Working Paper

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Rewards for environmental services scheme: River Care program

Way Besai watershed, Lampung, Indonesia

Rachman Pasha, Tonni Asmawan, Beria Leimona,
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Southeast Asia

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

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Abstract

The World Agroforestry Centre, through its Rewarding Upland Poor for Environmental Services (RUPES) project, carried out action research on a rewards for environmental services scheme that bridges conservation and poverty alleviation objectives: the development of a River Care program in Way Besai watershed, Lampung province, Indonesia. The program involved farmers in Air Ringkih sub-watershed as environmental services providers and the Pembangkit Listrik Tenaga Air (Besai Hydropower Company/PLTA) under the authority of Perusahaan Listrik Negara Sektor Bandar Lampung (State Electricity Company, Sector Bandar Lampung/PLN-SBDL) as the environmental services beneficiary. The community was contracted to reduce the sedimentation rate in Air Ringkih sub-watershed by 30% in a one-year period. As the reward, PLN-SBDL provided a microhydropower unit valued at IDR 20 million (± USD 2120). The reduction target was determined through negotiations between ICRAF and PLN-SBDL, which showed PLN-SBDL's willingness to pay in turn for sediment reduction. River Care developed in four stages: 1) scoping; 2) stakeholder analysis; 3) negotiations; 4) implementation and monitoring.

At the end of the program, the community executed the contract with an 86% activity success rate. Analysis of sediment concentration showed a 20% decrease by comparison of the initial baseline slope value of 299.08 to the final value of 239.27 at the end of program. The agreed 30% reduction target was not achieved. However, PLN-SBDL very much appreciated the community's efforts in reducing the sediment concentration in Air Ringkih River and gave the microhydropower unit as a reward regardless of the results. The appreciation showed by PLN-SBDL had a big impact on the community's role in improving the maintenance of their environment, in particular, their watershed. This was the main objective of the rewards for environmental services mechanism: the community in the upper stream area continue to manage their land using soil and water conservation techniques to maintain natural resources and reduce sedimentation.

The case of River Care showed a shift in the paradigm from 'commoditized environmental services', which is focused on market or environmental services trade, to 'co-investment in landscape conservation', which is focused on co-investment for watershed conservation. In practice, 'co-investment' in such schemes' implementation promote stakeholders' participation—both upper and downstream communities, government and private entities—to take into consideration efficiency and fairness, building stakeholders' trust, promoting transparency and collaborating in sustainable watershed management.

Keywords: watershed management, participative approach, river care program, rewards for environmental services, landscape conservation co-investment

Acknowledgements

The rewards for environmental services scheme through the River Care program in Way Besai Watershed, Lampung, Indonesia, is an action research site of the Rewarding Upland Poor for Environmental Services (RUPES) project initiated by the World Agroforestry Centre with funding from the International Fund for Agricultural Development. The River Care program involved the community of Buluh Kapur sub-village as the environmental services provider and PLN-SBDL as the environmental services beneficiary. It was supported by the active participation of village authorities and the Forestry Agency of Lampung Barat district.

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1. Introduction

1.1 Background

The function of a watershed is to store water and flow it from up- to downstream. A healthy watershed will deliver an optimum quantity and quality of water. The common view is that conversion of forests in upper watersheds into agricultural land decreases the function of the watersheds, thus, leading to hydrological disasters, such as floods and landslides. One of the objectives of watershed management, that is, to restore watershed function, is often connected with restoring land cover through tree planting. However, there are uncertainties regarding the causalities and whether watershed problems can be tackled by tree planting alone (van Noordwijk et al. 2004). The management of watersheds has not yet seriously involved communities and other relevant stakeholders; if there was any involvement, it was often just temporary (Bruijnzeel 2004).

A new approach to watershed management involves relevant parties. One of the innovative approaches to watershed management is payments for environmental services scheme (van Noordwijk 2005; van Noordwijk and Leimona 2010). In these schemes, farmers, espesially those living in upstream areas, are considered as decision makers regarding land use and contribute as environmental services providers. It is through their decisions and actions that a watershed can function well and produce hydrological environmental services, such as healthy and abundant water or a lack of same. Meanwhile, the wider community is considered as environmental services beneficiaries.

Market-based environmental economy policy became the basis of the payments for environmental services (PES) concept (Landell-Mills and Porras 2002; Gómez-Baggethun et al. 2010). The principle of this approach is that anyone who provides environmental services should receive payment for their efforts and anyone who uses such services should contribute to the payments. Based on that principle, environmental services voluntary transactions then emerged, through which environmental services providers who conduct environmentally sound land management received payments from environmental services beneficiaries only if they could ensure availability and continuous service (such a condition is called 'conditionality') (Pagiola and Platais 2002, Wunder 2005).

PES as a market-based instrument was initially designed to increase conservation efficiency. Highly efficient PES schemes required a strict conditionality on environmental services stock and supply while maintaining conservation aspects. These schemes did not take poverty alleviation into consideration because it was assumed it would reduce the efficiency of a PES scheme (Pascual et al. 2010).

There were some modifications and innovations required to implement these schemes in Asia because of the unique ecosystems and socio-economic conditions (Tomich et al. 2004; Neef and Thomas 2009; van Noordwijk and Leimona 2010). For example, PES as a market-based instrument required clarification of ownership and land rights for private entities. However, such conditions cannot be strictly applied in Asia, in particular, Indonesia, where there are uncertainties in land status and also collective ownership (Contreras-Hermosilla and Fay 2005). Furthermore, ignoring poverty alleviation will reduce PES efficiency because a tight relationship exists between poverty and conservation in developing countries (Leimona et al. 2009; Muradian et al. 2010).

The World Agroforestry Centre through the Rewarding Upland Poor for Environmental Services[1] (RUPES) project has conducted action research to analyse PES schemes that bridge conservation goals with poverty alleviation (van Noordwijk et al. 2004). To differentiate, RUPES used the term 'rewards for environmental services' (RES) to explicitly show that the schemes' focus were not only on transactional efficiency or a mere payment for environmental services.

In Indonesia, RUPES facilitated solutions to some of the problems in Way Besai watershed by developing the rewards for environmental services concept through the River Care program. This program was conducted by farmers in Air Ringkih sub-watershed as the environmental services providers and Pembangkit Listrik Tenaga Air (Besai Hydropower Company/PLTA) under the authority of Perusahaan Listrik Negara Sektor Bandar Lampung (State Electricity Company, Sector Bandar Lampung/PLN-SBDL) as the environmental services beneficiary. The PLTA provided an operational fund for the River Care program and also the rewards in the form of money or a microhydropower unit. The rewards given were to be adjusted to the agreed sediment reduction target by PLTA (the conditionality of the agreement). The program combined individual treatments by farmers with treatment of public facilities, such as paths, roads, drains, clean water facilities and direct activities in the river. The design of the RES scheme in the River Care program included arrangements for the amount of sediment reduction and its monitoring scheme, the establishment of a participants' group, contractual matters, and discussions on scheme sustainability.

The objective of this paper is to elaborate the River Care program action research and to analyze lessons learned for the improvement of RES quality in Indonesia. The process of developing the RES scheme will be discussed through the following structure: 1) scoping; 2) stakeholders' analysis; 3) negotiations; and 4) implementation and monitoring. This method was introduced by van Noordwijk, Tomich and Chandler (2004) as one of the RES development methods. Lessons learned from the River Care program will be discussed through three RES paradigms (commoditization, compensation or co-investment) recommended by van Noordwijk and Leimona (2010) in the theoretical framework section below. The analysis will provide an overview of the differences and similarities of the River Care program with other schemes in Asia.

1.2 Theoretical framework

One of the principles underpinning rewards for environmental services schemes is that beneficiaries voluntarily contribute to rewards for providers who maintain optimum watershed (hydrological) functions. Van Noordwijk and Leimona (2010) elaborated four principals in such schemes.

1) Realistic: The RES scheme produces real and tangible environmental services flows and maintains environmental services stock in relevant and relative time periods and spatial areas toward 'business as usual' practices.

2) Voluntary: the involvement of parties in RES is based on negotiations, using the principal of an individual's free, prior and informed consent.

3) Conditional: rewards received by providers are based on a contract between the parties that is acknowledged and understood by all parties involved. There are four level of conditionality that agreements are based on

[1] More on information on RUPES is available from http://rupes.worldagroforestry.org/ and http://asia.ifad.org/web/rupes.

a. quality and quantity (for example, the type and amount of sedimentation reduction);

b. agro-ecosystem condition (for example, land cover);

c. agreed activities (for example, tree planting); and

d. common objectives, criteria and planning (Figure 1).

4) Pro-poor: access, processes, decision making and outcomes of the RES scheme are prioritized based on welfare levels and gender, supported by a positive bias toward marginalized members of society.

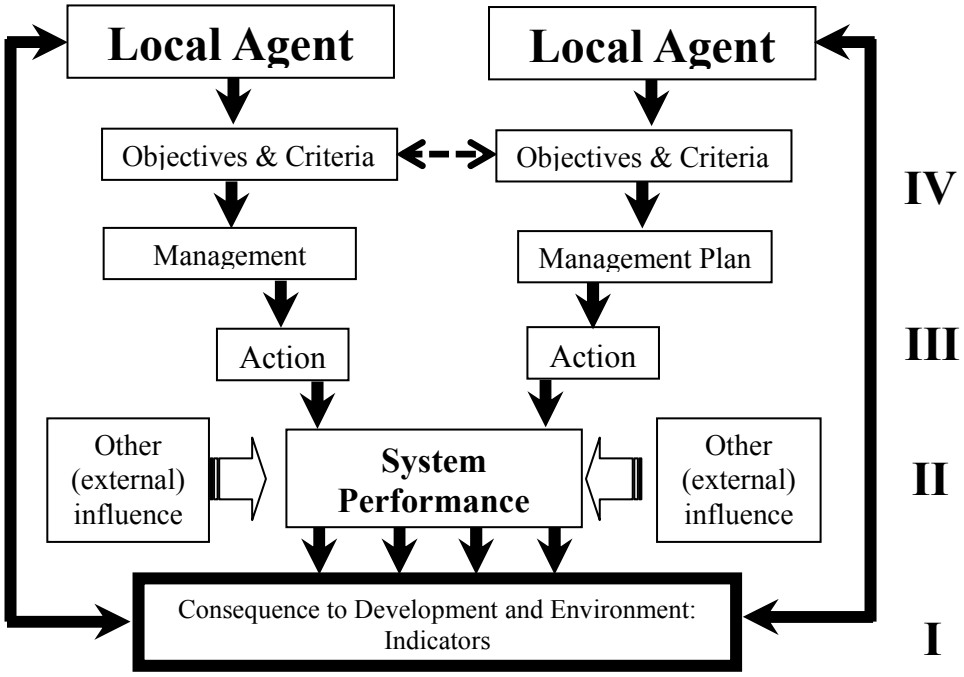


Figure 1. Conditionality levels in a rewards for environmental services scheme

From the above four principles and observation of PES and RES cases in Asia, van Noordwijk and Leimona (2010) concluded there are three paradigm in PES and RES cases.

1) Commoditized Environmental Services (CES): this type of scheme prioritizes level 1 conditionality, that is, clear transactions (supply of, and demand for, environmental services) between beneficiaries and providers. Beneficiaries do not pay providers if the latter cannot supply the agreed environmental services. Poverty alleviation is not an explicit objective. At the time of writing, there were no PES and RES schemes that purely applied the CES paradigm.

2) Compensating for Opportunities Skipped (COS): this type of scheme is based on conditionality levels 2 and 3, that is, the provider receives payment for their willingness to accept restrictions on their use of land. Most PES cases in Indonesia have been based on the COS paradigm. In Cidanau watershed, for example, the beneficiary, PT Krakatau Tirta Industri, represented by Forum Komunikasi Cidanau (Cidanau Communication Group) evaluated participant farmers by assessing the success rate of planting and maintaining trees in their fields.

3) Co-investment in landscape Stewardship (CIS): this type of scheme is based on level 4 conditionality, that is, a RES agreement that is flexible and has a high level of trust between the parties. The assessment or monitoring scheme funder the CIS paradigm is based on loose agreements regarding landscape planning. Cases in Bungo and Singkarak in Sumatra, Indonesia, and incentive schemes using water royalties, as have occurred at Lake Toba in Sumatra, apply the CIS paradigm.

The three paradigms are not fixed, rather, they are dynamics. When CIS implementation succeeds and there is a high level of trust between stakeholders, such schemes can evolve into the CES paradigm with an efficient conservation approach that has tangible environmental services provided with conditionality.

2. Methodology

2.1 General conditions at the research location

In the Sumberjaya area of Sumatra, the last three decades have seen conversion of forests to coffee plantations and other crops, with forest coverage decreasing from 58% to 15% (Ekadinata 2001). The Government responded to this situation by reforesting the watershed area and removing farmers from protected forests. However, such an approach triggered new problems, such as forest encroachment and forest fires (Verbist and Pasya 2004).

Hydrological research in Sumberjaya showed that Way Besai watershed has experienced functional disturbance. An analysis of annual rainfall and Way Besai's debit for 23 years (1975–1998) revealed the tendency for increases in peak flow and decreases in base flow was related to the reduction of forest areas (Farida and van Noordwijk 2004). Sedimentation in Way Besai was 3 kg/m^3/second during peak flow and 50% of that sediment went to PLN-SBDL's reservoir (Verbist et al. 2005). The biggest sediment contributor was Way Lirikan sub-watershed with a sedimentation rate of 1–2.5 g/l/second (Verbist et al. 2006).

Such conditions affect the area downstream, for example, in lost opportunities to produce more electricity because of a shortage of water to spin the turbines and the need to empty the dam in order to remove sediment. PLN-SBDL estimated that 50% of their reservoir volume was filled by sediment, thus, reducing the water capacity for operating the hydropower turbine (PLN-SBDL 2006). A cost analysis conducted in 2001 showed a decrease in income owing to erosion of more than IDR 2.9 billion (± USD 307 000[2]) per year, while the income lost owing to electricity production shortages was more than IDR 3.4 billion (± USD 360 000) per year (at a selling rate of IDR 19/kWh) (Sihite 2001). To reduce losses downstream, better upstream management was needed and the benefits received by downstream users should be managed to improve conditions upstream, which was the sources of the benefits.

The River Care program was started in 2007 and ended in 2010, while the environmental services contract ran from February 2008 to February 2009. The program was conducted in Air Ringkih sub-watershed, Buluh Kapur hamlet, Gunung Terang village, Way Tenong sub-district, Lampung Barat district, Lampung province (Figure 2). The location was bordered by Semarang Jaya village (west), Rigis Jaya II village (east), Bedeng Sari hamlet (south) and Protected Forest Register 45B Bukit Rigis (north). Air Ringkih sub-watershed was one of the Way Besai tributaries, with a 522.30 ha catchment area. The topography was rolling hills dominated by medium-to-steep slopes at 700–900 masl. In general, the soil type was clay on the surface and sandy on the lower horizon. The soil condition was hard and sticky with erosion levels of medium to high. Soil colour was yellow-red (Widodo 2006).

Most of the land was used for coffee gardens, with a smaller part for rice fields and settlements. Old coffee gardens were mostly found on lower slopes while younger ones (land cleared around 10 years earlier) were on upper slopes. Land managers rarely used soil and water conservation techniques; however, mixed-garden management did exist. The land tenure status of the area was communal, with some protected forests. Most of the hamlet of Buluh Kapur was part of Register 45B, including the protected forests.

[2] USD 1 = IDR 9440

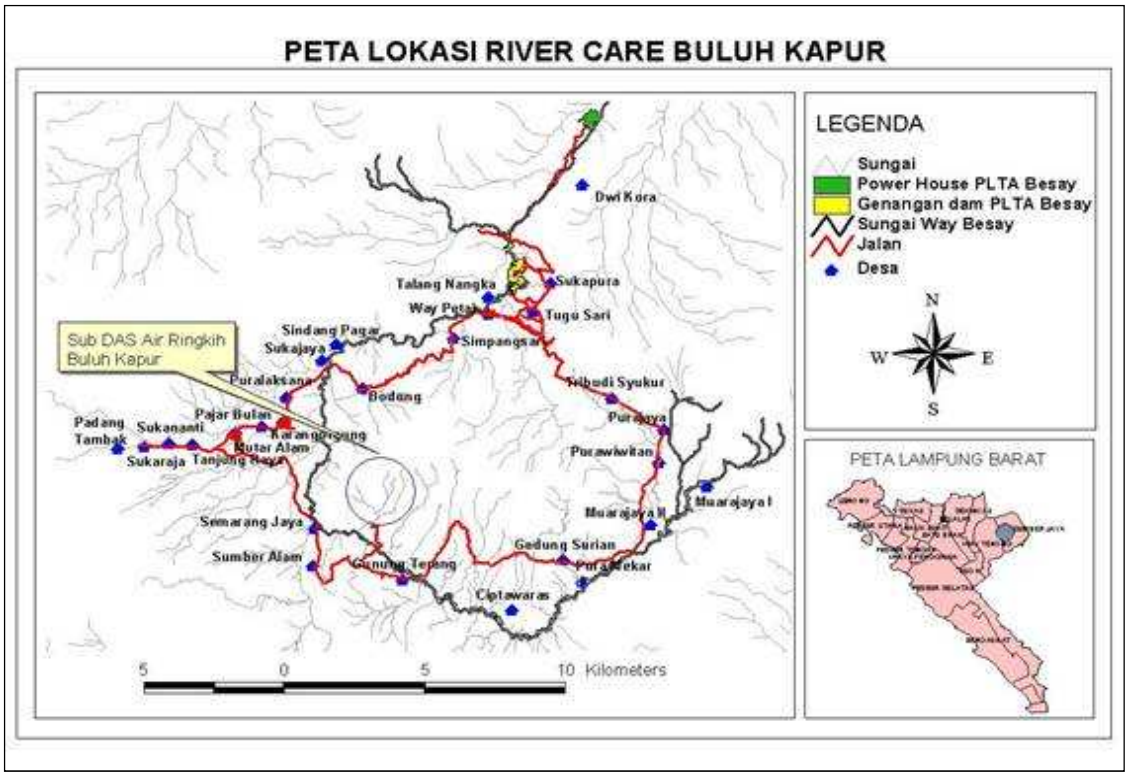


Figure 2. River Care program location map

2.2 Methodology

The River Care program was developed in four stages: 1) scoping; 2) stakeholders' analysis; 3) negotiations; and 4) implementation and monitoring. This method was introduced by van Noordwijk et al. (2004).

2.2.1 Scoping

The initial stage of the River Care program was to conduct a Participatory Landscape Assessment (PaLA) (Figure 3). PaLA is a tool based on Rapid Rural Appraisal/Participatory Rural Appraisal (RRA/PRA), the objective of which is to gain an overview of community-based environmental management (Fagerström et al. 2005). PaLA was conducted without any intervention of the views of the researchers. The implementation consisted of 'socialization' or explanation of the concept and techniques to participants; interviews and discussions; and land sketches and field monitoring, according to the needs of the community. In this study, the PaLA survey was carried out to obtain an overview of the watershed, such as the area's condition, important issues and problem-solving efforts. The results of the assessment were then used to determine key farmers and the scope of information required.

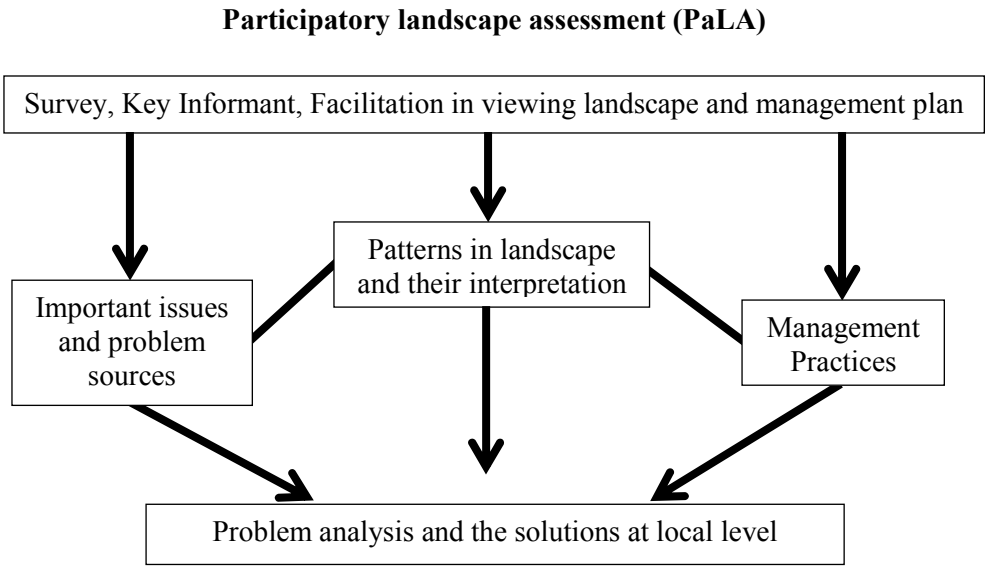


Figure 3. PaLA approach scheme (Farida et al. 2004)

2.2.2 Stakeholders' analysis

The objective of this stage was to determine which parties should be involved in the program. The initial step was to identify interested parties; the second step was develop a visual stakeholders' relationship scheme; and the last step was to determine the role of each stakeholder in the River Care Program. The techniques used in the analysis were key informant and stakeholders' interviews, field observations and literature study.

2.2.3 Negotiations

Public payment schemes usually require intensive negotiations between upstream and downstream areas to determine how much should be paid to private land owners and/or public resources managers. The payments collected can be used for management such as land developments or to pay land owners or resources managers to change their land management behaviour (Conservation Finance Alliance 2003). By this stage, face-to-face negotiations can happen and stakeholders can know the benefits they will receive. This is possible owing to the clear connectivity of watershed management activities and the possible positive impacts. On a smaller scale, a complex agreement, adjusted to local conditions, can be established (Conservation Finance Alliance 2003).

2.2.4 Implementation, monitoring and evaluation

Implementation, monitoring and evaluation are the last stages of development of an environmental rewards scheme. These stages determine whether or not a program will be successful. The question needing to be answered is whether the scheme will be able to run effectively, efficiently and sustainably. Furthermore, the process should examine the extent of equity and fairness of the scheme in relation to all stakeholders. In general, there are three phases involved in this stage: 1) pre-contract; 2) contract implementation; 3) post-contract. Each phase must be documented and informal interviews conducted with relevant stakeholders to obtain community opinion, including the problems encountered.

In this study, also taking place at this stage was monitoring of sediment concentrations, which was conducted in a collaborative fashion by ICRAF and the community. There were

four water observation locations chosen and each was monitored by two observers. Monitoring consisted of two steps: 1) water sample collection; and 2) sediment concentration analysis in a laboratory. The collection of samples was conducted by field observers who were community representatives, use the following techniques.

- Samples collected by depth-integrating method in the middle of the river. Taken every 15 minutes, water samples were put in a plastic bag complete with information on date, hour, water surface height and location.
- Water samples taken each time rain fell and affected the water surface level and increased turbidity.

The next step was analysis of the sediment concentrations, conducted by ICRAF in a simple laboratory.

1) A litre was taken from each sample and put in a plastic container then the turbidity was measured with a turbidity meter and the conductivity measured using a conductivity meter.
2) Three hundred and thirty millilitre was taken from each sample and put in a metal bowl of known weight.
3) The remaining sample was kept in the plastic container as an archive.
4) The water was left to precipitate for three days.
5) Half of the precipitated water sample was removed and the remainder placed in the bowl in an oven for about 45 minutes.
6) The bowl with sample was removed from the oven and left to cool for about 10 minutes and then weighed.
    - **Net sediment weight (mg) = oven bowl weight – empty oven bowl weight**
    - **Sediment concentration (mg/L) = (net sediment weight x 1000)/0.33**

Other supporting hydrological data were collected, aside from water samples.

1) Rainfall data was obtained using an automatic rainfall measuring device installed in one of the community members' houses (Figure 4). The location of the installation was determined by considering safety factors and easy access. The data consisted of manual daily observations and a data logger that extracted information monthly. Both techniques were used to support data continuation and lessen any loss of information owing to data logger failure, with the manual observations providing missing data.
2) Debit data. Water surface level data was obtained from manual observations and an installed sensor. The flow debit was obtained using the following formula:

Figure 4. Automatic rainfall measuring device

$$Q = 2/3\ Cd\ (2g)^{1/2}\ b\ H^{3/2}$$

Where:
Q = debit (m^3/s)
b = weir width (m)
Cd = debit coefficient
H = water level (m)
g = gravity
Cd = 0, 6035 + 0, 0813 H/p
p = weir height from river base

3) Sediment concentration changes were assessed at Station 4, which was at the outlet of the Air Ringkih River before it joined the Way Besai River. The measurement was calculated in percentage of sediment reduction, using the following formula:

$$\textbf{Sediment reduction value (\%)} = \frac{\textbf{baseline slope} - \textbf{final slope}}{\textbf{baseline slope}} \times 100\%$$

3. Results and discussion

3.1 Scoping

Scoping included participative observation of watershed problems and their solutions with the Buluh Kapur community as the potential environmental services provider. ICRAF provided scientific support to determine the baseline for monitoring sedimentation. The value of sedimentation reduction resulting from the community's activities was the basis of the contract with PLN-SBDL.

3.1.1 Watershed problems and participative solutions

A Participatory Landscape Appraisal was conducted along the river and other locations considered as the source of problems in the Air Ringkih sub-watershed. The results showed that there were various environmental problems faced by Buluh Kapur, such as high levels of erosion, landslides and floods along the Air Ringkih River. These problems caused sedimentation of the river body and the community's coffee gardens to become dry. The lack of clean water was another problem owing to the low quality of available water.

A small group of community members had made some effort to address these problems by planting grass to strengthen the soil and planting timber or fruit trees (with high crown) in gardens or river side. They also made several simple conservation constructions, such as terracing. Nevertheles, the efforts had little impact since only a small group of the community participated. Some challenges in addressing problems in Air Ringkih sub-watershed were the low awareness among the community about the importance of reforestation, owing to limited information and lack of assistance from Government agencies. Limited manpower, time and finances were also among the challenges, as well as critical land condition that made it harder to grow some plants.

Ideas that came from discussions with the community during the Participatory Landscape Appraisal were realized as part of the conservation activity plan, especially on critical land around the river banks. Those activities were:

- to plant bamboo and sugar palm;
- to minimize grass cutting/weeding in coffee gardens;
- to develop conservation techniques on agricultural land, such as ridges and terraces;
- to increase soil fertility by the use of compost and manure as alternative fertilizers; and
- to strengthen farmers' groups so they could actively participate in seeking alternative funding to support environmentally and economically sustainable watershed rehabilitation.

3.1.2 Determination of sedimentation data baseline and sedimentation reduction

Baseline data calculation was done at the beginning of the contract, before conservation activities on land or in the river were conducted. Water monitoring was conducted in March, especially during rain events. During this activity there were 12 rain events, however, only three were measured: 10 (55 mm), 11 (31 mm) and 18 (38 mm) March, because only on those three dates did the water surface level rise 10–50 cm. Sediment data was associated with debit data using liner regression formula, which resulted in a regression coefficient value (slope) of 299.08 (Figure 5). Based on this result, in order to get the microhydropower

unit as a reward, the community had to reduce the regression coefficient value (slope) to 30% or 206.56.

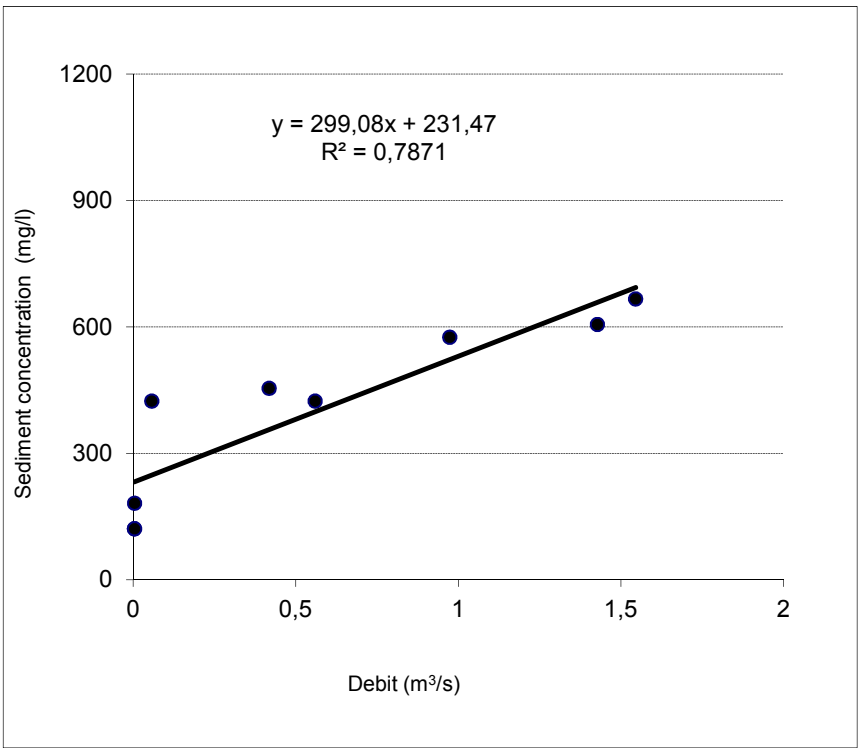


Figure 5. Sediment concentration trend in station 4 (outlet) at baseline

3.2 Stakeholders' analysis

The first step in the stakeholders' analysis was to identify parties to be involved or having an interest in the program by interviewing key informants, field observations and a literature study. Based on the stakeholders' analysis, we found the potential stakeholders were:

- Hydropower company: PT Perusahaan Listrik Negara Sektor Pembangkitan Bandar Lampung (PLN-SBDL) as environmental services beneficiary or 'buyer'. In this program, PLN-SBDL through its Besai Hydropower Unit (PLTA Besai) provided an operational fund for conservation activities and a reward at the end of the program.
- Buluh Kapur community through the River Care Forum as environmental services provider or 'seller'. The community conducted conservation activities in Air Ringkih sub-watershed to reduce sedimentation as the product of their service.
- World Agroforestry Centre (ICRAF) as facilitator (Intermediary). ICRAF facilitated the overall process of the River Care program.
- Forestry Agency of Lampung Barat Regency, ICRAF, PLN-SBDL and PLTA Besai as evaluators.
- Village and district government officials as caretakers of the River Care program in Gunung Terang administrative area.

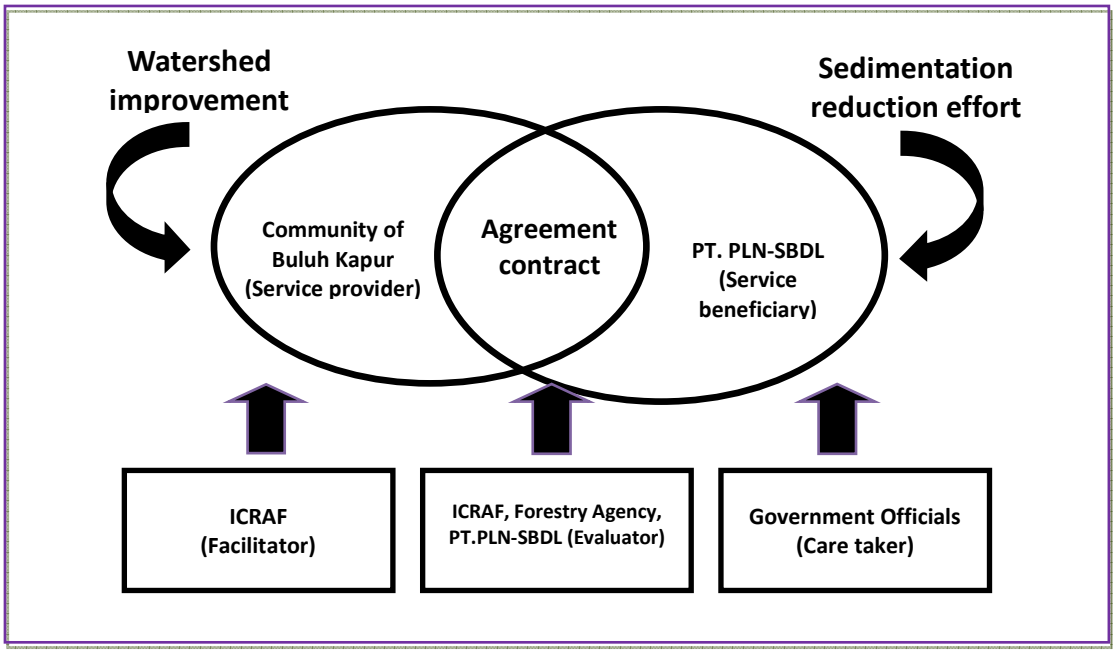


Figure 6. Analysis of stakeholders in the River Care program

Analysis of stakeholders (Figure 6) in the River Care program can be elaborated as follows:

- Environmental services beneficiary, PLN-SBDL, coordinating five diesel and two hydropower plants or PLTA (one of which is PLTA Besai). PLN-SBDL was interested in reducing sedimentation in its reservoir.
- Environmental services provider, River Care Forum, needed stimulation and rewards to rehabilitate Way Besai watershed upstream, thus, a microhydropower unti was offered to improve community welfare.
- Intermediary/Facilitator, ICRAF, was interested in research and development of concepts and new findings from implementation of environmental services schemes in the field, especially with non-cash rewards.
- Caretaker, village government, had an interest in integrating and developing community welfare opportunities in each administrative area and creating a good investment environment.
- Evaluator, a joint team representing PLN-SBDL, ICRAF, PLTA Besai and Lampung Barat Forestry Agency.

Table 1. Actors in River Care program and their role

Type of actor	Stakeholder	Role
Environmental services provider	Community	▪ Participate in determining watershed problems and solutions, and determining value and content of contract ▪ Reduce sedimentation ▪ Implement river care activity
Environmental services beneficiary	PLTA Besai coordinated by PLN-SDBL	▪ Participate in determination of reward for environmental services value and contract content ▪ Provide operational fund ▪ Provide reward for the program ▪ Included in evaluator team
Intermediary/Facilitator	World Agroforestry Centre (ICRAF)	▪ Conduct participative program scoping ▪ Conduct stakeholder analysis of parties involved ▪ Facilitate negotiations between environmental services providers and beneficiaries ▪ Facilitate the cooperation contract development ▪ Assisting environmental services providers during program ▪ Involved in evaluator team
Care taker	Village government	▪ Support the cooperation between environmental services providers and beneficiaries ▪ Support community in program implementation
Evaluator	Representatives of PLN-SBDL, ICRAF, PLTA Besai unit and Forestry Agency of Lampung Barat	▪ Conduct a six-monthly program monitoring and evaluation including activity implementation and institutions ▪ Determine and analyze sediment concentration at baseline and end of the program

3.3 Negotiations

Negotiations were carried out between Buluh Kapur hamlet and PLN-SBDL. Negotiations with the community used focus group discussions to raise awareness of the activities in the program and the value of the rewards that the community expected at the end of the program. Negotiations with PLN-SBDL included a seminar, workshop, presentation and discussions. The objective of the negotiations was to help both the community and PLN-SBDL understand the concept of environmental services, types of participation, and rewards given to the community as an appreciation of successful activities.

The negotiations, which were facilitated by ICRAF, resulted in the following points of agreement:

- PLN-SBDL was willing to reward the Buluh Kapur community if the community could reduce sedimentation in Air Ringkih sub-watershed in one year according to the agreed terms (Table 2).

- PLN-SBDL gave IDR 10 million (± USD 1054) to Buluh Kapur River Care Forum to fund watershed conservation and sedimentation reduction activities by the community.
- The community would implement sedimentation reduction activities for a year in coffee gardens, pathways or the river body (Table 3).
- During implementation, ICRAF would remain neutral so the final result could be accepted by all parties and accountable to the public.

Table 2. Contract value based on sedimentation reduction of River Care Program

Type of fund	Contract value
Operational fund	IDR 10 000 000 (50% after contract signing and 50% after 3 months operations)
Erosion reduction level (conditionality)	**Reward value**
≥ 30 % from baseline	Microhydropower unit equal to IDR 20 000 000
21–29%	IDR 7 500 000
11–20%	IDR 5 000 000
1–10%	IDR 2 500 000

Table 3. River Care Program activity plan

No.	Program of work
1	Establish 'cempaka' nursery (*Magnolia longifolia)*
2	Water monitoring
3	Construct dams made of stone, wood pile and stone pile
4	Training in technical civil conservation, water monitoring, building dam
5	Build conservation construction (terrace, ridge, wind hole etc)
6	Planting bamboo, sugar palm, grass strips and trees
7	Maintenance of all activities (including road drainage)

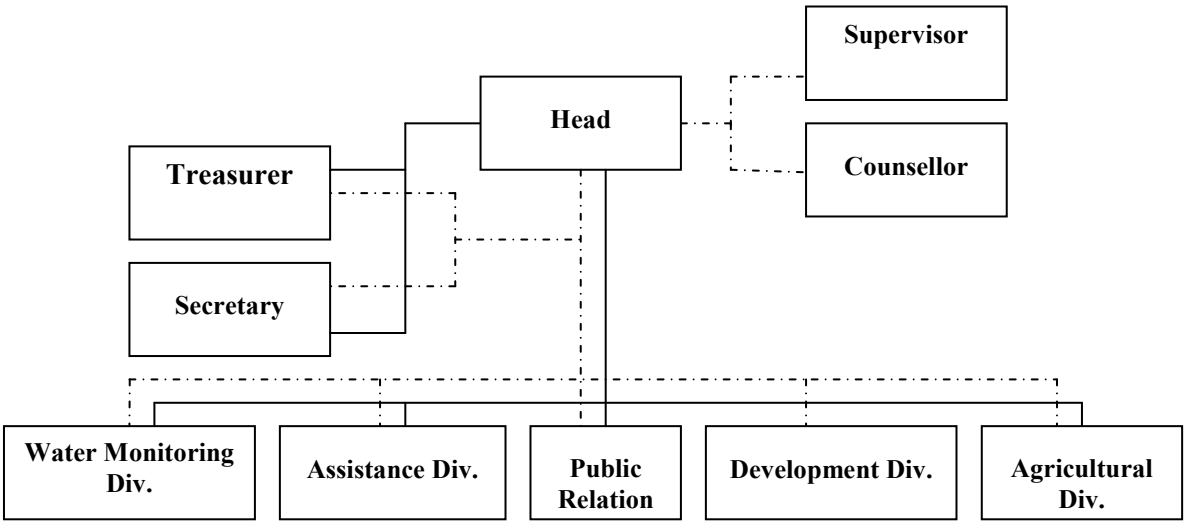
3.4 Implementation

Implementation took place in two stages: 1) pre-contract, when preparation for management of the River Care program took place; and 2) contract implementation, when conservation activities by the community were executed according to the contract: participative water monitoring, local institution management and physical construction and maintenance.

3.4.1 Pre-contract stage

There were four processes in this stage: focus group discussions, establishment of forum organization, socialization and training. ICRAF, together with a field extension officer from the Forestry Agency of Lampung Barat, held two focus groups with Buluh Kapur community, the objective of which was early socialization of the River Care program to community leaders. Another objective was to discuss the details of the draft agreement between the community and PLN-SBDL, such as form of reward, time frame and activities. For simplicity of organization, the River Care Forum was formed through a community meeting attended by all the Buluh Kapur community. The meeting resulted in a consensus without any

intervention from other parties. The members of Buluh Kapur River Care Forum were all the community living in Buluh Kapur hamlet. The organizational structure of the forum is presented in Figure 7.



Note:
Command line
Coordination line

Figure 7. River Care Forum organization structure

The new River Care organization then finalized the draft of the upstream–downstream cooperation agreement and socialized the result to all members for input and endorsement of the River Care program plan. To improve the capacity of the community to implement the River Care program, ICRAF, together with the field extension officer of the Forestry Agency, held several training sessions as presented in Table 4.

Table 4. Training for improving the community's capacity

Training	Objective	Remarks
Group dynamics	Increase capacity of the organization	Held on 6 December 2007 at Buluh Kapur meeting hall, attended by 36 community members, of which 21 were male and 15 female
Water monitoring	Provide understanding of the hydrological cycle and simple watershed monitoring techniques	Held on 16 December 2007. Attended by 12 community representatives. Topics presented were: the hydrological and watershed cycle and simple watershed monitoring techniques, consisting of • determining observation location • water sample collection technique • sedimentation concentration analysis by *Secchi* disc method

3.4.2 Contract implementation stage

This stage began once the contract was signed on 16 February 2008 at Buluh Kapur meeting hall. The signing was attended by representatives of all stakeholders involved in River Care program: PLN-SBDL represented by the company's Besai unit, ICRAF, River Care Forum, village officers and the forestry agency. Following the contract signing, PLN-SBDL handed over the operational fund to the River Care Forum (IDR 5 million or 50% of the total fund). The remaining 50% was to be paid in the third month of implementation. The program implementation was divided into four activities: 1) conservation activities (vegetative, river body, and land conservation); 2) water monitoring; 3) institutionalization; and 4) maintenance.

3.4.2.1 Conservation activity

According to the contract, there were three conservation activities that should be done by the community: 1) vegetative conservation in areas vulnerable to erosion and landslides; 2) conservation of the river banks and body; and 3) conservation in the community's coffee garden.

1) Vegetative conservation

Vegetative conservation included nursery development and planting in areas which were vulnerable to erosion and landslides. The species chosen were 'cempaka' wood (*Magnolia longifolia*), bamboo, areca nut (*Areca catechu L*), 'medang' wood (*Litsea spp*), sugar palm (*Arenga pinnata*), durian (*Durio zibethinus*) and 'suren' wood (*Toona sureni Merr*) (Figure 8). These species were chosen based on community preferences taking into account their ecological and economic functions. Ecologically, the species stored water and strengthened soil structures, abilities which were to expected to reduce erosion and landslides. Economically, they have high value, for example, bamboo could be used for cattle pens, sugar palm could be processed to produce drink or sugar, and the areca nut could be processed for traditional medicines.

Figure 8. Leaf of cempaka (*Magnolia longifolia*), one of the trees preferred by the community

Figure 9. Grass strip of *Setaria* sp

In addition to these species, the community also planted grass strips of *Setaria sp*, which can prevent erosion and water surface flow in gardens (Figure 9). Grass strips also can be used as fodder since most of the Buluh Kapur community kept cattle.

2) River banks and body conservation

Sedimentation controllers and vegetation planting (figures 10 and 11) were constructed to conserve the river banks and body. The community was trained, facilitated by the field extension officer of the Forestry Agency, in how to construct stone dams as sedimentation controllers. There were three types of dam made: semi-permanent; wooden; and stone (Table 5). Furthermore, conservation of the banks involved planting grass, sugar palm and bamboo alongside of the tributary up to the junction of the Way Besai River.

Table 5. Dam and sediment controller construction

Type of dam	Amount (unit)	Description
Semi-permanent	3	Made of wire, river stone, fibre and plastic mulch
Wooden	3	Made of wood pile
Stone	7	Made of stone pile

Figure 10. Wooden dam (left) and semi-permanent stone dam (right).

Figure 11. Planting sugar palm (left) and bamboo (right) on river bank

3) Land conservation

Sedimentation treatments was carried out both in the river body and on community land by building land and water conservation constructions, such as terraces, infiltration pits, pathway shunts and drainage improvements (furrows) (Figure 12). These techniques were designed to reduce erosion and surface flow when rain occurred. They also positively affected coffee growth because the land became more fertile and friable. Prioritized land for conservation was that located along the river. Most of these activities were done on community forest land (Hutan

Kemasyarakat/HKm) of the Hijau Kembali Farmers Group. Land conservation activities were carried out by all male members of the community, with the exception of children. The heavy work required much labour, especially in making terraces and infiltration pits.

Figure 12. Simple conservation techniques: infiltration pit (left) and terrace (right)

3.4.2.2 Participative water monitoring

Water monitoring was conducted by members of the Buluh Kapur community after training by ICRAF. The task of this team was to collect samples of river water during rain events. These observers were very important to ensure successful sedimentation measurement, because they had to collect representative water samples. During 2008, water monitoring was conducted from March to December. Owing to few rainy days in March, there were only a few samples collected. However, rainy days increased in December. There were 15 samples collected during March to December with a total 186 samples from four observation points. There were 137 samples able to be analyzed in the laboratory; the remainder were unusable owing to leaks in the containers and errors in collection.

3.4.2.3 Local institution management

As part of group management and internal evaluation, the River Care Forum organizer and Buluh Kapur community held routine meetings to discuss the program and related issues. The forum organizer held at meeting at least once a month to evaluate past activities and plan those for the following month. Members' meetings were held every three months. The main objective was to evaluate the activities so problems could be identified and solutions found. The meeting also served the purpose of providing transparency of management.

3.4.2.4 Physical construction maintenance

All the activities would not work optimally without maintenance. Maintenance included dealing with sediment discharges that filled shunts, infiltration pits, and in front of the main dam (the semi-permanent stone dam). The maintenance aimed to optimize holding sediment. Maintenance was flexible, which meant it could be adjusted to current conditions. Frequency was increased during the rainy season (September–December) since sediment rapidly filled the shunts, pits and the dam. Sediment that was collected was returned to gardens, while sand collected was used for infrastructure renovations. The community's participation level was high (70%) from the beginning until the end of the contract; as documented on the list of attendances for each activity.

3.5 Monitoring and evaluation

Monitoring and evaluation of conservation activities was conducted every six months, at the middle and the end of the year, while that for sedimentation was carried out serially throughout the year from the beginning until the end of the program. Both monitoring and evaluation were done by a joint team consisting of ICRAF, PLN-SBDL Besai unit and the field extension officer of the Forestry Agency.

3.5.1 Monitoring and evaluation of conservation activities

Monitoring and evaluation of conservation activities consisted of two stages: 1) assessment of the contribution of conservation activities to reducing sedimentation; and 2) interviews with community members to evaluate institutional aspects, water monitoring and other activities in general. To check physical constructions, the team and representatives of the River Care Forum worked from upstream to downstream areas. The result of monitoring and evaluation is presented in tables 6 and 7.

From the results table, the percentage at the mid-year evaluation was 77% and the final evaluation was 86%. The results showed a performance increase compared to the mid-year evaluation. This increase is in line with the quality of the physical constructions and forum institutions. In the mid-year evaluation, the quality of the semi-permanent stone dam, other dams, shunts, infiltration pits and drainage was not sufficiently high to properly hold sediment. Recommendations from the mid-year evaluation were the basis for improvement, such as, fixing a leaking dam; deepening shunts, infiltration pits and drainage; and planting sugar palm and bamboo on the river banks as well as maintaining the constructions for optimum function. Other improvements were also made to institutional management. Challenges that were faced in the middle of the program became valuable lessons for the forum organizer and members and supported better program implementation. The evaluating team was satisfied with River Care Forum's performance. With the final percentage of 86% involvement, the evaluating team concluded that Buluh Kapur community performed the activities well.

Table 6. Recapitulation of mid-year evaluation

Evaluation aspect	Weight	Evaluator				
		Forestry Agency	Hydropower Company	ICRAF 1	ICRAF 2	ICRAF 3
Physical constructions	115	80	72	77.5	76	63
Institutional	45	38	43	43	33.5	38
Water monitoring	60	56	56	55	51	51
General activities	30	23	27	24	24	26
TOTAL	**250**	**197**	**198**	**199.5**	**184.5**	**178**

Average result	**191.4**
Percentage of result to weight value	**77 %**

Table 7. Recapitulation of final evaluation

Evaluation aspect	Weight	Evaluator						
		Forestry Agency	Hydropower company	PLN-SBDL 1	Hydropower company	PLN-SBDL 2	ICRAF 1	ICRAF 2
Physical constructions	115	104	111	97.5	97,5	95,5	97	89.5
Institutional	45	37.5	41	43	40	32.5	39.5	35
Water monitoring	60	52	57	55.5	52	41	54.5	42
General activities	30	27	26	28	25	23	28	26
TOTAL	250	220.5	235	224	214,5	192	219	192.5
Average value				**213.9**				
Percentage of result to weight value				**86%**				

3.5.1.1 Sedimentation monitoring and evaluation

Based on rainfall measurement, the heaviest rain occurred in March and May and October to December (Figure 13). In March there were 12 rain events but only three were measured—on 10, 11 and 18 March 2009—with precipitation of 55 mm, 31 mm and 39 mm, respectively, because those events caused an increase of the river's surface level by 10–50 cm. Rainfall under 30 mm did not increase water level nor affect turbidity.

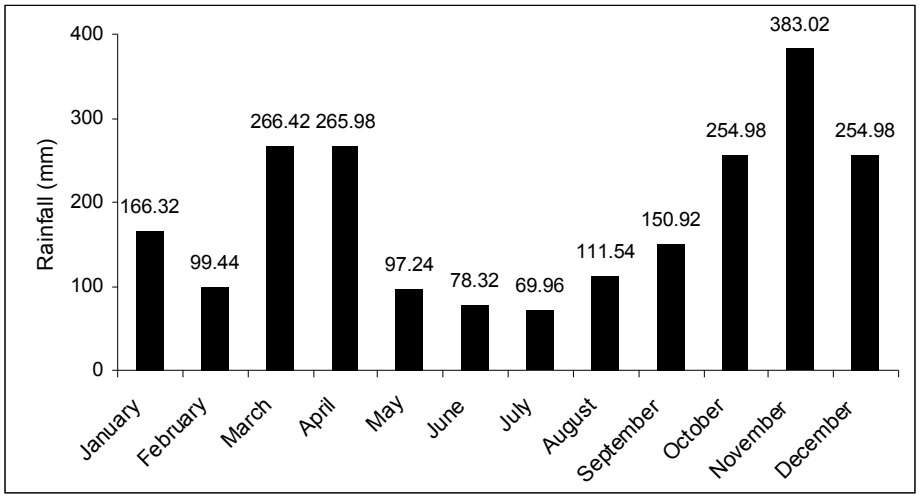


Figure 13. Diagram of monthly rainfall in Buluh Kapur

Analysis of debit data measured a rating curve for each observation station with regression analysis between debit and water level (Table 8). The rating curve was less satisfactory at stations 1 and 2, especially on water levels during peak debit: there are outliers that are far from the trend line. This was suspected to be caused by a leak in the weir and inaccurate water-level readings. The wavy and unstable river surface during peak debit made it difficult for observers to read the gauge.

Table 8. Rating curve similarity at each observation station

Observation location	Rating Curve	R^2
Station 1	Q = 0.0000902*(wl-28)^2.46928	0.77
Station 2	Q = 0.000523*(wl-27)^1.09143	0.57
Station 3	Q = 0.0000503*(wl-35)^2.40526	0.91
Station 4	Q = 0.0000472*(wl-41)^3.12095	0.96

The rating curves at stations 3 and 4 were relatively better than stations 1 and 2, as can be seen by the R^2 value at station 3 (0.91) and station 4 (0.96). The curve of water level and debit value at station 4 was in concordance with the trend line (Figure 14). Analysis of sedimentation concentration changes was carried out using debit and sediment concentration at station 4, because the station was an outlet (last gate) of the Air Ringkih River flow before joining the main Way Besai River. After the debit value was obtained, the next analysis was the relationship between debit values and sediment concentration values measured at station 4 (outlet).

Analysis of dissolved sediment concentration changes divided into three periods: March (to determine baseline/early trends before the program started; April–May (to analyze sediment concentrations during the contract period; and August–December (to gain the final slope trends).

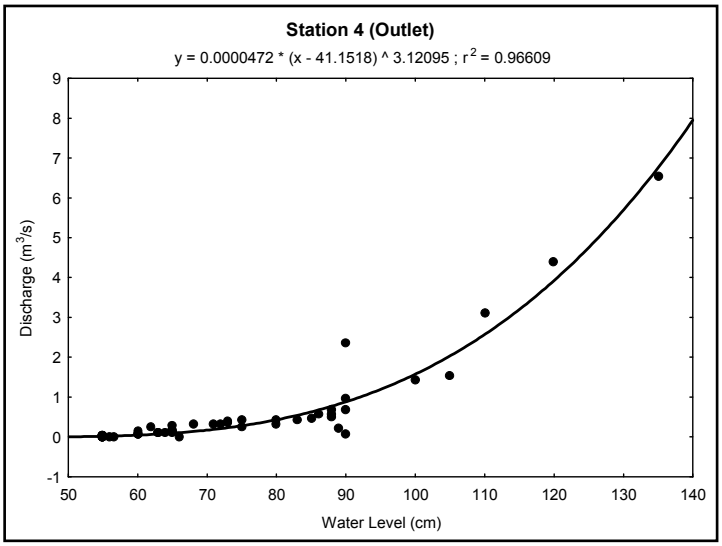


Figure 14. Curve rating at station 4 (outlet)

The result from analysis of sediment concentration changes was 299.08 at baseline and 239.27 at final. From the analysis, it was clear there was a 20% decrease on slope (Figure 15), thus, the reward that would be given to the Buluh Kapur community would be IDR 5 million (± USD 530).

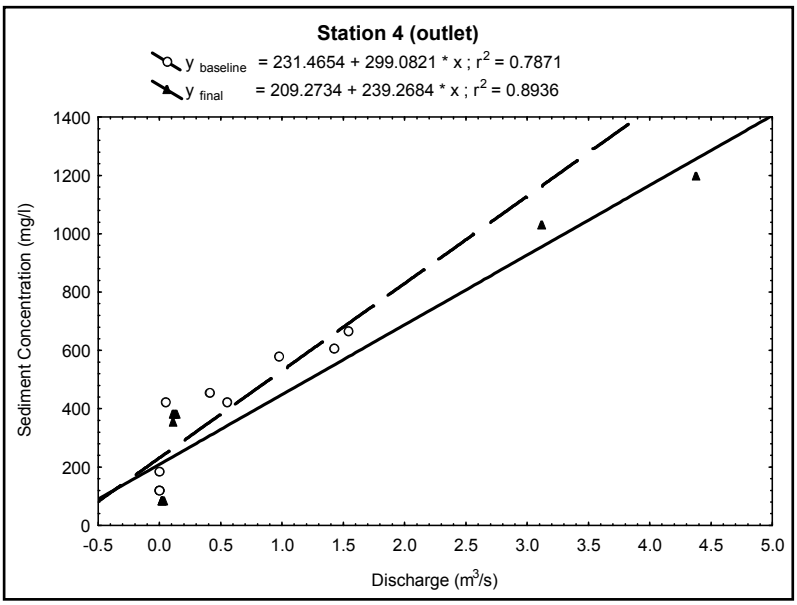


Figure 15. Relational graphs of sediment concentration to flow debit at baseline and end of program at station 4 (outlet) of Air Ringkih watershed

3.5.1.2 Environmental services reward from PLN-SBDL

The community realized that it would not be easy to achieve the 30% reduction target. However, they accepted the final result that their effort was not sufficient to be rewarded with the microhydropower unit. However, after receiving the activity report and seeing community activities in the field, PLN-SBDL was very impressed with the community's efforts to reduce sediment concentrations and decided to provide the microhydropower unit nonetheless, a reward equivalent to IDR 20 million (± USD 2119). The appreciation showed by PLN-SBDL had a big impact on the community, encouraging them to keeping maintain their environment, especially the watershed. This is the main goal of a rewards for environmental services scheme: upland communities continue managing their land by implementing soil and water conservation techniques to sustain natural resources and reduce sedimentation rates.

4. Discussion and conclusion

4.1 The process of developing the scheme

As elaborated in the Methodology section, the stages of developing a rewards for environmental services scheme include scoping, stakeholders' analysis, negotiations, implementation and monitoring. In this section, we will discuss lessons learned from the River Care Program for each stage.

4.1.1 Scoping, stakeholders' analysis and negotiations

Community participation in determining the scope of the program was very useful for increasing participation and a sense of belonging within the community. The River Care program, using the Participatory Landscape Appraisal method, encouraged the community to participate from the beginning through analyzing watershed problems and the possible solutions, which eventually became part of the contract with the hydropower company. The usefulness of this process was reflected in the contract execution and achievement of the final value of 213.93 or 86% of total weight (250 points).

The ICRAF team provided recommendations as to the value of sedimentation decrease in the contract. According to the analysis results of sediment concentration, there was a trend decrease of 19.99% (≈ 20%) of the comparison of regression coefficient value or slope, which was 299.08 at baseline, and 239.27 at the end of the program (final). We needed to re-evaluate the recommendation of 30% sedimentation decrease in a year. This considered sources of erosion that were impossible to detect and deal with, such as landslides and floods that occurred upstream and the time-based effectiveness of planting trees and grass strips, which require time to grow before they are able to fulfill their function of protecting against surface erosion and landslides. Consequently, the contract in the River Care program needed to be re-evaluated, especially in determining results, so that it included not only a decreasing trend of sedimentation concentration but also considered the percentage of activity implementation during the contract period.

4.1.2 Implementation

The operational budget allocated for the River Care program was IDR 10 million (± USD 1060) per year. This budget probably needed revision owing to price variables that tended to increase from time to time. Such a budget made it difficult for the forum to allocate funds, thus, resulting in less-than-optimum outputs.

During implementation of the River Care program, the forum as program implementer encountered several difficulties that were caused by both external and internal factors. The external factors were uncertain weather conditions and natural disasters. The dry season was long, from March to August, and prevented the forum from working optimally in both planting activities and taking water samples needed for sedimentation calculation. This caused the schedule of planting activities to change and water monitoring to become less than optimal because of a shortage of water samples for analysis.

As for internal factors, there were a limited budget, dependency on the forum leader and internal conflicts among members. At the early stage of program implementation, it appeared that the forum was heavily dependent on its leader. But after a meeting in which the authority of each organizer was restated, along with their attitude toward motivating each other, such dependency was minimized.

The forum felt the need for a facilitator to be present in order to give them direction and motivation. There were times when the forum experienced boredom when implementing the activities or when they encountered internal and external problems. A facilitator helped to lift their spirits. In addition, it was also expected that the forum facilitators were able to create a conducive atmosphere among the management and all members.

4.1.3 Monitoring and evaluation

There were two types of monitoring and evaluation in the program, that is, monitoring and evaluation of conservation activities and of sedimentation. The monitoring and evaluation of sedimentation was set as the program success indicator, while the result of the monitoring and evaluation of conservation activities was only used for recommendations for further activities.

The success of the monitoring and evaluation of sedimentation in the River Care program strongly depended on water samples taken during monitoring activities when rain occurred. Unfortunately, rain occurred less than expected. In light of this, future contracts should be extended to two years in order to gain more representative results.

Some technical problems were encountered when collecting water samples.

- Water samples were less likely to represent sediment concentrations, especially during peak flow when observers were not able to collect them. This problem was a challenge to observers, especially when the peak flow occurred at night.
- The process of transporting samples from sampling locations to the laboratory led to leakage from several samples. Consequently, the water sample volume reduced and could not be processed.

The River Care program requires a special team from institutions other than ICRAF, which can continually analyze changes of sedimentation concentration. Such a team should be neutral and their results accountable. The team members should come from neither the environmental services buyer nor the provider but still have the necessary interest in environmental improvement, especially watersheds. Likely organizations would be Balai Pengelolaan Daerah Aliran Sungai (Central Management of Regional River Flow/BPDAS), environmental agencies and educational institutes. In addition, it is important to encourage community participation in analyzing sediment concentrations using simple methods, such as the Secchi disk, and reduce reading errors through observer calibration.

Water monitoring activities require several simple tools. During the River Care program, such tools were provided from the operational budget, which was supported by ICRAF. In addition, these activities require observers' commitment since they consume a lot of time. Often, water monitoring activities were prioritized over rest time and even working in the fields. Therefore, it is advisable to consider a special budget allocation outside the operational budget for water monitoring.

4.2 Impact of the activities on the local community

The River Care program was conducted for around 15 months, from pre-contract to post-contract, and had impacts, both negative and positive, on the community. According to the result of discussions with the local community, the negative impact was that the activities consumed so much time and effort, so much so that people were prevented from freely doing their own activities, such as working in their gardens and village administration. On the other hand, there were several positive impacts.

- A change in people's attitudes to maintaining their environment, such as:
  - no longer catching fish using poison in Air Ringkih River
  - the number of land clearance activities around the Air Ringkih River has decreased
  - physical conservation in gardens, such as terraces, infiltration pits and grass strip, continue to be maintained and provide benefits
- Improved knowledge of organizational matters
- Improved communication and togetherness
- Improved experience in solving problems and resolving conflicts
- Improved knowledge of conservation techniques
- Conservation constructions have improved the quality of the coffee plantations
- Grass strips provide a alternative cattle feed

4.3 Commodification or co-investment?

The River Care program in Sumberjaya can be seen as an innovation in applying the concept of payments for environmental services or, in other words, it can be classified under the paradigm of commoditized environmental services. This is marked by level 1 conditionality (van Noordwijk and Leimona 2010), where contracts between environmental services providers and beneficiaries are based on an agreed sedimentation reduction during the contract period.

Based on this theory and the actual written contract, the community were entitled for compensation in form of cash in the order of IDR 5 million (± USD 530) because the sedimentation reduction was only around 20%. But in practice, THE hydropower company as the environmental service beneficiary rewarded providers with a microhydropower unit, which was intended to be the reward only if sedimentation reduction was a maximum 30%. This confirms that there are other reasons or motivations beyond merely fulfilling contractual terms, such as improving people's awareness of the importance of maintaining watershed sustainability, which in turn indirectly reduces sedimentation levels.

This case demonstrates a shift of paradigms, from that of 'commoditized environmental services', which focuses on markets and trade in environmental services, to the paradigm of 'co-investment in sustainable landscapes', which focuses on co-investment in maintaining watershed sustainability. The term 'co-investment' can also mean that a rewards scheme is not viewed simply as a way of transferring money and environmental services. Instead, implementation strongly encourages participation by all stakeholders, including upstream and downstream communities, government and the private sector, to consider efficiency and equity, to build trust of all parties involved and uphold transparency and togetherness in sustainable watershed management.

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The World Agroforestry Centre is the international leader in the science and practice of integrating 'working trees' on small farms and in rural landscapes. We have invigorated the ancient practice of growing trees on farms, using innovative science for development to transform lives and landscapes.

Our vision

Our Vision is an 'Agroforestry Transformation' in the developing world resulting in a massive increase in the use of working trees on working landscapes by smallholder rural households that helps ensure security in food, nutrition, income, health, shelter and energy and a regenerated environment.

Our mission

Our mission is to advance the science and practice of agroforestry to help realize an 'Agroforestry Transformation' throughout the developing world.

FUTURE HARVEST CGIAR

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