

## Achieving sustainable use of environment: a framework for payment for protected forest ecosystem service

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**Abstract.** Over the last decade, deforestation in Indonesia has reduced the forest area down to more than 6 million hectares. There is conflict that the protected forest ecosystem service is still often perceived as public goods. Many of them went unrecognized in planning process and continue to be undervalued. The challenge lies in maintaining socioeconomic development and ecosystem services sustainability without overlooking the people's opportunities and improving their livelihoods over the long term. An integrated approach is required to understand the comprehensive concept of protected forest ecosystem service. This research aims to formulate a scheme of payment for ecosystem service (PES) in a protected forest. It is a first step towards the attempt for the value of ecosystem services to be reflected in decision-making. Literatures, previous researches and secondary data are reviewed thoroughly to analyze the interrelated components by looking at the environment as a whole and recognize their linkages that have consequences to one another both positive and negative. The framework of implementation of PES schemes outlines the complexity of human-environment interconnecting relationships. It evaluates the contributing actors of different interest i.e. long term use and short term use. The concept of PES accommodates the fulfillment of both conservation and exploitation with an incentive scheme to the contributing parties who are willing to implement conservation and issuance of compensation expense for any exploitation means. The most crucial part in this concept is to have a good and effective communication between every policy makers concerning the forest ecosystem and local communities.

### 1. Introduction

The increasing deforestation in Indonesia reflects the poor management of forestry. The indirect causes of the deforestation and forest degradation in Indonesia are divided into four: 1) ineffective land use plan, 2) land ownership problems, 3) ineffective and inefficient forest management, and 4) poor law enforcement and corruption. The reformation era and regional policy initiate the pressure on protected forest and conservation forest. Illegal logging, forest fire, and land conversion are few examples of disturbance to protected forest function. Today, the total area of protected forest in Indonesia has reached down to 29.9 million Ha. The condition raises the urge to provide sustainability of its services.

The environmental services from protected forest come as various forms, such as water management, biodiversity, carbon storage and landscape view. Many of the products of forest services are regulated in the Regulation No. 32 year 1999 about Environmental Management and Regulation No. 37 year 2014 about Soil and Water Conservation. Both regulations mention that the payment for environmental services (PES) is an economic instrument to manage the sustainability of the environment. In Java Island, the protected forest is organized under the *Perum Perhutani* as a Forest Management Unit (FMU). The challenges on each FMU vary depending on its local condition and external pressures. One of interesting cases can be seen in FMU of North Kedu, that is located in Serayu Watershed, Central Java Province. The pressure on agriculture within this area is incredibly



high over the last decades. Land conversion from protected forest area into agricultural land was initiated in the early 2000 and still continues until present day. The potential of high income from agricultural products drive the local community and involving investors to cultivate land without proper conservation [5].

A conflict of multi-stakeholders comes as the protected forest lies within the Sikunir and Prau Volcanic Complex. The magnificent view from the peak of Sikunir Hill attracts as a new tourism object. An environmental service of the protected forest now comes in form of landscape beauty. Several environmental problems are triggered around the area of tourism area of Sikunir Hill, Sembungan village, such as the alteration of initially natural areas into shops, disturbance to local plants and animals, litter problems and soil compaction. The human activities within the area of FMU of North Kedu, such as agriculture, mining and tourism, tend to exploit the protected forest function for a short-term use. Only few parties consider the long-term sustainability of the forest. In return, the conservation measures are still temporary and depend on the popularity of a policy and resources from the government. The poor law enforcement gives impacts to another damage of the functions of protected forest.

The environmental issue particularly in protected forest consists of complicated elements. Many different perspectives, uncertainties and complexities are difficult to formulate and solve [9]. There are only few previous research regarding “ecosystem services” as the concept was first acknowledged only in late 1980s [2]. The concept of ecosystem services can be set in different scales of space and time. The challenge lies in the need for a comprehensive and practical framework to simplify the complexity of social-ecological problems. This research aims to formulate a scheme of payment for ecosystem service (PES) in a protected forest. This is a first step to be applied in the decision-making process of maintaining the value of ecosystem services.

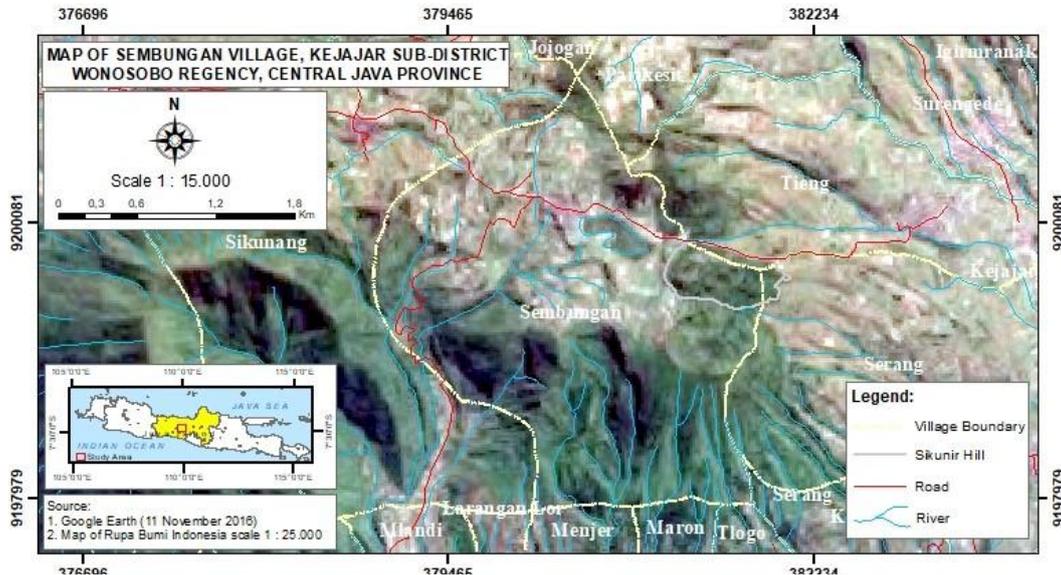
## **2. Methods for data collection**

Secondary data collection was initiated by literature studies through previous research, regulations and other articles. Information regarding the study area is delivered through basic and thematic maps, statistical data and other spatial information. Primary data was collected through field survey and in-depth interview towards important actors as key respondents, such as visitors of Sikunir Hill, farmers, service owners (for tourism) and the member of Forest Village Community Institution (FVCI).

## **3. Result and Discussion**

### *3.1 Understanding human environment system of Sembungan Village*

*3.1.1 Environment System.* Sembungan Village is situated within Dieng Volcanic Complex in Central Java Province. It is located within the Keajar Sub-district, Wonosobo Regency, and Central Java Province. Sembungan village lies in the northern part of the Dieng Volcanic Complex where the highest altitude is approximately 2350 metres above sea level and the coldest temperature is around 5°C at nights. Cebong Lake lies in the midst of the Sembungan village, surrounded by small hills. The northeast part of Sembungan village covers a Plot7 Forest Management Unit (FMU) North Kedu. It is a 513,1 Ha area of protected forest covering the volcanic slope of Sikunir Hill, a well-known area of tourism attraction. Protected forest in Sembungan is classified as community-based forest and managed under the authority of state-run forestry company (PT. Perhutani) since 1961 [9]. The vegetation covering most of the forest is dominated by pine and mahogany trees.



**Figure 1.** Map of Study Area.

Local people in Sembungan Village mostly rely on their livelihood on agricultural products. The intensive weathering process over porous volcanic material resulted in fertile soil and high productivity. Many farmers cultivate dry land agriculture with crop rotation as one of land management measures. Potatoes (*Solanum tuberosum*) and cabbages (*Brassica oleracea*) are the most cultivated vegetables within the area. The incomes from potato farming have also madeset the living standard of farmers in Sembungan village. Other commodities vary from corns (*Zea mays*), chinese cabbages (*Brassica rapa*), spring onions (*Allium cepa*), tobacco (*Nicotiana tabacum*), coffee (*Coffea arabica*) and rhubab (*Rheum officinale*) [9]. The agricultural land in Sembungan Village is distributed along the moderately slope, strongly sloping up to very steep slope. Monoculture system is used as the cultivation method. Bench terrace system is the most popular cultivation strategy applied in Sembungan Village. Parallel farming on steep slope is cultivated based on the consideration that it would provide good drainage facility [10]. The farmers also use sprinkles to spray water through pipes along the cultivated land as irrigation system. Land use alteration from agricultural land into settlements within the last decades has not been significant due to preference of keeping the lands to be cultivated instead of houses or buildings [9].

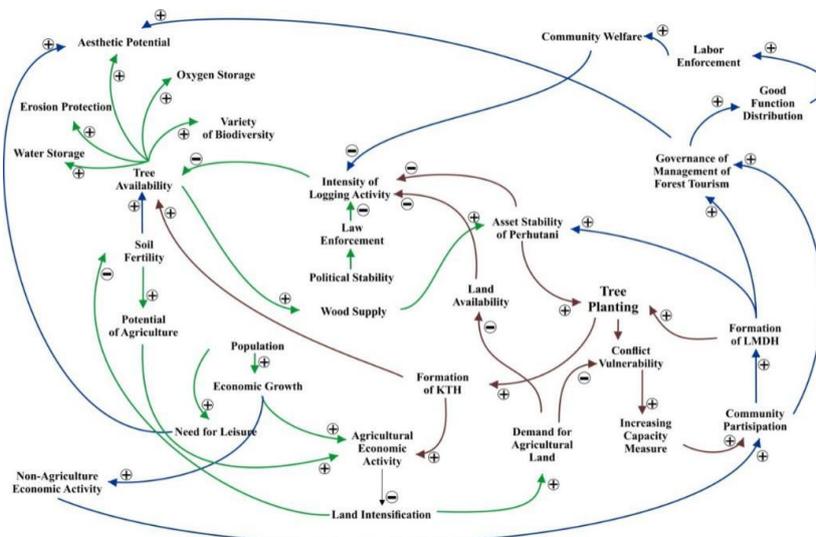
Being situated within Dieng Plateau, Sembungan village also suffered from deforestation that put the village at risk of erosion, landslides and floods [7]. Forest clearance and improper potato farming system play significance role to the driving factors of soil erosion and sedimentation. The erosion of Serayu Watershed has led to the increasing sedimentation and pollution in the river. The sedimentation also contaminated some lakes, including Cebong Lake in Sembungan village. It not only reduced the size of the lake, but also caused silting. Recovering the environmental damage in Sembungan village is not easy due to multi-sectoral issues that involve many aspects [6].

**3.1.2 Human system.** There are many actors involved in the application of forest management in Sembungan Village. Different actors with multi-interest interact in the management process, although not all of them are actively participate. PT. Perhutani holds a central role as

an authorized agency that controls any activities in the protected forest within Dieng Volcanic Complex. Towards the initiation of Community-Based Forest Management (CBFM) as PT. Perhutani realized that the utilization of forest function cannot be separated from local community participation. Local farmers are starting to get involved in the maintaining forest sustainability. Together with CSR, financial aids are given to local farmers with intention to increase their welfare. Based on interviews with key persons, it is discovered that the financial aid can range from 4 million to 8 million IDR per ha and is given to any farmer who is willing to cultivate the available land. However, the program goes practically uncontrolled since the farmers are expanding their agricultural land, replacing the trees in the forest area. Therefore, PT. Perhutani take a step to reorganize the forest management program by forming organizations for each forest plot called Forest Village Community Institution (FVCI).

The members of FVCI consist of local community within Dieng Volcanic Complex. FVCI practically not only supervise the agricultural-related activities within protected forest area, but also manage the forest tourism (non-agricultural activities) through the formation of community groups called Tourism Awareness Group (*Pokdarwis*). Pokdarwis is the practical team who works directly on the field regarding the management of forest tourism, initiated by the village government. The interconnection and relationship between those actors describe the governance state in Sembungan Village regarding its contribution to manage the protected forest sustainability towards expanding tourism activities.

**3.1.3 Human-Environment system.** According to regulations, the utilization of protected forest can be done by not altering its landscape and only limited to the use of forest land and forest non-wood products. Such three kinds of exploitation also require supervision. The case of multi-stakeholder involvement in the protected forest of Sembungan village will be explained using a system thinking to break down the complex element and to show its relationship among them. The system thinking approach recognizes the interconnections and their consequences across different scales of time and space, depending on the value-laden decisions that we consider [4]. It allows us to see the causal-effect relationships between physical and social elements in the utilization of protected forest of Sembungan village. The positive and negative relationships are also shown in each arrow within the diagram to indicate a positive or negative causal link.



**Figure 2.** System Thinking of Forest Management in Sembungan Village.

Field observation and interviews are conducted to collect data and information on the stakeholders and their conflict of interest. The system dynamic of multi-interest conflict within Sembungan village is divided into three main stages. The first stage is regarded as the period where the nature of the forest area in Sembungan village is still well managed. A work plan to organize the sustainability of the forest is managed by the PT. Perhutani without community participation. As the soil fertility is still preserved, replanting the forest is done, thus the tree population grows. In this period, the economic needs driven by the dynamic of population is still limited to land cultivation. Although the needs for more space for agricultural purpose tend to increase, the political stability is able to control the law enforcement, thus the intensity of logging is still low and supervised. Therefore, the protected forest functions of conserving water management, recharge area, biodiversity and oxygen storage are also still well preserved. In figure 2, this stage is depicted using the green arrows.

A change in involving actors in the forest area management initiates the second stage. Within this phase, the forest governance grows by involving the local community to step in together with the PT. Perhutani to manage the sustainability of the forest. This phase is also characterized by the formation of Community-Based Forest Management (CBFM) by the PT. Perhutani. An organization of farmers called Forest Farmers Group (FFG) is built. An effort by the PT. Perhutani to preserve their asset of wood supply is by replanting the forest together with FFG. However, lack of law enforcement such as legal problems towards forest damage in this period leads to poor forest management. Each member of the organization was offered a financial aid to help them cultivating the land. Farmers tend to use the financial aid to expand their agricultural land. Such situation leads to uncontrolled forest logging and cause a collapsing function of the forest. The red arrows in figure 2 explained this stage.

The last stage is shown in figure 2 using blue arrows. This stage is characterized by the need for leisure as population grows. It initiates the efforts to increase economical need by expanding the non-agricultural measures. Community participation is strongly involved within this phase. They also stand as measure to develop capacities towards conflict vulnerability due to previous replanting program. The main activities that are very depending on agricultural products alter into the exploitation of tourism attraction particularly in Sembungan village. Shops, home stays and restaurants are built and expanded to the areas around Sikunir Hill and Cebong Lake. The *Perhutani* then form an organization involving local community called Forest Village Community Institution (FVCI). The formation is under the concern that the sustainability of forest began to be threatened by such activities. Supervised by *Perhutani*, FVCI works directly in controlling and managing the tourism in forest area within Dieng Volcanic Complex. Several programs encouraged by the FVCI are developing access for tourist, replanting the forest and managing waste. A community group is built to involve most of the local people in Sembungan village in managing the tourism activities, called Tourism Awareness Group (*Pokdarwis*). The governance of tourism in Sembungan village in particular interacts harmoniously as the functions of each involving actor are specific and clear. The community welfare is also well preserved because the activities also require employees from local people in Sembungan village.

### 3.2 PES Framework for protected forest

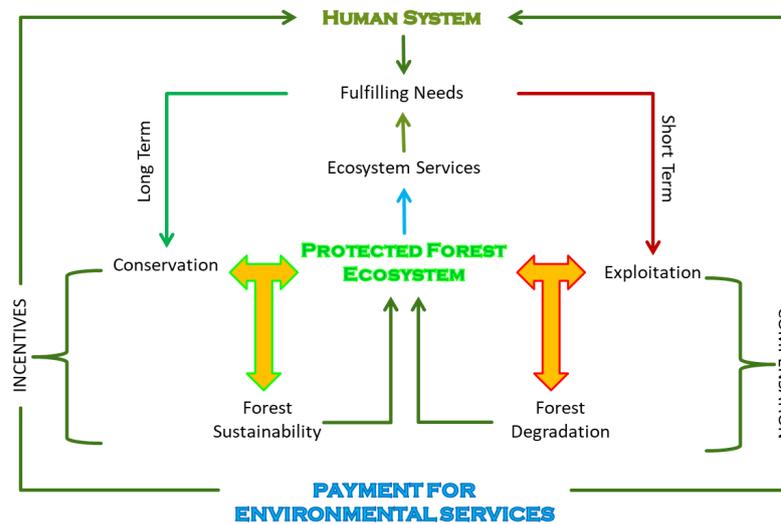
Payment for Environmental Service (PES) occurs when the service user offers payment to the service provider whenever the service provider conducted activities that give benefit to the user [3]. The ecosystem of protected forest provide many forms of services such as function of recharge area, landscape beauty, biodiversity protection, oxygen supply and protection from landslide and flash floods. These benefits of services are utilized by local communities. Based on its time scale, human needs can be divided into short term and long term period. Fulfilling the short-term needs tend to exploit the potential of the forest, while fulfilling the long-term needs comprises conservative measures. Conservative measures bring optimization to the environmental services for communities by preserving the sustainability of the forest. The exploitation to the forest is commonly regarding the economical orientation, where the local communities intend to expand their land by altering the forest area. In the end, these measures lead to collapsing function of the forest which then leads to expensive

cost of the environmental services. Figure 3 depicts the scheme of environmental service as a solution to balance the conservative and exploitative human activities within the context of forest area management. The concept of payment of environmental service accommodates both kinds of activities. Conservative measures will be awarded by incentives to the actors, while compensation cost will be given to any exploitative measures. These forms of payment of environmental services will be given back to both service provider and user.

In case of Sembungan Village, exploitation of the forest goods dominates the phase when the FFG is formed and given opportunities to cultivate the land within the forest area. In short term context, the ecosystem services provided by the forest such as wood supply and the benefits of tree availability are being utilized in an exceeding amount. In this period, the relationship between the local community and Perhutani was not in a good term, as there was violation to the cutting of trees by the local people and led to the arrests of the committed people by the Perhutani. This tense situation created non-conducive circumstances in the ongoing forest management. In result, deforestation and forest degradation occurred significantly, leading to secondary environmental impacts. Such impacts comprise roads damage, water scarcity and deeper water table during dry season, erosion due to land clearing and cultivation, and landslides in wet season.

Community-Based Forest Management (CBFM) is formed by PT. Perhutani according to provision No. 682/KPTS/DIR/2009 about CBFM. It is a forest resources management system, carried out by PT. Perhutani and local community together with stakeholders. Community participation incorporates the FFG and FVCI work with the agenda of planning, conducting, utilization, monitoring and evaluation of the forest resource management. The formation of CBFM poses as a resolution to the multi-interest conflicts in using the ecosystem services provided by the Sikunir forest. Its effectiveness can be seen by the active participation of the community and good communication with the PT. Perhutani. While the utilization of forest goods by the local community keeps on going, the presence of CBFM helps with the cooperation between the local communities and PT. Perhutani. Thus the forest resources and products are well managed and supervised. The performance of CBFM can be seen as a long-term conservation measure in preserving forest sustainability in Sembungan village. With the well-supervised sustainable forest management, the benefit of forest service comes back to the local community for their livelihood.

The emergence of other economic interests beyond the agricultural cultivation drives the local community to start exploiting the forest for tourism activities. New buildings, infrastructures and facilities are built and started to spread, thus the sustainability of forest nature is threatened. Concerning this situation, FVCI together with *Pokdarwis* and Perhutani work on managing the forest tourism in Sikunir village, ensuring the activities are well-organized. Under the supervision of the village government, division of tasks and profit sharing of the tourism activities are arranged. The entrance ticket fees to the tourism objects are delivered as income for the village. It is fairly shared between the Perhutani, *Pokdarwis*, FVCI, regional development, social activities, cleaning service and group interest. Supported by the funding, the local communities incorporated in FVCI and *Pokdarwis* are active in succeeding a sustainable management of the forest ecosystem in Sikunir village. This mechanism poses as a design of payment of environmental services (PES) in Sikunir village. The practice of PES in Sembungan village is implemented through communication and negotiation between the affected parties. The process and relationships of these components are explained in figure 3.



**Figure 3.** PES scheme of forest management in Sembungan Village.

#### 4. Conclusion

The payment for environmental service in Sembungan village is implemented through management measures toward protected forest sustainability. Compensation expense is issued for any exploitation means. Good communication between stakeholders and involving actors is crucial in implementing conservation means. Consideration towards sustainability of forest ecosystem and local community participation is the key to accommodate the long-term conservation of protected forest. The biggest challenge in this concept is the difficulties in communicating the involving actor that determine the policy of the forest area and local communities.

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