests. In this study, Cost Benefit Analysis (CBA) model with three option namely, Option1: Status Quo, Option 2: Compromise and Conservation and Option 3: Translocation is used to provide alternative solution to local residents in Lower Kinabatangan which faced with problems due to insufficient of forest management. A total of 234 respondents were randomly selected from four villages with high conflict because of the of oil palm cultivation namey Kg, Kg Bilit, Kg Sukau and Kg Batu Putih. Study results found that Option 2, which recorded the highest NPV is the best option selected by the local people in solving their problems. This study thus shows that there is awareness among the local community on the importance of balancing development and environmental conservation to ensure sustainable forest management can be achieved in Lower Kinabatangan, Sabah.

Keywords: *Cost benefit analysis, sustainable forest management, environmental conservation, sustainable agriculture*

1. Introduction

Sabah is rich in forest resources and among the most biologically diverse in the world (Koh & Wilcove, 2007). Unfortunately, over the last 20 years the emphasis on developing the state's economy has led to significant and drastic changes in the landscape of the land use. As the availability of valuable hardwood species declined, so did the rate of logging, but this did not stop forestlands from being depleted further. As the state developed, forestland was harvested and cleared for conversion to agriculture activities especially the palm oil plantations, which provides a significant source of income to the state and is the main export product. The development of oil palm plantations began in by the late 1980s and many of the private owners of these plantations come from Peninsular Malaysia seeking the cheaper and abundantly available land in Sabah. Degraded forests were de-gazette and cleared to make way for plantations, and the rate of conversion to palm oil plantation was extremely high. In this context, forest management in Sabah is still prudent concern. As indicated by previous studies for example, Prudente and Balamurugan (1999) "Sungai Kinabatangan "Partners for Wetlands Project: A partnership for sustainable development and conservation" showing that the strong increase in deforestation over the years in Sabah's forest. In fact, these weaknesses are significant in forest management policies and legal aspects, planning and control of forest and cooperation between the sectors involved. Besides that, unsustainable land use development for example cultivation of oil palm which require large areas resulting in several parts of the interior had to deal with the threat of extinction of the forests and affected by high deforestation.

The Lower Kinabatangan is the largest alluvial floodplain in Malaysia. Lower Kinabatangan is known for its remarkable wildlife and fascinating habitats such as limestone caves at Gomantong hill, dryland dipterocarp forests, riverine forest, freshwater swamp forest, oxbow lakes and salty mangrove swamps near the coast. Since the 1980s, scientific research has consistently produced evidence of the vital importance of the Lower Kinabatangan in wildlife conservation (Hutton et al.,

2005). According to Hutton et al (2005), an estimated 50 mammal species and approximately 200 bird species have been recorded in the area and freshwater fish biodiversity is high with more than 100 species, and so is fish productivity (Prudente & Balamurugan, 1999). Thus, this study aims to propose a number of choice or alternatively by using the Cost Benefit Analysis (CBA) model that introduces three options (Option 1: Status Quo, Option 2: Compromise and Conservation and Option 3: Translocation) which can be chosen to minimize the problems that arise in Lower Kinabatangan because of the inefficiency of the forest management. The objectives of this study is to conduct a CBA of investment of the state to reduce the agriculture-human-wildlife conflict in Lower Kinabatangan, Sabah by selecting four villages with highest conflict and problems. The result also becomes a basic platform to suggesting an approach in order to create sustainability in forest management in study area

Problem Statement: Areas under agriculture and pasture are expanding, often at the expense of forest. According to the FAO (2000) and reports that agricultural land is expanding in approximately 70% of the countries examined. The impact of agricultural expansion has been particularly severe in tropical forest regions, where pasture and crop land is expected to continue to increase over the next 30 to 50 years. In the case of Lower Kinabatangan, Sabah Malaysia, according to Payne (1997), the progressive disappearance and degradation of tropical rainforests constitutes one of the major environmental problems. The Kinabatangan District was one of the first areas in Sabah to be opened for logging. This intensified when the logging monopoly held by the British North Borneo Timber Company was lifted in 1952, and logging reached its peak in the 1970s and 1980s (Hutton et al, 2005). With the disappearance of valuable hardwood trees, economic policy favoured the conversion of forest in the Lower Kinabatangan to agriculture. Unfortunately, land clearing for agriculture has transformed the Lower Kinabatangan and the whole ecosystem is changing. Plantation companies, aggrieved by damage to young palms, now see the merits of an ambitious project to restore the forests along the river. Land use conversion, most recently and drastically for oil palm plantations, has reduced natural forest cover to a relatively thin (or even non-existent) strip.

Currently, there remains a small amount of forest along the river, 27,000 hectare of which is gazette as the Kinabatangan wildlife sanctuary (WWF Malaysia, 2005). Beside large-scale conversion, the forest to agriculture another problem in Lower Kinabatangan is the insufficient knowledge about scientific and technological planning among various stakeholders in the field of forest management (Kinabatangan District Office, 2007). Hence, an appropriate institutional framework needs to be developed further in order to maximize the contribution of forestry and of forest industries to development while maintaining the productive capacity of the resource and its contribution to environmental and social stability (Payne, 1997). Based on the problem presented this study aims propose an option through the Cost Benefit Analysis approach for achieving sustainable forest management in Lower Kinabatangan that will benefit all stakeholders including the government, private sector and local community. In this study, CBA model with three option namely, *Option1: Status Quo*, *Option 2: Compromise and Conservation* and *Option 3: Translocation* is used to provide alternative solution to local residents in Lower Kinabatangan which faced with problems due to insufficient of forest management and to enhance the sustainable forest management in study area.

Research Objectives and Hypotheses: Based on the problem presented, the objectives of this study is to estimate the costs and benefits of three option that been given to local community due to forest management issues in Lower Kinabatangan, especially the land use conversion to agriculture (oil palm). This study aims to propose an option through the Cost Benefit Analysis approach for achieving sustainable forest management in Lower Kinabatangan that will benefit all stakeholders including the government, private sector and local community. Therefore, in order to accomplish the above objective, the following hypotheses were evaluated in this paper:

- The current types of environmental issues especially the forest fragmentation become increasing in Lower Kinabatangan.
- The level of willingness to pay to protection of forest resources in Lower Kinabatangan between the respondents, expressed a mixture of positive and negative results.
- The result in Cost Benefit Analysis (CBA) is an option, which suggests specific areas for future research and allows for analysis of development scenarios and policies.

2. Literature Review

The origin of CBA is introduced by a French Economist, Jules Dupuit in 1884 regarding the utility of public works (Ashworth, 1994 & Seeley, 1996). However, according to Briscoe (1991), the first systematic use of CBA in discussing the North's American water resources programme in 1930s. There are many definitions of CBA. According to Seeley (1996, p470), CBA is setting out of the factors which need to be taken into account in making economic decisions. Ferry and Brandon (1984, p12) defined the CBA as quantify all factors including the various social benefit and disadvantages. Ashworth (1994, p1) agree with this definition and stated that CBA mainly used in public sector in connection with investment decisions where some account needs to be taken of considerations which are not purely financial. Hence, Manser (1994, p206) described that the purpose of CBA is to determine the net gain to the community. However, Sassone (1978) conclude that CBA can be defined as the application of economic and social in order to make a good decision or choice. Method that applied in this study in order to manage the forestry in term of the sustainability is Cost-benefit analysis (CBA). As stated in the beginning definition, cost benefit analysis is based on a framework of assumptions and decisions making (Seeley, 1996). Decision-making is about choices for an individual, company or government. CBA is an analytical tool used to assess the benefits and costs of option or scenario and also used to calculate the net benefits for each option or alternative, rank alternative by their net benefits and recommend the option or alternative with the greatest net benefit or Net Present Value (NPV).

There are many factors or indicators used in CBA namely, Present Value (PV), Net Present Value (NPV), Internal Rate of Return (IRR) and Sensitivity Analysis. Present value, also known as present discounted value, is actually a future amount of money that has been discounted to reflect its current value, as if it existed today. In CBA, the present value is always less than or equal to the future value because money has interest-earning potential, a characteristic referred to as the time value of money. Thus, NPV or Net Present Worth (NPW) is defined as the sum of the present values (PVs) of the individual cash flows of the same entity. Calculating the NPV, of a stream of cash flows consists of discounting each cash flow to the present, using the PV factor and the appropriate number of compounding periods, and combining these values. NPV is an indicator of how much value an investment or project adds to the firm.

If...	It means...	Then...
NPV > 0	The option or project would add value to the individual, firm or government	Accept the option or project
NPV < 0	The option or project would subtract value from the individual, firm or government	Reject the option or project
NPV = 0	the option or project would neither gain Decision should be taking into account many criteria or factor.	Accept or reject the project.

In CBA, time frame is an important element because it will affects the result of cost benefit analysis, especially with regard to natural resource development. In calculation the CBA of environmental protection, many researchers believe that the timeframe for cost benefit analysis of forest use should be theoretically infinite. Another important element in CBA is community or group. The choice of the community, or group of people, to which the cost benefit analysis will be limited is important for running the CBA. This concept is closely associated with discounting. Cost benefit analysis must account for all costs and all benefits from a project in order to be valid. Whether or not this is achieved is dependent on the ethic and the skill of the analyst. As explained above, the full accounting of costs and benefits also is related to the time frame chosen as the limits of the analysis.

There are significant challenges in using CBA. One of the challenges is measurement problems. In this case, it difficult to encounter in measuring intangible costs such as foul atmosphere or intangible benefits such as a peaceful neighbourhood and uneven distribution of benefit to community. The second problems are time. Tackling future time problems by discounting future costs and benefits or

calculating the correct rate for future value as well as accounting for additional benefits and costs associated. The third problems are accuracy because some researcher says that CBA is based on complex assumptions, and hence likely to be inaccurate. However, CBA is a pragmatic tool for drawing attention or making decision any option or alternative. Even though, quantifying costs and benefits is challenging but not impossible by given sufficient time, skill and resources. Hence, CBA can play an important role in improving the quality of regulatory option or alternative.

3. Methodology

The research focuses on one case study area where conflicts have been arisen between human activities and biodiversity population in Lower Kinabatangan, Sabah East Malaysia. The required data for the study were collected from Lower Kinabatangan using the Cost Benefit Analysis questionnaire method. Thus, this study aims to propose a number of choice or alternatively by using the Cost Benefit Analysis (CBA) model that introduces three options (Option 1: Status Quo, Option 2: Compromise and Conservation and Option 3: Translocation) which can be chosen to minimize the problems that arise in Lower Kinabatangan because of the inefficiency of the forest management. In this study, CBA has been conducted to evaluate and compare three options or scenarios of dealing with communities in a critical fragile area namely Lower Kinabatangan.

Structure of the Cost-Benefit Analysis: In this study, CBA has been conducted to evaluate and compare three scenarios of dealing with communities in a critical fragile area in East Malaysia namely Lower Kinabatangan, Sabah. These scenarios are discussed in detail later. According to Hanley (2000), the CBA consist of six steps for analyse the option (refer to Figure 1).

Figure 1: Structure of Cost-Benefit Analysis

Step 1: Specify the set of scenario, option or alternative projects: There are usually a huge number of potential options or alternative projects. In this stage, specify the set of policy options to solve a problem and one of the options should always be 'maintain current scenario or status quo'. The CBA compares the net social benefits of the project with the net social benefits of a hypothetical project or specific project if that is what would be displaced if the project would proceed. This hypothetical project is called the *counter-factual* or usually in CBA, they called it *status quo*. In this study, the portfolio of the project consists of three scenario or option:

- Option 1: Status Quo scenario in which no change will be made and always maintain the current situation
- Option 2: Compromise and Conservation scenario between land use change and environmental protection.
- Option 3: Ex-Situ Conservation (Translocation) in which the entire endangered species will be translocate in location outside the Lower Kinabatangan area.

Step 2: Decide whose costs and benefits count: In this stage, *standing* determines whose benefits and costs will count. Standing is usually most appropriately specified at the national level. However,

there is contention as to when standing should be specified at the global level. Usually only take account of costs and benefits at the national level, for example, from the Malaysian community's perspective. However, some argue costs and benefits to non-nationals should also be included for international or global issues. However, for most regulatory options or scenario, measuring national costs and benefits is appropriate. In this study, the information about the outputs, impacts and potential impacts of the cost and benefit are collecting from findings of the field survey and discussion with the Sabah Forest Department (SFD), Sabah Wildlife Department (SWD), Kinabatangan District (KD), villagers and local and international NGOs. Besides that, the information also collects from reviews of literature, some important documents, papers and journals.

Step 3: Quantifying the outputs and impacts: In this stage, catalogue the impacts and select measurement indicators for example, identify the full range of impacts of the option or proposal and incremental costs and benefits relative to the base case (i.e. Option 1: Status Quo-maintain current situation). List the physical impacts as benefits or costs and specify the impacts units. Impacts include both inputs and outputs. In this stage, the choice of measurement indicator depends on data availability and ease of monetisation. In this study, field survey findings are used to quantify the outputs and impacts of all options. In this stage, the impacts will be quantified for each time period over the life of the option or scenario. However, prediction of future impacts is difficult because there will always be some uncertainty surrounding the outcome of a scenario or option. Therefore, forecasts of costs and benefits require some assumptions to be made and must be justified and made transparent in any option. According to Hanley (2000), in this stage the calculation will be performed with using varying levels of uncertainty. Many assumptions have to be made for example, under the Option1: Status Quo scenario, assuming that the conversion of forest in Lower Kinabatangan is still continuous as usual. Besides, under the Option 2: Compromised scenario and Option 3: Translocation scenario, this study assuming that many conservation activities such as protection the forest resources and endangered species in Lower Kinabatangan will help to reduce the pressure of conversion forest to other activities or development.

Step 4: Compute of Present Value (PV) and Net Present Value (NPV): The calculation of Net Present Value (NPV) is equal to present value of benefits minus present value of costs: $NPV = PV(B) - PV(C)$. In this stage, choose the alternative with the largest NPV. The alternative with the largest NPV at least represents a more efficient allocation of resources. In this study, the period of each option is 20 years and the discount rate is 6%, 8%, 10% and 12%. In CBA, each option or scenario with highest NPV ($NPVs > 0$) are considered the best option. Other than NPV, many criteria have been used to selecting the beat option or scenario, for example using the B/C ratio and the Internal Rate of Return (IRR). In this study, the PV and NPV are calculated from the following:

a) Present Value (PV) over multiple years

$$PV(B) = \frac{B_0}{(1+i)^0} + \frac{B_1}{(1+i)^1} + \dots + \frac{B_n}{(1+i)^n} \rightarrow PV = \sum_{T=0}^n \frac{B_t}{(1+i)^t}$$

$$PV(C) = \frac{C_0}{(1+i)^0} + \frac{C_1}{(1+i)^1} + \dots + \frac{C_n}{(1+i)^n} \rightarrow PV = \sum_{T=0}^n \frac{C_t}{(1+i)^t}$$

b) Net Present Value (NPV)

$$NPV = \sum_{T=0}^n \frac{B_t}{(1+i)^t} - \sum_{T=0}^n \frac{C_t}{(1+i)^t} \rightarrow NPV = \sum_{T=0}^n \frac{NB_t}{(1+i)^t}$$

Note:

Project time frame (t) = 20 years

Discounts rates (i) = 6% (year 5), 8% (year 10), 10% (year 15) & 12% (year 20)

Step 5: Performing the sensitivity analysis: In CBA, there is usually considerable uncertainty about predicted costs and benefits. According to Folmer and Gabel (1998), the purpose of sensitivity analysis stems from the uncertainty over various assumptions that relate to the predictions of the parameters and their future relative values, which means that sensitivity analysis shows how these uncertainties affect the CBA results. In sensitivity analysis, there are three types namely, worst/best case analysis, partial sensitivity analysis and Monte Carlo sensitivity analysis. Sensitivity analysis clarifies for decision makers how these uncertainties affect the CBA results.

Step 6: Make a recommendation: In this stage, the analyst should specify which option or scenario is the most efficient and usually, it will be the option with the largest or highest NPV. Normally CBA recommend the option or scenario with the highest NPV, but also take into account sensitivity analysis results.

Main survey: In this study the totals of 300 households were visited (Table 1). However, due to the several reason, for example there were 30 rejections because households not wanting to answer the questionnaire, 20 households without a qualified respondent for example people at home were either incapable of understanding the questionnaire, or insisted that the household head was the only appropriate respondent, and 15 no-responses because no one at home. Overall, the number of interviews of the survey completed was therefore 235.

Table 1: Summary of Survey Responses.

Total number of households visited	300
Number of rejections	30
No. of households without qualified respondent	20
No. of households with no one at home	15
No. of interviews completed	235

Statistical Analysis: All economic impact assessment data collected were interpreted and analyzed by using the SPSS Software Programme and Cost Benefit Analysis method.

4. Result and Discussion

Socio-economic Characteristics: From the results shows that the age of respondents ranges from under 21 (but over 18) to over 70. In term of educational attainment, half of the survey sample had received an education to primary school level. In the occupation section, a high percentage of respondents are farmers (42%), while 22% of respondents are unwaged (housewives, unemployed, retired, and student) as shown in Table 3. The average household income was RM1500. Nearly 90% of respondents report incomes below this average. Nearly, 30% earn less than R500 per month, and may be under the poverty line set at RM per month for Sabah and Malaysia.

Table 2: Socio-economic Characteristic of Respondents

Age	%	Education	%	Occupation	%	Income	%
< 21	4	No formal education	10	Professional	2	No income	0
21-30	23	Primary school	47	Administrative and managerial (includes: businessmen; government servants; and teachers)	8	RM500 and below	30
31-40	29					RM501- RM1000	40
41-50	23					RM1001 –RM1500	10
51-60	15					RM1501 – RM2000	10
61-70	3	SRP/PMR	12			RM2001 – RM3000	4
			27			RM3001 – RM4000	1
		SPM/SPMV	2			RM4001 – RM5000	0
						RM5001 – RM6000	0
						RM6001 – RM7500	0
		STPM	1	Clerical and related Workers	3	Above RM7500	0
						No response	5
> 70	3	Diploma/ Professional certificate		Sales worker	2		
			1	Service workers	1		
					42		

Degree		
	Agricultural (includes fishermen)	20
	Production workers (includes: factory workers; lorry drivers)	22
	Others (includes housewives; unemployed; part- time workers; retired and students).	

Net Present Value (NPV) and Present Value (PV) of Three Options: Details in this section were based on field survey data of 243 respondents from four villages; Kampung Abai, Kampung Bilit, Kampung Sukau and Kampung Batu Putih which high human-agriculture-wildlife conflict in the Lower Kinabatangan (refer to Figure 2 below).

Figure 2: Village with high human-agriculture-wildlife conflict in Lower Kinabatangan

LEGEND:
○ High Conflict Areas
● Villagers
— Sahah Coastline
— Gravel Road
— Main Road
— Rivers
■ Forest
■ Agriculture Land

From the CBA results, all option are reliable and have opportunity to be chosen as a best option because in principal, all project or results with NPV >0 or positive are considered to have passed the NPV test since it is deemed as an improvement in the social welfare. However, comparison of the value of NPV constitutes the main criteria to choose which the best solution among project.

Table 3: Distribution of Present Value (PV) Cost, Present Value (PV) Benefit and Net Present Value (NPV) for all option

				PV Cost (RM Million)	PV Benefit (RM Million)	TPV (NB) (RM Million)	NPV (RM Million)
	* i. rate	* rate	D.	$PVC/(1+i)^t$	$PVB/(1+i)^t$	$PVB - PVC$	$NB/(1+i)^t$
Year 5	4%	7%					
Option 1				\$ 25.41	\$ 44.85	\$ 19.44	\$ 2.09
Option 2				\$ 18.45	\$ 42.46	\$ 24.00	\$ 2.49
Option 3				\$ 31.25	\$ 47.64	\$ 16.38	\$ 1.76
Year 10	6%	7%					
Option 1				\$ 40.08	\$ 70.75	\$ 30.67	\$ 1.01
Option 2				\$ 29.55	\$ 66.97	\$ 37.42	\$ 1.21
Option 3				\$ 49.32	\$ 75.15	\$ 25.84	\$ 0.85
Year 15	8%	7%					
Option 1				\$ 48.70	\$ 85.97	\$ 37.26	\$ 0.41
Option 2				\$ 36.07	\$ 81.38	\$ 45.31	\$ 0.49
Option 3				\$ 59.93	\$ 91.31	\$ 31.41	\$ 0.34
Year 20	10%	7%					
Option 1				\$ 52.16	\$ 93.44	\$ 41.27	\$ 0.14
Option 2				\$ 39.27	\$ 88.45	\$ 49.18	\$ 0.16
Option 3				\$ 65.13	\$ 99.25	\$ 34.13	\$ 0.12

*Interest rate (i)

*Discount rate (D)

Note: USD 1.00 = RM 3.50

EUR 1,00 = RM 5.00

From the survey, the result from Figure 3 and Table 3 shows that Option 2: Compromise and conservation option as “winner” with higher NPV among the option which is RM2.50 (mil) in year 5, RM1.20 (mil) in year 10, RM0.49 (mil) in year 15 and RM0.16 (mil) in year 20 and also suitable with the CBA method assumption that higher NPV is the best option among the other option. The result of CBA showing the higher NPVs under Option 2 (Compromise and Conservation) means that the villagers prefer to protect the nature resources and connectively with economic activities that can be help to increase their daily income.

Figure 3: Net Present Value (NPV) for all options

Another result in Figure 4 shows the decreasing of Present Value (PV). In this case the decreasing of PV of future amount because, the interest (i) or discount rate (D rate) increase each year. According to the CBA rules, the best option which should be chosen is when the PV of a future amount decrease because the interest rate (i) or discount rate (D) increase and in this case Option 2 has fulfil this criteria.

Figure 4: Present Value (PV) for all options

The comparison between three option show that Option 3: Translocation involves higher expenditures than the Option 2: Compromise and Conservation. This is because under translocation process, in addition to the required expenses for protection and conservation of forestry resources, there are also expenses for the land acquisition in the destination areas as well as the management costs for wildlife conservation itself. Besides, it also cost for technical maintaining and provide training skill for the new worker and directly increasing the cost for applying this Option 3.

Sensitivity Test of Three Options: In addition to the three main options, namely Option 1: Status Quo, Option 2: Compromise, Conservation, and Option 3: Translocation (Ex-situ conservation), several option or situation has been made to illustrate sensitivity of the NPV of each option. The option or situation for conducting sensitivity analysis for this study will include:

1. Deforestation controlled
2. Changes in the inclusion of wildlife value

Table 4: Sensitivity Analysis for policy option

Policy Option	Benefit (RM Mil.)	Cost (RM Mil.)	NPV (RM Mil.)	B/C Ratio
<i>Base Case</i>				
Option 1	16.14	9.14	7.00	1.77
Option 2	15.28	6.91	8.37	2.21
Option 3	17.14	11.25	5.89	1.52

Excluding Wildlife Value

Option 1	12.91	6.86	6.06	1.88
Option 2	12.22	5.18	7.04	2.36
Option 3	13.71	7.87	5.84	1.74
<i>Deforestation Controlled</i>				
Option 1	14.53	6.40	8.13	2.27
Option 2	14.52	5.87	8.64	2.47
Option 3	3.71	6.75	6.96	2.03
<i>Excluding Wildlife Value Year 1-5</i>				
Option 1	55.12	29.26	25.86	1.88
Option 2	52.18	22.12	30.06	2.36
Option 3	58.54	33.61	24.93	1.74
<i>Excluding Wildlife Value Year 1-10</i>				
Option 1	95.76	50.84	44.92	1.88
Option 2	90.66	38.44	52.22	2.36
Option 3	101.70	58.39	43.31	1.74
Translocation delay 5 year	14.57	6.63	7.94	2.20
Translocation delay 10 year	16.28	6.30	9.98	2.59

Refer to the Table 4 above, the sensitivity analysis results shows that even if the wildlife value is excluded altogether, the NPV of the Option 2: Compromise and Conservation option is still high at RM 7.04 million compare to option 1 and option 3. As a conclusion, from the three options, Option 2: Compromise and conservation option is the best solution and become a basic platform for suggesting any approach in order to achieve sustainable forest management in Lower Kinabatangan, Sabah.

5. Conclusion

Results show that although there are villages in fragile areas such as Lower Kinabatangan, but using the compromise and effective conservation approach like Option 2: Compromise and Conservation, environmental balance can still be achieved, means that the balancing of ecosystem still protected under development and the most viable one suggests that 'man' cannot live in the forest without incurring a net loss to society. However, there are several on-going actions to develop the fragile areas such as Lower Kinabatangan. One of the action or indicator is introduce sustainable land use practices and active participation from all stakeholders. Even though, the results of the Compromise and Conservation option suggest a win-win situation between the environment and social welfare with the highest NPV among the option, in reality is only can be achieve if the stakeholders concerned accept the conditions and the altered costs and benefits of the option together in order to achieve the sustainable forest management in study area.

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