Payment for Environmental Services (PES) Scheme Implementation in Upstream and Downstream Areas as an Alternative for Sustainable Ecological Network

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ABSTRACT

Today either urban development or sustainable development should regard a balance between the development's objectives and environmental conservation as essential in order to ensure the sustainability of the existing ecological network, horizontally i.e. within the city and vertically i.e. between the city as the downstream area and the upper watershed. Through the implementation of Payment for Environmental Services (PES) scheme in watershed services management, eco-city or green city development's objectives will be accommodated since there will be sustainable ecological functions and, therefore, a sustainable ecological network. The PES scheme implementation is able to promote the establishment of an ecological network and at the same time a sustainable green city.
There are several alternatives viable for the conservation of natural resources in upper areas, as follows: Future development of reward mechanisms in the area could be linked to activities that improve (i) the tree cover along river banks as well as (ii) converting non-productive land, as these areas are contributing to sedimentation in the river. The lack of existing hydrological data shows the important part of water and river monitoring activities in the overall scheme.

1. INTRODUCTION

At a national seminar on green city development, Emil Salim stated that eco or green city or sustainable city development should consider a balance between development and environment (Emil Salim, 2006). This is certainly relevant to the fact that the increasing population density has led to social, economic and ecological problems in urban areas (Ibrahim, 2006). Similarly, Wardani (2006) has mentioned that green city should be established through active participation.

The implementation of PES scheme in green city or eco city development is an alternative to achieve the balance between development and environment. Actually, PES is a system of sustainable financing for conservation through which beneficiaries of ecosystem services, such as clean water, biodiversity, landscape beauty, and carbon sequestration, compensate the providers for maintaining those critical services. This paper will describe water as one aspect of PES and related to watershed management in Mendalam Sub Watershed in West Kalimantan Province. As a consequence of ecological network, landscape variability and site-specific characteristics of watershed functions, it is important that conduct a general approach to monitor and assess the biophysical condition of a watershed, prior to developing reward mechanism. Otherwise, the development of reward mechanisms could be based on myths or general beliefs about land use and water relationship that lead to inappropriate solutions (Kaimowitz, 2001). According to Pagiola (2001), PES is an appropriate incentive and option to address both the conservation of watershed functions and the enhancement of the livelihood of upland poor peoples. Moreover, the fundamental principles of PES are that those who provide environmental services should be compensated for doing so and that those who receive the services should pay for their provision. In general, PES mechanism proposed seven necessary stages in the development of reward mechanisms (Jeanes, *et al.*, 2006): (1) Scoping, (2) Awareness, (3) Identifying Partners, (4) Negotiations, (5) Action Plans, (6) Environmental Services Rewards: Support for Actions and (7) Monitoring.

Scheme of PES can be implemented in particular areas within the area scale in accordance with the agreement between this scheme's stakeholders: users, providers and independent institutions assisting in PES management. The area scale is set to decide which areas between upstream and downstream have greater flexibility for the scheme. Basically, the environmental problems in upper areas are the main concerns in this PES implementation. Cost- sharing is necessary for the restoration and the conservation of the existing natural resources. Cost- sharing mentioned here is the cost shared with users, or community living downstream. It is hoped that, through this scheme's implementation, the upstream-downstream ecological network can be developed sustainably.

Actually, PES has been implemented in several locations in Indonesia, among others: Singkarak-West Sumatera, Kapuas Hulu-West Kalimantan, Belu-East Nusa Tenggara, Lombok-West Nusa Tenggara and Cidanau-West Java. And this paper is based on the results of a Agroforestry Landscape study made by the Indonesia Network for Agroforestry Education (INAFE) team in Kapuas Hulu.

2. METHODS

a. Study Sites

The research was conducted start to August 2007 up to June 2008 at in one of river basin in the upper stream of Kapuas Watershed, namely Mendalam River Basin. The research area is located in West Kalimantan Province, Indonesia 123° 55' 58" East Longitude – 113° 37' 26" East Longitude and 0° 49' 22" North Latitude – 1° 19' 28" North Latitude. The area of Mendalam river basin is about 147,200 ha or about 1.5 % of total Kapuas Watershed (9,874,910 Ha).

b. Data and Analysis

Data were collected consist of two main factors, i.e. (1) biophysical factor, and (2) socio-economic and cultural factor. Data were analyzed base on data collected on biophysical and socio-economic-cultural factors as written in the Table 1. Both biophysical and socio-economic-cultural data were used in characterization of Landscape Agroforestry (LAF) in term of processes – activities and spatial pattern of its. More over, base on characterized of LAF was classified the structure of LAF in five categories as follows: (1.)Tree-Soil-Crop-Climate-Fauna interactions, (2.)Farmer management of agroforestry patches on farm, (3.) Value chain and marketing of AF products, (4.) Landscape scale pattern of interactions, emergence of 'environmental services' and (5.) Multi stakeholder interactions, governance, conflict, incentives

Table 1. **Matrix of Data Analysis**

Components	Characteristics of LAF: Processes of Nature and Activities of Socio-Economic-Culture	Characteristics of LAF: Spatial Pattern	Related Factors: Hydrology	Climate	Vegetation	Soil Type	Slope Class (%)	Geomorphology	Elevation	Identification of the Structure of LAF: *Tree-Soil-Crop- Climate-Fauna interactions*	*Farmer management of agroforestry patches on farm*	*Value chain and marketing of AF products*	*Landscape scale pattern of interactions, emergence of 'environmental services'*	*Multi stakeholder interactions, governance, conflict, incentives*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Biophysical Feature	Water Cycle	Watershed area (hydrologic unit)	0	0	0	0	0	0	0	0	0	0	0	0
	Precipitation	Isohyets boundaries	0	0	0				0	0	0	0	0	0
	Temperature	Iso-term boundaries	0	0	0				0	0	0	0	0	0
	Humidity	Iso-humidity bound.	0	0	0				0	0	0	0	0	0
	Vegetation, succession, distribution	Vegetation Map	0	0	0	0	0	0	0	0	0	0	0	0
	Infiltration	Infiltration Map	0	0	0	0	0			0	0	0	0	0
	Run off Potential	Run off Map	0	0	0	0	0	0		0	0	0	0	0
	Erosion Potential	Erosion Map	0	0	0	0	0			0	0	0	0	0
	Geomorphologic Process	Geomorphologic Map	0	0	0		0			0	0	0	0	0
	Soil Process	Soil Map	0	0	0	0	0	0		0	0	0	0	0
Socio-Economic-Cultural Phenomenon	Land Management	Land Cover/Land Use Map	0	0	0	0	0	0		0	0	0	0	0
	Farming System	Farming System Map	0	0	0	0	0	0	0	0	0	0	0	0
	Mean of Livelihood	Mean of Livelihood Distribution										0	0	0
	Waged Received	Wage Received Distribution										0	0	0
	Marketing Product	Marketing Distribution										0	0	0
	Occupation	Occupation Distribution										0	0	0
	Population Dynamic	Population Density Map										0	0	0
	Government Policy	Government Policy Boundaries											0	0

3. RESULTS AND DISCUSSION

Guntur (2006) stated that ecological city/eco-city conceptually means a green, healthy and environmentally friendly city. This concept put emphasis on people's physical dependency on environmental conditions. Ecocity also promotes better health and quality of life, which in turn promotes sustainable development. The Government, entrepreneurs, politicians and society need to reshape the concept of city as an ecosystem and the relation between city activity and its surroundings; in other words, city's alteration and the environment should go in harmony. Ecocity should be developed by its own residents, not by the local planning board or the government. However, the establishment of such city requires leadership, especially of the government, in every line and level.

In relation to the issue mentioned above, the implementation of PES scheme in Mendalam watershed will make a positive impact on Putusibau city. This capital of Kapuas Hulu District will be able to develop an eco-city/green city as the existing ecological network will be well-maintained alongside the well-conserved natural resources in both upstream and downstream areas. The implementation of PES program also implies a mutual understanding of natural resource management and conservation between upstream community as environmental service providers and downstream community as users (Wulandari, 2008). Meanwhile, the funding for this conservation effort is provided not only by the government and upstream community. A sharing-cost scheme will be applied through incentives or rewards from all downstream stakeholders as users (Leimona *et al.*, 2009).

Actually, the upper reaches of Kapuas river has its own ecological network, typical of upstream region (included in Mendalam watershed) inhabited by the Dayak peoples. Considering PES scheme potentially implemented in Kapuas Hulu within the establishment of a sustainable ecological network, the mapping result shows that the upper watershed serves as the upstream area and the downstream area is Putusibau city. Thus, the water resource users are the Putusibau's residents (through PDAM/the Drinking Water Company) and the water environmental service providers are those living in villages around the upper river.

Upstream Ecological Network

Based on surveys, the ecological network existing in the upper area has become a typical feature of the Dayaks living along the river-bank. The ecological types found are, as follows:

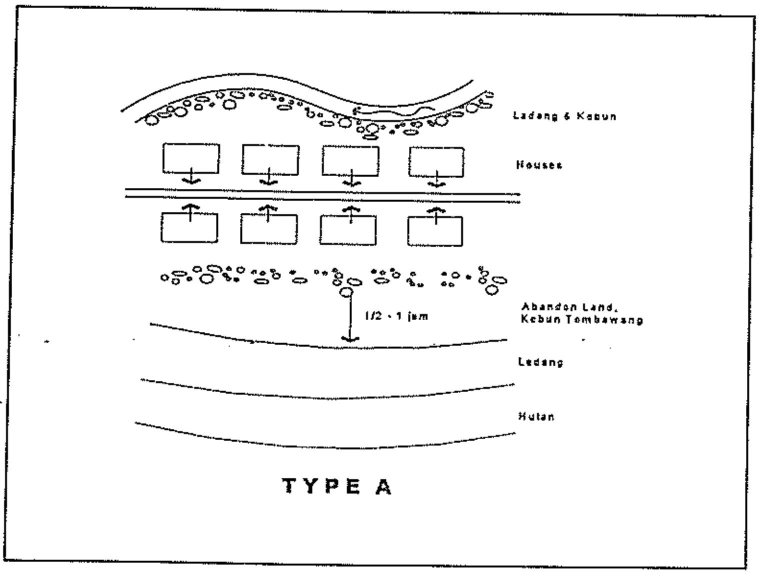

Figure 8. Landscape Mosaic of Type A in Mendalam River Basin

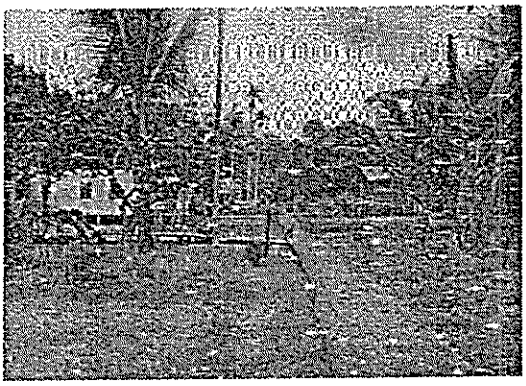

Figure 9. Nanga Hovat Residential Area

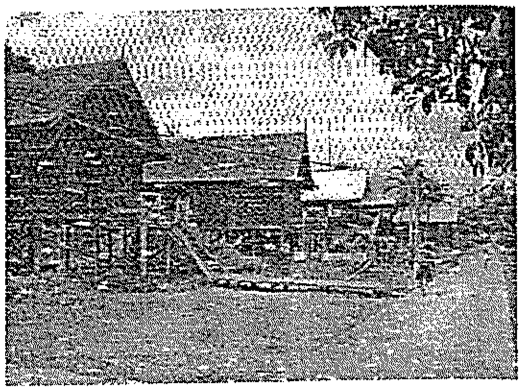

Figure 10. Uma' Suling Residential Area in Datah Diaan Village

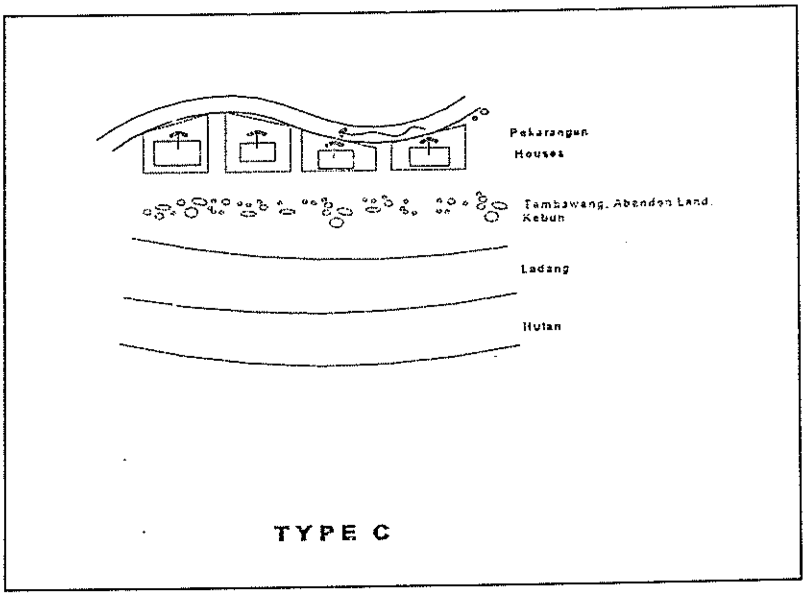

Figure 13. Landscape Mosaic of Type C in Mendalam River Basin

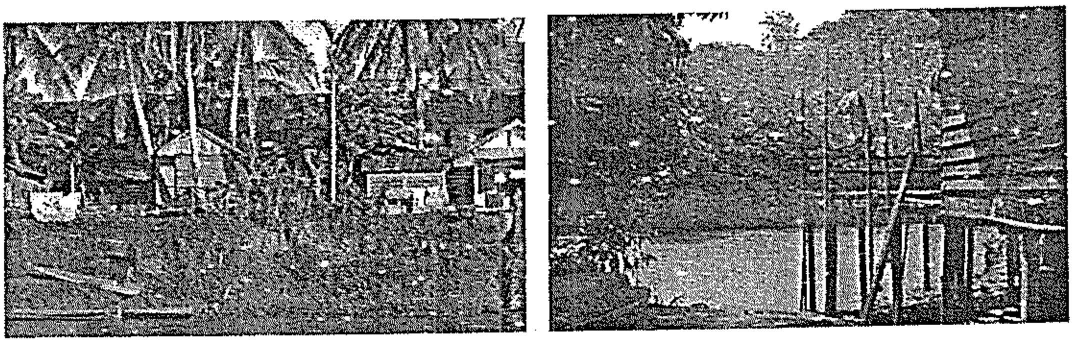

Figure 14. Type of Kampong (Settlement) which is Located in the Riverside

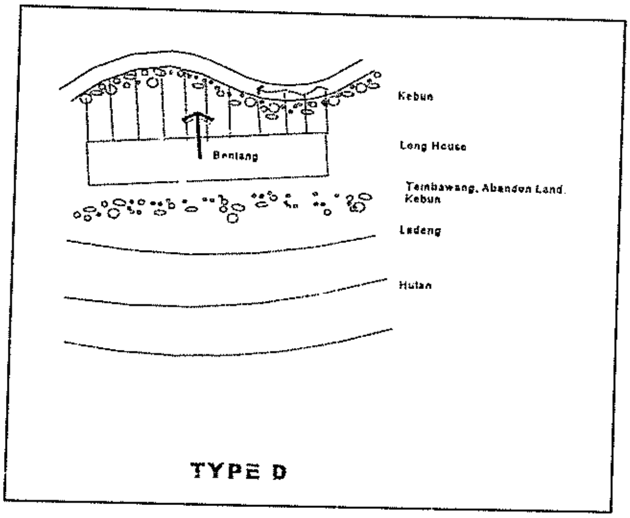

Figure 15. Landscape Mosaic of Type D in Mendalam River Basin

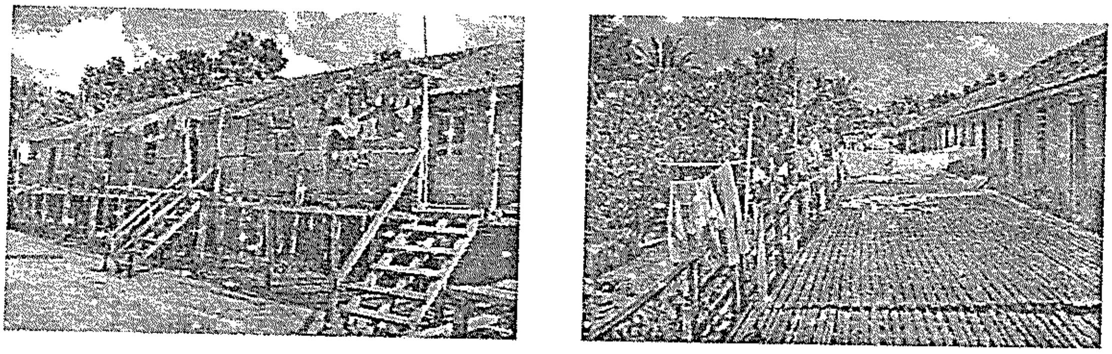

Figure 16. Performance of Long House

In addition, community in the upper watershed practiced traditional/semi-modern/modern patterns in managing their gardens, as described in the following table 2: Some patterns of agroforestry practices were found in Mendalam river basin, especially traditional agroforestry or complexed agroforestry. Those practices are found (Table 2) from *tembawang* (*kebun campuran* = mixed gardens) which is located in riparian (river side), then pekarangan (home gardens), *kebun tanaman/perkebunan* (plantation) *ladang* (dry land) and *hutan* (forest)..

Table 2. **Complexed Agroforestry and Vegetation Structure in Mendalam River Basin**

No	Type of Agroforestry	Vegetation Structure Pattern	Remarks
1.	*Tembawang* (Mixed gardens) in river side	Durian, fern (*paku ikan*), palm sugar, coconut, banana, sweet potato, peanut, green bean.	Cash crops are cultivated intensively.
2.	*Pekarangan* (Home Gardens)	Durian, rambutan, pamelo, coconut, pumpkins, pepper, *juna* (Dayak onion), taro, vegetable zinger (*Alpinia* sp.), poultry.	
3.	*Kebun Tanaman*/ Perkebunan (Plantations)	Rubber, coffee, cocoa	
4.	*Ladang* (Dry Lands)	Rice, corn, vegetable zinger (*Alpinia* sp.), cucumber, pepper, cassava	
5.	*Hutan* (Forest)	Mangosten, cekalang, pandanus, star fruit (*belimbing darah*), rambutan, bamboo, rottan, tengkawang (*Shorea stenoptera*), trees for honey bee (*lebah madu*)	Cultivated extensively

The agroforestry practices are related with settlement patterns. Four ethnics, i.e. Bukat, Kayaan, Taman and Malay have already settled in kampong, which is usually located along the river side. Table 2 shows the land use type in each kampong. From the upper stream to the down stream of Mendalam River Basin were found kampongs area, i.e. Nanga Hovat, Padua Komplek (Uma Suling, Pagung, and Teluk Telaga), Tanjung Karang, Lung Miting, Semangkok and Nanga Sambus

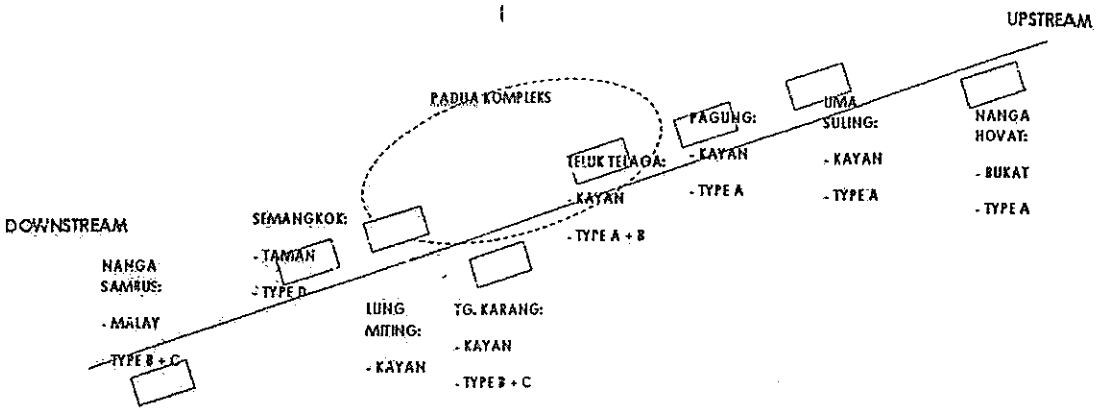

Figure 17. Profile of Settlements along Mendalam River

Table 3. **Land Use Type in Each Kampong in Mendalam River Basin**

No	Kampong	Ethnic	Land Uses Type
1.	Nanga Hovat	Dayak Bukat	Type A
2.	Uma Suling (Padua Kompleks)	Dayak Kayan	Type A
3.	Pagung (Padua Kompleks)	Dayak Kayan	Type A
4.	Teluk Telaga (Padua Kompleks)	Dayak Kayan	Type A & Type B
5.	Janjung Karang	Dayak Kayan	Type B & Type C
6.	Lung Miting	Dayak Kayan	Type A
7.	Semangkok	Dayak Taman	Type D
8.	Nanga Sambus	Malay	Type C

Viewed from upstream and downstream areas mapped vertically, the implementation of PES scheme is highly relevant to the river-water quality problem caused by human activities upstream. As described in the following table, land management in upper areas does not follow the principles of water and soil conservation, which leads to the increasing rate of river-water erosion.

Table 4. **Erosion and sediment concentration measured around study area**

Catchment	Catchment size (km^2)	Erosion (Mg/ha/year)	Sedimentation concentration (mg/l)
Mendalam	1685	Year 1986-2004: 2	Year 1986-2004: 25.
		Year 2005 : 3	Year 2005: 31
Sibau	1472	Year 1986-2004: 2	Year 1986-2004: 6
		Year 2005 : 4	Year 2005: 9
Kapuas Koheng	5992	Year 1986-2004: 1	Year 1986-2004: 5
		Year 2005 : 2	Year 2005: 9

Source: Dinas Kehutanan, 2006

Factually, in the hotspot land clearing, between 2001 and 2004, forest area in the Kapuas Hulu basin was reduced by around 130 km^2, while the total area managed by farmers increased by around 42 km^2. Both are insignificant changes in terms of percentage to the total basin area, but they represent a substantial relative increase in the agriculturally used area. Settlement area has more than doubled within this period. These changes mostly occurred in the designated Dry Agricultural land area.

Table 4 presented various point measurements on soil erosion and sedimentation in Kapuas Hulu. The current measured sedimentation rate around the study area, particularly in Mendalam is much lower than threshold that WHO recommended, which is 1500 mg/l (Widjarnarto A.B. *et al*, 2005 in Wulandari *et al.*, 2007). Although the erosion rate from 2004 to 2005 is still below its critical limit, such increasing rate needs anticipating. It also estimated that on certain location, bank collapse could have a size of 3 m, with vertical depth of 1– 2.5 m (*Dinas Kehutanan*, 2006). Loss of forest cover is considered to increase sedimentation and erosion and decrease river flow. In this instance, collaboration between upstream and downstream communities on the conservation of the available natural resources should be established, i.e. through PES implementation.

Based on the Cost and Benefit Analysis (CBA) result, Economic cost arising based on recommendation of community as a highly recommendation to apply for PES, the added benefit obtained will reach the wider community, both directly and indirectly in an amount of 2,079,535,100 rupiah or it will be give a benefit to community of 3,345,120 rupiah per ha (or equal to 371.68 USD per ha). Currently, Kapuas Hulu District PDAM operates at a loss as the income after direct expenditures and taxes is smaller that its income, and also because of water leakage. This problem will intensify and remain protracted should current rate of damage to the water catchments continue. In addition, should this program not be implemented, it can be assumed that PDAM will have additional costs as much as 10% annually as the supply it obtains declines and the level of environmental destruction increases upstream. Should they join in this program, it is projected that PDAM's production costs will decrease as there will be an increase in the quality and quantity of supply. Projected profit for PDAM with an increase in sales of 10% per year until 2018 accumulatively.

Meanwhile, various conservation efforts keep being made since there are incentives given by water service users, i.e. downstream community and PDAM (local government or owner of PDAM). The conservation of natural resources in the upper area will certainly protect the existing ecological network between upstream and downstream areas. This parallels Arifin *et al.* opinion (2007) that the implementation of PES program is an alternative natural resource conservation effort.

4. CONCLUSIONS AND RECOMMENDATIONS

The PES scheme implementation is able to promote the establishment of an ecological network and at the same time a sustainable green city. There are several alternatives viable for the conservation of natural resources in upper areas, as follows: future development of reward mechanisms in the area could be linked to activities that improve the (i) tree cover along river banks as well as (ii) converting non-productive land, as these areas are contributing to sedimentation in the river. The lack of existing hydrological data shows the important part of water and river monitoring activities in the overall scheme. To ensure that the hydrological condition of Kapuas Hulu basin can be maintained or improved, attention should be paid also to large logging activities as well as gold mining activities.

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