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# Completion Report

## Development Participatory Management of Micro Catchment at the Bengawan Solo Upper Watershed (Phase II) (2020P1-INA)

September 2020 - August 2022

2022



Document No.: 2020P1-INA-CR

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*Asia-Pacific Network for Sustainable Forest Management  
and Rehabilitation*

## COMPLETION REPORT

Development Participatory Management of Micro  
Catchment at The Bengawan Solo Upper Watershed  
(Phase II)  
(2020P1-INA)

September 2020 – August 2022

Supervisory Agency:

Extension and Human Resources Development Agency, Ministry of  
Environment and Forestry, Indonesia (BP2SDM)

Executing Agency:

Watershed Management Technology Center (WMTC)

September 2022

## BASIC INFORMATION

|   |  |                                 |        |
|---|--|---------------------------------|--------|
| Project Title (ID)  | Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed (Phase II)    |                                 |        |
| 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: [5/August/2020]  |  |                                 |        |
| Duration of implementation: [September/2020-August/2022], 24 months                   |  |                                 |        |
| Total project budget (in USD)   | 99,820   | APFNet assured Grant (in USD)   | 99,820 |
| Actual project cost (in USD)  | 99,820   | APFNet disbursed Grant (in USD) | 99,820 |
| Disbursement Status   | Date of disbursement   | Amount (in USD)                 |        |
| Initial disbursement  | 2/11/2020  | 58,629.6                        |        |
| Second disbursement   | 15/11/2021   | 31,208.4                        |        |
| Balance to be disbursed   | -  | 9,982                           |        |
| Reporting Status  | Schedule implementation  | Project progress status         |        |
| Semi-annual Progress Report 1 (MYR-1)<br>(period covered: 09/2020-02/2021)            | On track   | Moderately satisfactory         |        |
| Annual Progress Report 1 (APR-1)<br>(period covered: 09/2020-08/2021)                 | On track   | Moderately satisfactory         |        |
| Semi-annual Progress Report 2 (MYR-2)<br>(period covered: 09/2021-02/2022)            | On track   | Moderately satisfactory         |        |
| Final Report (Completion Report + Technical Report) (period covered: 09/2020-08/2022) | 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 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 NMC 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.

Watershed Management Technology Center (WMTC) proposed a cooperation project with APFnet with a title of Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed. This project was implemented in 2017 to 2019 for Phase I, and was extended in 2020 to 2022 for Phase II. The Extension and Human Resources Development Agency of the Indonesian Ministry of Environment and Forestry (BP2SDM) serves as the project's supervisory agency, with WMTC serving as the project's executing agency.

The project 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 as the implementing agency in terms of Indonesia's watershed management, 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 objective of Phase II project is to implement micro catchment management by improving the available plan and extending the impact area. The project was 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 2020-2022 of Phase II, this project has produced the following output: Output 1: Detailed participatory land management plan for the demonstration plot; Output 2: Demonstration plot of conservation farming and watershed rehabilitation; Output 3: Enhanced of farmers' skill and income through on-farm and off-farm activities; Output 4: Information on the impacts of the demonstration plots of conservation farming and watershed rehabilitation; and Output 5: Recommendation and policy brief of the best agroforestry model.

The project's implementation both in Phases I and II demonstrated that its activities were successful in changing how the community saw the significance of sustainable land management. They realize the importance of mechanical and vegetative land conservation. They actively participated in making plans, planting, and maintaining plants, and actively participated in the FGD and trainings. 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 mechanical conservation structures. Land rehabilitation with an agroforestry pattern will provide additional income at the end of the 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 officers 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 vegetative and mechanical conservation structures, 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 technical assistances to users. Overall, the process of preparing the planning and management of the Micro Watershed will be used as counseling material for extension agents and teaching materials for forestry trainers (widyaiswara) of the Ministry of Environment and Forestry (MEF) of Indonesia.

It might be suggested that micro watershed delineation has the potential to be a best alternative for long-term watershed management units as a result of the lessons

acquired from the project experience. All management processes, from planning to monitoring, are easier to implement in small units. At the policy level, the NMC management process can be used as a reference for the management of national-level micro catchment in Indonesia.

A Micro-catchment Management Model in the future must not only serve as an example and prototype but also to be used as an implementation unit for watershed management at the practical level. Village-based watershed delineation is ideally suited for participatory planning so that issues can be accurately identified and suitable consideration given to possible technological solutions. To support the participative sustainable micro-watershed management model based on villages and local resources, a series of flowcharts were prepared. By providing a policy brief, this can be a useful information for policymakers.

The agroforestry model, which consists of a combination of woody plants, MPTS (multi-purpose tree species), and seasonal crops, offers the best advantage in terms of ecological and economic benefits. As a result, additional regions with agroecological similarities to the NMC can adopt the proposed agroforestry model.

## Abbreviations 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   |
| BPSILHK SOLO | : Institute for Implementation Standard of Environment and Forestry Instrument (ex-WMTC) |
| BPUSDATARU   | : Center of Public Works, Water Resources and Spatial Planning                           |
| BSI-LHK      | : Agency for Standardization of Environment and Forestry Instruments (ex-FORDIA)         |
| BUMN/BUMD    | : State-owned Enterprise/District-owned Enterprise                                       |
| CDK          | : The Forestry Services Branch   |
| FGD          | : Focussed Group Discussion  |
| FP           | : Field partner  |
| 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   |
| 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  |
| Perhutani    | : State-owned Forest Company   |
| PIC          | : Person in Charge   |
| RHL          | : Forest and Land Rehabilitation   |
| RLPS         | : Land Rehabilitation and Social Forestry  |
| SWC          | : Soil and Water Conservation  |
| WMTC         | : Watershed Management Technology Center   |

## CONTENTS

|  |    |
|--|----|
| BASIC INFORMATION .....                                    | 2  |
| List of Project Steering Committee and Project Team .....  | 3  |
| Executive Summary.....                                     | 4  |
| Abbreviations and Acronyms .....                           | 7  |
| CONTENTS.....  | 8  |
| LIST OF TABLES .....                                       | 9  |
| LIST OF FIGURES .....                                      | 10 |
| LIST OF ANNEXES.....                                       | 11 |
| 1. BACKGROUND AND INTRODUCTION .....                       | 1  |
| 1.1 Project context .....                                  | 3  |
| 1.2 Project goal and objectives .....                      | 3  |
| 1.3 Project expected outputs and outcomes .....            | 4  |
| 2. PROJECT IMPLEMENTATION .....                            | 4  |
| 2.1 Project schedule and implementation arrangements ..... | 4  |
| 2.2 Project resources and costs.....                       | 5  |
| 2.3 Procurement and consultant recruitment .....           | 6  |
| 2.4 Monitoring & evaluation and reporting.....             | 7  |
| 2.5 Dissemination and knowledge sharing .....              | 9  |
| 3. PROJECT PARTNERS' PERFORMANCE .....                     | 13 |
| 3.1 Performance of Supervisory Agency .....                | 13 |
| 3.2 Performance of Executing Agency .....                  | 13 |
| 3.3 Performance of Consultants (technical assistants)..... | 16 |
| 3.4 Performance of APFNet .....                            | 16 |
| 4. PROJECT PERFORMANCE .....                               | 16 |
| 4.1 Project achievements.....                              | 16 |
| 4.2 Project Impacts.....                                   | 19 |
| 4.3 Sustainability .....                                   | 21 |
| 5. CONCLUSION, LESSONS LEARNED AND RECOMMENDATIONS.....    | 22 |
| 5.1 Conclusion .....                                       | 22 |
| 5.2 Lessons learned .....                                  | 23 |
| 5.3 Recommendations .....                                  | 24 |
| 6. REFERENCES .....  | 24 |
| ANNEXES .....  | 25 |

## LIST OF TABLES

|  |    |
|--|----|
| Table 1. Procurement data .....                                | 6  |
| Table 2. National consultants .....                            | 7  |
| Table 3. Monitoring & Evaluation, and Reporting.....           | 7  |
| Table 4. List of project output dissemination activities ..... | 9  |
| Table 5. List of publications.....                             | 14 |

## LIST OF FIGURES

|   |    |
|---|----|
| Figure 1. Project location map .....  | 1  |
| Figure 2. Locations of vegetative and mechanical SCW activities at NMC, both in Phase I and II.....   | 19 |
| Figure 3. The monthly hydrological data which is monitored during Phases I and II; (a) Rainfall versus total runoff, (b) Rainfall versus sediment yield ..... | 21 |

## LIST OF ANNEXES

|   |    |
|---|----|
| Annex A. Implementation status .....  | 25 |
| Annex B. Policy Brief of “Village-based Participatory-Sustainable Micro Watershed Management Model” ..... | 35 |
| Annex C. Details of project cost .....  | 44 |
| Annex D. Project audit report .....   | 48 |
| Annex E. Project Outputs (Technical Report).....  | 65 |
| Annex F. Feature stories from the project for promotion.....  | 66 |
| Annex G. Photos, Leaflets, Posters and Documentary films .....  | 72 |

## 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 and they may not align with each other. Moreover, their activities may not focus on the right targets if they are not based on the actual and factual field conditions. Until now, integration of watershed management is still very difficult to do, so the examples of successful watershed management are rare. Instead of improving the condition of the watershed, land degradation frequently occurs in the watershed due to mismanagement. It is shown by the many degraded watershed in the government data base.

Therefore, it is necessary to integratively manage the various sectors from upstream to downstream by considering the various interests as well as biophysical and socio-economic conditions. 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 resulting demonstration plots may be used as an example of proper watershed management.

This project location is in Naruan Micro Catchment (NMC), upstream part of the Keduang Watershed, in 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 area of rural development.

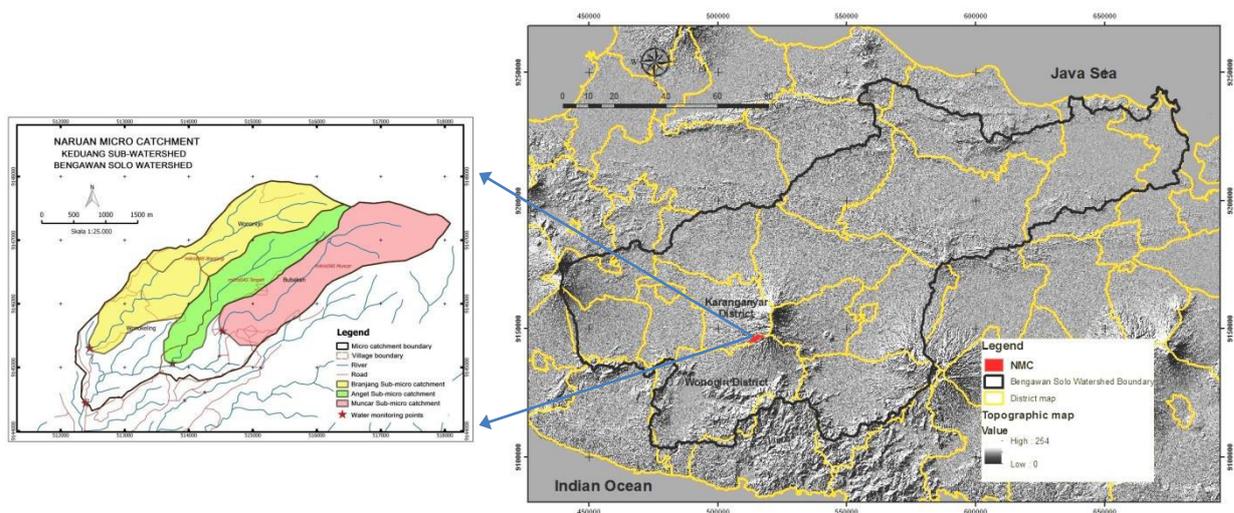


Figure 1. Project location map

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 be due to erosive land use practices. An open-minded community that is willing to support soil and water conservation activities is one of the social capitals. Another potential capital are supportive government officials from the village level up to the district level.

Participatory management plans for the area have already been arranged. The plan draft contains the indicated 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 at the micro catchment scale, development of conservation and rehabilitation demonstration plots, building community awareness toward micro watershed management, as well as increasing the performance of micro catchment at landscape and household scale.

The project is expected to (1) improve the quality of the environment by increasing forest cover, 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, improve 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 2020-2024, and it is also included in the 4 super-priority watersheds that should be restored until the year of 2019, and extended until 2024. This project supports the national priority of food sovereignty 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 people in the utilization of natural resources, environmental management, and appropriate technology.

This project also supports the goals of the Sustainable Development Goals (SDGs), namely goal number 6, which is to ensure the availability and sustainable management of clean water and sanitation, as well as goal number 15, which is to protect, restore, and promote sustainable use of terrestrial ecosystems; manage forests sustainably; stop desertification; reverse land degradation; and halt biodiversity loss.

## 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 signs of less successful watershed management, especially at the operational level. Sedimentation issues also become a concern in the management of the MRGM of Wonogiri District. The issue has become a national problem, because the 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 for an electricity power plant.

Among the 18 rivers that go into the MRGM, the Keduang River is the river which has the largest watershed area, as well as the largest contribution of sediment. The report of JICA (Japan International Cooperation Agency) showed that from 1993 to 2004, the average sediment load to the MRGM was 3.18 million  $\text{m}^3 \cdot \text{y}^{-1}$ . The biggest sediment contributor was Keduang Watershed with approximately 1.22 million  $\text{m}^3 \cdot \text{y}^{-1}$  or about 33% of total sediment input (Rahman, et al., 2012). Moreover, Tjakrawarsa & Pramono (2012) revealed that from 1994 through 2002 sediment loaded in Keduang River was about 29.36  $\text{ton} \cdot \text{ha}^{-1} \cdot \text{y}^{-1}$  and from 2009 to 2010 it increased to 45.41  $\text{ton} \cdot \text{ha}^{-1} \cdot \text{y}^{-1}$ . Sutrisno et al., (2011) predicted soil erosion of Keduang Sub Watershed using a USLE model, and the result showed that soil erosion in Keduang Sub Watershed was about 44.00  $\text{tons} \cdot \text{ha}^{-1} \cdot \text{y}^{-1}$  or 1.9 million  $\text{ton} \cdot \text{y}^{-1}$  of sediments. Another study resulted by Rahman et al., (2012) using an AVSWAT model revealed the total erosion of Keduang Sub Watershed was 172.24  $\text{ton} \cdot \text{ha}^{-1} \cdot \text{y}^{-1}$ .

The cause of the high sedimentation rate in the MRGM is the high rate of soil erosion in the catchment area, especially from the Keduang Watershed. This is a result of land cover conditions, namely 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 worsened by the behavior of people who are paying few attentions to soil and water conservation when managing their land. The high rate of population led to population pressure on land resulting in excessive land use, which is a trigger for land degradation.

At the operational level, land use planning in watershed management activities has not been going well. Yet previous examples at the operational scale can be used as a reference.

## 1.2 Project goal 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) as the implementing agency in terms of Indonesia's watershed management, and other institutions associated with watershed management, from the planning and

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 use sustainability and land productivity as well as socio-economic welfare. The objective of the Phase II project is to implement micro catchment management by improving the available plan and extending the impact area.

### **1.3 Project expected outputs and outcomes**

The expected outputs of this project were:

- a. Improve the quality of the environment by increasing forest cover, increasing the quantity and quality of water resources as well as reducing the rate of erosion and sedimentation to the MRGM;
- b. 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
- c. Increase capacity building and the awareness in managing and conserving natural resources.

## **2. PROJECT IMPLEMENTATION**

### **2.1 Project schedule and implementation arrangements**

The planned activities of the APFNet Phase I project were continued in Phase II. Phase I micro watershed management efforts included community participation in planning, building demonstration plots for conservation and land rehabilitation, and community empowerment. The project's final physical activity, monitoring and evaluation (M&E), assesses both the socio-economic situation of the community and the biophysical components (land and hydrology). For Phase II, the objective is to implement micro catchment management by improving the available plan and extending the impact area.

The stages of project implementation carried out in Phase II included the following activities:

- a. The FGD with field partners (FPs) and village officers (from the villages of Wonorejo, Wonokeling, and Bubakan) aimed to evaluate the results of the Phase I project, the obstacles encountered, and the strategy for the upcoming stages of land rehabilitation operations. As an outcome of on the discussions, farmers no longer prefer planting albizia for land rehabilitation projects as a result of the gall (karat puru) disease outbreak, and the drop in albizia wood prices during COVID-19 pandemic. In Phase II, the community prefers to plant MPTS such as avocado, coffee, lemon in large quantity, and woody plants like albizia and limpaga in smaller quantity.

- b. Based on the Phase I identification, the building of gully erosion control structures has been planned. Application of civil engineering or mechanical measures were carried out in a participatory manner involving both the community and field forestry extension agents.
- c. The discussions with the FPs also revealed information about the training themes needed by the community. Some of the themes consisted of honey bee cultivation, coffee cultivation and processing, avocado cultivation, and grafting techniques, as well as household and agricultural waste processing.
- d. Activities related to monitoring and evaluation (M&E) were conducted in terms of both management and technical aspects. From a management aspect, M&E aims to gather data on whether project activities are being carried out in accordance with the proposal. WMTC/BPSILHK Solo, BSI-LHK/FORDIA, and BP2SDM were in charges of managing the M&E. The technical M&E aims to obtain information on the impact of project implementation related to the biophysical aspects (land and water management) as well as the socio-economic community. At the end of each project year, a financial evaluation was carried out by an external auditor team.
- e. Internal meetings have been carried out both on a scheduled and an unscheduled basis. Internal team meetings were frequently held prior to the beginning of each step of an activity and following its completion. Meanwhile, the scheduled internal meeting was in the form of discussions with the consultant team, M&E staff from WMTC and WMTC's researchers. The meeting aimed to discuss project outputs in the form of recommendations for best practice agroforestry at the NMC, as well as policy brief recommendations in the form of a participatory-sustainable micro-watershed model.
- f. To obtain management support for post-project sustainability and sustainable management of the NMC and upper Bengawan Solo River Basin, a workshop with related parties has been held. The workshop, which included representatives from several agencies (state, provincial, and district), as well as members of the village community, sub-districts, extension agents, and NGOs, was held at the end of the project's implementation.
- g. To make the project's findings available to a wide range of users, dissemination and publication efforts were carried out. Project-related science and technology dissemination was accomplished through technical assistance, leaflet, poster, and a film documentary. Scientific publications were made through various media, including books/book-chapters, journals, and proceedings both national and global publisher, and semi-scientific articles.
- h. Additionally, a number of purchases were made to support the performance of the project's activities. These purchases included PCs or laptops, cameras, a mobile projector, and field observation equipment.

## **2.2 Project resources and costs**

The project of "Development Participatory Management of Micro Catchment at

The Bengawan Solo Upper Watershed (Phase II)" was conducted based on Project Proposal and Project Agreement. The financial contributions from APFNet and EA complemented each other during project implementation. Funding from APFNet was used to run activities such as covering costs of consultant fees, travel and related costs, meeting and training, field activities, publication and dissemination, office operation, procurement, and monitoring and evaluation. Financial funding from the Executing Agency (in-kind resources) covered project team salaries, several parts of field activity, official equipment, and procurement of several types of equipment.

Procurement of equipment was carried out in accordance with Presidential Regulation No. 16 of 2018 concerning procurement of government goods/services with a direct appointment system through two contracts from the Head of WMTC namely: 1). SPK.12/BPPTPDAS-Pjb/06/2021 dated June 10, 2021 by CV. Daya Elang Utama, and 2). SPK.33/BPPTPDAS-Pjb/08/2021 dated Agustus 2, 2021 by 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 is listed in Annex B.

A financial audit was carried out by an independent external auditor at the end of the first year and in the second year (at the end of the project) to ensure accountability of the use of funds in project implementation. The public consultant in the first year and the second year was a credible and professional consultant, namely "Wartono and Partners". The financial audit result is presented in Annex C.

### 2.3 Procurement and consultant recruitment

The implementation of the "Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed (Phase II)" project was supported by some equipment. The types of goods purchased are presented in Table 2.

Table 1. Procurement data

| No. | Items             | Type                           | Quantity | Cost (IDR/unit) | Date of purchase |
|-----|-------------------|--------------------------------|----------|-----------------|------------------|
| 1.  | Laptop            | Asus UX325EA-EG751TS           | 1 unit   | 19,950,000      | June 25, 2021    |
| 2.  | Laptop            | HP Pavilion 13-BB0062TU Silver | 1 unit   | 13,850,000      | June 25, 2021    |
| 3.  | Laptop            | A514-53-331L Silver            | 1 unit   | 8,750,000       | June 25, 2021    |
| 4.  | Camera 360        | Samsung Gear 360 series        | 1 unit   | 5,250,000       | June 25, 2021    |
| 5.  | Camera Mirrorless | Sony A6000 Kit 16-50 mm        | 1 unit   | 9,750,000       | June 25, 2021    |

|    |                                   |                        |        |            |                 |
|----|-----------------------------------|------------------------|--------|------------|-----------------|
| 6. | Mobile Projector                  | LG PH30JG              | 1 unit | 12,450,000 | June 25, 2021   |
| 7. | Data Logger Optic Base station    | Hobo U-DTW-1           | 1 unit | 23,000,000 | June 25, 2021   |
| 8. | Automatic Rainfall Recorder       | Hobo S-RGB-M002 Sensor | 1 unit | 28,750,000 | June 25, 2021   |
| 9  | Automatic Water Level Data Logger | Hobo U20L-02 (100ft)   | 2 unit | 53,660,000 | August 26, 2021 |

The project team also required academic advice from experts in the project implementation. 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 2.

Table 2. 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 a final report about to soil and water conservation | National consultant<br><br>Duration of employment: 2 years |
| 2.  | Dr. Joko Sutrisno       | Social, economic, and agribusiness | Giving assistance and advice in project implementation and formulating a final report about the social-economic aspects    | National consultant<br><br>Duration of employment: 2 years |

## 2.4 Monitoring & evaluation and reporting

Monitoring and evaluation (M&E) were carried out by BP2SDM and BSI-LHK (in August 2022). The results of M&E and its follow-up action is presented in Tabel 3.

Table 3. Monitoring & Evaluation

| Monitor/Evaluator                      | Findings   | Recommendations and Suggestions  | Follow-up Actions   |
|--|--|--|---|
| Internal:<br>BPSILHK Solo<br>(ex-WMTC) | In general, the activities are in accordance with the proposal | The findings of this project can be used as the basis for developing micro-watershed management standard for similar watershed condition | BPSILHK Solo proposes the materials to BSI-LHK for the development of a micro-watershed management standard |

|   |   |  |  |
|---|---|--|--|
| <p>External:<br/>BP2SDM</p>   | <ul style="list-style-type: none"> <li>- The participatory approach applied in the demonstration plot development is a suitable method for land rehabilitation program</li> <li>- The most suitable agroforestry pattern used in the demonstration plots is also a model that provides economic and environmental benefits</li> </ul> | <ul style="list-style-type: none"> <li>- Disseminate the results to the soil and water conservation implementing agencies such as CDK, BPDASHL, and other local agencies</li> <li>- Intensify the discussion forum between researchers, trainers, and extension agents (FKPWP) so that the demonstration plots can be widely disseminated and adopted by the community</li> </ul>                      | <ul style="list-style-type: none"> <li>- Arranging a policy brief as a material consideration for making policies in watershed management</li> <li>- Establish communication and provide training to CDK officers and other local agencies</li> <li>- Communicating the results to BP2SDM as material for preparing the Participatory Micro Watershed Management Assistance Modules, Curriculum, and Syllabus</li> </ul> |
| <p>BSI-LHK (ex-FORDIA)</p>  | <ul style="list-style-type: none"> <li>- The land rehabilitation method that combines technical (vegetative and civil) and social (community participation) engineering become a lesson learn</li> <li>- The local materials (bamboo) utilization for the construction of erosion control can reduce the costs</li> </ul>             | <ul style="list-style-type: none"> <li>- Disseminate the result to the implementing and local agencies</li> <li>- Use the result of a scientific basis for the establishment of standards especially those related to forest and land rehabilitation</li> <li>- Transfer technology of the construction of gully erosion control using local material to the community and extension agents</li> </ul> | <ul style="list-style-type: none"> <li>- Prepare materials for technical guidance for conservation activities</li> <li>- Training has been conducted for the community</li> <li>- Coordination with CDK to conduct training for forestry extension agents</li> </ul>   |
| <p>The Expert Staff of the Minister of Environment and Forestry for Industry and International Trade as the Board of Director (BoD) of APFNet</p> | <p>Agroforestry planting patterns, especially with MPTS as perennial crops, are the suitable choice to meet the economic and environmental needs</p>  | <ul style="list-style-type: none"> <li>- Increasing technology transfer and community empowerment for the sustainability of the activities</li> <li>- Socializing the method among the parties implementing soil and</li> </ul>  | <ul style="list-style-type: none"> <li>- Increasing the capacity of the community in on-farm and off-farm activities, as well as the maintenance of conservation structures</li> </ul>   |

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| (Ms. Novia Widyaningtyas) |  | water conservation so the cropping pattern and participatory approach can be replicated elsewhere | <ul style="list-style-type: none"> <li>- Involvement of forestry extension agents in order to be able to provide assistance to the community in a sustainable manner</li> <li>- Workshop among the parties</li> <li>- Technical Assistance for stakeholders such as the PDASHL and CDK staffs</li> </ul> |
|---------------------------|--|---|--|

Project activities are reported in the form of:

1. 1th Mid Year Report (MYR1), Sept 2020-Feb 2021.
2. 1th Annual Project Report (APR1), Sept 2020-August 2021
3. 2nd Mid Year Report (MYR2), Sept 2021-Feb 2022
4. Technical report, Sept 2020-August 2022
5. Completion report, August 2020- August 2022

## 2.5 Dissemination and knowledge sharing

The project's output and knowledge experiences have been disseminated to the parties through several forums, such as listed in Table 4.

Table 4. List of project output dissemination activities

| No. | Venue/Date                       | Organizer   | Themes   | Participant           | Topics to be disseminated  |
|-----|----------------------------------|---|--|-----------------------|--|
| 1.  | Semarang/<br>January 29,<br>2020 | The Forestry Service of central Java Province (Dinas Kehutanan Jawa Tengah) | FGD Implementation of the Policy for SWC Development in Groundwater Recharge Areas in Central Java | Multiple stakeholders | Implementation of Vegetative and Mechanical SWC in Watershed Units (PIC: AB. Supangat) |

|    |                                   |   |   |   |   |
|----|-----------------------------------|---|---|---|---|
| 2. | Surakarta/<br>January-March, 2020 | WMTC  | Internship  | Soedirman University Students (3 persons) | The Erosion Potential of the Keduang Sub Watershed, Bengawan Solo River Basin Using USLE and SIG (PIC: N. Wahyuningrum) |
| 3  | Surakarta/<br>July 6, 2020        | Directorate of Watershed Control Planning and Evaluation, MEF | Technical assistance on watershed management planning   | Technical Staff of BPDAS-HL               | The Identification of Degraded Land (PIC: N. Wahyuningrum)  |
| 4. | Surakarta/<br>July 9, 2020        | Directorate of Watershed Control Planning and Evaluation, MEF | Technical assistance on watershed management planning   | Technical Staff of BPDAS-HL               | Community Participation in Micro Catchment Management (PIC: DR. Indrawati)  |
| 5. | Surakarta/<br>July 9, 2020        | Directorate of Watershed Control Planning and Evaluation, MEF | Technical assistance on watershed management planning   | Technical Staff of BPDAS-HL               | Micro Watershed Management Planning: Sharing Experiences from Action Research (PIC: AB. Supangat)                       |
| 6. | Surakarta/<br>July 15, 2020       | Directorate of Watershed Control Planning and Evaluation, MEF | Technical assistance on watershed management planning   | Technical Staff of BPDAS-HL               | Monitoring and Evaluating the Success of Forest and Land Rehabilitation (PIC: N. Wahyuningrum)                          |
| 7. | Surakarta/<br>July 16, 2020       | Faculty of Forestry, North Sumatera University                | Forestry Webinar Series "Watershed Restoration in the New Normal Era: Experience from site level" | Multiple stakeholders                     | Implementation of Technology of Watershed Management in Upstream Watershed (PIC: AB. Supangat)                          |
| 8. | Surakarta/<br>August 5, 2020      | WMTC & Makasar Forestry Research and Development              | Webinar (Link You tube: <a href="https://youtu.be/Pd7t3JtPXQ">https://youtu.be/Pd7t3JtPXQ</a> )   | Multiple stakeholders                     | Micro Watershed Management: Planning, Implementing, Monitoring (PIC: Project team)                                      |
| 9. | Surakarta/<br>November 9, 2020    | BPDASHL Benain-Noelmina, East Nusa Tenggara Province          | Technical assistance on capacity building of staff of BPDASHL Benain-Noelmina                     | Staff of BPDASHL Benain-Noelmina          | Micro Watershed Management: Implementation Watershed Management in Site-Scale (PIC: AB. Supangat)                       |

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| 10. | Surakarta/<br>November<br>12-13, 2020  | The Forestry<br>Services of East<br>Java Province<br>(Dinas Kehutanan<br>Jawa Timur)          | The consultancy on<br>the soil and water<br>constructions<br>assessment   | The Forestry<br>Services<br>Branch staffs<br>(9 branches)                 | 1. The Principles and<br>Concepts of the Soil<br>and Water<br>Conservation in the<br>Watershed<br>Management<br>2. Methods for Assessing<br>the Effectiveness of<br>Mechanical SWC<br>Constructions<br>(PIC: AB. Supangat & N.<br>Wahyuningrum) |
| 11. | Yogyakarta/<br>January-June<br>, 2021  | Center for<br>Research and<br>Development of<br>Biotechnology<br>and Forest Plant<br>Breeding | R&D: Soil and<br>Water Conservation<br>Model in the<br>Kaliurang forest<br>research plots for<br>recreational<br>purposes | Forestry<br>Research<br>and<br>Developmen<br>t Agency<br>research<br>team | Establishing SWC<br>Constructions and Water<br>Balance Monitoring<br>Installations<br>(PIC: Project team)   |
| 12. | Wonogiri/<br>February 16<br>& 18, 2021 | The Forestry<br>Services Branch<br>XI, Central Java<br>(CDK XI)                               | Socialization of the<br>improvement of<br>forest farmer group   | Forest<br>farmer<br>groups  | Forest Farmer Group<br>Dynamics<br>(PIC: DR. Indrawati)   |
| 13. | Wonogiri/<br>March 3,<br>2021          | The Forestry<br>Services Branch<br>XI, Central Java<br>(CDK XI)                               | Training on forestry<br>extension skills<br>improvement   | Forestry<br>Extension   | The Benefits and<br>Methods of Making<br>Bokashi Fertilizer for<br>Community Groups<br>(PIC: D. Yuliantoro)   |
| 14. | Wonogiri/<br>March 16,<br>2021         | The Forestry<br>Services Branch<br>XI, Central Java<br>(CDK XI)                               | Technical assistance<br>for community<br>timber<br>administration   | Local wood<br>industries  | Community Timber<br>Administration<br>(PIC: Purwanto)   |
| 15. | Malang/<br>March<br>16-17, 2021        | The Forestry<br>Services of East<br>Java Province<br>(Dinas Kehutanan<br>Jawa Timur)          | Technical assistance<br>for the<br>implementation of<br>SWC constructions   | The Forestry<br>Service<br>Branch staffs                                  | Implementation of<br>Integrated SWC<br>Constructions<br>(PIC: AB. Supangat & D.<br>Yuliantoro)  |
| 16. | Bojonegoro/<br>March 23,<br>2021       | The Forestry<br>Services Branch of<br>Bojonegoro<br>District, East Java<br>(CDK Bojonegoro)   | FGD on Micro<br>Watershed Modelling   | Multiple<br>Stakeholders  | Micro Watershed Model<br>as an Alternative<br>Solution to Watershed<br>Problems<br>(PIC: AB. Supangat)  |

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| 17. | Surakarta/<br>April-May,<br>2021   | WMTC  | Internship  | Padjajaran<br>University<br>student (1<br>person)          | Learning the Process of<br>Land Capability<br>Evaluation in Supporting<br>Micro Catchment<br>Management Planning<br>(PIC: N. Wahyuningrum)     |
| 18. | Surakarta/<br>June-July,<br>2021   | WMTC  | Internship  | Sebelas<br>Maret<br>University<br>student (1<br>person)    | Runoff Identification in<br>Agroforestry Land in<br>Nauran Micro Watershed<br>by Cook Method<br>(PIC: AB. Supangat)                            |
| 19. | Surakarta/<br>July-August,<br>2021 | WMTC  | Internship  | Malang<br>Islamic<br>University<br>students (3<br>persons) | The Use of BIOTILIK<br>Methods to Identify the<br>Health of Naruan River<br>Waters<br>(PIC: AB. Supangat, N.<br>Wahyuningrum, E.<br>Sulasmiko) |
| 20. | Semarang/<br>March<br>22-25, 2022  | The Forestry<br>Services Branch<br>III, Central Java<br>(CDK III) | Development model<br>of micro-watershed<br>management   | Forestry<br>Extension,<br>Village<br>communities           | Baseline data survey of<br>Sepakung<br>Micro-Watershed<br>(PIC: AB. Supangat, N.<br>Wahyuningrum,<br>Purwanto, D. Yuliantoro)                  |
| 21. | Semarang/<br>July 22, 2022         | The Forestry<br>Services Branch<br>III, Central Java<br>(CDK III) | Development model<br>of micro-watershed<br>management   | Forestry<br>Extension,<br>Village<br>communities           | Participatory planning of<br>Sepakung<br>Micro-Watershed<br>(PIC: AB. Supangat, N.<br>Wahyuningrum,<br>Purwanto, D. Yuliantoro)                |
| 22. | Semarang/<br>July 26, 2022         | The Forestry<br>Services Branch<br>III, Central Java<br>(CDK III) | Development model<br>of micro-watershed<br>management   | Related<br>parties   | Socialization of Sepakung<br>Micro-Watershed<br>Management Planning<br>(PIC: AB. Supangat,<br>Purwanto, D. Yuliantoro)                         |
| 23. | Lampung/<br>July 27-29,<br>2022    | BPDASHL Way<br>Seputih Way<br>Sekampung,<br>Lampung<br>Province   | Technical assistance<br>on capacity building<br>of staff of BPDASHL<br>Way Seputih Way<br>Sekampung | Staff of<br>BPDASHL<br>Way Seputih<br>Way<br>Sekampung     | Development of<br>mechanical soil and<br>water conservation<br>measures<br>(PIC: AB. Supangat, D.<br>Yuliantoro)                               |

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|-----|------------------------------------|---|---|---|--|
| 24. | Wonogiri/<br>September<br>6, 2022  | The Forestry<br>Services Branch<br>XI, Central Java<br>(CDK XI)   | Technical assistance<br>on capacity building<br>of non-governmental<br>forestry extension<br>agents | Non-govern<br>mental<br>forestry<br>extension<br>agents from<br>Wonogiri<br>and<br>Sukoharjo<br>Districts   | Benefits of using organic<br>fertilizers in terms of<br>economy, human health,<br>and the environment<br>(soil and plants)<br>(PIC: AB. Supangat,<br>Purwanto) |
| 25. | Semarang/<br>September<br>12, 2022 | The Forestry<br>Services Branch<br>III, Central Java<br>(CDK III) | Technical assistance<br>on capacity building<br>of staff of CDK III                                 | Government<br>al forestry<br>extension<br>agents from<br>Semarang,<br>Salatiga and<br>Boyolali<br>Districts | Revitalizing the role of<br>forestry extension agents<br>in watershed<br>management activities<br>(PIC: AB. Supangat)  |

### 3. PROJECT PARTNERS' 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 follow the proposal outline. In terms of technical fieldwork, BP2SDM provided new directions and innovations for the perfection of field activities. BP2SDM commented that the agroforestry pattern used in the demonstration plots can be a model that provides economic and environmental benefits. Therefore, it is necessary to disseminate information to the soil and water conservation implementing agencies such as CDK, BPDASHL, and other local agencies. After visiting the field, BP2SDM also suggested that as an exit strategy of the project, the forum between researchers, trainers, and extension agents (FKPWP) needs to be intensified so that the patterns and technology applied in the demonstration plots can be widely disseminated and quickly adopted by the community.

#### 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, Ir. Yoyok Sigit Haryotomo, MM., was part of the steering committee as well as of the control team for the project. As part of the control 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 in 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 5. List of publications

| No | Title   | Media of Publications  |
|----|---|--|
| 1. | Supangat AB. (2019). Integration of Management toward Watershed Sustainability: An Introduction (in Indonesian)   | (Bookchapter), In: Supangat AB, Dharmawan IWS (eds). Building Integration of Watershed Management at the Implementation Level. IPB-Press., Bogor, pp 1–20.<br><a href="http://puslitbanghut.or.id/index.php/publikasi/download/MzAw">http://puslitbanghut.or.id/index.php/publikasi/download/MzAw</a>  |
| 2. | Wahyuningrum N (2020). Watershed Spatial Planning as a Basis for Integration Between Aspects of Micro Watershed Management (in Indonesian)  | (Bookchapter), In: Supangat AB, Dharmawan IWS (eds). Building Integration of Watershed Management at the Implementation Level. IPB-Press., Bogor, pp 21–34.<br><a href="http://puslitbanghut.or.id/index.php/publikasi/download/MzAw">http://puslitbanghut.or.id/index.php/publikasi/download/MzAw</a> |
| 3. | Purwanto. (2020). Economic Considerations that Influence The Selection of Mechanical Soil and Water Conservation in The Naruan Micro Watershed (in Indonesian)                      | (Bookchapter), In: Supangat AB, Dharmawan IWS (eds). Building Integration of Watershed Management at the Implementation Level. IPB-Press., Bogor, pp 35–44.<br><a href="http://puslitbanghut.or.id/index.php/publikasi/download/MzAw">http://puslitbanghut.or.id/index.php/publikasi/download/MzAw</a> |
| 4. | Indrawati DR. (2019). Stakeholders Participation and Collaboration in The Management of The Naruan Micro Watershed (In Indonesian)  | (Bookchapter), In: Supangat AB, Dharmawan IWS (eds). Building Integration of Watershed Management at the Implementation Level. IPB-Press., Bogor, pp 45–55.<br><a href="http://puslitbanghut.or.id/index.php/publikasi/download/MzAw">http://puslitbanghut.or.id/index.php/publikasi/download/MzAw</a> |
| 5. | Supangat AB, Indrawati D, Wahyuningrum N, Purwanto, & Donie S. (2020). Developing a participatory planning process of micro-watershed management: a lesson learned (in Indonesian). | (Journal)<br>J. Penelit Pengelolaan Drh Aliran Sungai 4:17–36.<br><a href="https://doi.org/10.20886/jppdas.2020.4.1.17-36">https://doi.org/10.20886/jppdas.2020.4.1.17-36</a>  |
| 6. | Indrawati DR, & Yuliantoro D. (2022). The role of extension agents for empowering community in watershed  | (Journal)<br>Jurnal Ekonomi Pertanian dan Agribisnis (JEPA), Vol. 6, no. 1, 2022.  |

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|     | management (in Indonesian).  | <a href="https://doi.org/10.21776/ub.jepa.2022.006.01.12">https://doi.org/10.21776/ub.jepa.2022.006.01.12</a>   |
| 7.  | Supangat AB, Agus C, Wahyuningrum N, Indrawati DR, Purwanto (2021). Soil and Water Conservation Planning Toward Sustainable Management of Upstream Watershed in Indonesia                              | (Bookchapter). In: Filho WL, Setti AFF, Azeiteiro AM (eds) Sustainability in Natural Resources Management and Land Planning. World Sustainable Series. Springer, Cham, Switzerland. pp 77–92. <a href="https://doi.org/10.1007/978-3-030-76624-5">https://doi.org/10.1007/978-3-030-76624-5</a> |
| 8.  | Supangat AB & Wahyuningrum N. (2021). Evaluation on biophysical carrying capacity to support land rehabilitation planning in the upstream watershed  | (Proceedings)<br>IOP Conf. Series: Earth and Environmental Science 914 (2021) 012030. <a href="https://doi.org/10.1088/1755-1315/914/1/012030">https://doi.org/10.1088/1755-1315/914/1/012030</a>   |
| 9.  | Indrawati D, Supangat AB, Purwanto, Wahyuningrum N & Subandrio B. (2022). Community participation in soil and water conservation as a disaster mitigation effort                                       | (Proceedings)<br>In progress published in IOP Conf. Series: Earth and Environmental Science (EES)<br>Paper presented in the 2022 – UN4DRR International Symposium on Disaster Risk Reduction, Mitigation and Environmental Sciences (The 2022 – UN4DRR SYMPOSIUM), Bogor: July 21, 2022         |
| 10. | Wahyuningrum N. (2020). The potential of Cilampuyang Village for the participatory soil and water conservation activities (in Indonesian). CERDAS magazine, Vol. 6/October 2020. WMTC                  | Semi-popular Magazine CerDAS, Vol. 5., No.1, May 2019   |
| 11. | Sulasmiko E (2020) The efforts to control gully erosion in the Naruan Micro Catchment (in Indonesian). CERDAS magazine, Vol. 6/October 2020. WMTC  | Semi-popular Magazine CerDAS, Vol. 5., No.1, May 2019   |
| 12. | Swandayani TH & Yuliantoro D. (2022). 2021. The Integrative Participatory Model of Micro Watershed (MDM) can be a reference for watershed management in the New National Capital (IKN) (in Indonesian) | Semi-popular Magazine of BSILHK, Vol.1., No.3 (2022):<br>STANDAR: BETTER STANDAR BETTER LIVING.<br><a href="HTTP://MAJALAH.BSILHK.MENLHK.GO.ID/INDEX.PHP/STANDAR/ARTICLE/VIEW/39/35">HTTP://MAJALAH.BSILHK.MENLHK.GO.ID/INDEX.PHP/STANDAR/ARTICLE/VIEW/39/35</a>                                |
| 13. | Economic and Environmental Benefits of Some Albizia-based Agroforestry Patterns in the Naruan Micro Catchment  | (International Journal)<br>-Manuscript Draft  |

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| 14. | Village-based Participatory-Sustainable Micro Watershed Management Model | (Policy Brief, in Indonesian)<br>- Drafts of manuscript and charts |
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### 3.3 Performance of Consultants (technical assistants)

This project employed two technical consultants. The first is Dr. Dwi Priyo Arianto, Ph.D., an expert in the field of Soil and Water Conservation, and the second is Dr. Joko Sutirno, an expert in social science, economy and agribusiness. Both consultants had the responsibility of providing advice and criticism in planning, as well as mediating scientists and farmers. The consultants were always involved in planning discussions, discussions with parties and in discussions on project evaluation results.

### 3.4 Performance of APFNet

Overall collaboration with the APFnet agency represented by Mr. Li Zhaochen (project management officer) was very good, communication and direction were very clear and easy to implement. Every problem could be communicated and APFNet always responded quickly. Likewise, the disbursement of funds was always timely. Due to the ongoing COVID-19 situation and travel restrictions, in agreement with APFNet no external final evaluation was conducted.

The only obstacle was the difference in the system of disbursement of funds between donors and Indonesian Government regulations. Following applicable regulations in Indonesia, the disbursement of funds must be based on the DIPA (Annual Government Coverage Plan) contained in official documents. Disbursements that are not following the DIPA are considered as 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 (temporarily) cover the 10 percent lack of funds. However, with the support of a strong leader and team, this could be overcome so that activities were completed on time.

## 4. PROJECT PERFORMANCE

### 4.1 Project achievements

During the project phase (1 September 2020-31 August 2022), the outputs proclaimed were achieved, although in the implementation there were some adjustments. In the proposal, several outputs have been announced, i.e:

- Output 1. Detailed participatory land management plan for the demonstration plot

- Output 2. Demonstration plots of conservation farming and watershed rehabilitation
- Output 3. Enhancement of farmers' skill and income through on-farm and off-farm activities
- Output 4. Information on the impacts of the demonstration plots of conservation farming and watershed rehabilitation
- Output 5. Recommendation and policy brief of the best agroforestry model

**Output 1** has been achieved through Activity 1.1. (FGD to develop participatory demonstration plot) and Activity 1.2 (FGD among stakeholders to support the implementation of activities). Plans for participatory land management have been developed in three villages: Wonorejo, Wonokeling, and Bubakan. Each village had 24, 43, and 48 farmers. FGDs in each village were used to create detailed plans. The plan includes spacing, cropping pattern and plant species selection. Farmers have the right to receive plant seeds based on their cropping pattern and land area while they must plant and maintain their crops. FGDs with stakeholders in two districts, Wonogiri and Karanganyar, have been conducted (Activity 1.2). Stakeholders are organizations and institutions that have duties and functions capable of being committed to supporting the success of activities. Various parties, including sectoral institutions in Karanganyar and Wonogiri District, BPDASHL Solo, BBWS Bengawan Solo, Jasa Tirta, Pusdataru, Solo Watershed Forum, forestry, and agriculture extension agents, CDK Region XI, PDAM Wonogiri, NGO Persepsi and head of the villages (Wonorejo, Wonokeling and Bubakan) were involved. Based on the discussion, the stakeholders have carried out several programs to support upper watershed management. Some of the programs potentially to be followed up by village government.

**Output 2** has been obtained through Activity 2.1. (Determining the site of demonstration plot), Activity 2.2. (Applying vegetative soil conservation measures) and Activity 2.3. (Applying civil technique soil conservation measures). The location of the demonstration plots has been found. The measurement of the participating farmers' land ownership boundaries has been completed. The number of seeds received was determined by the area and land cover conditions of participating farmers. The measurement results are then mapped and its physical characteristics are identified, such as the current land use type, slope, and cropping pattern and the name of the landowner (Activity 2.1). For a control treatment, the research team built a non-participatory demonstration plot that is entirely maintained by the research team and adheres to the treatment plan devised by the research team. The non-participatory demonstration plots cover approximately 3 hectares and are in the villages of Wonokeling and Bubakan. Through activity 2.2, planting is carried out with an agroforestry pattern as agreed in the previous FGD. The number of seeds, both fruit trees and tree crops (forestry), is adjusted to each participant's land area and cropping patterns, as well as the spacing agreed upon during the demonstration plot planning. Agroforestry patterns have also been applied in the non-participating

demonstration plots. The species types and spacing is determined entirely by the research team. The patterns applied were coffee-based and avocado-based agroforestry. Through activity 2.3, the gabion head structure (1 unit), bamboo gully plug (4 units), spesi gully plug (1 unit) and spesi small check dam (1 unit) have been built in the first year. In the second year, a gabion head structure (1 unit), further bamboo gully plug (13 units), spesi small check dam (1 unit), and gabion small check dam (1 unit) were built in addition.

**Output 3** has been achieved with the implementation of activity 3.1 (Development of apiculture), activity 3.2 (Training to improve farmer's skill in processing agricultural yields for higher value-added products) and activity 3.3 (Training to improve farmer's skill in processing household and agriculture waste). Training on *Trigona sp.* cultivation was attended by 30 people in each village (Wonorejo, Wonokeling and Bubakan). Participants consisted of FP representatives, non-FP farmers, and village officials. The trainers are experienced breeders from Klaten Regency. After training, the team provided 10 colonies of *Trigona sp* as an incentive to each village (activity 3.1). Training on the topic of coffee cultivation and coffee post-harvest processing, and avocado cultivation and avocado grafting techniques were attended by 45 participants from Wonorejo, Wonokeling and Bubakan. They were coffee growers and traditional beverage traders (activity 3.2). The training on household and agricultural waste management has also been carried out in three villages (Wonorejo, Wonokeling, and Bubakan) with 15 participants in each session from each village. The trainers were from the Berseri waste management group from Kradegan Village, Bulukerto District, Wonogiri Regency (activity 3.3).

**Output 4** was obtained through three activities namely water yield and sedimentation monitoring (Activity 4.1), land evaluation (Activity 4.2), and evaluation of economic and community behavior on land management (Activity 4.3). Data collected was 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 4.1 was rainfall, river flow discharge, total runoff, and sediment yield. Data collected for activity 4.2 was slopes, soil type, land cover, and the height and diameter performance of perennial trees and MPTS. Data collected for activity 4.3 was economic and community behavior regarding land management, community participation in the project activity, local institution, and business group support. Besides, monitoring and evaluation of the project implementation has been carried out by WMTC as the executing agency, by the Research, Development and Innovation Agency of the Indonesian Ministry of Environment and Forestry as the direct supervisor of WMTC and by the Extension and Human Resources Development Agency (also MEF) as the supervisory agency.

**Output 5** has been achieved with the implementation of activity 5.1 (Internal meeting to discuss and formulate the best agroforestry model) and activity 5.2 (Workshop to Share and discuss the project results). The meeting was attended by researchers and WMTC officials and consultants. The internal meeting concluded: (1) The participatory and sustainable micro watershed management model at the NMC

can be used as a national policy brief for the improvement of the Regulation of the Director General of RLPS Number: P.15/V-Set/2009 concerning Guidelines for the Development of Micro Watershed Models by prioritizing balance and sustainability of economic, social, and environmental aspects, and (2) Agroforestry produces the best performance for physical crops and is the most financially profitable, compared to albizia and seasonal monocultures (activity 5.1). The workshop (activity 5.2) was attended by 50 participants, including the project team, project consultants, steering committee, researchers, and stakeholders involved in the project activities. The workshop resulted in the formulation of an commitment agreement between the parties for collaborative management in the upstream Solo River Basin (Annex 8. In Technical Report).

The whole of outputs, activities, and results completely presented in the document of Technical Report (Annex D.). Figure 2 also displays all project-related physical activities, including those from Phases I and II.

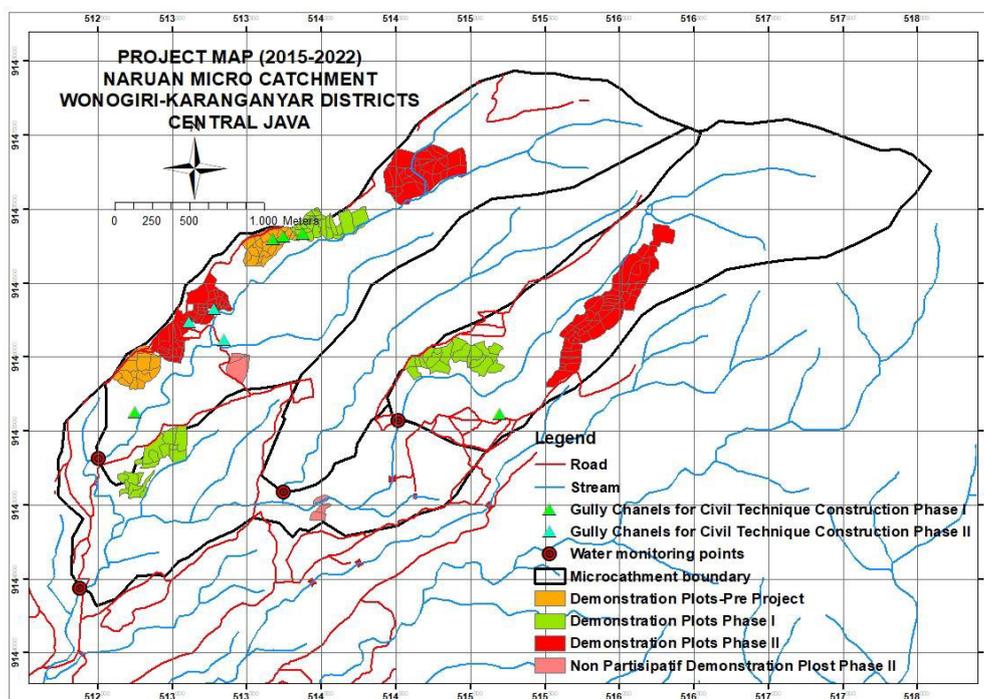


Figure 2. Locations of vegetative and mechanical SCW activities at NMC, both in Phase I and II.

Remark: Each gully channel consists of a series of erosion control structures, namely a gully-head structure, some gully plugs, and a small check dam.

#### 4.2 Project Impacts

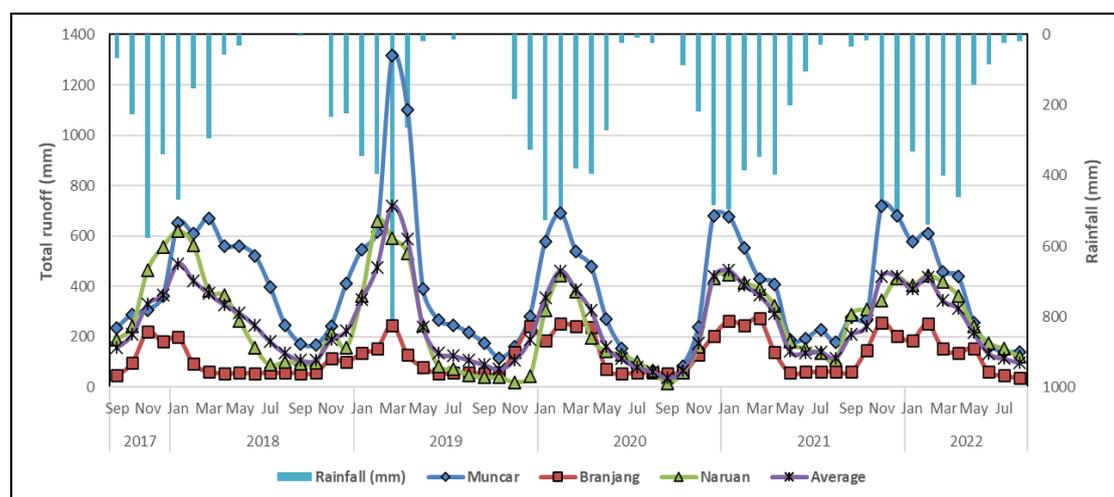
This project enhanced public awareness of the importance of soil and water conservation. Selected and applied agroforestry patterns provided economic and environmental benefits. Economically, agroforestry patterns can offer higher income compared to the income from monocultures of perennial woody plants or seasonal

crops patterns. However, to minimize farmer dependence on the land, off-farm income must be developed. For the sustainability of soil and water conservation, community independence is needed. This requires continuous assistance. Therefore, the involvement of forestry extension agents (i.e. government officials who provide technical guidance of forestry to the community) must be continued in at every stage of the activity.

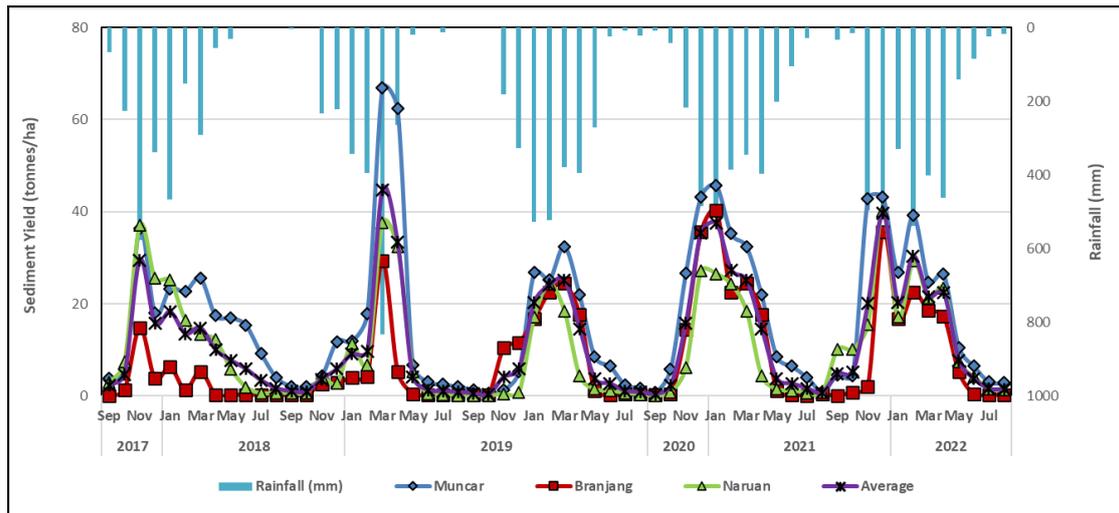
Through this project, stakeholders are reminded that watershed management must be carried out in an integrated manner. In this project, some parties have contributed to soil and water conservation efforts according to their duties. However, the sustainability of soil and water conservation will depend on the commitment of the parties to continue the program in an integrated manner.

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 beyond the scope of this project. 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 compared to the total area of the micro watershed. Figure 3 displays the series data for hydrological monitoring in both Phase I and Phase II.

Besides having an impact on the local community and environment, this project is also expected to be replicated elsewhere. Therefore, the results of the project have been disseminated through scientific publications, leaflets, posters, and technical assistants to users. In addition, extension agents from related institutions can consult about all processes in participatory micro watershed management.



(a)



(b)

Figure 3. The monthly hydrological data which is monitored during Phases I and II; (a) Rainfall versus total runoff, (b) Rainfall versus sediment yield

### 4.3 Sustainability

Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed Project (Phase II) ended in September 2022, 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 without any support from other parties.
2. Involvement of forestry extension agents 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. Handing over the civil technique structures to each village government, so that there is a responsibility to maintain the conservation structures.
5. Involvement of the Agriculture District Services and the Cooperation and Trade District Services of Wonogiri and Karanganyar Districts to deliver training of bee

keeping, avocado and coffee cultivation, post-harvest processing and marketing. Through this training, hopefully the community will increasingly master the techniques of coffee and avocado cultivation. In addition, the community can also increase income from processing coffee yields. Thus, it is hoped that people will be more interested in maintaining avocado and coffee plants in a sustainable manner.

6. Involvement of Environmental District Services of Wonogiri and Karanganyar Districts to deliver consulting on treatment of household and agriculture wastes. The results of processing agricultural waste can be used as organic fertilizer for sustainable land management
7. Development of micro watershed management models in other regions of Indonesia based on the experience of Naruan Micro Catchment Management Project.
8. Input for improving micro watershed management policies in Indonesia, so that the model can be replicated elsewhere.

It is expected by completing the project, the parties can carry out their role in managing the NMC in an integrated and sustainable manner.

## **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, but it does not affect the achievement of the targeted outputs.
- Micro-scale watershed management includes planning activities, followed by implementation as well as monitoring and evaluation. Planning activities start with gathering baseline data on the characteristics of the watershed, followed by participatory planning and building collaborative commitment of the parties. To support sustainable management, communication and coordination amongst the parties involved need to be intensified at every stage and level of management (Figure 3.).
- Demonstration plots with community involvement, incorporating mechanical and vegetative SWC measures, as well as community empowerment, have been constructed.
- The main challenge in developing demonstration plot models, is the commitment of the landowners to comply with the agreement with the project team in the case of perennial trees maintenance and the under-forest stand land utilization.

- Rehabilitation activities have impacted the ecological and socio-economic aspects of the community. Ecologically, agroforestry plot development activities have improved land cover and controlled erosion, but in the project term, there has not been any visible hydrological impact at micro watershed outlets (runoff and sedimentation).
- In social terms, activities have an impact on increasing farmers' knowledge of watershed management and SWC, as well as changing perception and motivation to implement SWC's measures. Economically, the agroforestry pattern has improved household income through the added value of wood and fruit crops at the end of the cycle of perennial crops.
- Micro watersheds have the potential to be an alternative for sustainable watershed management in operational level. All management processes, from planning to monitoring, are easier to implement in small units.
- At the policy level, the NMC management process can be used as a reference for the management of national-level micro catchment in Indonesia

## 5.2 Lessons learned

Lessons learned from this project include:

- The perception that timber-based plants must be used in land rehabilitation activities has to be questioned. After 4-5 years, timber-based plant species like albizia (which are typically fast-growing species/FGS) will be harvested. As a result, there will be a period of bare soil that is vulnerable to erosion when it rains. The prevalence of gall is another barrier to the adoption of FGS like albizia. In addition, changes in the local timber market's pricing have a significant impact on production stability. At the beginning of rehabilitation, planting MPTS such fruit trees may be the best option. The absence of a critical period caused by tree felling is an ecological benefit, in addition to having advantages in production and prices that are more stable and continuous. The planting of MPTS can still be combined in the field with small amounts of woody plants (such albizia and limpaga) as well as middle stratum crops (such as coffee, cocoa, etc.).
- Farmers still have a limited level of technological skill expertise, necessitating extra care from associated parties. Through assistance actions by local and district-related parties, farmers' capacity in terms of cultivation method, post-harvest processing, and trade system of agricultural goods is continuously needed.
- In community-based rehabilitation initiatives, community involvement must be the key factor. However, for the proposed participatory plan to be in line with the existing problem and the suitable technology selection, the bottom-up paradigm in rehabilitation planning must still be accompanied by a top-down pattern as a control.
- There are still misconceptions in the community about the sustainability of the rehabilitation activities. Some people believe that maintenance is not vital or has

not taken priority after the implementation both in planting efforts and the construction of SWC buildings. In fact, the success of the rehabilitation program in the long run will depend on these maintenance procedures.

- In every governmental rehabilitation program, it is necessary to learn the behavior and local culture in land management. The program should not only distribute plant seedlings to the village level but must also carry out monitoring until the critical crop period has passed.

### 5.3 Recommendations

Based on the project experiences, there are some recommendations as follows:

- Micro Watershed Management Model in the future must not only be understood as an example and prototype but it should be used as an implementation unit for watershed management at the site level. Village-based watershed delineation is ideally suited for participatory planning so that issues can be accurately identified and suitable consideration given to possible technological solutions. A policy brief on a participatory-sustainable micro-watershed management model based on villages and local resources were prepared as part of the project to support this (Annex 2.). This policy brief can be a useful information for policymakers.
- The agroforestry model, which consists of a combination of perennial woody plants, MPTS, and seasonal crops, offers the best advantages regarding ecological and economic benefits. As a result, additional regions with agroecological similarities to the NMC can adopt this model

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- Sutrisno J., Sanim, B., Saefuddin, A. & Sitorus, S.R.P. (2011). Arahan Kebijakan Pengendalian Erosi dan Sedimentasi di Sub Daerah Aliran Sungai Keduang Kabupaten Wonogiri (*Policy Direction for Erosion and Sedimentation Control in the Keduang Sub Watershed, Wonogiri Regency*). Sains Tanah, 8 (2) 2011. <http://jurnal.fp.uns.ac.id/index.php/tanah/article/view/5>
- Tjakrawarsa, G. & Pramono, I.B. (2012). Perubahan Tingkat Sedimen Terlarut di Sungai Keduang Periode 1994-2010 (*Changes in Sediment Load Levels in the Keduang River for the Period of 1994–2010*). Prosiding Seminar Nasional Penelitian Dan Pengembangan Pengelolaan DAS 2012.

Annex B. Policy Brief of “Village-based Participatory-Sustainable Micro Watershed Management Model”

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|  | <p><b>POLICY BRIEF</b></p> <p>BALAI PENELITIAN DAN PENGEMBANGAN TEKNOLOGI PENGELOLAAN DAERAH ALIRAN SUNGAI<br/>(Watershed Management Technology Center)</p>   |
| <p><b>Title</b></p>   | <p><b>Village-based Participatory-Sustainable Micro Watershed Management Model</b></p> <p>By: Agung B. Supangat, Nining Wahyuningrum, Dewi R. Indrawati, and Purwanto</p>   |
| <p><b>Executive summary</b></p>   | <p>The unresolved issue of watershed management raises serious concerns about what is really going on in Indonesian watershed management. Poor watershed management is evidenced by the extent of degraded land, the high rate of land degradation, and various hydrometeorological disasters. This is inextricably linked to the difficulty of integrating management in the field, for both parties, across sectors, and across administrative areas. In the field, it is still difficult to find examples of properly managed watersheds that can be used as references. The existence of several formal regulations is also still difficult to implement in the field due to various obstacles ranging from the complexity of the rules, the lack of capacity to implement the rules, and the lack of commitment of the parties in implementing the rules. The development of the Micro Watershed Model (MWM) area based on a small management area such as a village is very strategic and prospective in supporting watershed management activities by providing examples of proper management and can solve existing problems. Through participatory micro watershed management action research, there are several lessons learned about the weaknesses in various aspects of watershed management at the implementation level. Several technical recommendations and suggestions for policy improvement have been formulated based on the results of this activity.</p>                     |
| <p><b>Statement of the issue/problem</b></p>                                      | <p>The success of watershed management in Indonesia is still being questioned. This is based on the fact that there are still many critical lands both inside and outside forest areas, the high rate of forest and land degradation, the large number of poor land farming communities, as well as various hydrometeorological disasters that cause a lot of losses. According to data from the SetDirjen PDASHL (2018), there are approximately 14 million hectares of degraded land as of today, with 9.5 million hectares classified as "degraded" and 4.5 million hectares classified as "very degraded". The rate of land degradation remains high, at around 300,000 ha per year. Among the 17,076 watersheds in Indonesia, 2,415 are designated as "to be restored", while the remainder are designated as "to be maintained". This situation demonstrates the need for better watershed management in Indonesia. Therefore, each stage of watershed management functions must be evaluated, beginning with planning and progressing to implementation and monitoring-evaluation.</p> <p>The difficulty of implementing watershed management in the field cannot be separated from the preceding fact. There are numerous actors (stakeholders), numerous regulations related to natural resource management, and various science and technology for watershed management are available. It has, however, had no effect on the achievement of watershed management objectives as stated</p> |

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|                                  | <p>in Government Regulation (PP) Number 37 of 2012. The integration of watershed management is also still difficult to realize, so the slogan of “CISS” (Coordination, Integration, Synchronization and Synergy) is also difficult to achieve.</p> <p>So far, it is rare to find a watershed that can be used as an example as a watershed that is managed properly and correctly, which is planned in a participatory manner, implemented collaboratively-integratively, and its processes and impacts are monitored periodically and measurably. Participation and integration of watershed management should begin from the site level without leaving a more macro management plan, and taking into account the characteristics of the field. Watershed management prototypes can be created at the operational/site level, on a micro scale and located upstream of the watershed which is the spearhead of land rehabilitation and soil and water conservation activities. This action research on micro watershed management is expected to be able to answer the above watershed management problems, through the development of a “Village-based Participatory-Sustainable Micro Watershed Management Model”.</p>  |
| <p><b>Existing condition</b></p> | <p>At the regulatory level, there are several rules related to integrative watershed management and procedures for developing micro watershed model areas, namely Minister of Forestry Regulation No. P. 39/Menhut-II/2009 concerning Guidelines for the Preparation of Integrated Watershed Management Plans (RPDAS-T), and Regulation of the Director General of RLPS No. P. 15/V-SET/2009 concerning Guidelines for Development of Micro Watershed Model Areas (MWM). However, at the practical level in the field, these two rules are difficult to apply, and/or have not been implemented properly. Since the issuance of the Regional Government Law (UU) no. 23 of 2014, all forestry affairs were handed over to the provincial government, including the field of watershed management. This requires adjustments and new arrangements related to the implementation of watershed management at the regional scale, especially related to institutional matters.</p> <p>The RPDAS-T which has been prepared in a participatory manner by involving related parties, facilitated by BPDASHL, still often ends up as a planning document that cannot be implemented properly. The necessity of internalizing RPDAS-T into regional spatial planning has not gone well, even though the Director General of PDASHL has issued regulation No. P.8 of 2018 concerning technical instructions for internalizing RPDAS into the RTRW. RPDAS-T is still very difficult when it has to be referred to by sectoral agencies in the region as a guide for natural resource management, because it has not been well integrated into the Regional Spatial Planning (RTRW) and Regional Medium-Term Development Plan (RPJMD). In the end, each sector manages natural resources according to its own duty and function, and it is not uncommon to experience overlapping management activities, both types of activities and the location of the target activities. Watershed management integration is not realized and is not sustainable.</p> <p>Likewise, the development of MWM, which has been mandated to the BPDASHL institution as a prototype in accordance with regulation P.15/2009, is still difficult to realize in the field. There aren't many MWMs that have been built perfectly and can be used as examples of watershed management that can solve existing problems and produce standards and criteria for natural resource management guidelines in watersheds. The collaborative management pattern is still difficult to implement due to a failed participatory planning process. Since the 2014 Regional Government Law, Regulation P.15/2009 has required modifications.</p> |

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| <p><b>Method</b></p>                   | <p>The activity is based on action research, to develop and implement science and technology for watershed management into watershed management activities at the implementation scale, namely micro watersheds with an area of 1,000 hectares. The project occurs in the Micro Naruan watershed, the Keduang watershed, and the Bengawan Solo watershed. It includes three villages and two sub-districts in the Wonogiri and Karanganyar districts. Project carried out between 2015 and 2022.</p> <p>Project carried out are in accordance with the functions of watershed management, starting from planning, implementation, institutional development and monitoring-evaluation of watershed management performance. At each stage an evaluation is also carried out on: 1) the rules and implementation of the rules; 2) difficulties and obstacles at each stage of implementation in the field; and 3) alternative solutions to the problems found. The evaluation is a lesson learned activity as material for formulating policy and technical recommendations regarding watershed management at the micro watershed implementation level. In the final stage, a participatory and sustainable village-based micro watershed management model is formulated, which is expected to be input for government policy through the preparation of a policy brief.</p>  |
| <p><b>Findings and discussions</b></p> | <p><b>Micro Watershed Management Planning</b></p> <p>According to Regulation P.15/2009, the requirement of a maximum MWM area of 5,000 ha is challenging to implement in all places, particularly in Java, where it is extremely unmanageable. On Java Island, an upper watershed micro-watershed area with a size of up to 5,000 hectares typically has a large number of possible places for rehabilitation. This will result in an imbalance between the area that must be rehabilitated and the small annual budget allocation per village.</p> <p>As a result, managing a micro watershed of 5,000 ha will take a long time, and evaluating its success will be difficult. Meanwhile, outside of Java, finding a 5,000 ha micro watershed in the upstream watershed is difficult. Even if there are, it is usually a very small portion of the location that requires RHL activities, because they are usually all forest areas with no settlements, so there are few problems.</p> <p>Based on project's findings, it is recommended that the MWM area requirements be divided into three categories: for Java, outside Java, and small inhabited islands. The MWM area in Java is recommended to be around 1,000 ha, with the caveat that the hydrological response of the water system to the activities carried out can be observed and measured (Purwanto et al., 2015), whereas outside of Java it can be larger and adjusted to local conditions, particularly the presence of the community. The village unit should be used by the planning and implementation unit so that it can be aligned with the village development program.</p> <p>The MWM created by the main institution, BPDASHL, is expected to represent the diversity of parent materials in its working area. The developed MDM was then adopted by local governments for use in their respective administrative areas. The Forestry Service Branch (CDK) in the district area, as an extension of the Provincial Forestry Service, can be tasked with adopting the MWM prototype from BPDASHL. CDK collaborates with the Regency Planning Agency (Bappeda) in its implementation.</p> <p>The community has not fully implemented the participatory planning process in MWM management. The government's top-down mechanism is still required as a</p> |

control to oversee and provide indicators in the participatory management process (Supangat et al., 2020).

### **Implementation of Management Plan**

The implementation of micro watershed management is carried out collaboratively by implementing institutions (related parties). Each implementing agency prepares the Technical Implementation Plan (RTP) on H-1 in accordance with their respective capacities, duties, and functions. The RTP refers to the completed MWM Master Plan. Site identification is no longer required in the preparation of the RTP (as in P.15/2009). What is more important is the detailed design of selected activities, both vegetative and civil-technical, the preparation of budget plans, and the identification of the community's role/shares in watershed management as a form of "participatory-collaborative" activities. Community empowerment activities are carried out in addition to RTP through training and strengthening farmer group institutions, as well as coordination between related sectors/institutions.

In implementation, the community needs to be equipped with knowledge and skills regarding soil and water conservation practices (vegetative and civil engineering) with innovative, easy and inexpensive technology, and are expected to have an impact on self-reliance and self-reliance. An example is the use of bamboo in gully erosion control.

### ***Monitoring and Evaluation (M&E) of Watershed Management Performance***

M&E performance of micro watersheds is carried out by BPDASHL or CDK agencies, while management M&E is the responsibility of the relevant implementing agencies. In practice, BPDASHL and implementing agencies can share data. The district "Bappeda", through the regent's regulation on Micro Watershed Management, is responsible for conducting M&E implementation of the MWM Plan, to oversee and ensure the "sustainability" of management activities.

M&E of watershed performance at the stretch (plot) scale is carried out at the location of rehabilitation activities to monitor the impact of activities. Equipment for M&E can use V-notch weir or erosion plots for monitoring water management and land degradation. Monitoring activities must be carried out throughout the year the activity lasts up to at least 1 cycle of rehabilitation plants. Meanwhile, evaluation activities are carried out at least every 2 years to see and evaluate the progress of the impact of watershed management activities carried out. Farming communities also need to be involved in M&E activities in order to independently understand the conditions and productivity of their respective lands from time to time.

### ***Watershed Management Integration and Sustainability***

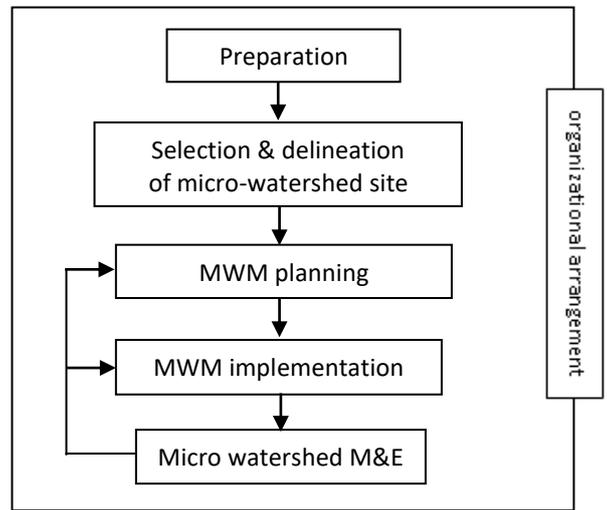
Watershed management integration remains the main weakness of watershed management in Indonesia, both at the watershed and operational/site levels. Based on action research findings, it is suggested that integration must be built collectively by the relevant parties, beginning before MWM development activities, namely through activities such as perception equalization, raising

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|   | <p>awareness of upstream-downstream relationships in watersheds (such as erosion and sedimentation linkages), conservation land and water counseling, and community empowerment. The mutually agreed-upon MWM management master plan serves as the foundation for the development of joint commitments. The sustainability of micro watershed management activities will be maintained if good integration is established up to the implementation stage.</p> <p>Local government (district) support, particularly from Bappeda agencies, is highly anticipated as a coordinating agency at all stages of management activities. Bappeda will be expected to bridge the interests of the central government, local governments, and the community. In the district development plan deliberation forum (Musrenbang), Bappeda must be able to oversee so that the RPDAST and RIP-MWM (MWM master plan) can be internalized into the spatial plan (RTRWK) and RPJMD, so that the watershed management plan can be referred to in the regional development plan through the following activities: sectoral activities. At the operational level of micro watersheds, CDK can become a team leader in developing micro watersheds in their respective working areas based on the prototype example of MWM built by BPDASHL.</p>  |
| <p><b><i>Policy options and recommendations</i></b></p> | <p>Several policy recommendations can be offered, including:</p> <ul style="list-style-type: none"> <li>- The village-based participatory-sustainable micro watershed management model can be used as input for improving the previous MWM, and has accommodated Law no. 23 of 2014 concerning local government</li> <li>- Improvements are needed to regulation P.15/2009 on Guidelines for developing micro watershed model areas related to micro watershed area, participatory and collaborative processes, as well as community involvement in M&amp;E of MWM.</li> <li>- BPDASHL must develop MWMs that represent the diversity of parent materials in the watershed area. Furthermore, CDK will replicate it in the districts, in coordination with BPDASHL and Regency Bappeda.</li> <li>- Bappeda's role as a coordinating agency in managing micro watersheds is critical, and this role must be revitalized to support the successful development of MWM areas.</li> <li>- Efforts are needed to increase the community's capacity to carry out soil and water conservation activities on their own land using innovative, simple, low-cost, multifunctional techniques like the use of bamboo in ravine erosion control.</li> <li>- MWM development is only a prototype, but it is suggested that it can be used as an implementation unit for watershed management at the site level</li> </ul> |
| <p><b><i>Sources for consultation</i></b></p>           | <ol style="list-style-type: none"> <li>1. Agung Budi Supangat (<a href="mailto:maz_goenk@yahoo.com">maz_goenk@yahoo.com</a>)</li> <li>2. Nining Wahyuningrum (<a href="mailto:nining0709@yahoo.com">nining0709@yahoo.com</a>)</li> <li>3. Dewi Retna Indrawati (<a href="mailto:dw_indrawati@yahoo.com">dw_indrawati@yahoo.com</a>)</li> <li>4. Purwanto (<a href="mailto:purwanto_fris@yahoo.com">purwanto_fris@yahoo.com</a>)</li> </ol>   |

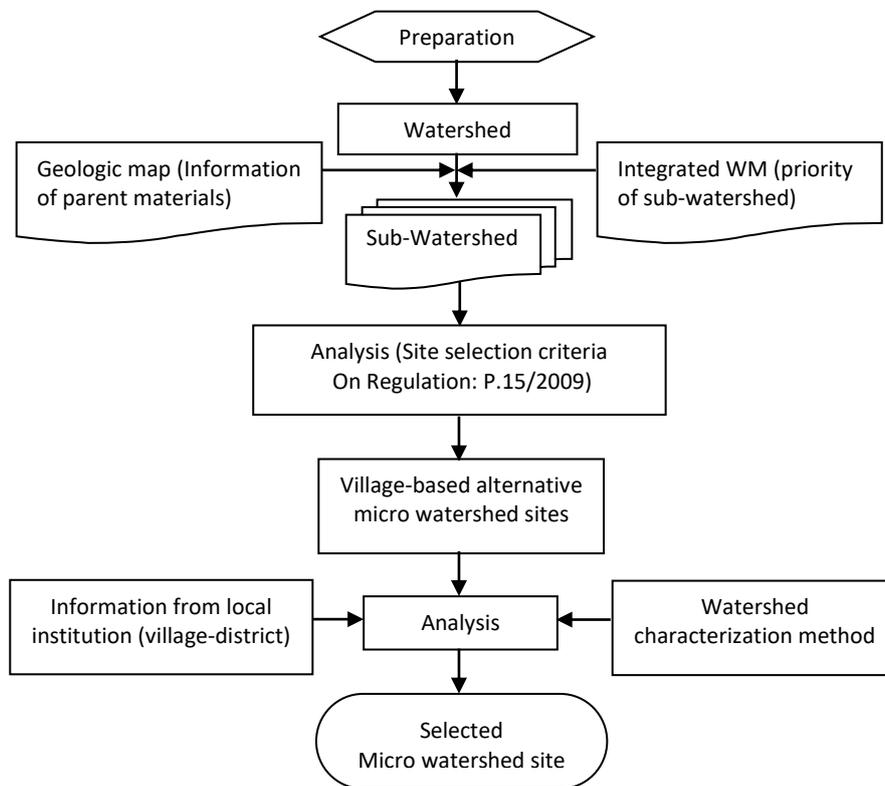
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| <p><b>References</b></p>      | <p>Paimin, Sukresno, dan Purwanto. (2010). Sidik Cepat Degradasi Sub Daerah Aliran Sungai. Pusat Litbang Hutan dan Konservasi Alam. Badan Penelitian dan Pengembangan Kehutanan. Bogor.</p> <p>Peraturan Direktur Jenderal Rehabilitasi Lahan dan Perhutanan Sosial Nomor P. 15/V-SET/2009 tentang Pedoman Pembangunan Areal Model DAS Mikro (MDM).</p> <p>Peraturan Menteri Kehutanan Nomor P. 39/Menhut-II/2009 tentang Pedoman Penyusunan Rencana Pengelolaan Daerah Aliran Sungai Terpadu.</p> <p>Peraturan Pemerintah Republik Indonesia Nomor 37 Tahun 2012 tentang Pengelolaan Daerah Aliran Sungai.</p> <p>Purwanto, Harjadi, B., dan Supangat, A.B. 2016. Belajar dari Pengalaman: Pengelolaan Daerah Aliran Sungai (DAS) Mikro (<i>Cetakan ke-1</i>). UNS Press. Surakarta.</p> <p>Sekretaris Direktur Jenderal Pengendalian DAS dan Hutan Lindung (SetDitjen PDASHL). 2018. Kebijakan Pengelolaan DAS. Materi paparan pada acara Workshop Peningkatan Kapasitas SDM Fungsional dalam Pengembangan Pengelolaan DAS Mikro Partisipatif. Surakarta, 20 September 2018.</p> <p>Supangat, A. B., Indrawati, D., Wahyuningrum, N., Purwanto, P., &amp; Donie, S. (2020). Developing a participatory planning process of micro-watershed management: a lesson learned (in Indonesian). <i>Jurnal Penelitian Pengelolaan Daerah Aliran Sungai</i>, 4(1), 17-36.</p> <p>Undang-Undang No. 23 tahun 2014 tentang Pemerintah Daerah</p> |
| <p><b>Acknowledgement</b></p> | <p>This research was funded by APFNet Projects Nos. 2017P6-INA and 2020P1-INA, entitled "Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed".</p>   |

# Flowchart of “Village-based Participatory-Sustainable Micro Watershed Management Model”

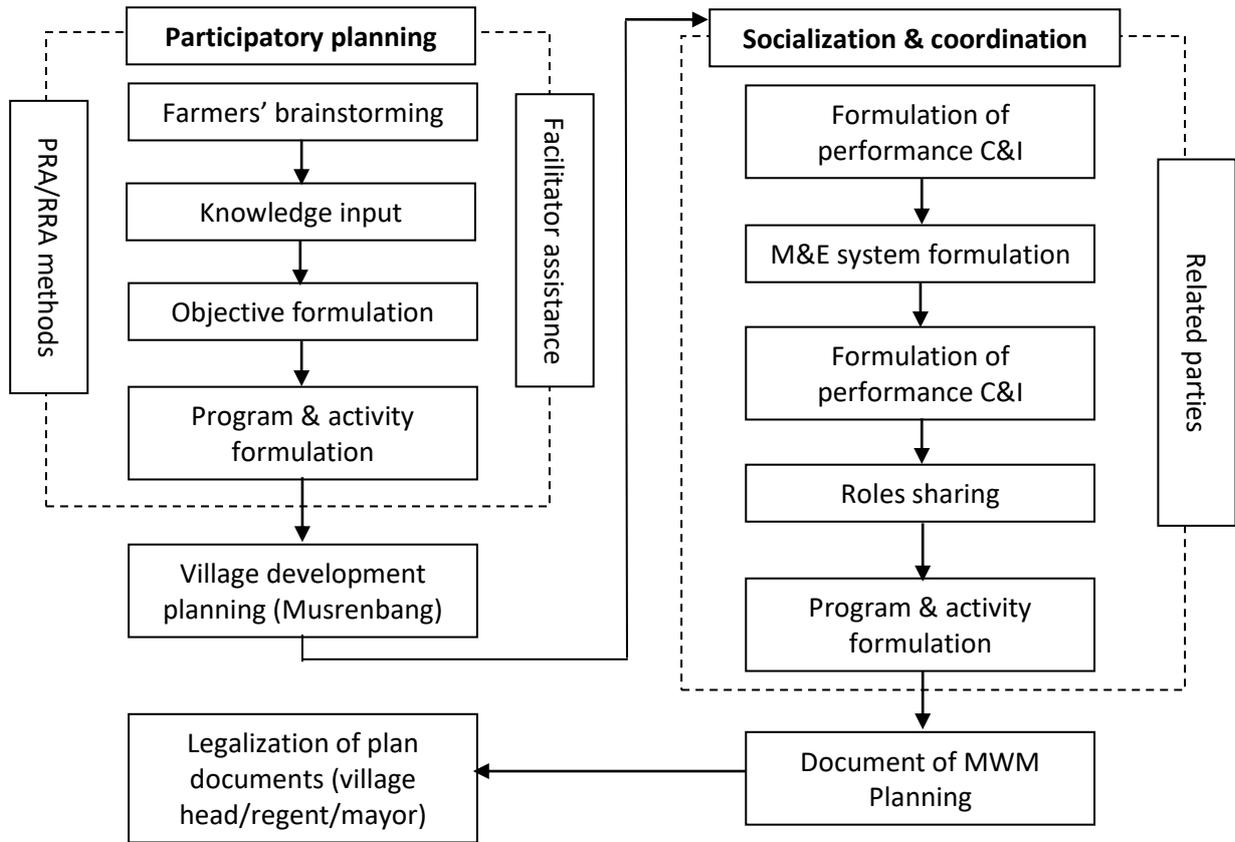
## Stages of Micro Watershed Management (MWM) Model



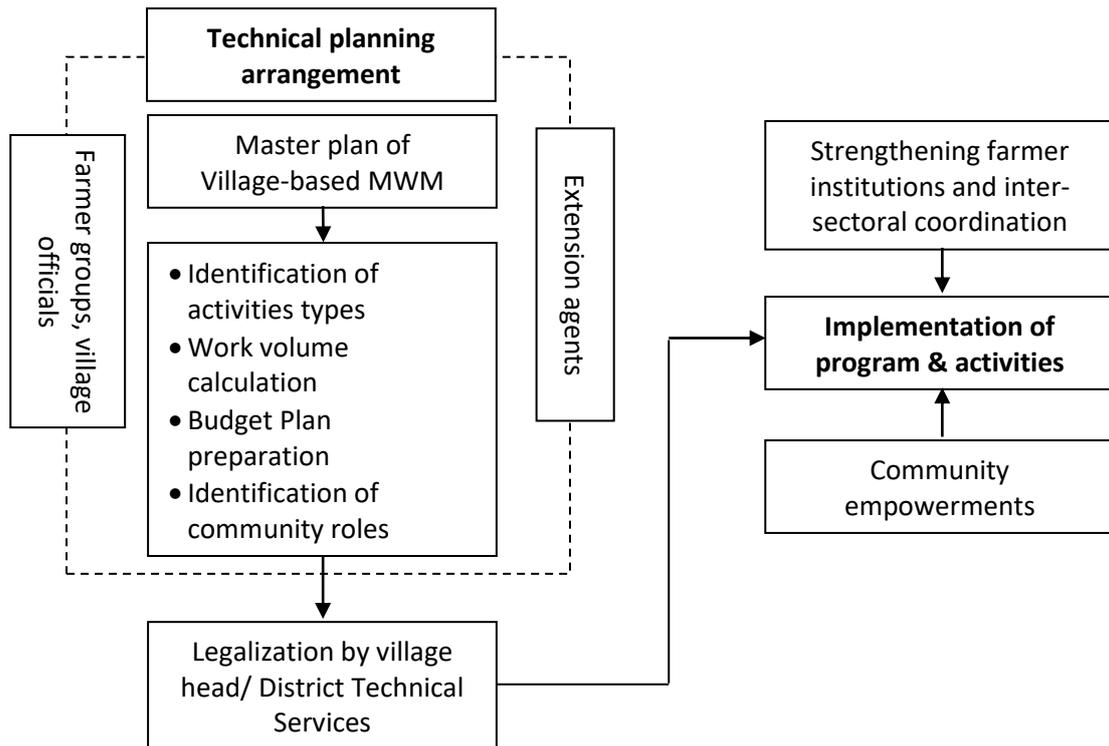
## I. Selection & delineation of micro watershed site



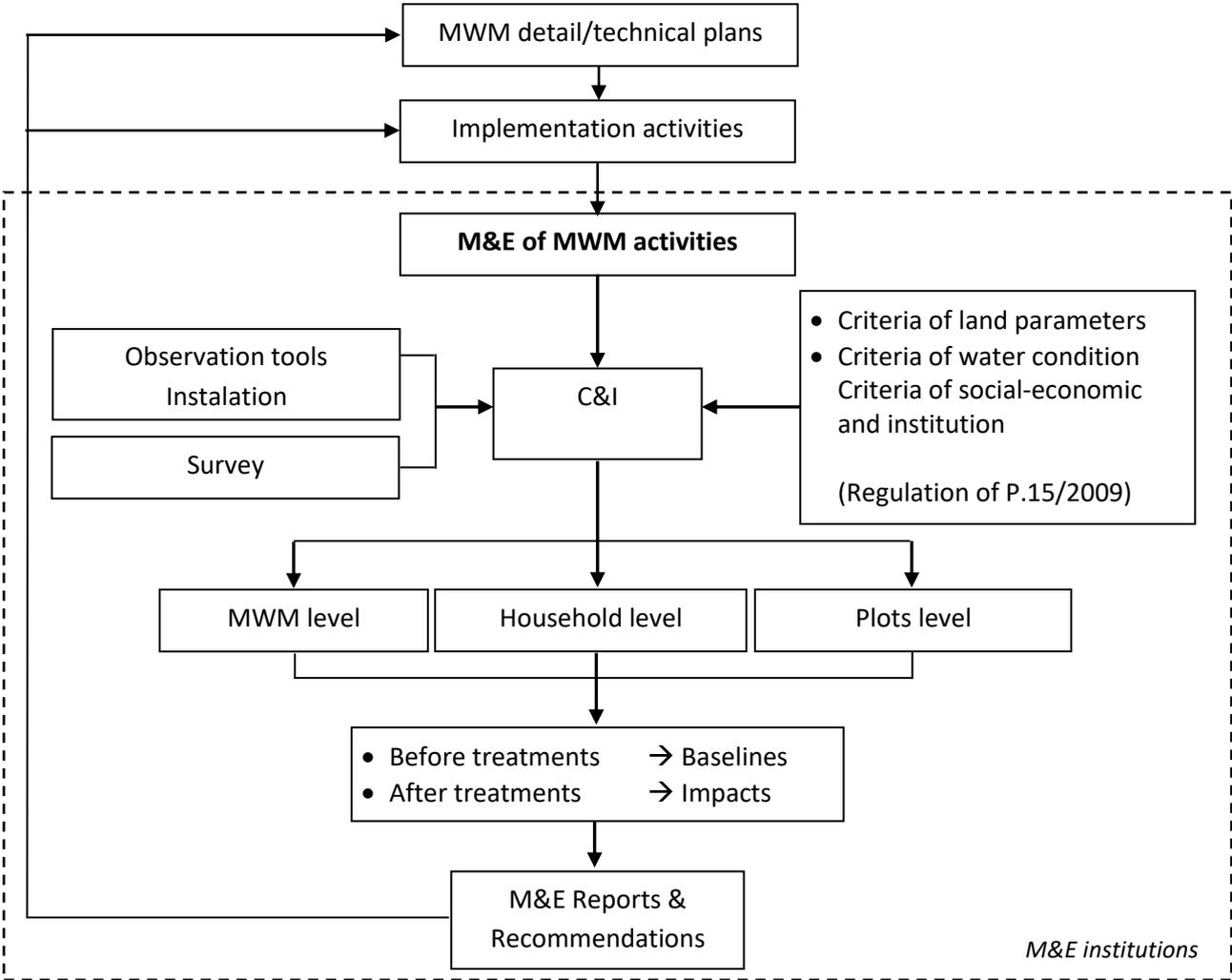
## II. Master plan preparation of MWM



## III. Implementation of MWM



**IV. Monitoring & Evaluation of MWM Performance**



## Annex E. Project Outputs (Technical Report)

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

## 1. Community Indigenous knowledge in soil and water conservation

By: Dewi R. Indrawati

The Naruan Micro Catchment (NMC) is the upstream part of the Bengawan Solo river basin. The NMC area is dominated (more than 50%) by land with steep slopes (>250) which is prone to erosion. In accordance with conservation principles, land with steep slopes should be cultivated by perennial crops in a monoculture or agroforestry pattern. The actual dominant land use in that area is dry land cultivated by maize and cassava, which is prone to erosion. Erosion that continues to occur not only has an impact on the downstream area but also reduces on-site soil fertility. This condition needs optimal soil and water conservation effort. To gain the successful effort, it is necessary to apply the appropriate technology and the participation of the community as landowners.

Looking at the history of farming practices in NMC, farming land in the NMC was originally bare land. To meet their needs of food, the community then cleared land and planted maize and cassava. Along with the increasing knowledge and needs of the community, the cultivated commodities are growing. Considering that land is the main source of food needs, the people at that time already had local wisdom to maintain the fertility of their land. They realize that without preventive measures, the soil fertility of the land will decrease; as a result, yields will also decrease. The people at that time did not realize that those actions were part of soil and water conservation efforts. Currently, soil and water conservation is generally carried out in a civil technique and vegetative manner, while soil and water conservation carried out by the community at that time was only carried out the vegetative measures. Some forms of local wisdom in the NMC were:

### 1. Prevention of surface erosion

To prevent surface soil erosion, Community made grass barriers and mounds. Grass barriers were planted in the waterways (*panciran*), which aimed to trap the soil that was carried by water. The fodder grass was chosen to be planted because at that time the community also raising cows. The fodder grass was chosen to be planted because at that time the community also raising cows. The mounds were carried out on strips for seasonal crops, which also gained to trap the soil.



Figure 1. Grass barrier

At that time, the community had also planted woody plants. The species to be planted was pine which was expected to give conservation function and provide wood for housing. Along with the development of community knowledge in woody plant species, woody plants also function as savings. But unfortunately, the timber plantation is only carried out on the land boundary, so its conservation function is not optimal. It showed that social and economic considerations were taking into account in the selection of actions and plant species.



Figure 2. Woody plants in NMC

## 2. Prevention or gully erosion

In some places, there are gully that potential to be bigger if not addressed. To control the gully, the community planted several clumped plant species. The species commonly planted are bamboo, cordyline, and king grass. To trap the soil eroded, those species were planted at the toe of the gully. Hopefully, the eroded soil would be restrained by

the plants and accumulated in the gully. Finally, the gully will be naturally closed.

The traditional soil and water conservation showed that the community already had the awareness to maintain their land, and it becomes a capital to increase community participation in soil and water conservation. However, due to the increasing pressure on land, more serious efforts and better technology are needed to encounter the erosion that occurs continuously.



Figure 3. Cordyline as gully erosion

## 2. Land Rehabilitation and Income-Generating Challenges

*By: Purwanto*

The Naruan micro watershed is made up of Lawu Mountain parent material, which has a high fertility but is easily eroded due to the steep slope conditions (average > 40%). This type of land is commonly used in Indonesia for the cultivation of seasonal crops such as corn, cassava, and vegetables. Although allocating limited land resources for these seasonal crops is economically sound, these activities increase the likelihood of soil erosion. As a result, soil fertility is declining and water bodies are silting up (rivers and reservoirs).

Narrow land ownership, averaging 0.595 ha per household, leads to low farmer incomes, causing young people to migrate to cities. Farmers migrating at a young age have a habit of selling meatballs and herbs in the city. As a result, the working age of farmers in the Naruan Micro Watershed exceeds 56 years, resulting in low productivity. According to Lewis (1954), the movement of people from rural to urban areas is caused by the difference in labor wages between rural and urban areas, where wages for labor in cities are higher than wages for workers in rural areas. In terms of land rehabilitation, the migration of people from villages to cities is expected to increase the area of vegetation cover because they will leave their cultivated land and plant trees that do not require intensive management.

Some of the returning nomads in their village were actively involved in this project activity. Some of them took the initiative to purchase avocado plants with their own money, but after evaluation, some of the plants were successful while others were not. The success of rehabilitation activities on land owned by migrants was observed to be due to the diligence or laziness of the smallholders who were trusted by the land owners to manage their land. Plant growth is good when cultivators are diligent; however, plant growth is slow when they are lazy. This has consequences for the extension method that must be used for project sustainability or as an exit strategy in the extension sector. It is necessary to provide counseling to land cultivators in addition to liaison officers.

APFNet-funded land rehabilitation in the Naruan Micro Watershed for Phase I increased farmers' income by an average of Rp. 1,318,486/ha/year. This increase in yield was achieved through the use of agroforestry, specifically a combination of woody plants (albizia) and seasonal crops (corn and cassava).

Farmers make money by felling albizia trees and growing seasonal crops. The owners of the albizia plants planted in Phase I have partially cut them down. The diameter of the tree's base has grown to an average of 33 cm. Up to 10% of the avocado plants planted in early 2018 (Phase I) have flowered. One avocado tree yielded approximately 52 fruits. Because 1 kg of avocado is estimated to contain three fruits, the initial production per tree is approximately 17 kg. If the price of an avocado is Rp. 15,000 per kg, the income per tree can reach Rp. 255,000. According to farmers, avocados over 10 years old can produce Rp. 1,500,000 per tree per year if purchased directly by the merchant while still in the tree. Some of the citrus plants are already bearing fruit. However, because avocados and citrus are still early fruit production, there is not

enough data to be included in financial analysis.

Plant from Phase II, avocado, coffee, limpaga, and albizia, are still in the vegetative growth stage. Farmers' income is expected to increase once the avocado and coffee plants bear fruit. There is currently a culinary development in Indonesian urban areas that has the potential to accommodate their production.



(a)



(b)



(c)



(d)



(e)



(f)

Figure 1. Some potential yields of agroforestry patterns: albizia (a) & (b); corn (c) & (d); citrus (e); and avocado (f)

Annex G. Photos, Leaflets, Posters and Documentary films

**A. Photos**

Activity 1.1. FGD to develop participatory demonstration plot



Activity 1.2. FGD among stakeholders



Activity 2.1. Determining the site of demonstration plot



Activity 2.2. Applying vegetative soil conservation measures



Activity 2.3. Applying Civil Technique soil conservation measures



Activity 3.1. Development of apiculture



Activity 3.2. Training to improve farmer's skill in processing agricultural yields for higher value-added products



Activity 3.3. Training to improve farmer's skill in processing household and and agriculture waste



Activity 4.1. Water yield and sedimentation monitoring



Activity 4.2. Land evaluation



Activity 4.3. Evaluation of economic and social aspect on land management



Activity 5.1. Internal meeting to discuss and formulate the best agroforestry model



Activity 5.2. Workshop to share and discuss the project results



Procurements

|   |  |   |
|---|--|---|
|    |   |   |
| <p>360 Camera</p>   | <p>Optic Base Station</p>  |   |
|    |     |  |
| <p>Laptop</p>   |  |   |
|  |  |   |
| <p>Automatic Water Level Data Logger</p>  | <p>Mirrorless Camera</p>   |   |
|  |  |   |
| <p>Mobile Projector</p>   | <p>Automatic Rainfall Recorder</p>   |   |

## B. Leaflets (in Indonesian)

### 1. Budidaya Lebah Trigona Mensukseskan Pengelolaan DAS Mikro (Trigona Beekeeping to Support Successful Micro Watershed Management)

Pembiakan lebah bisa dilakukan setiap 6 bulan. Ditandai dengan adanya kerumunan baru yang ada ratunya.

Tanaman pakan lebah tersedia dengan cara alami maupun pengkayaan tanaman.

Jenis tanaman buah dan semusim yang mengandung serbuk sari, nectar dan getah mencukupi kebutuhan pakan lebah.

Panen madu dilakukan antara 1-2 bulan setelah musim bunga.

Ciri madu siap dipanen apabila sarang madu/dompolan telah tertutup lilin tipis.

Sarang madu diambil kemudian diekstrak/diperas, disaring dan dimasukkan botol.




Balai Penerapan Standard Instrumen Lingkungan Hidup dan Kehutanan Solo

Alamat : Jl. Jend. A. Yani-Pabelan, Kartasura, PO BOX 295 Surakarta.  
Telp. (0271) 7167098




Pelatihan budidaya Lebah Trigona

**BUDIDAYA LEBAH TRIGONA MENSUKSESKAN PENGELOLAAN DAS MIKRO**

Trigona Beekeeping to Support Successful Micro Watershed Management

Konservasi tanah dan air akan berhasil jika didukung banyak komponen.

Kesungguhan dan pengetahuan pelaku konservasi tanah salah satu modal keberhasilan program.

Budidaya lebah Trigona mendukung keberhasilan pengelolaan DAS Mikro.

Budidaya lebah Trigona meningkatkan pendapatan masyarakat.

Produksi 1 koloni antara 600 – 2.000 ml/th

**Produksi Lebah**

- Madu
- Bee Pollen
- Lilin Lebah
- Propolis





Sumber pakan lebah mendorong petani melakukan pengkayaan tanaman

Terjaganya konservasi tanah dan air pengelolaan DAS Mikro

Kotak lebah, membantu dalam budidaya lebah.

Ukuran kotak Lebah Trigona panjang 30, lebar 15, tinggi 12 cm.

Kotak ditempatkan di daerah yang banyak pakan lebah.

2. Sambung Pucuk Alpukat: Teknik Mudah dan Murah Pengembangan Budidaya Tanaman Alpukat (Avocado Tree Grafting: An Easy and Cheap Technique for Developing Avocado Cultivation)

## Cara Sambung Pucuk

- Siapkan seedling & entresnya
- Panjang entres 10-20 cm
- Pangkas daun entres untuk mengurangi penguapan (sisakan 2 daun paling atas)
- Sayat runcing bagian pangkal entres (menyerupai segitiga kurang lebih 1-2 cm)
- Potong seedlingnya 10-20 cm dari permukaan tanah
- Belah bagian tengah kurang lebih 1-2 cm
- Masukkan entres, agar menyatu
- Ikat dengan tali plastic, ikatannya tidak perlu tertutup rapat
- Sungkup hasil sambungan kurang lebih 20-30 hari






Balai Penerapan Standar Instrumen Lingkungan Hidup dan Kehutanan Solo (BPSILHK) Solo  
Jl. A. Yani – Pabelan, Kartasura  
PO.BOX 295 Surakarta, Jawa Tengah  
Telp. (0271) 716 709

## Sambung Pucuk Alpukat

(Avocado Tree Grafting)

Teknik Mudah & Murah Pengembangan Budidaya Tanaman Alpukat



Oleh :  
Tim Kegiatan APFNet BPSILHK Solo






### Apa itu Sambung Pucuk?

Teknik menggabungkan batang bawah (understem) dengan batang atas entres agar nantinya tercipta tanaman baru

- Batang bawah dikenal dengan istilah seedling (dari biji)
- Batang atas dikenal dengan istilah entres (mata tunas yang diambil dari cabang yang tumbuh keatas)

Kapan Waktu yang tepat untuk Sambung Pucuk?

Waktu yang tepat untuk sambung pucuk adalah musim kemarau, dikarenakan kelembaban tidak terlalu tinggi.




### Syarat Batang Bawah

- Sehat (dari benih yang utuh dan sehat)
- Akar baik dan dalam
- Mampu bertahan pada kondisi ekstrem (biasanya varietas lokal)
- Tidak mengurangi kualitas & kuantitas buah yang akan disambungkan
- Umur 2 s/d 4 bulan setelah semai

### Syarat Batang Atas

- Diambil dari alpukat yang pernah berproduksi & unggul
- Mampu menyatu dengan bagian bawah (ukuran hampir sama)
- Sehat
- Tidak sedang berdaun muda/tumbuh aktif
- Tidak bercabang
- Panjang kurang lebih 10-20 cm




### Kendala

- Tanaman menjadi kerdil
- Cepat mati
- Kaki gajah (bagian bawah tumbuh lebih besar)
- Kaki bangau (bagian bawah lebih kecil)
- Pembungaan cepat/lambat/sama sekali tidak berbunga
- Buah masam

### Alat & Bahan

- Alat potong (Cutter, pisau, silet)
- Sungkup
- Tali palstik
- Seedling & Entrees yang ukurannya hampir sama





3. Bank Sampah: Sebuah Upaya Pengelolaan Sampah Rumah Tangga (Waste Bank: An Effort to Manage the Household Waste)



**PENGOLAHAN SAMPAH**  
Sampah organik yang dihasilkan oleh rumah tangga dapat diolah menjadi kompos, pupuk cair dan juga dapat dijadikan sebagai media untuk menghasilkan magot (larva lalat)

Sampah anorganik yang dihasilkan oleh rumah tangga dapat diolah dan digunakan kembali (reuse) dan didaur ulang (recycle) menjadi berbagai barang kebutuhan rumah tangga seperti kerajinan tangan, asesoris, sabun bahkan bahan bakar minyak (BBM)

**BANK SAMPAH**  
Sebuah upaya pengelolaan sampah rumah tangga  
WASTE BANK  
An effort to manage the household waste

**BALAI PENERAPAN STANDAR INSTRUMEN LINGKUNGAN HIDUP DAN KEHUTANAN SOLO**  
Alamat : Jl. Jend. A Yani-Pabelan, Kartasura POBOX 295, Surakarta, Teip. (0271) 716709





**BANK SAMPAH**  
Tempat untuk mengelola sampah dengan prinsip 3R (reduce, reuse, recycle) yang dikelola oleh masyarakat, pemerintah dan dunia usaha yang memiliki sarana dan prasarana paling sedikit berupa sistem administrasi dan sarana pemilahan sampah. Juga diartikan tempat pemilahan dan pengumpulan sampah yang dapat didaur ulang atau diguna ulang yang memiliki nilai ekonomi

**VISI dan MISI**  
Membangun ekonomi kerakyatan, lingkungan yang bersih sehingga tercipta masyarakat yang sehat. Mengurangi timbunan sampah, merubah prilaku masyarakat, menciptakan lingkungan yang bersih dan menciptakan lapangan pekerjaan

**TUJUAN**  
Membangun kepedulian masyarakat akan pentingnya berkawan dengan sampah untuk mendapatkan manfaat ekonomi langsung dari sampah melalui langkah-langkah berupa pendekatan ke masyarakat dan sosialisasi pentingnya pengelolaan sampah.

**JENIS-JENIS SAMPAH**  
Sampah organik: sampah yang berasal dari makhluk hidup yang mudah terurai baik yang bersifat kering maupun basah  
Sampah anorganik : sampah yang dihasilkan dari bahan-bahan non hayati berupa produk sintetik maupun hasil proses teknologi bahan tambang yang sulit diurai

**MEKANISME KERJA**

- 1. Pemilihan sampah**  
Dalam pengelolaan sampah perlu dilakukan pemilahan terhadap sampah yang dihasilkan. Sampah dipilah berdasarkan jenisnya yaitu organik dan anorganik. Selanjutnya khusus sampah anorganik dipilah kembali sesuai nilai jualnya.
- 2. Penyetoran sampah**  
Sampah anorganik yang telah dipilah selanjutnya disetorkan ke Bank Sampah
- 3. Penimbangan**  
Sampah selanjutnya ditimbang sesuai jenisnya untuk mengetahui volume berat sampah yang disetorkan
- 4. Pencatatan**  
Hasil penimbangan selanjutnya dicatat di buku tabungan dan selanjut di konversi menjadi uang untuk dinikmati oleh nasabah.




#### 4. Pengolahan Kopi Paska Panen (The Processing Coffee Bean After Harvest)

### ROASTING KOPI

merupakan memasak (menggoreng) kopi, pada dasarnya roasting adalah proses mengeluarkan air dalam kopi, mengeringkan dan mengembangkan bijinya, mengurangi beratnya memberikan aroma pada kopi tersebut. Ketika kopi dimasak ada suatu reaksi kimia yang menyertai sehingga karakter biji kopi pun berubah. Lebih lama biji kopi itu dimasak, semakin banyak pula bahan kimia yang berubah karakteristiknya.





### PENYIMPANAN KOPI

Biji kopi sangat sensitif, kondisi lingkungan penyimpanan sangat berpengaruh terhadap keaslian rasa dan kesegarannya. Oleh karena itu dalam penyimpanan kopi harus:

- Jauh dari sinar matahari langsung
- Tidak dekat dengan benda-benda berbau tajam
- Tempatkan dalam suhu ruang dan kering
- Tempatkan ke dalam wadah yang kedap udara

### ESPRESSO

Proses ekstraksi kopi dengan mesin espresso, sebanyak 7-10 gram bubuk kopi yang diberi tekanan air sebesar 8-10 bar, suhu 92°-96°C selama 20-30 detik.

Turunan Espresso: Espresso, americano, doppio, lungo, cafe late, cappuccino, ristretto, mochacino

### PENGOLAHAN KOPI PASKA PANEN

The Processing coffee bean after harvest

### CUPPING

Proses mengobservasi rasa kopi dalam cangkir sebelum disajikan ke penikmat kopi

- Aroma bubuk kopi kering
- Keasaman, kekentalan, kombinasi aroma, sweetness dll



BALAI PENERAPAN STANDAR INSTRUMEN LINGKUNGAN HIDUP DAN KEHUTANAN SOLO  
JL. JEND. A.YANI – PABELAN, KARTASURA PO BOX 295  
SURAKARTA TELP (0271)716709



### SEJARAH KOPI

Tahun 1696  
Kopi dibawa oleh belanda ke Batavia (Indonesia) dengan jenis Arabica

Tahun 1700  
Kopi menjadi komoditas andalan VOC dan penjualannya meningkat hingga pasar eropa sehingga dimonopoli oleh Belanda

Tahun 1876  
Terjadi serangan hama Karat Daun besar-besaran hingga kopi jenis Arabica banyak mengalami kerusakan dan kematian

Tahun 1900  
Dilakukan penggantian kopi dengan jenis kopi Robusta yang lebih mudah dalam perawatannya.

Tahun 2000an  
Indonesia menjadi salah satu penghasil kopi terbesar ke empat di dunia



**Kopi Arabica**  
Cenderung asam, aroma kuat, wangi (buah, bunga), kekentalan sedang-berat, kental, kafein 0,8%-1,4%, bentuk oval

**Kopi Robusta**  
Cenderung pahit, kekentalan sedang-berat, rasa nutty, kafein 1,7%-4%



**Kopi Liberica**  
Cenderung asam, wangi, bentuk oval panjang, kafein 0,7%-1,2%

**Kopi Excelsa**  
Aroma sangat kuat cenderung pahit, biji lebih besar dari arabika dan robusta, kafein 1,7%-3,5%



**Metode picking**  
Buah kopi dipetik khusus yang telah matang satu persatu

**Metode stripping**  
Buah kopi dipetik dari seluruh tangkai

### PROSES KOPI

**Full Washed**  
Biji kopi di cuci dan sekaligus dipisahkan dari kulitnya dengan bantuan mesin

**Natural/Dry proses**  
Biji kopi dikeringkan utuh bersama kulitnya dengan menjemur di bawah sinar matahari

**Semi Washed/Wet Hulled**  
Biji kopi dipisahkan dari kulitnya yang masih basah dan disimpan 1 malam agar mengalami fermentasi dan di cuci. Sisa lendir yang menempel akhirnya menghasilkan biji kopi semi washed

**Honey Proses/Pulvet Natural**  
Biji kopi di kupas dan diambil langsung dengan menggunakan alat mekanis dengan bantuan sedikit air.

**Digestive bio processing**  
Biji kopi dipindahkan ke saluran pencernaan hewan dan mengalami fermentasi alami

**Fermentasi aerob dan anaerob**  
Memasukkan biji kopi ke dalam wadah baik terbuka (aerob) dan tertutup (anaerob)

### C. Posters (in Indonesian)

1. Budidaya Lebah Trigona Mensukseskan Pengelolaan DAS Mikro (Trigona Beekeeping to Support Successful Micro Watershed Management)

**BUDIDAYA LEBAH TRIGONA MENYUKSESKAN PENGELOLAAN DAS MIKRO**

**TRIGONA BEEKEEPING TO SUPPORT SUCCESSFUL MICRO-WATERSHED MANAGEMENT**

**BUDIDAYA LEBAH TRIGONA MENYUKSESKAN PENGELOLAAN DAS MIKRO**  
**MEMINANGKATKAN PENDAPATAN MASYARAKAT**

TANAMAN PAKAN LEBAH DIANTARANYA TANAMAN BUAH DAN SEMOGAM YANG MENGANDUNG SERBUK SARI, NEKTAR DAN GETAH

PRODUKSI LEBAH: MADU, BEE POLLEN, LILIN LEBAH, PROPOLIS

PEMBIAKAN DILAKUKAN SETIAP 6 BULAN

PANEN MADU DILAKUKAN 1-2 BULAN SETELAH MUSIM BUNGA

CIRI MADU MATANG APABILA SARANG MADU/DOMPOLAN TERTUTUP LAPISAN LILIN.

PRODUKSI MADU 600-2.000ML/TH/KOLONI

Balai Penerapan Standard Instrumen Lingkungan Hidup dan Kehutanan Solo

Alamat : Jl. Jend. A. Yani-Pabelan, Kartasura, PO BOX 299 Sukoharjo  
Telp. (0271) 7167090

2. Sambung Pucuk Alpukat: Teknik Mudah dan Murah Pengembangan Budidaya Tanaman Alpukat (Avocado Tree Grafting: An Easy and Cheap Technique for Developing Avocado Cultivation)

# SAMBUNG PUCUK ALPUKAT

(AVOCADO TREE GRAFTING)



### SYARAT :

**Batang Atas :**

- ❖ Dari produksi unggul
- ❖ Mampu menyatu
- ❖ Sehat
- ❖ Tidak bercabang
- ❖ Tidak sedang berdaun muda
- ❖ Panjang 10-20 cm

**Batang Bawah :**

- ❖ Sehat
- ❖ Akar baik & dalam
- ❖ Adaptif
- ❖ Umur 2 s/d 4 bulan



### KENDALA

- ✓ Tanaman Kerdil
- ✓ Cepat mati
- ✓ Kaki Gajah
- ✓ Kaki Bangau
- ✓ Pembungaan lambat
- ✓ Buah Masam

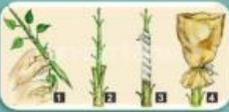


### ALAT & BAHAN

- ✓ Alat Potong
- ✓ Sungkup
- ✓ Tali Plastik
- ✓ Seedling & Entrees

### CARA KERJA

- Siapkan seedling & entrees
- Pangkas daun entrees
- Sayat runcing bagian pangkal entrees
- Potong seedling 10-20 cm
- Belah bagian tengah
- Masukkan entrees
- Ikat dengan tali plastik




**Balai Penerapan Standar Instrumen Lingkungan Hidup dan Kehutanan Solo (BPSILHK) Solo**  
 Jl. A. Yani – Pabelan, Kartasura  
 PO.BOX 295 Surakarta, Jawa Tengah  
 Telp. (0271) 716 709




3. Bank Sampah: Sebuah Upaya Pengelolaan Sampah Rumah Tangga (Waste Bank: An Effort to Manage the Household Waste)

**BANK SAMPAH**  
**Waste Bank**

Tempat mengelola sampah dengan prinsip 3R (Reuse, Reduce, Recycle)

**JENIS-JENIS SAMPAH**

- Organik
- Logam
- Kertas
- Plastik
- Kaca

**MEKANISME KERJA BANK SAMPAH**

- 1. Pemilahan sampah**  
Sampah dipilah sesuai jenisnya
- 2. Penyetoran sampah**  
Sampah berpisah diserahkan ke Bank sampah
- 3. Penimbangan Sampah**  
Sampah ditimbang untuk mengetahui beratnya
- 4. Pencatatan**  
Hasil timbangan dicatat di buku tabungan
- 5. Penilaian sampah menjadi uang**  
Usabah menikmati hasil tabungan sampah

**3R**

- Magot
- SSM
- Kerajinan
- Kompos

**BALAI PENERAPAN STANDAR INSTRUMEN LINGKUNGAN HIDUP DAN KEHUTANAN SOLO**  
Alamat : J. Jend. A. Yani-Pabelan . Kartasura POBOK 295, Sukakarta. Telp. (0271) 716709

APENet

#### 4. Pengolahan Kopi Paska Panen (The Processing Coffee Bean After Harvest)

## KOPI

### PENGOLAHAN PASCA PANEN

The processing after harvest

#### Proses kopi

- **Full Washed.** Kopi dicuci dan dipisahkan dari bijinya
- **Dry proses.** Kopi dijemur utuh
- **Wet Hulled.** Kopi dikupas tanpa cuci dan difermentasikan
- **Pulpet Natural.** Kopi dikupas dengan sedikit air
- **Digestive bioprocessing.** Kopi dimasukkan ke pencernaan

#### Espresso (ekstraksi)

#### Penyimpanan biji kopi

- Jauhkan dari benda berbau tajam
- Hindari terkena sinar matahari langsung
- Simpan di suhu ruangan dan kering
- Masukkan ke wadah kedap udara

#### Roasting biji kopi

Level Roasting

**APFNet**

**BALAI PENERAPAN STANDAR INSTRUMEN LINGKUNGAN HIDUP DAN KEHUTANAN SOLO**

Jl. A. Yani-Pabelan, Kartasura PO BOX 293, Surakarta  
Telp. (0271) 716709

**D. Documentary Film (in CD/Google Drive)**

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

This document is presented in a separate way through APFNet Google Drive:

(<https://drive.google.com/drive/folders/1gXqDNzku-f9thgG-fjYDq0m3puuXSnA>)



**Balai Penerapan Standar Instrumen Lingkungan Hidup dan Kehutanan - Solo**  
bekerjasama dengan  
**Asia-Pacific Network for Sustainable Forest Management and Rehabilitation**