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APFNet

Asia-Pacific Network for Sustainable Forest Management and Rehabilitation

Completion Report

Development Participatory Management of Micro Catchment at the Bengawan Solo Upper Watershed (2017P6-INA)

September 2017 - August 2019

Supervisory Agency :

Extention and Human Resources Development Agency, Ministry of Environmental and Forestry, Indonesia (BP2SDM)

Executing Agency :

Watershed Management Technology Center (WMTC)

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BASIC INFORMATION

Project Title(ID)	Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed		
Supervisory Agency	Extension and Human Resources Development Agency, Ministry of Environment and Forestry, Indonesia (BP2SDM)		
Executing Agency	Watershed Management Technology Center (WMTC)		
Implementing Agency	-		
Date of Project Agreement: [30/June/2017]			
Duration of implementation: [September/2017-August/2019], 24 months			
Total project budget(in USD)	97,928	APFNet assured Grant (in USD)	97,928
Actual project cost(in USD)	97,928	APFNet disbursed Grant(in USD)	97,928

Disbursement Status	Date of disbursement	Amount(in USD)
Initial disbursement	11/10/2017	45,741.6
Second disbursement	19/10/2018	42,393.6
Balance to be disbursed		9,792.8

Reporting Status	Schedule implementation	Project progress status
Semi-annual Progress Report 1 (MYR-1) (period covered: 09/2017-02/2018)	On track	Moderately satisfactory
Annual Progress Report 1 (APR-1) (period covered: 09/2017-08/2018)	On track	Moderately satisfactory
Semi-annual Progress Report 2 (MYR-2) (period covered: 09/2018-02/2019)	On track	Moderately satisfactory
Final Report (Completion Report + Technical Report) (period covered: 09/2017-08/2019)	On track	Satisfactory

Executive Summary

Naruan Micro Catchment (NMC), upstream part of Keduang Watershed, The Upper Bengawan Solo River Basin has a strategic role because it is in the catchment of the Multipurpose Reservoir of Gajah Mungkur (MRGM), which serves as the Solo River flood control, sediments storage, provider of agricultural raw water to the downstream area, as well as for electricity power plants. Besides, Keduang Watershed also became a national priority targeted areas of rural development and integrated watershed management. Because of its location, which is located in the upper reaches of the watershed, most of it is very sloping land (slope > 45%) which is used for seasonal crops. From the results of the analysis of land capability, locations with such slopes should not be intensively cultivated to prevent soil erosion and land degradation. The land in NRM is largely community-owned land, where most of the livelihoods depend on agricultural products. To overcome this problem, a form of land management pattern is needed that can meet economic needs while fulfilling the functions of the protection of land and water. In addition to preventing a decrease in land productivity, protection efforts are needed so that the sedimentation produced does not interfere with the function of MRGM.

WMTC proposes a cooperation project with APFnet with the goal is to build a successful watershed management model following soil and water conservation principles at the operational level (micro-catchment). This model may be used as an example for the Institute of Watershed Controlling and Protection Forest (BPDASHL SOLO), and other institutions associated with watershed management, from the planning, implementation to the monitoring and evaluation process. The developed model may become a prototype applied on a broader scale. The specific objective of the project is to develop participatory management of micro-catchment based on community participation and stakeholder collaboration, which emphasizes the rules of soil and water conservation. The project is expected to (1) improve the quality of the environment by increasing forest cover, so as increasing the quantity and quality of water resources as well as reducing the rate of erosion and sedimentation to MRGM; (2) increase people's incomes by the diversification of their farm commodities, improvement of soil and water conservation technology and development of creative small businesses based on natural resources; and (3) increase capacity building and the awareness in managing and conserving natural resources.

To achieve this goal, during 2017-2019, this project has produced the following output: Output 3. Increased stakeholders' commitment to effective participatory management of micro catchment; Output 4. Formulation of integrated participatory management of micro catchment; Output 5. Demonstration plot of conservation farming and watershed rehabilitation; Output 6. Enhanced community awareness in management of micro catchment; Output 7. M&E of watershed performance within a scale of micro catchment, landscapes, and household.

This project has succeeded in influencing community perceptions about the importance of sustainable land management. They realize the importance of civil and vegetative technical land conservation. They actively participated in making plans, planting and maintaining plants and actively participated in the FGD and training that we held. However, to increase participation and change their mindset, assistance needs to be done so that they are more independent, instead of relying on the incentives from the government, especially to build civil technical conservation. Land rehabilitation with an agroforestry pattern will provide additional income at the end cycle (6 years). However, non-land based income sources need to be developed so as not to cultivate land intensively which may cause land degradation.

From the institutional aspect, this project has succeeded in developing a participatory watershed management plan that involves stakeholders from the local to the national level. Village institutions have planned to develop these activities according to their capacity. The sustainability of this project will depend on the commitment of the parties to carry out the plan, especially the maintenance of conservation buildings and community assistance.

From the environmental aspect, there will be changes in land cover from seasonal crop farming patterns on sloping lands that are prone to erosion to agroforestry patterns. This change in land cover will reduce the level of erosion. The gully erosion will be more controlled, especially if the community can make gully control structures independently. However, from the hydrological aspect, this activity has not yet had a significant impact because the proportion of the area managed is still too small when compared to the total area of the micro watershed.

The results of the project activities are disseminated through scientific publications, leaflets and posters, and technology transfer to users. Overall, the process of preparing the planning and management of the Micro Watershed will be used as counseling material for extension agents of the Ministry of Environment and Forestry (MEF) of Indonesia.

Abbreviation and Acronyms

Baperlitbang	:	District Planning, Research and Development Agency
BBWS BS	:	Bengawan Solo River Basin Organization
BP2SDM	:	Extension and Human Resources Development Agency
BPBD	:	Regional Disaster Management Services
BPDASHL	:	Institute of Watershed Controlling and Protection Forest
BPH	:	Forest Management Center
BPUSDATARU	:	Center of Public Works, Water Resources and Spatial Planning
BUMN/BUMD	:	State-owned Enterprise/District-owned Enterprise
COP	:	Conference of the Parties
FGD	:	Focussed Group Discussion
FKPWP	:	Forestry Researcher-Trainers-Extention Agents Communication Forum
FORDIA	:	Forestry Research, Development and Innovation Agency
Forum DAS	:	Watershed Management Forume
GNKPA	:	National Campaign for Water Conservation Partnership
KBR	:	Village nursery
MEF	:	Ministry of Environment and Forestry
MOL	:	Mikro Organisme Lokal (local microorganisms)
M&E	:	Monitoring and Evaluation
MPTS	:	Multi-purpose Tree Species
MRGM	:	Multipurpose Reservoir of Gajah Mungkur
NMC	:	Naruan Micro Catchment
NGO	:	Non-Government Organization
OPD	:	Local Sectoral Institution
PDAM	:	District Water Services
PEPDAS	:	Directorate Planning and Evaluation of Watershed Control, MEF
Perhutani	:	State-owned Forest Company
RHL	:	Forest and Land Rehabilitation
UNCCD	:	United Nation Convention to Combat Desertification
WMTC	:	Watershed Management Technology Center

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1. BACKGROUND AND INTRODUCTION

In the field, the implementation of watershed management is not easy to do. This is due to the many parties involved. Each has its interests that may not align with each other. Moreover, their activities may not on the right targets because it is not based on the actual and factual field condition. Until now, integration of watershed management is still very difficult to do, so it can still be said watershed management has not been successful. Instead of improving the condition of the watershed but land degradation frequently occurs in the watershed due to mismanagement. It is showed by the more degraded watershed in the list that needs to be restored.

Therefore, it is necessary to integratively manage the management of various sectors from upstream to downstream by considering the various interests, biophysical and socio-economic existence. Action research at the operational scale is necessary to develop demonstration plots of micro watershed management using participatory and collaborative management based on the principles of soil and water conservation. The resulted demonstration plots may be used as an example of proper watershed management.

This project is located in Naruan Micro Catchment (NMC), upstream part of Keduang Watershed, The Upper Bengawan Solo River Basin (Figure 1.). This site has a strategic role because it is in the catchment of MRGM which serves as the Solo River flood control, sediments storage, providers of agricultural raw water to the downstream area, as well as for electricity powerplan. The micro catchment also became a national priority target areas of rural development.

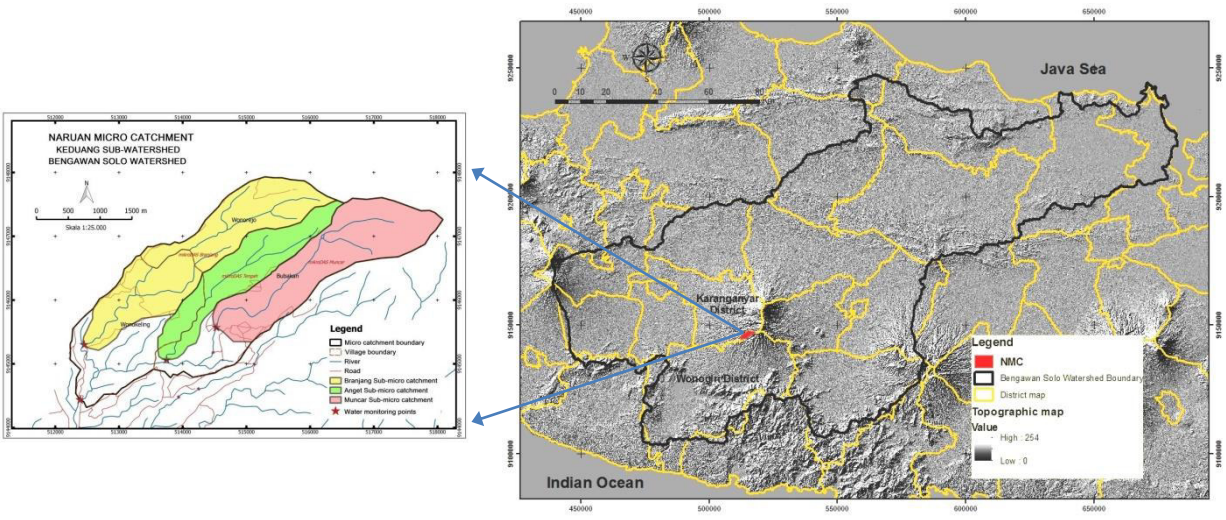


Figure 1. Project location map

Preliminary studies have been conducted, including the identification of issues/problems in the main study area. The main issue in the study area is soil erosion, which contributes to the high rate of sedimentation in MRGM. This may due to the land use that is not in accordance with its capability. An open-minded community that is willing to support soil and water conservation activities is one of the social capitals. Other potential capital is the supportive government officials from the village level until the district level.

Participatory management plans for the area have already been arranged. The plan draft contains the indicative area that should be rehabilitated as well as community development plans and coordination mechanisms between the parties. The next stage of the activities include: building commitment among actors of watershed management to support effective participatory management, formulation of integrated participatory management for micro catchment scale, development of conservation and rehabilitation demonstration plots, building community awareness toward micro watershed management, as well as building the M&E performance of micro catchment, landscape and households scale.

The project is expected to (1) improve the quality of the environment by increasing forest cover, so as increase the quantity and quality of water resources as well as reducing the rate of erosion and sedimentation to MRGM, (2) increase people's incomes by the diversification of their farm commodities, improvement of soil and water conservation technology and development of creative small businesses based on natural resources, and (3) increase capacity building and the awareness in managing and conserving natural resources.

The project is relevant to the one of APFNet priority activity namely “Improving forest management to reduce forest loss and degradation”, included in project category “Demonstration Projects”. The location of the project is upstream of Bengawan Solo River Basin which is one of 108 priority watersheds that should be restored in the medium-term development plan (RPJM) of 2010-2014, and it is also included in 4 super-priority watersheds that should be restored until the year of 2019. This project supports the national priority of food sovereignty and rural and rural region development, especially in the Priority Program of Natural Resources Management and Sustainable Environment. Activities of the project are following the priority activities of MEF namely (1) irrigation rehabilitation, upper watershed rehabilitation, dam and small dam development, and (2) strengthening the capacity of rural communities and indigenous peoples in the utilization of natural resources, environmental management, and appropriate technology.

1.1 Project context

Watershed management in Indonesia still has many obstacles. Many environmental problems in the watershed, such as floods, droughts, landslides, and sedimentations show the less successful watershed management, especially at the operational level.

Sedimentation issues also become a concern in the management of the Multipurpose Reservoir of Gajah Mungkur (MRGM) of Wonogiri District. The issue has become a national issue, because the reservoir MRGM has a strategic function as flood control in the Upper Solo watershed, as suppliers of agricultural water in many districts in the downstream, and as electricity powerplan.

Among the 18 river that goes into MRGM, the Keduang River is the river which has the largest watershed area, as well as the largest contributor of sediment. JICA's study showed that from 1993 to 2004, the average sediment flew to MRGM was 3.18 million $m3.y^{-1}$. The biggest sediment contributor was Keduang Watershed that was approximately 1.22 $m3.y^{-1}$ or about 33% of total sediment (Rahman, et al., 2011). Moreover, Tjakrawarsa & Pramono (2012) revealed that from 1994 through 2002 sediment loaded in Keduang River was about 29.36 $ton.ha^{-1}.y^{-1}$ and from 2009 to 2010 it increased to 45.41 $ton.ha^{-1}.y^{-1}$. Sutrisno et al., (2011) predicted soil erosion of Keduang Sub Watershed using USLE model, and the result showed that soil erosion in Keduang Sub Watershed was about 44.00 $tons.ha^{-1}.y^{-1}$ or 1.9 million $ton.y^{-1}$. This erosion value was equal to 164,000 $ton.y^{-1}$ of sediments. Another study resulted by Rahman et al., (2012) using AVSWAT model revealed the total erosion of Keduang Sub Watershed was 172.24 $ton.ha^{-1}.y^{-1}$. or equal to 1.15 million $ton.y^{-1}$ of sediments.

The high rate sedimentation cause in MRGM was the high rate of soil erosion in the catchment area, especially from Keduang Watershed. This was a result of a land cover condition which was a lack of forest cover. Based on the land cover analyses using the 2011 Landsat 7 ETM, forest cover in the area was only 2.25% of the total area. The condition was worse by the behavior of people who are paying less attention to soil and water conservation in managing their land. The high rate of population led to population pressure on land resulting in excessive use of land, and this might trigger land degradation.

At the operational level, land use planning in watershed management activities has not been going well. Yet their example at the operational scale used as a reference. This is a challenging situation that might be solved.

1.2 Project goal(s) and objectives

The goal of the project is to build a model of successful watershed management in accordance with soil and water conservation principles at the operational level (micro catchment). This model may be used as an example for the Institute of Watershed Controlling and Protection Forest (BPDASHL), and other institutions associated with watershed management, from the planning, implementation to the monitoring and evaluation processes. The developed model may become a prototype applied on a broader scale.

The objective of this project is to develop participatory management of micro catchment based on community participation and stakeholder collaboration, considering the soil and water conservation principles. The well managed micro catchment may improve environmental services such as water sustainability and land productivity as well as socio-economic welfare.

1.3 Project expected outputs and outcomes

The expected outputs of this project are:

a. Potential and vulnerability of micro catchment (already obtained in 2015)
b. Micro catchment management plans (already developed in 2016)
c. Increased stakeholder's commitment to effective participatory management of micro catchment
d. Formulation of integrated participatory management of micro catchment
e. Demonstration plot of conservation farming and watershed rehabilitation
f. Enhanced community awareness in the management of micro catchment
g. Monitoring & Evaluation (M & E) system of watershed performance within a scale of a micro catchment, landscapes, and household

2. PROJECT IMPLEMENTATION

2.1 Project schedule and implementation arrangements

To achieve the project objective, there are several stages of activities carried out starting with synchronizing perception of the stakeholders related to integrated watershed management, preparing management plans and demonstration plots, increasing community capacity, constructing demonstration plots to monitoring and evaluation. All stages and timelines for implementation have been planned in detail by considering the sequence of achievements, the interests of stakeholders and the seasons (rainy and dry season).

In general, activities have been carried out according to targets and schedules, and there has been only a slight shift in implementation time (Annex A.). This happened because the project team had to adjust the implementation time to the planting schedule and farmers' traditions. However, there are some significant changes that must be made, namely:

1. Institutional meetings (FGDs) were planned twice in each district with 20 participants. In its implementation, the Institutional meeting was only held once because of the large number of stakeholders involved in watershed management. However, it did not change the substantial output that must be achieved and the number of participants.
2. In the first year, workshops will be held in each district. However, considering that the NMC is part of the two districts, the workshop was only held once, so that the discussion among stakeholders was carried out comprehensively.
3. In the proposal, the planned area of demonstration plot was 125 Ha which budget allocation was only for the procurement of plant seeds. However, based on Regulation of the Minister of Finance Republic of Indonesia No. 106 / PMK.02 / 2016 on Standard Cost Output of the Fiscal Year 2017 and Governor Regulation no. 45 The year 2016, the standard cost of land rehabilitation activities

conducted on community land not only the procurement of seedlings. Therefore, after recalculating by taking into account some components such as seedling of perennial crops, subsidies for land preparation and fertilizer, then the possible area of the demonstration plot was only about 30 Ha as stated in AWP1. The realization of the demonstration plot in three villages was 30 hectares.

4. There are 34 units of civil technique soil conservation will be built. However, the realization is 35 units (more than targeted), because funds for the construction of civil technique soil conservation are still available to build one more unit.
5. Honey bee hives for FP's was not planned in AWP 2. However, based on input from the monitoring and evaluation team from FORDIA and considering that honey bees are potential to be cultivated in NMC, the project team allocated a portion of funds from applying a demonstration plot to purchase 15 units of honey bee hives for FP's representatives in three villages.
6. In AWP 2, the equipment to be purchased is 1 unit mini projector, 1 unit printer, 1 unit recorder, and 3 units of the external hard drive. However, due to the consideration that the project team needed a drone to support project activities, especially to help analyze the detail land cover at the end of the project and to assist in making visual documentation, equipment purchase funds were allocated for the purchase of 1 unit drone. This change has been approved by APFNet. The procurement of equipment planned for the second year can be functionally covered by equipment purchased in the first year and also by using the WMTC's equipment.

However, those changes did not change the existing budget and the targeted output of the whole project.

The risks that were occurred in the project implementation and efforts to overcome it are shown in Table 1.

Table 1. Risks and effort to overcome the problems

No.	Risk	Responding actions
1.	Equality of the parties	In this project, all parties involved are equal and contribute to the project implementation. However, the community mindset that leads to participation mobilized by aid has not been fully changed
2.	The involvement of the parties	
	There was a problem in community participation in the form of the inconsistency of planting time and planting distance with the schedule and design, due to constraints in the availability of labor, land tenure, and existing land cover	Giving financial support for labor to plant, building intensive communications with FPs and leaders to motivate them in implementing the design, and monitoring their activity periodically.

	The participation of the parties has been carried out since the first stage of project implementation, but not all activities can be realized immediately due to bureaucratic reasons	Building the intensive communication with relevant agencies that have the potential to support the implementation of activities, assisting the community in preparing aid proposals, and facilitating the communication between FPs and donors
	It is still an ego sectorial in development activities (watershed management), where stakeholders only focus on their task and function	In the framework of future sustainable management for the NMC, communication and co-coordination among stakeholders needs to be done regularly and well organized. Baperlitbang can be a facilitator for this activity so that each stakeholder can communicate their activities
3.	Natural disasters	
	Gall attack on the albizia plants	Farmers have independently overcome gall by cutting and buried burning parts of the albizia plants that were attacked by gall. However, this is still not effective if there are a lot of plants
4.	Continuity of Funding	
	Most of the civil technique construction are located in areas far from the road there must be extra costs for transporting materials to the location so that it becomes more costly	To reduce costs, it was required community participation and modification of building materials. The building material used local materials such as bamboo

2.2 Project resources and costs

The project of "Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed" was run according to Project Proposal and Project Agreement. The financial contributions from APFNet and EA complemented each other in project implementation. Funding from APFNet was used to run activities such as cost for consultant fee, travel and related cost, meeting and training, field activities, publication and dissemination, office operation, procurement, and monitoring and evaluation. Financial from Executing Agency (in-kind resources) covered project team salaries, several parts of field activity, and procurement of several types of equipment.

Procurement of equipment is carried out in accordance with Presidential Regulation No. 16 of 2018 concerning procurement of government goods/services with a direct appointment system through a contract from the Head of WMTC No. SPK.13/BPPTPDAS-Pjb/05/2019 dated May 22, 2019. Procurement was done through CV. Media Teknindo.

The financial cash flow was recorded and reported periodically to the Head of Executing Agency for internal monitoring of project implementation. Periodic financial reports were also reported to the Indonesian Ministry of Finance as a form of responsibility to the Republic of Indonesia. The project's financial statement as listed in Annex B.

To ensure accountability of the use of funds in project implementation, at the end of the first year and the second year (at the end of the project) a financial audit was carried out by an independent external auditor who had credibility and professionalism. The public consultant who conducted the financial audit process in the first year was the Public Accountant "Rachmad Wahyudi", while the second year was conducted by the Public Accountant "Wartono and Partners". The Financial audit results will be presented in Annex C.

2.3 Procurement and consultant recruitment

To support the implementation of the "Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed" project, some equipment was purchased. The types of goods purchased are presented in Table 2.

Table 2. Procurement data

No.	Items	Type	Quantity	Cost (IDR/unit)	Date of purchase
1.	Printer	Canon Pixma MX497	1 unit	1.500.000	November 30, 2017
2.	Laptop	Asus E202SA-FD111	5 unit	4.600.000	November 30, 2017
3.	Voice Recorder	Sony ICD-BX140	2 unit	900.000	November 30, 2017
4.	External Hard Disk	Toshiba Canvio Ready 500GB	2 unit	900.000	November 30, 2017
5.	Drone	DJI Mavic PRO Combo	1 unit	20.360.000	May 28, 2019

In the project implementation, the project team required academic advice from experts. For this reason, there were two consultants hired to give assistance and advice, especially in formulating the demonstration plot design and evaluation of activities. Consultant data and responsibilities are presented in Table 3.

Table 3. National consultants

No.	Name	Expertise	Responsibility	Remarks
1.	Dwi Priyo Arianto, Ph.D	Soil and water conservation	Giving assistance and advice in project implementation and formulating final report relating to soil and water conservation	National consultant Duration of employment: 2 years

2.	Dr. Sapja Anantanyu	Social and institution	Giving assistance and advice in project implementation and formulating final report relating to the social and institutional conditions of the community	National consultant Duration of employment: 2 years

2.4 Monitoring & evaluation and reporting

Table 4. Monitoring & Evaluation, and Reporting

Monitor/Evaluator	Findings	Recommendations and Suggestions	How Actions taken in Actions
Internal: WMTC (Watershed Management Technology Centre)	The application of the Micro Watershed Management model will make it easier to monitor and measure the hydrological response continuously; facilitate observation of socioeconomic and institutional changes	1. Make a crop map 2. Submit the measurement of water discharge to the Data Management section 3. Submit the final report to the Planning and Evaluation section	1. Plant maps are represented by maps of the demonstration plot locations per land ownership 2. Suggestions will be followed up 3. Suggestion will be followed up
BP2SDM	The participatory watershed management demonstration plot is a good model to be applied by the implementing agency	1. Disseminate the result by inviting the main user, BPDASHL from all over Indonesia in a workshop 2. Establish a communication forum between researchers, and extension workers (FKPWP) to follow up the project with the preparation of a syllabus and training materials	1. Report to FORDIA to follow up on this matter, because in the hierarchy FORDIA is authorized to make contact with BPDASHL throughout Indonesia directly 2. Communication has been carried out in the form of a workshop on September 20-21, 2018 in Surakarta. 3. The workshop will be followed up by BP2SDM through

			preparing (a) Participatory Micro Watershed Management Assistance Modules, and (b) Curriculum and Syllabus
FORDIA (Forestry Research, Development, and Innovation Agency)	This project activity shows that the state is present in the improvement of the environment and the welfare of society in the area	Find alternative of not land-based income source. Honey beekeeping is an alternative source of income that is not land-based.	1. Comparative study into honey bee farm has been carried out and followed up with the distribution of beehives to farmer groups for joint management 2. Coordination with forestry extension agents to conduct various community trainings
Reporting	1. 1th Mid Year Report (MYR1), Sept 2017-Feb 2018. 2. 1th Annual Project Report (APR1), Sept 2017-August 2018 3. 2th Mid Year Report (MYR2), Sept 2018-Feb 2019 4. Technical report,Sept 2017-August 2019 5. Completion report , August 2017- August 2019		

2.5 Dissemination and knowledge sharing

Project output has been disseminated to the parties through several forums, such as in Table 5.

Table 5. List of project output dissemination activities

No.	Venue/Date	Organizer	Themes	Participant	Topics to be disseminated
1.	Surakarta/ November 13, 2017	BBWS-BS	Discussion of land capability class distribution, soil erodibility and land use direction in the Solo watershed	Multi stakeholders	Distribution of land capability classes, soil erosion and land use recommendations for upstream Solo watershed
2.	Surakarta/ April 12, 2018	BBWS-BS	Workshop of National Campaign for Water Conservation Partnership (GNKPA), 2018	Multi stakeholders	Measuring the success of conservation activities in the upstream watershed: Sharing experiences in managing Naruan Micro Catchment (NMC)
3.	Surakarta/ August 28, 2018	BBWS-BS	Coordination meeting of the water resources management of Solo River Basin	Multi stakeholders	Impact of successful regreening and conservation of the Bengawan Solo Watershed: Sharing conservation experiences in the upstream watershed
4.	Surakarta/ September 20,2018	BP2SDM	FKPWP (Discussion forum between forestry researchers, trainers and extension agents) Workshop	Trainers and forestry extension agents	Micro watershed management: Look for a participatory watershed management model (sharing experiences of the action research activities)
5.	Surakarta/ November 1, 2018	FORDIA-Bogor	Workshop on coordination of Central Java region's watershed management	Multi stakeholders	Micro watershed management: Participatory and integrative watershed management model (the material of policy brief)

6.	Wonogiri/ November 8, 2018	District Gov't of Wonogiri	The socialization of the Wiroko sub-watershed management	Farmers, river volunteers, village and sub-district apparatus	Upstream watershed management techniques: sharing experiences of conservation activities in NMC
7.	Surakarta/ December 17, 2018	BPDASHL Solo	The internalization of the integrated management plan of Solo River Basin into the Regional Spatial Plan	Multi stakeholders	Watershed-based spatial planning: sharing experiences from research activities
8.	Bandung/ February 21, 2019	BPDASHL Cimanuk Citanduy	Sharing the results of participatory watershed management research	Staffs of BPDASHL Cimanuk-Citanduy	Micro Watershed Management: Search for a participatory watershed management model (sharing experiences from action research activities)
9.	Surakarta/ April 9, 2019	Forestry Service Branch (CDK) Regional X	Technical guidance on land and water conservation structure planning	Forestry extension agent for regency area of Surakarta, Sragen Klaten and Karanganyar	Planning soil and water conservation techniques to control gully erosion
10.	Surakarta/ April 11-13, 2019	Directorate of Planning and Evaluation of Watershed Control (PEPDAS), Directorate General of PDASHL, Jakarta	Technical meeting of Java, Bali and Nusa Tenggara region	Technical staffs of BPDASHL Java, Bali and Nusa Tenggara region	Micro Watershed Management: Search for a participatory watershed management model (sharing experiences from action research activities)
11.	Salatiga/July 30-31, 2019	Forestry Service Branch (CDK) Regional III	Technical assitance for planning community forest management	Community forest farmer groups in the areas of Semarang, Salatiga and Boyolali districts	Community forest management planning: sharing experiences from NMC management
12.	Wonogiri/August 5, 2019	District Gov't of Wonogiri	Workshop of National Campaign for Water Conservation Partnership (GNKPA), Wiroko Sub Watershed	Farmers, river conservation volunteers, village and sub-district officials	Upstream watershed conservation technique: Sharing NMC management experience

13.	Semarang/ August 6, 2019	Forestry Service Branch (CDK) Regional III	Meeting on watershed rehabilitation	Forestry extension agents from Semarang, Salatiga and Boyolali regencies	Forest and land rehabilitation planning and gully erosion control techniques
14.	New Delhi/ September 5, 2019	UNCCD	Side event on COP 14 of UNCCD	All members of UNCCD	Research and development supporting forest rehabilitation in Indonesia: A study on the development of participatory management of NMC in Upper Bengawan Solo River Basin

3. PROJECT PARTNERES' PERFORMANCE

3.1 Performance of Supervisory Agency

BP2SDM as a supervisory agency has carried out its responsibilities properly and appreciatively. In terms of administration, BP2SDM has always provided fast and appropriate responses. BP2SDM, FORDIA, and WMTC as steering committee jointly directed the research to be following what was stated in the proposal. In terms of technical fieldwork, BP2SDM and FORDIA provided new directions and innovations for the perfection of field activities. For example, honey bee development activities, which were not yet included in the project work plan, after the FORDIA Team visited the field, the Team suggested that honey bee development would be carried out to support the community's economy. Likewise, the BP2SDM team, after visiting the field, suggested that more demonstration plots be modeled for the community. The FORDIA Team, chaired by Mrs. Dr. Sylvana Ratina and the BP2SDM Team under the coordination of Mr. Sudayatna, M.Sc, during the life of the project has conducted two field visits. WMTC in addition to being a steering committee member also acts as an executing agency, always accompanying the team in every field visit in the context of M&E.

3.2 Performance of Executing Agency

As an executing agency, WMTC is responsible for the success and achievement of the project. The realization of these responsibilities, WMTC has taken various steps, including preparing operational work plans, forming an Implementation Team, implementing work plans following the time frame and evaluating activities regularly. Head of WMTC, Dr. Nur Sumedi, who was later replaced by R. Gunawan Hadi Rahmanto MSc. act as a steering team as well as a control team. As the controlling

team, the head of WMTC conducted administrative and field supervision and provided direction for the improvement of activities. Problems that need to be corrected were followed up as quickly as possible, including administrative improvements and physical improvements to the field. Another responsibility of the Implementation Team was to disseminate the results of activities. The Team has conducted workshops with various related agencies. Also, the dissemination was carried out through technology transfer activities to various parties, including extension workers, lecturers, and researchers and through seminars and accredited journals. Scientific publications that have been published related to the project were as follows:

Table 6. List of publications

No.	Title	Media of Publications
1.	Nining Wahyuningrum & Agung Budi Supangat. 2016. Spatial land capability analysis in micro watershed management planning, case study in Naruan Micro Watershed, Keduang Sub Watershed, Solo Watershed	Journal of GLOBE, Vol. 18, No. 1, April 2016, 43-52
2.	Nining Wahyuningrum & Agung Budi Supangat. 2016. Landslide susceptibility analysis using different data scale of Naruan Microcatchment, Keduang Sub Watershed	Journal of GLOBE, Vol. 18, No. 2, October 2016, 53-60
3.	Dewi Retna Indrawati. 2018. Developing Community Participation in Naruan Micro Catchment Management	Semi-popular Magazine CerDAS, Vol. 4., No. 2, October 2018
4.	Nining Wahyuningrum. 2019. Land management of Upper Solo Watershed: starting from the small to the more comprehensive action	Semi-popular Magazine CerDAS, Vol. 5., No.1, May 2019

3.3 Performance of Consultants (technical assistants)

This project employs two technical consultants. the first is Mr. Dr. Dwi Priyo Arianto, Ph.D., an expert in the science of Soil and Water Conservation, and the second is Dr. Sapja Anantanyu, an expert in Social Sciences, Economic and Institution. Both consultants have the responsibility of providing advice and criticism in planning, as well as mediating scientists and farmers. Consultants are always involved in planning discussions, discussions with parties and also involved in discussing project evaluation results.

3.4 Performance of APFNet

Overall collaboration with the APFnet agency represented by Mr. Li Zhaochen (project management officer) is very good, communication and direction are very clear and easy to implement. Every problem can be communicated and always get a quick response from APFnet. Likewise, the disbursement of funds is always timely.

The obstacle is the difference in the system of disbursement of funds between donors and Indonesian Government regulations. Following applicable regulations, the disbursement of funds must be based on the DIPA (Annual Government Coverage Plan) contained in official documents. Disbursements that are not following DIPA are considered not valid. A budget of 10 percent which was postponed by APFnet made it difficult for the implementation of activities so the Team had to find funds to cover (temporarily) the 10 percent lack of funds. However, with the support of a strong leader and team, this can be overcome so that activities can be completed on time.

4. PROJECT PERFORMANCE

4.1 Project achievements

During the project (2017-2019), the outputs proclaimed were achieved, although in the implementation there were some adjustments. In the proposal, several outputs have been announced, i.e:

- Output 3. Increased stakeholders' commitment to Effective participatory management of micro catchment
- Output 4. Formulation of integrated participatory management of micro catchment
- Output 5. Demonstration plot of conservation farming and watershed rehabilitation
- Output 6. Enhanced community awareness in management of micro catchment
- Output 7. M&E of watershed performance within a scale of micro catchment, landscapes, and household
- Output 8. Final report and dissemination

Output 3 has been achieved which is shown by the commitment of all stakeholders to support activities in sustainable watershed management. This goal was achieved through FGDs at the village and district levels. FGD was conducted twice in each village and district. At the village level, FGD was held in 3 villages (Wonorejo, Wonokeling, and Bubakan). The participants were landowners or farm workers, village apparatus, community leaders, and farmer's group manager in the project area. The first FGD formulated the farmer's perception of the land condition including the problems, expectations for land improvement, and efforts to improve land conditions (Activity 3.1.). The second FGD output was a general design of land management suitable for soil and water conservation efforts which includes patterns,

planting distances, types of plants, and farmer's contributions in its implementation (Activity 3.2.). At the district level, FGD (institutional meeting) among stakeholders and representatives of FP's was held in 2 districts (Wonogiri and Karanganyar). The first output was programs and activities of every stakeholder that potentially support the integrated NMC management (Activity 3.1.), and the second output was stakeholders support in implementing the design resulted in farmer's meeting, especially for the locations outside the demonstration plot built through APFNet funds (Activity 3.2.).

The formulation of integrated participatory management of micro catchment (**Output 4**) was achieved through FGD to develop participatory demonstration plots and workshops with all stakeholders. The FGD was held in three villages attended by FP's (landowners or farm workers whose land was selected for the project activities). The FGD produced the detailed planning of sustainable land management of each land in the demonstration plot, and an agreement about the right and obligation of each party (FP's, project team, group leaders, and village apparatus) in the development of demonstration plots (Activity 4.1.). The detailed planning was then presented in a workshop with stakeholders to get their support. In this workshop was formulated the role of relevant institutions in supporting the sustainable management of NMC (Activity 4.2.).

Output 5 was achieved through three activities. Activity 5.1 (determining the site of demonstration plot) was done through a field survey by the project team and FP's. The output of activity 5.1 was delineation and map of the demonstration plot including its attributes based on the field measurement. Applying vegetative soil conservation measures (Activity 5.2) was done through several stages. The total size of the demonstration plot of vegetative conservation measures was 30 ha distributed in three villages with an agroforestry pattern. The agroforestry pattern was applied consist of woody plants (albizia and limpaga), MPTS (avocado, durio, and parkia), and seasonal crops. Several stages were done to apply activity 5.3. The output of activity 5.3 was the development of 35 civil technique soil conservation measures in three villages, consist of several types and shapes including small check dam (4), gully plug (4), small-gully plug (26) and gully head structure (1). The construction used two kinds of material namely stone and bamboos.

There were two activities conducted to achieve **Output 6**. The first activity (activity 6.1) was a community extension. The extension was carried out through two ways namely assistance and training. The training was attended by FP's in each village. The topics of the extension were the process of making organic fertilizers and pesticides, also the construction of civil techniques conservation using bamboo. Assistance was provided for the maintenance of demonstration plots. The second activity (Activity 6.2) was an excursion. The excursion was carried out in two stages with different objects. The objects of the first stage were integrated community forest in Boyolali District and integrated livestock farming in Klaten District. The objects of the second stage were integrated dairy cow farming in Boyolali District and honey bee farm in Surakarta District.

Output 7 was obtained through three activities namely water yield and sedimentation monitoring (Activity 7.1), land evaluation (Activity 7.2), and evaluation of economic and community behavior on land management (Activity 7.3). Data collected were data before the treatment as baseline data and data after the treatment to monitor and evaluate the impact of the micro catchment. Data collected for activity 7.1 were rainfall, river flow discharge, total runoff, and sediment yield. Data collected for activity 7.2 were slopes, soil type, land cover, and the high and diameter performance of albizia. Data collected for activity 7.3 were economic and community behavior on land management, community participation in the project activity, local institution, and business group support.

Besides, there were also carried out monitoring and evaluation of the project implementation by WMTC as executing agency; Research, Development and Innovation Agency as the direct supervisor of WMTC; and Extension and Human Resources Development Agency as the supervisory agency.

Final report and dissemination (**Output 8**) were achieved through two activities namely meeting to share the project outcomes (Activity 8.1), and formulating a final report and developing dissemination materials (Activity 8.2). The activity 8.1 was done through a workshop and an internal meeting. The workshop was aimed to socialize the project outcomes to get feedback from stakeholders and steering committee. An internal meeting was done to formulate the project result. The result from activity 8.2 was Semi-annual Progress Report I and II, Annual Progress Report (APR) I, Final Report, and dissemination materials in the form of six leaflet topics, five poster topics, and CD of all project activities documentation.

The whole of outputs, activities, and results completely presented in the Technical Report (Annex D.).

4.2 Project Impacts

This project has succeeded in influencing community perceptions about the importance of sustainable land management. They realize the importance of civil and vegetative technical land conservation. They actively participated in making plans, planting and maintaining plants and actively participated in the FGD and training that we held. However, to increase participation and change their mindset, assistance needs to be done so that they are more independent, not rely on the incentives from the government, especially to build civil technical conservation. Land rehabilitation with an agroforestry pattern will provide additional income at the end cycle (6 years). However, non-land based income sources need to be developed so as not to cultivate land intensively which may cause land degradation.

From the institutional aspect, this project has succeeded in developing a participatory watershed management plan that involves stakeholders from the local to the national level. Village institutions have planned to develop these activities according to their capacity. The sustainability of this project will depend on the commitment of the parties to carry out the plan, especially the maintenance of conservation buildings and community assistance.

From the environmental aspect, there will be changes in land cover from seasonal crop farming patterns on sloping lands that are prone to erosion to agroforestry patterns. This change in land cover will reduce the level of erosion. The gully erosion will be more controlled, especially if the community can make gully control structures independently. However, from the hydrological aspect, this activity has not yet had a significant impact because the proportion of the area managed is still too small when compared to the total area of the micro watershed.

The results of the project activities are disseminated through scientific publications, leaflets and posters, and technology transfer to users. Overall, the process of preparing the planning and management of the Micro Watershed will be used as counseling material for extension agents of the MEF.

4.3 Sustainability

Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed Project ended in August 2019, while the impact of NMC management will be felt in the long term. Therefore, the demonstration plots that applied vegetative and civil technique soil conservation measures must be maintained, so that the benefits of watershed management can be felt by the community. Besides, assistance and extension to the community must also continue. The steps that have been taken by the team for the sustainability of NMC management are:

1. Community involvement in the preparation of the NMC management plan and its implementation, including their contribution to the implementation activities. Thus, it is hoped that the community will be able to carry out soil and water conservation efforts without any support from other parties
2. Involvement of forestry extension agent in training and extension activities to the community, so that extension agents will continue to guide the community in soil and water conservation activities
3. Involvement of the stakeholders (including the village government) since the beginning of the activity: a) to build common understanding of integrated watershed management; b) to get support in managing NMC through the programs of each party; c) to formulate the role of relevant institutions in supporting the sustainable management of NMC; and d) to develop a participatory and sustainable micro watershed management model
4. Hand over the civil technique soil and water conservation to each village government so that there is a responsibility to maintain the conservation structures

Hopefully, after the project, the parties can carry out their role in managing the NMC in an integrated and sustainable manner.

Based on the success of the project implementation and the positive response from the stakeholders, the Executing Agency is interested in submitting a concept note for funding to scaling up the scope of the project in the same area. The proposed project is aimed to build a model of sustainable micro catchment

management based on soil and water conservation principles, to enhance ecological functions and promote socio-economic development. The activities will be focused on:

1. Expansion of demonstration plots of conservation farming and watershed rehabilitation (agroforestry and civil technique conservation structure)
2. Improvement of farmers' skills in processing agricultural yields for higher value-added products, processing household and agriculture waste, and beekeeping
3. Monitoring and evaluation (M&E) on the performance of micro catchment

5. CONCLUSION, LESSONS LEARNED AND RECOMMENDATIONS

5.1 Conclusion

- The project activities have been completed under the agreement. All objectives have been achieved. However, there have been changes in the schedule for the implementation of some activities and also changes in the purchase of goods that have been consulted with APFNet
- The commitment of the parties from the community level to the district level (Output 3 & 4) has increased as indicated by increasing participation in the management of the NMC
- Demonstration plots have been built that involve community participation (Output 5)
- Improved understanding of the management of the NMC has been carried out through training and comparative studies to increase farmers' knowledge of soil and water conservation techniques (Output 6)
- Hydrological aspect (Output 7.1), this activity has not yet had a significant impact because the proportion of the area managed is still too small when compared to the total area of the micro watershed
- Land aspects (Output 7.2), there will be changes in land cover from seasonal crop farming patterns on sloping lands that are prone to erosion to agroforestry patterns. This change in land cover will reduce the level of erosion. The gully erosion will be more controlled, especially if the community can make gully control structures independently
- Social and economic (Output 7.3), this project has succeeded in influencing community perceptions about the importance of sustainable land management. However, to increase participation and change their mindset, assistance needs to be done so that they are more independent, not rely on the incentives from the government, especially to build civil technical conservation. Land rehabilitation with an agroforestry pattern will provide additional income at the end cycle (6 years). However, non-land based income sources need to be developed so as not to cultivate land intensively which may cause land degradation

- Overall, the participatory management of NRM activities are following the objectives of this project. The sustainability of this project depends on the commitment of the parties to implement NRM management plans and community assistance
- At the policy level, the NRM management process can be used as a reference for the management of national-level micro catchment in Indonesia

5.2 Lessons learned and recommendations

Lessons learned from this project include:

- Micro Watershed management activities that have stages of planning, implementation, and monitoring-evaluation, need to coordinate, integrate, and synergize between stakeholders at each stage. In reality, the concept is difficult to apply. For example, when conducting FGDs at the district level, all institutions are willing to participate in these activities. However, at the time of implementation only 2 institutions namely PDAM (District Domestic Water Services) and Perum Jasa Tirta (National Water Services Company) contributed to the implementation. The lesson to be taken is that intensive communication with stakeholders will facilitate coordination. Besides, figures who have strong leadership are needed, such as the Major, who has the authority to direct all stakeholders in his working area.
- The community is aware that the current land management is not appropriate so that erosion and sedimentation increase while soil productivity decreases. This awareness is shown in the design of demonstration plots which include perennial crops (timber and fruit) as well as the mechanical structure for soil conservation. Community participation is also demonstrated by the willingness of the community to contribute to labor and manure in the implementation. However, this level of participation did not occur during design implementation. Although the written agreement on rights and obligations had been made and all the boundaries of the FPs land tenure and the design had been mapped, they did not follow and obey
- In every land rehabilitation project, it is necessary to learn the behavior and local culture in land management. The national land rehabilitation program should not only distribute plant seedlings to the village level but must also carry out monitoring until the critical crop period has passed
- Farmers are early adopters who must continue to be fostered to spread their knowledge to other farmers
- Bamboo gully plug techniques can be disseminated to be applied in other locations. This is because the technique is easy to imitate, the material is easy to obtain, and the cost is cheap

Annex D. Project Outputs (Technical Report)

---This annex is presented as **The Technical Report** in a separate document---

Annex E. Feature stories from the project for promotion

1. LAND MANAGEMENT OF UPPER SOLO WATERSHED: STARTING FROM THE SMALL TO THE MORE COMPREHENSIVE ACTION

By: Nining Wahyuningrum

As the world's population increases and the demand for food and other agricultural commodities grows, it is inevitable that more demands will be placed on land which is marginal for agriculture. Much of the world's marginal land is on medium to steep slopes and is very prone to water erosion. Not only are farmers' yields declining, but erosion from the sloping areas is causing serious problems downstream, including the silting up of streams and dams, damage to hydro-electric and irrigation schemes, and an increased frequency and severity of flooding. The causes of these problems should be understood widely by politicians, administrators and, to some extent, the public in general including farmers. These stakeholders are responsible for the impact caused by erosion in accordance with their roles.

There are various reasons for the failure of soil conservation schemes, but one of the most important reasons is the lack of understanding by the planners of the basic processes of soil erosion and the principles of its control and prevention. The basic process of soil erosion is that raindrops falling on a bare soil break down the structure of the surface soil and detach particles. If the land is sloping and the water cannot be immediately absorbed by the soil, or detained by the micro topography, the water moves down the slope in the form of run-off, carrying dislodged particles with it. The basic factors affecting water erosion are the erodibility of the soil, the erosivity of the rainfall, the slope of the land and the type of land use. The first and the second factors are given factors while the third and the fourth factors can be manipulated or managed. Soil conservations are normally managing these two factors, slope and landuse.

Soil conservation measures are usually described under the two convenient methods i.e. biological measures and physical or mechanical measures. In practice, there are commonly applied both types of measures. The basic principle of biological measures is that vegetation is used, alive or dead, in sufficient amount to cover the soil surface from the detachment force of raindrops and to create a uneven surface which will physically prevent run-off and slow down its erosive velocities. Mechanical conservation works to prevent the effect of raindrop impact, slow down, partially or entirely, the movement of run-off, so that the infiltration rate is increased and the velocity of run-off is decreased.

Problems in The Upstream Bengawan Solo River Basin

Preliminary studies have been conducted, including the identification of issues/problems in the main study area, which is located in Naruan micro-watershed, upstream part of Bengawan Solo river basin. The main issue in the study area is soil erosion, which contributes to the high rate of sedimentation in the Multipurpose Reservoir of Gajah Mungkur (MRGM), located in the downstream. The issue has become a national issue, because the reservoir MRGM has a strategic function as a flood control in the Upper Solo watershed, as suppliers of agricultural water in many districts downstream, and as electricity power plant.

The Naruan micro-catchment is naturally prone to erosion hazard. It can be seen from the Figure 1, of the 957 ha more than 50% area are occupied by steep slope (>25^0). In addition, this condition is compounded

by rainfall intensity (1963 mm/year) and its three-days daily cumulative rainfall (201-300 mm). By USLE model, it is predicted that 33% area are potentially to encounter the extremely heavy erosion (>480 ton/ha/year). The erosion problems are mainly from the agriculture area. Figure 2 shows the water flow from settlement (a) and from agriculture area (b). The picture (a) and (b) were taken simultaneously soon after rain with moderate intensity down for approximately one hour. Water from agriculture area has a thicker color contained more sediment resulted from soil detachment and displacement.

Land capability assessment showed that 56% of the area was classified into VIg class and 42% into VIIg class with gradient as limitation. These classes are normally not suitable for seasonal crops, but for agroforestry or undisturbed forest instead. In contrast, it was found that dominant landuse in the area is dry land cultivated by cassava, maize and ginger while the woody plant normally planted along the land boundary. This actual fact may accelerate soil erosion occurrence although traditional soil conservation has been applied. Figure 3 shows strip cropping pattern with furrows, grass barriers in the waterways while Figure 4 shows land preparation stage which are prone to erosion hazard.

Figure 1. The overview of the Naruan micro-catchment
(Photo by: Nining Wahyuningrum)

(a) (b)

Figure 2. Water flow from settlement (a), from agriculture area (b)
(Photo by: Nining Wahyuningrum)

Since each unit of land has its own particular characteristics or capabilities limitations therefore landuse arrangement should fall within the capabilities of the particular unit. If this is done properly, it may lead to the optimum and sustainable production. To introduce appropriate landuse, it may require people displacement from the steep slopes to the area that relatively flat or landuse change to the type of landuse system which are less intensive or at least which are compatible with the capabilities of the land. This may cause problems. For political, social and economic reasons, it may not be possible to move the people. Moreover, more suitable land may not be available or people are generally reluctant to move from their established homes, families and communities.

There may be a number of reasons why changes in land use are difficult. Where commercial agriculture is being practiced, farmers are growing certain crops because of the pricing structure and are unlikely to change unless it can be clearly demonstrated that the growing of other crops can be at least as financially attractive. In the case of most sloping land, the need to grow seasonal crops to meet the immediate needs of the family is the farmer's primary concern. In such cases, a compromise is needed in determining the cultivation pattern. Cultivations patterns that financially benefits the farmers and also ensures the sustainability of the land may become the best solution.

Figure 3. Pattern applied in the area: strip cropping with furrows, grass barriers in the waterways (Photo by: Nining Wahyuningrum)

Figure 4. Land preparation for seasonal crops: erosion prone period (Photo by: Nining Wahyuningrum)

Finding The Most Profitable Solution

Based on preliminary studies, participatory management plans for the area have already been arranged including plan draft contains the indicative area that should be rehabilitated as well as community development plans and coordination mechanism between the parties. Based on this, the action to overcome the degradation process can be executed. The key of the action is participation.

Participation is the active engagement of people in decision-making processes. It is about communities having access and control over common resources and about giving voice to those who are disadvantaged and excluded. It is also about the right to engage in these processes. Not only the farmers but also the entire stakeholders involved should take part in the action. Because the arranged plan has already considered the interests of many parties, it is expected all parties may contribute during implementation based on their function.

The activity should be start within plot since, the limitation of the resource. Plot by plot could be made until all degraded land in micro-catchment resolved. This happen if the built plots are able to achieve the financial and environmental goal. Conservation agriculture with minimal soil disturbance, year-round land cover, and crop rotations, is being promoted in improving the efficiency of water-use, reducing soil erosion, and increasing crop production. Cropping pattern that can meet this goal is agro-forestry that combines seasonal crops and perennial trees.

At the research area, it has been applied seasonal crops and timber plants, but the applied cropping pattern has not fulfilled the purpose of conservation, because permanent vegetation is generally only applied in the boundary of land tenure. Thus there are stages of land preparation for annual crops, which is so vulnerable to rain water splashing as shown in Figure 4. The pattern design is made to encounter this problem. The applied pattern is to combine the timber plants with seasonal crops, timber plants not only planted in the boundary alone but throughout the field with the appropriate spacing. The selected plants are in line with the landowners' interest.

The success of the activity can be monitored from the aspects of land productivity, erosion control and sedimentation, and hydrology. In addition, social and institutional aspects are managed to ensure the sustainability and development of activities to a wider location. The success of managing this micro-catchment may become the good example to the other micro-catchments.

2. MULTI STAKEHOLDERS PARTICIPATION ON MICRO WATERSHED MANAGEMENT

By: Dewi Retna Indrawati

Taking into account the critical condition of the Solo watershed and looking back at the efforts that have been made to improve its condition, a question arises: Why are efforts to improve the condition of the Solo watershed have not shown real results? Is there anything wrong with the management?

It cannot be denied that the Solo Watershed covers a large area (1.6 million hectares) and across administrative boundaries. In addition, in the Solo Watershed there are a lot of resources utilization involving many parties. Therefore, efforts to improve the Solo Watershed can't only be done by a single sector or party, it needs to be done in an integrated manner by all those who manage and utilize the resources in the Solo Watershed. Unfortunately it's almost never done. Each party undertakes its activities without paying attention to the framework of watershed conservation.

In relation to the Solo Watershed Management, BPDASHL Solo has developed a plan for the management of Solo Watershed, but the scope is too wide because it encompasses the entire Solo Watershed and the parties has not been involve in its implementation. As a result, the activities of BPDASHL Solo and the parties are only done partially at different spots, so it does not have a real impact on improving the condition of Solo Watershed.

In Naruan Micro Watershed management, there is an interesting phenomenon where watershed management uses a micro-scale watershed approach and involves the parties in its implementation. There are several advantages of using this micro-scale watershed approach that is to ease the coordination of the parties to conduct integrated management, community participation in activities, also monitoring and

evaluation of its success.

The involvement of stakeholders begun with an effort to synchronize the perception of stakeholders on the importance of integrated watershed management. Subsequently, the stakeholders were informed of the management plan of the Naruan micro catchment, which was developed participatively with the community, and stakeholders were asked to commit and support the implementation of the activities. The effort is considered as an effort of offering or marketing the planning to stakeholders.

(a)

(b)

Figure 1. Stakeholders' FGD in each district (a) Karanganyar; (b) Wonogiri

That effort was successful, because there were several parties involved in the implementation of activities. Jasa Tirta I has provided seedlings of perennial crops such as sengon, suren, alpokat and kopi for Bubakan Village, while PDAM Giritirtasari provided seedlings of perennial crops for the conservation of springs in Bubakan Village. Besides these two agencies, there are several institutions that commit to engage in the implementation of activities in the form of extension, conservation and livestock. It shows that offering or marketing the planning to stakeholders is an appropriate breakthrough to engage stakeholders in integrated watershed management.

3. THE POTENCY OF HOUSEHOLD ECONOMIC BASED ON LOCAL RESOURCES IN NARUAN MICRO CATCHMENT

By: Purwanto

From economic aspect, Naruan Micro Catchment has comparative advantages than other locations. In terms of potential natural resource: the soil is very fertile with top soil more than 30 cm, solum of more than 1 meter, and Lawu Vulcan as its parent material. Rainfall in the Naruan Micro Catchment is 2,405 mm per year (observations in 2016-2018) with significant differences between the rainy season and the dry season, so this area is suitable to be developed into upland dry land agriculture.

In terms of human resources, 72% of FPs have experience of seasonal migration and some of them are still do so until now. They generally sell meat ball, noodles and traditional herbal medicine. During seasonal migration, they have enough experience and income, so they can participate in developing infrastructure in their village.

FP sources of income are from annual crops (28.1%), timber (24.6%), livestock (20.8%), trade (14.3%), and salaries and other sources (12.1%). Seasonal crops, timber, and livestock are the three main sources of FP's income, so agroforestry and silvo-pasture systems is potentially to be developed in those areas.

In this agroforestry pattern, plant species that have economic value and is suitable for planting in the Naruan Micro Catchment is albizia (*Paraserianthes falcataria*). The plant can be harvested after 6 years. Based on the farmer's experience, if albizia is planted in monoculture pattern, the harvest volume is more or less 1.3 m3 / tree. Market opportunities for the timber are also promising because there are many tradesmen who buy timber from the community. In addition, there are wood processing and plywood industries in Sukoharjo District which are between 20-50 km from the Naruan Micro Catchment.

Besides timber, community in the Naruan Micro Catchment also want to plant fruit especially avocados and durians. The growing culinary business influences the increasing demand for fruits. The results of the interview indicated that at harvest time, the sale of avocados was Rp. 1,500,000 per tree. To increase the value of avocados, post-harvest processing needs to be done.

Another potency of economic that can be developed is livestock. The survey results state that income from livestock is the third biggest source of income after annual crops and timber. Income from livestock is Rp. 4,268,000 per year. The average livestock ownership in the Naruan Micro Catchment is presented in Table 1. This is also supported by abundant animal feed. Farmers have planted various types of plants that can be used as sources of animal feed. However, integrated farms have not been developed in these areas. Training on making organic fertilizer and pesticide by the APFNet Research Team, and comparative studies are efforts to encourage the development of integrated livestock business. Excursion to Sukorejo and Banyuanyar Village (Boyolali District) and Mundu Village (Klaten District) is an effort to encourage the community to integrate land conservation, livestock, post-harvest processing and their associated efforts.

Table 1. Description of development of livestock in the Naruan Micro Catchment

Village	Livestock ownership per person		Animal feed	
	Cow	Goat	Source	Condition
Wonokeling	2	5	own land	Adequate - abundant
Wonorejo	1	5	own land	Adequate
Bubakan	2	2	own land	Adequate

Source: Primary data, 2018

Annex F. Photos, Leaflets, Posters and Documentary films

A. Photos

Activity 3.1. FGD to synchronize of stakeholder perception related to watershed management and soil and water conservation


Activity 3.2. FGD to design participatory micro catchment management plan




Activity 4.1. FGD to develop participatory demonstration plots

Activity 4.2. Workshop with all stakeholders

Activity 5.1. Determining the site of demonstration plots




Activity 5.2. Applying vegetative soil conservation measures




Activity 5.3. Applying civil technique soil conservation measures







Activity 6.1. Community extension related to conservation farming system








Activity 6.2. Excursion to a farm land which applying integrated farming system

Activity 7.1. Water yield and sedimentation monitoring

Activity 7.2. Land evaluation (Land cover, soil erosion rate)




Activity 7.3. Evaluation of economic and community behavior on land management




Procurements

Personal computer/Laptop

External hard drive

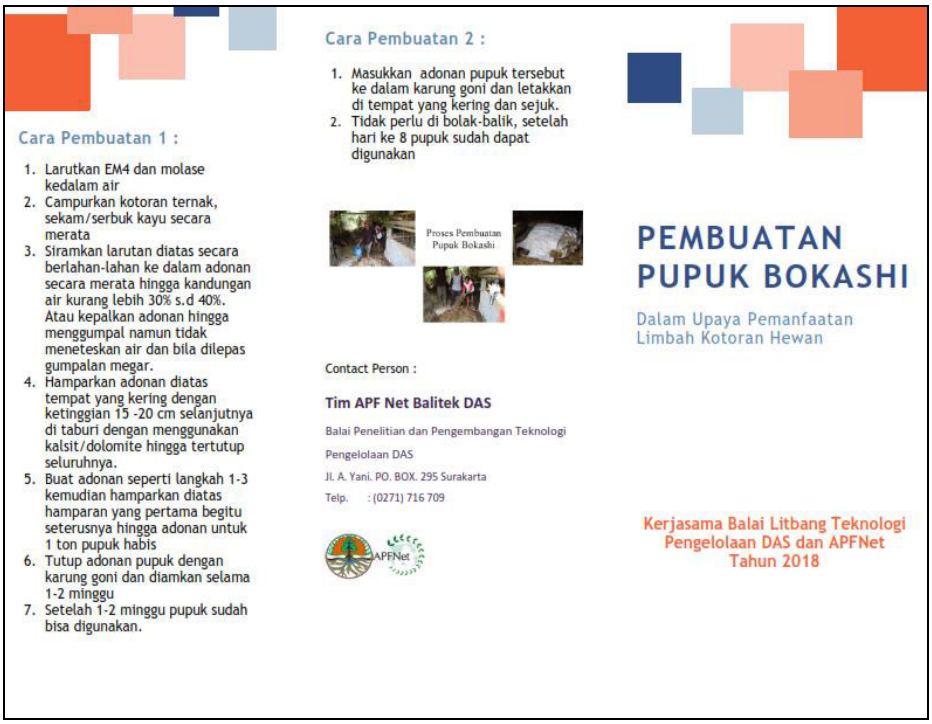
Printer

Voice Recorder

Drone

B. Leaflets (in Indonesian)

1. Making organic fertilizer from manure



Cara Pembuatan 1 :

1. Larutkan EM4 dan molase kedalam air
2. Campurkan kotoran ternak, sekam/serbuk kayu secara merata
3. Siramkan larutan diatas secara berlahan-lahan ke dalam adonan secara merata hingga kandungan air kurang lebih 30% s.d 40%. Atau kepalkan adonan hingga menggumpal namun tidak meneteskan air dan bila dilepas gumpalan megar.
4. Hamparkan adonan diatas tempat yang kering dengan ketinggian 15 -20 cm selanjutnya di taburi dengan menggunakan kalsit/dolomite hingga tertutup seluruhnya.
5. Buat adonan seperti langkah 1-3 kemudian hamparkan diatas hamparan yang pertama begitu seterusnya hingga adonan untuk 1 ton pupuk habis
6. Tutup adonan pupuk dengan karung goni dan diamkan selama 1-2 minggu
7. Setelah 1-2 minggu pupuk sudah bisa digunakan.

Cara Pembuatan 2 :

1. Masukkan adonan pupuk tersebut ke dalam karung goni dan letakkan di tempat yang kering dan sejuk.
2. Tidak perlu di bolak-balik, setelah hari ke 8 pupuk sudah dapat digunakan

Proses Pembuatan Pupuk Bokashi

Contact Person :

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Balai Penelitian dan Pengembangan Teknologi Pengelolaan DAS

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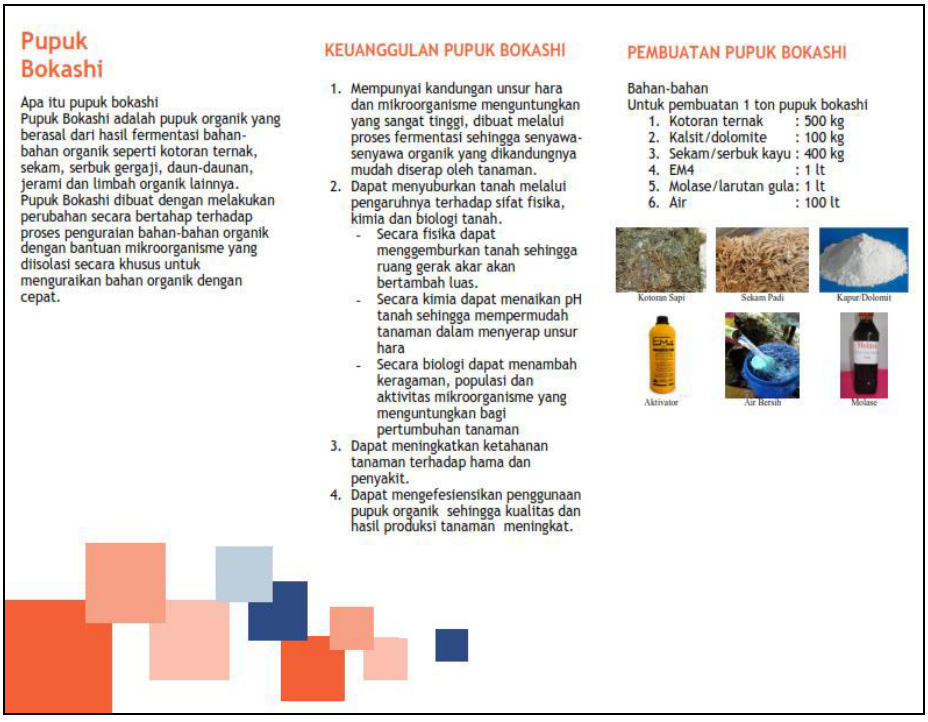
PEMBUATAN PUPUK BOKASHI

Dalam Upaya Pemanfaatan Limbah Kotoran Hewan

Kerjasama Balai Litbang Teknologi Pengelolaan DAS dan APFNet Tahun 2018



Pupuk Bokashi

Apa itu pupuk bokashi
Pupuk Bokashi adalah pupuk organik yang berasal dari hasil fermentasi bahan-bahan organik seperti kotoran ternak, sekam, serbuk gergaji, daun-daunan, jerami dan limbah organik lainnya. Pupuk Bokashi dibuat dengan melakukan perubahan secara bertahap terhadap proses penguraian bahan-bahan organik dengan bantuan mikroorganisme yang diisolasi secara khusus untuk menguraikan bahan organik dengan cepat.

KEUANGGULAN PUPUK BOKASHI

1. Mempunyai kandungan unsur hara dan mikroorganisme menguntungkan yang sangat tinggi, dibuat melalui proses fermentasi sehingga senyawa-senyawa organik yang dikandungnya mudah diserap oleh tanaman.
2. Dapat menyuburkan tanah melalui pengaruhnya terhadap sifat fisika, kimia dan biologi tanah.
   - Secara fisika dapat menggemburkan tanah sehingga ruang gerak akar akan bertambah luas.
   - Secara kimia dapat menaikan pH tanah sehingga mempermudah tanaman dalam menyerap unsur hara
   - Secara biologi dapat menambah keragaman, populasi dan aktivitas mikroorganisme yang menguntungkan bagi pertumbuhan tanaman
3. Dapat meningkatkan ketahanan tanaman terhadap hama dan penyakit.
4. Dapat mengefesiensikan penggunaan pupuk organik sehingga kualitas dan hasil produksi tanaman meningkat.

PEMBUATAN PUPUK BOKASHI

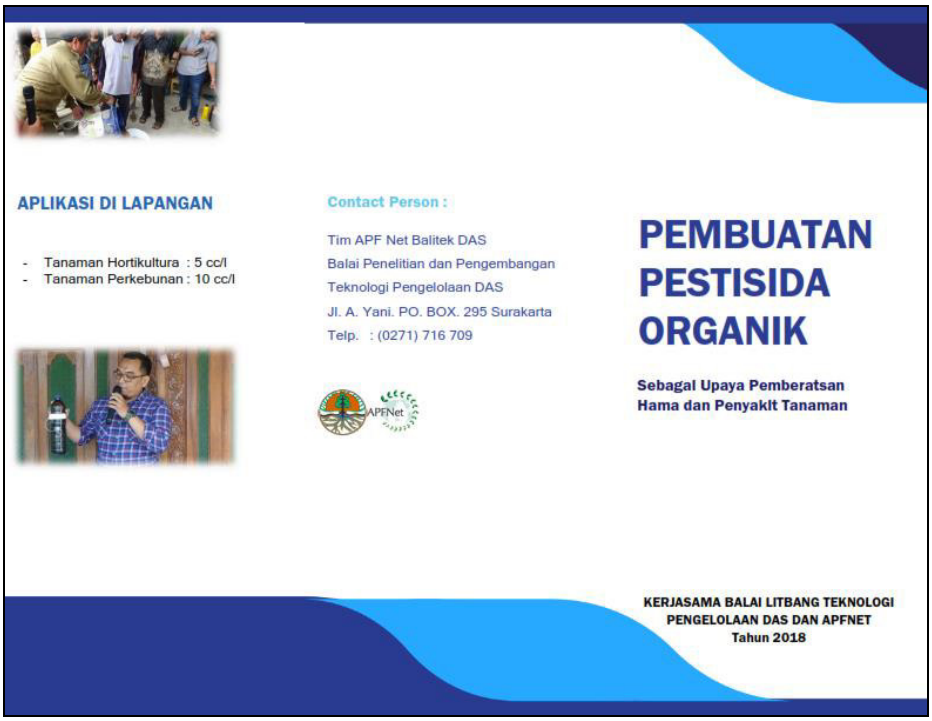
Bahan-bahan
Untuk pembuatan 1 ton pupuk bokashi

1. Kotoran ternak : 500 kg
2. Kalsit/dolomite : 100 kg
3. Sekam/serbuk kayu : 400 kg
4. EM4 : 1 lt
5. Molase/larutan gula : 1 lt
6. Air : 100 lt

Kotoran Sapi | Sekam Padi | Kapur/Dolomit

Aktivator | Air Bersih | Molase

2. Making organic pesticides from local raw materials



3. Developing community participation in micro-watershed management

4. Bamboo, an economical solution for controlling small gully erosion

Penutup :

Dengan adanya solusi ini diharapkan tercapainya aspek berupa :

1. Sadarnya masyarakat akan bahaya erosi pada lahan
2. Masyarakat lebih mandiri terkait konservasi tanah dan air pada lahan mereka tanpa mengharap bantuan pemerintah
3. Terkendalinya ersoi dan aliran permukaan didaerah tangkapan air (hulu DAS)
4. Menstabilkan morfologi jurang agar tidak berkembang semakin dalam dan lebar
5. Diharapkan bambu yang tumbuh dapat dimanfaatkan untuk berbagai keperluan masyarakat

Balai Penelitian dan Pengembangan Teknologi Pengelolaan DAS Surakarta
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APFNet

BAMBU
Solusi Ekonomis Atasi Erosi Jurang
(Kerjasama Balitek DAS Solo dengan APFNet Project)

Latar Belakang :

Erosi mengakibatkan degradasi di daerah aliran sungai, dengan terkikisnya unsur-unsur hara yang penting bagi tanaman, selain itu juga menyebabkan pendangkalan sungai dan waduk

Sebagai contoh kapasitas tampung waduk Wonogiri menurun drastis karena endapan sedimen yang bersumber dari daerah tangkapan airnya (hulu DAS)

Akibatnya menurunya pasokan listrik karena endapan lumpur sedimen memenuhi turbin pembanhgkit listrik

Salah satu penyumbang erosi tanah terbesar adalah erosi jurang yang berawal dari alur kecil dibatas kepemilikan kemudian menjadi jurang

Permasalahan :

Lokasi jurang yang jauh dari jalan seringkali lepas dari perhatian pemerintah melalui kegiatan rehabilitasi hutan dan lahan
Hal tersebut mengakibatkan mahalnya biaya angkut material karena lokasi jurang yang berada ditengah lahan masyarakat

Solusi :

Bambu merupakan solusi murah untuk penanganan jurang yang masih kecil pada batas-batas kepemilikan lahan yang jauh dari akses jalan dan berada ditengah lahan ataupun kawasan hutan dengan model bangunan KTA (Konservasi Tanah dan Air) berupa Small Gully Plug (SGP)

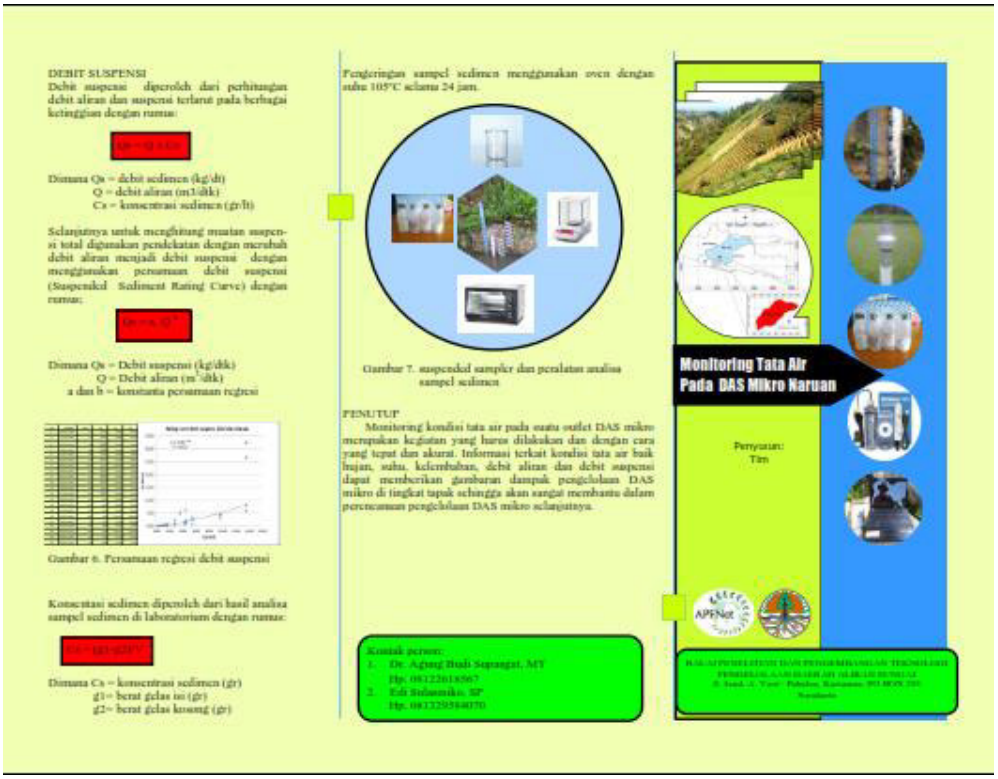
Bambu mudah diperoleh karena banyak terdapat pada lahan masyarakat dikawasan Hulu DAS, sehingga masyarakat tidak perlu membeli hanya memanfaatkan yang sudah ada pada lahan mereka

Selain mudah diperoleh, bambu juga mudah dirakit dalam proses pembuatannya menjadi bangunan SGP

Proses Pembuatan :

1. Pembekalan kepada masyarakat tentang pentingnya penanganan erosi jurang sejak dini
2. Peninjauan lokasi alur yang berpotensi menjadi jurang besar
3. Pengukuran dan penentuan titik lokasi bangunan
4. Penyediaan bahan dan tenaga kerja
5. Pelaksanaan pembuatan bangunan sesuai rencana

5. Water monitoring in micro-catchment scale



DEBIT SUSPENSI

Debit suspensi diperoleh dari perhitungan debit aliran dan suspensi terlarut pada berbagai ketinggian dengan rumus:

Dimana Qs = debit sedimen (kg/dt)
Q = debit aliran (m3/dtk)
Cs = konsentrasi sedimen (gr/lt)

Selanjutnya untuk menghitung muatan suspensi total digunakan pendekatan dengan merubah debit aliran menjadi debit suspensi dengan menggunakan persamaan debit suspensi (Suspended Sediment Rating Curve) dengan rumus:

Dimana Qs = Debit suspensi (kg/dtk)
Q = Debit aliran (m^3/dtk)
a dan b = konstanta persamaan regresi

Gambar 6. Persamaan regresi debit suspensi

Konsentasi sedimen diperoleh dari hasil analisa sampel sedimen di laboratorium dengan rumus:

Dimana Cs = konsentrasi sedimen (gr)
g1= berat gelas isi (gr)
g2= berat gelas kosong (gr)

Pengeringan sampel sedimen menggunakan oven dengan suhu 105°C selama 24 jam.

Gambar 7. suspended sampler dan peralatan analisa sampel sedimen

PENUTUP

Monitoring kondisi tata air pada suatu outlet DAS mikro merupakan kegiatan yang harus dilakukan dan dengan cara yang tepat dan akurat. Informasi terkait kondisi tata air baik hujan, suhu, kelembaban, debit aliran dan debit suspensi dapat memberikan gambaran dampak pengelolaan DAS mikro di tingkat tapak sehingga akan sangat membantu dalam perencanaan pengelolaan DAS mikro selanjutnya.

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Monitoring Tata Air Pada DAS Mikro Naruan

Penyusun:
Tim

PENDAHULUAN

Daerah Aliran Sungai (DAS) sebagai unit ekologis dan unit pengelolaan dapat merepresentasikan suatu kondisi keterpaduan dan kelestarian komponen-komponennya.

Untuk dapat mengetahui dampak suatu pengelolaan tingkat tapak yang lebih detil, maka diperlukan suatu upaya pemantauan di tingkat DAS mikro. DAS mikro Naruan merupakan salah satu DAS mikro dengan luas 957,12 ha, dimana tergolong DAS mikro karena sesuai dengan Pedoman Pembangunan Areal DAS mikro ((Peraturan Dirjen Rehabilitasi Lahan dan Perhutanan Sosial, No-

Gambar 1. DAS Mikro Naruan mor:P.15/V-Set/2009, 2009).

Selanjutnya untuk mengetahui efektifitas pengelolaan DAS mikro salah satunya adalah dengan melakukan monitoring dan evaluasi kondisi tata air secara kontinyu dan benar yang meliputi: Iklim (curah hujan, suhu dan kelembaban udara), debit aliran air (limpasan) dan debit suspensi. Tata air sendiri merupakan hubungan kesatuan unsur-unsur hidrologi yang mempengaruhi neraca air di suatu DAS mikro.

TUJUAN

Tujuan dari monitoring dan evaluasi tata air

IKLIM DAN CUACA

Data iklim dan cuaca yang dimaksud disini adalah data hujan, suhu udara, kelembaban udara, evaporasi dan kecepatan angin. Data hujan dimonitor dengan membuat Stasiun Penakar Hujan (SPH) di tiga lokasi yaitu di SPH Gandri desa Wonokeling, SPH Bubakan di desa Bubakan dan SPH Gondang di desa Wonorejo. Alat penakar hujan yang digunakan adalah berupa Ombrometer dengan luas corong 100 cm2 yang dilengkapi dengan gelas ukur. Pengukuran curah hujan dilakukan setiap hari pada pukul 07.00 pagi yang selanjutnya di catat di blanko hujan.

Gambar 2. Ombrometer

Data suhu dan kelembaban udara, evaporasi dan kecepatan angin di monitor dengan membuat stasiun klimatologi yang dilengkapi dengan *Integrated Sensor Suite (ISS)* dan *Console* sebagai perekam data. Data tersebut direkam secara realtime dengan interval waktu perekaman yang dapat disesuaikan kebutuhan. Untuk pembacaan data dapat dilakukan secara langsung dengan membaca pada *concole* maupun dengan mengunduh data yang terekam. Selanjutnya data hasil perekaman dapat diolah lebih lanjut dan di catat di blanko pengamatan.

Gambar 3. Stasiun Klimatologi

DEBIT ALIRAN

Data debit aliran (limpasan) di peroleh dengan membuat Stasiun Pengamatan Arus Sungai (SPAS) di outlet Mikro DAS Naruan. yangdilengkapi dengan alat pencatat tinggi muka air manual dan otomatis (logger) dan alat pengambil sampel sedimen *(suspended sampler)*.

Gambar 4. SPAS Naruan dan peralatannya

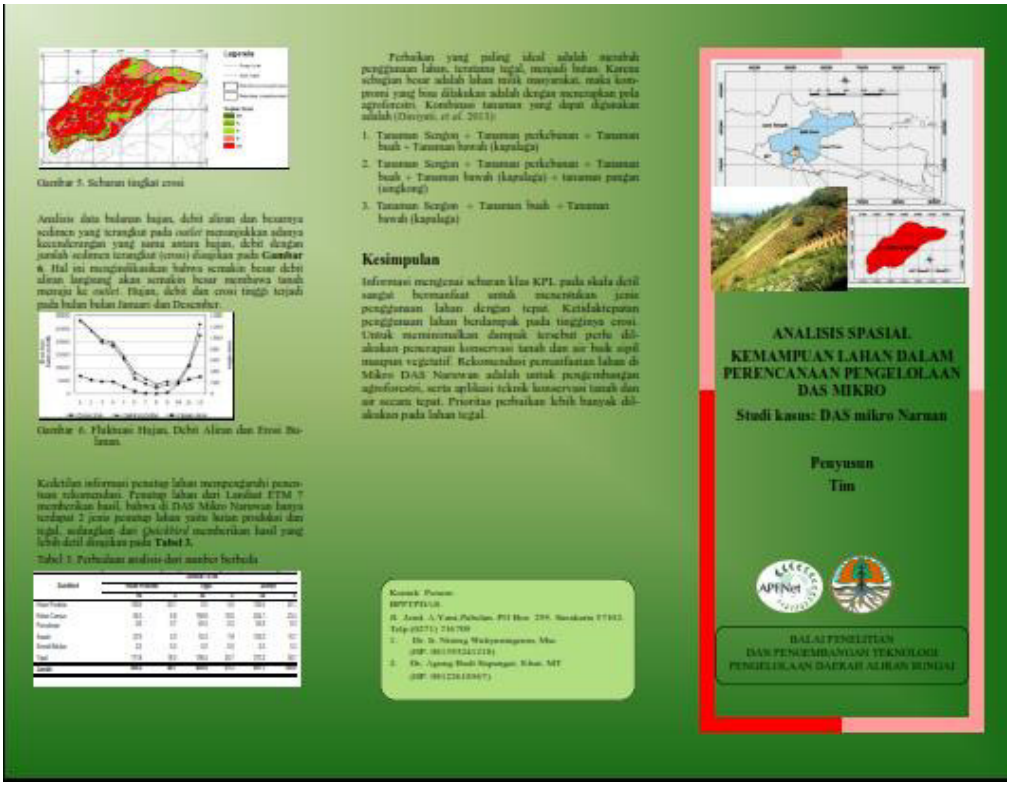
Hasil pencatatan tinggi muka air selanjutnya di rubah menjadi debit aliran dengan menggunakan persamaan debit aliran*(stage-discharge rating curve)* dari berbagai ketinggian yang telah dibuat sebelumnya dengan rumus:

Gambar 5. Persamaan regresi debit aliran

Dimana Q = debit aliran (m^3/dt)
H = tinggi muka air (m)
a dan b = konstantan persamaan regresi

Debit aliran dihitung dari hasil pengukuran kece-

6. Land capability analysis in micro-catchment planning



Gambar 5. Sebaran tingkat erosi

Gambar 6. Fluktuasi Hujan, Debit Aliran dan Erosi Bulanan

Tabel 1. Perbedaan analisis dari sumber berbeda

Perbaikan yang paling ideal adalah merubah penggunaan lahan, terutama tegal, menjadi hutan. Karena sebagian besar adalah lahan milik masyarakat, maka konservasi yang bisa dilakukan adalah dengan menerapkan pola agroforestri. Kombinasi tanaman yang dapat digunakan adalah (Dinyati, et al. 2013):

1. Tanaman Sengon + Tanaman perkebunan + Tanaman buah + Tanaman bawah (kapulaga)
2. Tanaman Sengon + Tanaman perkebunan + Tanaman buah + Tanaman bawah (kapulaga) + tanaman pangan (singkong)
3. Tanaman Sengon + Tanaman buah + Tanaman bawah (kapulaga)

Kesimpulan

Informasi mengenai sebaran klas KPL pada skala detil sangat bermanfaat untuk menentukan jenis penggunaan lahan dengan tepat. Ketidaktepatan penggunaan lahan berdampak pada tingginya erosi. Untuk meminimalkan dampak tersebut perlu dilakukan penerapan konservasi tanah dan air baik sipil maupun vegetatif. Rekomendasi pemanfaatan lahan di Mikro DAS Naruwan adalah untuk pengembangan agroforestri, serta aplikasi teknik konservasi tanah dan air secara tepat. Prioritas perbaikan lebih banyak dilakukan pada lahan tegal.

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ANALISIS SPASIAL KEMAMPUAN LAHAN DALAM PERENCANAAN PENGELOLAAN DAS MIKRO

Studi kasus: DAS mikro Narnan

Penyusun
Tim

BALAI PENELITIAN DAN PENGEMBANGAN TEKNOLOGI PENGELOLAAN DAERAH ALIRAN SUNGAI

Pendahuluan

Daerah Aliran Sungai (DAS) sebagai unit ekologis dan unit pengelolaan dapat merepresentasikan suatu kondisi keterpaduan dan kelestarian komponen-komponennya. Setiap komponen penyusun DAS, seperti lahan, vegetasi, air dan manusia, mempunyai peran yang saling berpengaruh satu dengan lainnya.

Dalam rangka mewujudkan kondisi lahan yang produktif yang sesuai dengan daya dukung DAS diperlukan rencana detil agar rencana tersebut mudah diterapkan dilapangan. Perencanaan detil perlu didahului dengan penelaahan global untuk mengetahui gambaran umum kondisi lahan aktual, dengan demikian akan dapat memotret distribusi dan variasi kondisi lahan terkini sehingga dapat digunakan untuk menetapkan prioritas-prioritas lokasi yang penting untuk segera ditangani.

Pendekatan kemampuan lahan (*land capability*) dapat digunakan untuk melakukan perencanaan detil. Analisis kemampuan lahan mengukur kondisi fisik lahan terkait dengan keterbatasannya untuk suatu jenis penggunaan (Bibby, *et al.* 1991; Fletcher, dan Gibb, 1990). Jenis penggunaan lahan yang sesuai dapat dilakukan dengan mengetahui jenis-jenis pembatasnya agar dapat berfungsi secara lestari.

Tujuan kegiatan ini adalah untuk mengevaluasi kemampuan lahan dalam rangka mendukung perencanaan pengelolaan DAS mikro. Dini akan dilakukan analisis Kemampuan Penggunaan Lahan (*land use capability analysis*) skala detil (DAS mikro) berdasar kepada informasi semi detil (sub DAS) dengan mendayagunakan GIS (*Geographic Information System*).

Metode

Kegiatan dilakukan di tingkat mikro DAS di sub DAS Mikro Naruan yang termasuk kedalam sub DAS keduang.

Bahan dan peralatan yang digunakan adalah: SPAS (Stasiun Pengamatan Arus Sungai), SPH (Stasiun Pengamatan Hujan), GPS (*Global Positioning System),* Peta RBI (Rupa Bumi Indonesia), DEM (*Digital Elevation Model*) Aster 30 x 30 m, Citra *Quickbird* tahun 2011 , Peta RePPProt skala, *Software:* ArcMap 9.3, *Google-earth-4.2.0196-Beta,* MSOffice: Excel, Word.

Tabel 1. Jenis Penutupan Lahan DAS Mikro Naruwan.

Jenis Penutupan Lahan	ha	%
Hutan	192,55	20,12
Kebun campur	226,62	23,66
Pemukiman	61,42	6,42
Sawah	102,16	10,67
Semak belukar	2,19	0,23
Tegal	370,19	38,68
Jumlah	957,12	100,00

Sumber: Data primer

Gambar 1. Lokasi DAS mikro Naruan, sub DAS Keduang

Klas Kelerengan	ha	%
15-25	10,22	1,07
25-45	537,11	56,12
>45	409,8	42,82
Jumlah	957,12	100

Sumber: Data primer

Hasil Pembahasan

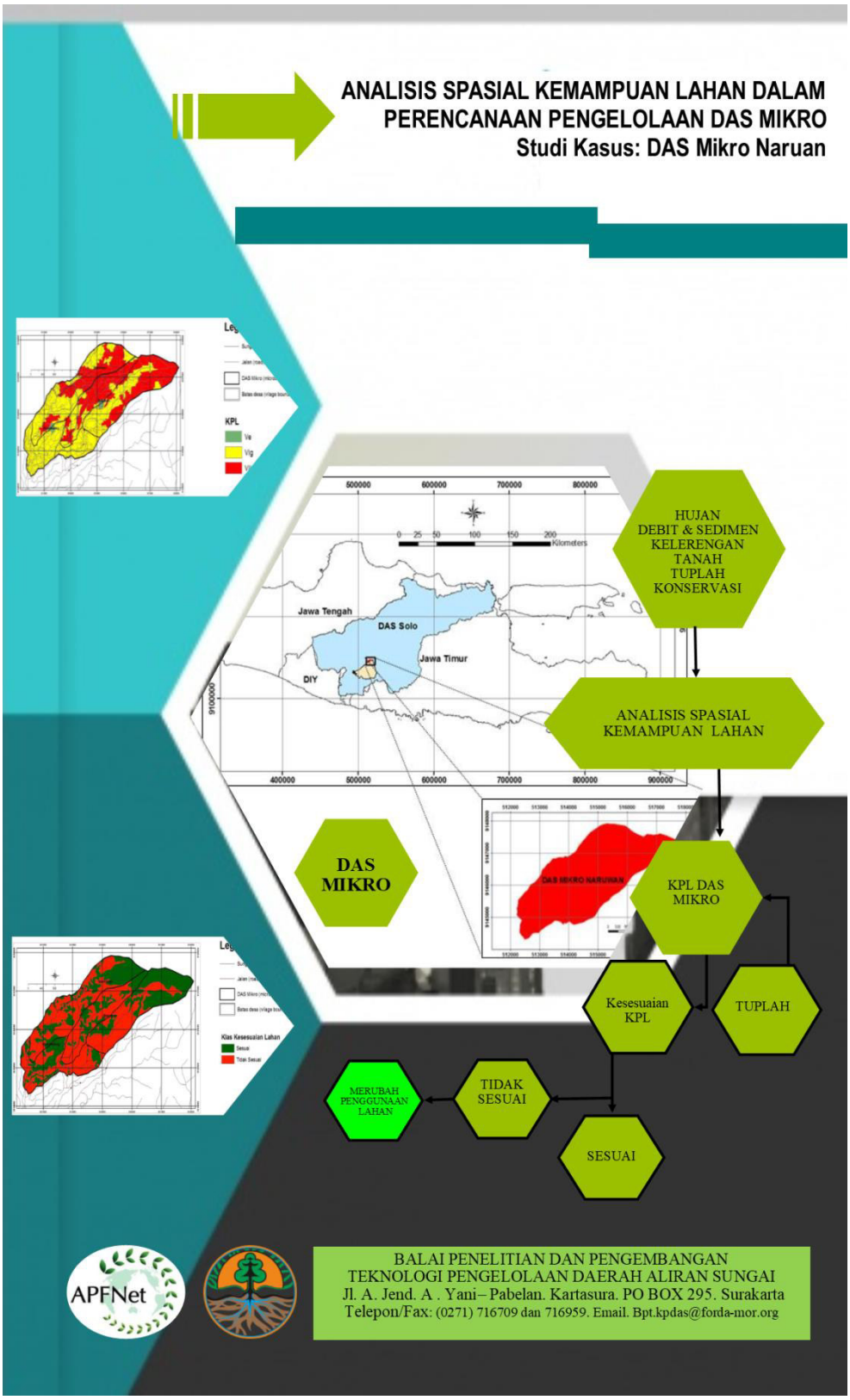
Hasil analisis di DAS Mikro Naruwan yang mempunyai luas 957,12 ha, dengan dominasi penutupan hutan dan kebun campur disajikan pada **Tabel 1**, sedangkan lereng dominan adalah klas lereng 25-45% dan > 45% disajikan pada **Tabel 2**.

Tabel 2. Kelas lereng DAS mikro Naruan

Perhitungan erosi dengan USLE menunjukkan bahwa besarnya erosi rata-rata

C. Posters (in Indonesian)

1. Land capability analysis in micro-catchment planning



2. Water monitoring in micro-catchment scale

No	Peralatan	Data	Informasi
1	St. klimatologi - Vantage Vue - Ombrometer	Suhu udara kelembaban udara Kecepatan angin Curah hujan	Iklim Mikro
2	SPAS - Peilskal - Logger - Laptop - Currentmeter	Tinggi muka air (TMA) Rating Curve Debit	Debit aliran Limpasan
3	- Suspended Sampler - Sampel sedimen - Peralatan lab (oven, gelas timbangan analitik)	Konsentrasi Sedimen Rating Curve Sedimen	Debit Suspensi Hasil sedimen

3. Developing community participation in micro-watershed management

4. Bamboo, an economical solution for controlling small gully erosion

5. Utilitiy of livestock waste

D. Documentary Film (in CD)

1. Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed (full activities)

2. Bamboo, a solution to deal with gully erosion (thematic)

Balai Penelitian dan Pengembangan Teknologi Pengelolaan DAS

bekerjasama dengan

Asia-Pacific Network for Sustainable Forest Management and Rehabilitation