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

PROJECT PROPOSAL

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

Watershed Management Technology Center (WMTC),
Research, Development and Innovation Agency,
Ministry of Environment and Forestry of Indonesia

April 2020

Project title	Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed (Phase II)	
Supervisory agency (if any)	Extension and Human Resources Development Agency, Ministry of Environment and Forestry, Indonesia (BP2SDM)	
Executing agency	Watershed Management Technology Center (WMTC)	
Implementing partners (if any)	-	
Expected project duration: 1 August/2020 to 31 July/2022, 24 months		
Target area (project locations and context) Naruan Micro Catchment is located in the upstream of Keduang Watershed, The Upper Bengawan Solo River Basin. Administratively, it is situated in Wonogiri and Karanganyar Districts, Central Java Province. The micro catchment is divided in 3 villages i.e Bubakan, Wonorejo, and Wonokeling (see: Annex A-1. and B-1.)		
Total budget (USD)	Expected APFNet grant (USD)	Conounterpart contribution (USD) (in cash and in-kind)
245,324	99,820	145,504
Project summary: (1) Problems/issues to be addressed Watershed management in Indonesia still has many obstacles. Many environmental problems in the watershed, such as floods, droughts, landslides, and sedimentations show the less successful watershed management, especially at the operational level. Sedimentation issues also become concern in the management of Multipurpose Reservoir of Gajah Mungkur (MRGM) of Wonogiri District. The issue has become a national issue, because the reservoir MRGM has a strategic function as a flood control in the Upper Solo watershed, as suppliers of agricultural water in many districts in the downstream, and as electric power plant. The high rate sedimentation cause in MRGM was the high rate of soil erosion in the catchment area, especially from Keduang Watershed. This was a result of land cover condition which was lack of forest cover. Based on the land cover analyses using 2011 Landsat 7 ETM, forest cover in the area was only 2.25% of the total area. The condition was worsening by the behavior of people who are paying less attention to soil and water conservation in managing their land. The high rate of population led to population pressure on land resulting in excessive use to land, and this might trigger land degradation. In the context of watershed management, two problems will be resolved through this project, namely environmental problems in the form of high erosion rates, and low income resulted from low land productivity caused by inappropriate land use. The problems were aggravated by the population pressure on land and peoples' who neglecting soil and water conservation which tend to triggere land degradation. To overcome this problem, examples of sustainable land management practices are needed through the creation of a demonstration plot along with the stages of participatory land management planning. By improving land cover condition and implementing soil and water conservation technique appropriately, it is expected to enhance the ecological functions and improve the socio-economic conditions of the local farming community.		

(2) Goal and Objective

The goal is to build a model of successful watershed management at the operational level (micro catchment). This model may be used as an example of the successful watershed management to be applied in other micro catchments. The objective of this project is to implement micro catchment management by improving the available plan and extending the impact area, based on community participation and stakeholder collaboration, considering the soil and water conservation principles.

(3) Expected outputs/outcomes and key activities

The expected outputs/deliverables of this project are:

- a. Detailed participatory land management plan for the demonstration plots
- b. Demonstration plots of conservation farming and watershed rehabilitation
- c. Enhancement farmers' skill and income through on-farm and off-farm activities
- d. Information on the impacts of the demonstration plots of conservation farming and watershed rehabilitation
- e. Recommendation and policy brief of the best agroforestry model

(4) The key activities are:

- a. Focus Group Discussion (FGD) among stakeholders
- b. Implementation of micro catchment management through the development of conservation farming demonstration plots
- c. Training to improve farmers skill in processing agricultural yields for higher value-added products, processing household and agriculture waste, and beekeeping
- d. Monitoring and evaluation (M&E) on the performance of micro catchment
- e. Discussion, socialization and workshop regarding the formulation of best agroforestry model and policy brief to sustain its application in national level

(5) Potential beneficiaries and main stakeholders

Potential beneficiaries and main stakeholders of the project are local community, central governments (the Directorate General of Watershed Controlling and Protected Forestry, Ministry of Environment and Forestry-MEF), local governments (district sectoral agencies), watershed management practitioners (private sectors, state-owned enterprises), and scientific community (researchers and university).

(6) Methodology and approaches

This project is an action research activity with the approach of micro catchment as a management unit that includes planning, implementation, monitoring and evaluation of watershed's performance. Micro catchment management planning approach has been done comprehensively through the identification of issues, problems, and the potential vulnerability of watersheds that include hydrology, land use and socio-economic institutions, and continued with the preparation of participatory planning. Planning and implementation activities on demonstration plot scale are undertaken collaboratively by involving all relevant parties (stakeholders) in watershed management, with the community as the main actor in it. Monitoring and Evaluation (M&E) is conducted using Criteria and Indicators (C&I) that have been built covering aspects of water, land and socio-economic-institutional, and performed in the micro watershed scale, landscapes and households.

(7) How the project could be sustained

Some approaches will be used in order to ensure the sustainability of the project:

- a. Communicating and consulting to various stakeholders on the project site, through FGD involving all concerned parties in micro catchment management
- b. Assigning committed personnels from each stakeholders to be part of the team to improve sense of responsibility to the whole project processes
- c. Encouraging stakeholders to be actively participate in the implementation of the project by involving them in each project activity stages
- d. Conducting workshop to validate the newly revised or redesigned monitoring system and techniques, regulation, guidelines and manuals
- e. Exposing and disseminating the project output to all stakeholders and local community

Project Proponent(s):

Contact organization/entity : Watershed Management Technology Center (WMTC)

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Abbreviations and acronyms

Bappeda/Baperlitbang	:	<i>Badan Perencanaan Pembangunan Daerah/Badan Perencanaan dan Penelitian-Pengembangan Daerah</i> (District Planning, Research and Development Agency)
BP2SDM	:	<i>Badan Penyuluhan dan Pengembangan Sumber Daya Manusia</i> (Extension and Human Resources Development Agency/ EHRDA)
BPDASHL	:	<i>Balai Pengelolaan DAS dan Hutan Lindung</i> (Watershed and Protection Forest Areas Management Office/ WPFAMO)
FGD	:	Focussed Group Discussion
FORDIA	:	Forestry Research, Development and Innovation Agency
JICA	:	Japan International Cooperation Agency
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
PDASHL	:	<i>Direktorat Pengendalian DAS dan Hutan Lindung</i> (The Directorate General of Watershed and Protection Forest Management)
RPJM	:	<i>Rencana Pembangunan Jangka Menengah</i> (Medium-Term Development Plan)
WMTC	:	Watershed Management Technology Center

Project details

1. Background

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

Among the 18 river that goes into MRGM, the Keduang River is the river which has the largest watershed area, as well as the largest contributor of sediment. JICA's (Japan International Cooperation Agency) study showed that in the period of 1993-2004, the average sediment that has flowed to MRGM was 3.18 million $\text{m}^3\cdot\text{y}^{-1}$. The biggest sediment contributor was Keduang Waterhed that was approximately $1.22 \text{ m}^3\cdot\text{y}^{-1}$ or about 33% of total sediment (Rahman, et al., 2011). Moreover, Tjakrawarsa & Pramono (2012) revealed that in the period of 1994-2002 sediment loaded in Keduang River was about $29.36 \text{ ton}\cdot\text{ha}^{-1}\cdot\text{y}^{-1}$ and in the period of 2009-2010 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 Waterhed using USLE (Universal Soil Loss Equation) model, and the result showed that soil erosion in Keduang Sub Watershed was about $44.00 \text{ ton}\cdot\text{ha}^{-1}\cdot\text{y}^{-1}$ or 1.9 million $\text{ton}\cdot\text{y}^{-1}$. This erosion value was equal to 164,000 $\text{ton}\cdot\text{y}^{-1}$ of sediments. Other study resulted by Rahman et al., (2012) using AVSWAT (Arc View Soil and Water Assessment Tool) model revealed the total erosion of Keduang Sub Watershed was $172.24 \text{ ton}\cdot\text{ha}^{-1}\cdot\text{y}^{-1}$. or equal to 1.15 million $\text{ton}\cdot\text{y}^{-1}$ of sediments. This erosion value was higher than that of the previous study.

The high rate sedimentation cause in MRGM was the high rate of soil erosion in the catchment area, especially from Keduang Watershed. This was a result of land cover condition which was lack of permanent vegetation cover. Based on the land cover analyses using 2011 Landsat 7 ETM (Land Remote-Sensing Satellite 7 Enhance Thematic Mapper), 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 less attention to soil and water conservation in managing their land. The high rate of population led to population pressure on land resulting in excessive use to land, and this might trigger land degradation.

The NMC is in the upper part of the Keduang watershed. NMC locations have hilly and mountainous topography. As much as 60% of the land has a slope of 25-45%, and >30% of the area is in slope >45%. Based on the results of Wahyuningrum and Supangat (2016) analysis, it was concluded that most of the NMC areas were in land capability classes VI and VII with a slope limiting factor, which means that in theory the area should have permanent cover. However, actual land cover is mostly in the form of dry land (dry land agriculture), and forests cover only occupy 20% of the area. This condition causes high erosion potential (>70% in severe and very severe erosion class), and is thought to have an impact on the high sedimentation rate at MRGM. This is a challenging situation that might be solved.

2. Significance and Necessity

To overcome the problems of soil erosion and sedimentation in the Keduang Sub-Watershed, a cooperation project with the title "Development Participatory Management of Micro Catchment

at The Bengawan Solo Upper Watershed” has been implemented in 2017-2019. The project was funded by APFNet and was completed. Project output has been produced and disseminated to parties through several media. Land management plans have been produced in the framework of watershed management on the micro-scale. The spatial plan has mapped the locations that need to be rehabilitated along with recommendations for its mitigation. To support the rehabilitation activities, stakeholders who directly involved and those who have the potential to support have been identified. Follow-up of the project is deemed necessary, especially to expand the impact of the activities on the general public and the impact on improving environmental quality, as well. Therefore, we propose a Phase II project. In the second phase, there will be an expansion of the rehabilitated area, an increase in the number of farmers involved and additional training activities. In addition, a special model area will be built, mainly managed by the WMTC team by applying the best model produced by previous activities. Water quantity and quality observations continue to be made so that the impact of activities on the environment will be known.

The Phase II Project is relevant to the APFNet Thematic Priority 1 (Promoting sustainable forest management to enhance ecological functions and ecosystem security of forests), and Priority 3 (Enhancing forests’ contribution to socio-economic development and improvement of local livelihoods). Moreover, it is included in project category of “Demonstration Projects”. Location of the project is the upstream of Bengawan Solo River Basin which is the one of 108 priority watersheds that should be restored in medium-term development plan (RPJM) of 2010-2014, and continued in period of 2015-2019. The river basin is also included in 4 super priority watersheds that should be restored until the year of 2024 related to the national issues of highly erosion rate at upstream and flooding at downstream. This project supports the national priority of food sovereignty and rural region development, especially in Priority Program of Natural Resources Management and Sustainable Environment. Activities of the project are in accordance to the priority activities of MEF namely (1) irrigation rehabilitation, upper watershed rehabilitation, dam and small dam development, and (2) strengthening the capacity of rural communities and indigenous peoples in the utilization of natural resources, environmental management, and appropriate technology.

Phase I Projects have been organized in 2017-2019 to manage Naruan Micro Catchment (NMC) which aims to build a model of participatory micro catchment management. This project integrated the management of various sectors from upstream to downstream by considering the various interests, biophysical, and socio-economic existence. Action research at the operational scale has been developed by means of participatory and collaborative managements based on the principles of soil and water conservation. This was done to overcome the issue of soil erosion which contributes to the high rate of sedimentation in MRGM, located at the downstream.

Participatory management plans for the area have already been arranged. Plan draft contains the indicative area that should be rehabilitated as well as community development plans and coordination mechanism between the parties. Based on the analysis, of the total NMC covering 957.1 ha, there were 594.4 ha (62.10%) of land that must be rehabilitated. Of the 594.4 ha, almost 30% of the area are on 45% slope which is very vulnerable to being degraded. This figure consists of actual cover of dry field area (370.2 ha) and mixed gardens (224.2 ha). To overcome this issue, demonstration plots of integrated farming system in the form of agroforestry has been built, covering an area of approximately 50 ha and distributed in 3 villages. To support these activities

community empowerment was carried out by establishing farmer working groups and training on soil conservation techniques as well as comparative studies on integrated agriculture to several locations with different topics. Farmers working groups has been involving 86 persons from 3 villages.

In addition to the land cover improvement plan, potential points for the implementation of technical civil activities have also been identified, including the construction of small checkdams (7 units), gully plugs (67 units), landslide control buildings (37 units) and check dams dredging (7 points). Some of them have been successfully executed in the first Phase, in the form of 34 units small gully plug and 4 units small check dam.

The impact of rehabilitation activities on the environment is carried out through climate and hydrological observations which began in 2015 and are expected to continue to approximately the same cycle of Albizia plants.

Based on the progress activities in 2017-2019, there are still a number of activities needed include:

- a. Expansion of agroforestry plot on the vulnerable areas
- b. Addition of civil technique conservation structures
- c. Establishing and training of farmer groups

Besides that, additional activities are needed to reduce population pressure on land and to increase non-land based income such as processing agriculture product and apiculture. Monitoring and evaluation (M&E) are also still needed to observe the impacts of the construction of demonstration plots on the environment and socio-economic aspects.

3. Goal and Objectives

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

The objective of this project is to implement micro catchment management by improving the available plan and extending the impact area, based on community participation and stakeholder collaboration, considering the soil and water conservation principles. The well managed micro catchment may enhance ecological functions by improving environmental services such as land and water sustainability, as well as promote socio-economic development by increasing land productivity and community welfare.

4. Outputs and Strategic Activities

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

The detailed planning of participatory land management for the demonstration plot is based on the micro watershed management plan that was designed in 2016 (through activities funded by the Government of Indonesia's National Budget). Therefore, the location of the demonstration plot is in 3 villages in the NMC, namely Wonorejo and Wonokeling Villages in Karanganyar District, and Bubakan Village in Wonogiri District.

Activity 1.1. FGD to develop participatory demonstration plot

Detailed planning for participatory land management is carried out through FGDs. Based on experience in Phase I, FGD's participants for Phase II will focus on the farmers in managing the demonstration plot (even if they are not the landowner). The demonstration plot location in Phase II is the area that has been included in the micro catchment management plan, but there is no implementation of activity in Phase I. Therefore, FGD's participants are land managers whose land is selected for the demonstration plot. They have also participated in the socialization in Phase I. They will be named field partners (FP's).

FGDs will be held in 3 villages, once in each village and each FGD will be attended by 30 FP's. The FGD will produce a detailed participatory land management plan for each land ownership that includes plant species and compositions. The FGD will also discuss the needs and location of conservation buildings. The types and composition of plants discussed are those that have the best performance in Phase I. In addition, through this FGD, it will also be agreed on types of training to increase the capacity and income of the community.

Activity 1.2. FGD among stakeholders to support the implementation of activities

FGD will be held in 2 districts (Wonogiri and Karanganyar). FGD in each district will be attended by 40 participants. The participants consist of local institutions such as BPDASHL, Bapperlitbang, local sectoral institutions, extension agents, NGO, and village government. The FGD will result in the commitment of all stakeholders (government institution/officers) to support implementation of the design according to their duties and functions.

Output 2. Demonstration plots of conservation farming and watershed rehabilitation

In this activity, two types of vegetative demonstration plots will be built, namely participatory demonstration plots and non-participatory demonstration plots (as a controlled treatment). Participatory demonstration plots are built based on the results of Activity 1.1. Non-participatory demonstration plots are intended to build the ideal demonstration plots in accordance to the basic concepts of the research team and are carried out under the control of the research team as well. Activities will consist of land rehabilitation through the application of soil and water conservation using vegetative and civil technique methods.

Activity 2.1. Determining the site of demonstration plot

Based on the results of Activity 1.1., a mapping of participatory demonstration plots area will be carried out. The plots will be mapped based on the field measurement (land boundary, slope, soil depth, etc.). The team and FP's will work together to map the plots. Field measurement will be conducted in every land parcel. The same activity will be carried out on non-participative demonstration plot land.

Activity 2.2. Applying vegetative soil conservation measures

On the participatory demonstration plot, vegetative soil conservation measure will be applied on approximately 30 ha distributed in 3 villages. Agroforestry pattern will apply the combination of timber trees, Multi-Purpose Trees Species (MPTS), and seasonal crops. The tree species and composition depends on the output of Activity 1.1.

In non-participatory demonstration plots, the types and composition of plants used were those that have the best performance in the Phase I. The construction of this demonstration plot was not carried out in a participatory manner but directly controlled by the WMTC team so that the plots that were built can really be used as a model for the community.

Activity 2.3. Applying civil technique soil conservation measures

In Phase II there will be built 23 units of gully erosion control, consisting of 20 units gully plug and head structure from bamboo, and 3 units small check dams using "spesi" (cemented-stone material). Conservation buildings will be built at the location that already exists in the micro catchment management plan (Annex C) and also based on the results of Activity 1.1.

Output 3. Enhancement of farmers' skill and income through on-farm and off-farm activities

Activity 3.1. Development of apiculture

The development of honey bee culture is a follow-up of the recommendation from the FORDIA monitoring and evaluation team to improve the community income. In Phase I, 10 colonies of *Trigona spp.* were given to two villages as well as the training on how to cultivate honey bees. In Phase II, the development of honey bee culture will be carried out through training and providing honey bee packages. Each group of demonstration plots (each village) will receive 5 units of honey bee colonies. Beekeeping training will be conducted once for each village, which will be attended by 30 FP's in each village.

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

The training will be conducted twice in each village with 15 participants per village. The training material is based on the results of the FGD in Activity 1.1. Training will be conducted by the WMTC team in collaboration with the relevant agencies in each district in accordance to the results of the FGD on Activity 1.2. FGD among stakeholders to support the implementation of activities.

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

Training to process waste from household and agriculture is conducted to address environmental problems in the three villages where the project is taking place. The training will be conducted once in each village with 30 participants in each village. Training will be carried out by the WMTC team in collaboration with the relevant agencies in each district in accordance to the results of the FGD on Activity 1.2.

Output 4. Information on the impacts of the demonstration plots of conservation farming and watershed rehabilitation

Data collection on the impact of demonstration plot development will be carried out through monitoring and evaluation (M&E) activities on the hydrological, land and socio-economic aspects. M&E is carried out on all demonstration plots built-in Phases I and II. Nonetheless, funding for M&E of the demonstration plots Phase I will be provided by WMTC.

Activity 4.1. Water yield and sedimentation monitoring

The equipment used in this activities are rain recorder, water level recorder, and sediment collectors. Some of the equipment is already installed in the area by WMTC. Some equipment is still needed, so that the observation can be carried out continuously with better data quality. The output of this activities are monitoring report and its analyses related to water and sediment yield and water quality.

Activity 4.2. Land evaluation

Land evaluation will be held through calculation of soil erosion rate based on the change in land cover resulted by the project. Measurements are done prior to and after the implementation of activities. The calculation will use USLE equation. For these calculations, an analysis of soil samples to calculate soil erodibility values, rainfall data analysis, slope, and soil conservation techniques are needed. In addition, there will also be an observation of the growth performance of perennial crops in the plot.

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

The evaluation will find out benefit cost of farming system, community participation in demonstration plots development, and institutionalization of land rehabilitation and soil conservation efforts. The evaluation will be held through observation, interview and direct measurement. This economic data collection will be conducted based on planting season.

Output 5. Recommendation and policy brief of the best agroforestry model

Recommendations and policy brief of the best agroforestry model will be formulated at the end of the project of Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed (Phase II).

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

The selection of the best agroforestry model is done by analysing the results of M&E activities which consist of water yield and sedimentation monitoring (Activity 4.1.),

Land evaluation (Activity 4.2.), and evaluation of economic and social aspects on land management (Activity 4.3.). For this purpose, an internal meeting will be held twice during the project. The participants of the meeting are the project team, the project consultant, and internal monitoring team. The outputs are the formulation of the recommended agroforestry model and a policy brief.

Activity 5.2. Workshop to share and discuss the project results

Workshop will be held once during the project. Workshop will be attended by 50 participants representing stakeholders (BPDASHL, Bapperlitbang, local sectoral institutions, extension agents, NGO, village governments, and representative of FP). The results of the workshop are feedback from stakeholders on the implementation of the project and the recommended agroforestry model.

5. Budget, Funding Resources and Financial Management

Project budget is constructed based on activities. They are presented in Annex A-4. Activities based budget include 13 activities supporting 5 outputs. Ten activities will be conducted in the first year, and eight activities in the second year. In the first year (period of August 2020 – July 2021) the amount of the proposed activities budget to APFNet is USD 65,144 with the contribution of counterpart (MEF) is USD 71,223. In the second year (period of August 2021 – July 2022), it will be USD 34,676 with the contribution of counterpart is USD 74,281. The total proposed budget for APFNet is USD 99,820 while the total contribution of counterpart is USD 145,504.

The project will be conducted through collaboration and participation with local community and also the stakeholder in the field. Therefore, the important aspect to be achieved by the end of the project is the self-reliance local community. The project will encourage the contribution of local community in the form of land and labor cost, the local governments (local sectoral institutions) and private sector according to their interest.

The use of the budget will be audited by a legitimate independent auditor. Auditing will be conducted upon the completion of each project year. The auditor will make a report and statement based on the assessment of the spending funds.

6. Monitoring and Evaluation

Four key indicators are used to monitor and evaluate the achievement of project objectives. Those are biophysical, social, economic and institutional indicators. Criteria for biophysical indicator are enhanced land cover, reduced flow coefficient, decreased sediment, reduced soil erosion, increased organic matters, and increased crop yield. Criteria for social indicator are improved understanding of soil and water conservation, improved community behavior in soil and water conservation, and increased community participation. Criterion for economic indicator is increased community income from agricultural sector and non-land based. While criteria for institutional indicator are improved farmer group dynamic and increased integrated activities of water and soil conservation. The successful micro catchment management is indicated by the change in the value of criteria as described in Table 1.

Table 1. Criteria for successful micro catchment management

Indicator	Criterion	Verifier
Biophysical	<ul style="list-style-type: none"> - Enhanced land cover - Reduced flow coefficient - Decreased sediment - Reduced soil erosion - Increased organic matters 	<ul style="list-style-type: none"> 30% after 5 years 10% after 5 years 15% after 5 years 30% after 5 years 5% after 5 years
Social	<ul style="list-style-type: none"> - Improved understanding of soil and water conservation - Improved community behavior in soil and water conservation - Increased community participation 	<ul style="list-style-type: none"> - People who apply soil and water conservation increase 10% - Community self-reliance in soil and water conservation activities increase - Community participation in farmer group activities rise 10%
Economy	Increased land based income in household level	20% after 5 years
Institution	<ul style="list-style-type: none"> - Improved farmer group dynamic - Increased integrated activities of water and soil conservation 	<ul style="list-style-type: none"> - Administrative requirements for farmer group (articles of farmer group and bylaws, work plan, organizational structure) - Decision making process is done democratically - Type and quantity of proposed activities from farmer group increase - Area and frequency of soil and water conservation activities increase

There will be two M&E activities, namely performance M&E and management M&E. The first M&E aims to evaluate the effects of treatment to the micro-catchment performance. This activity will conduct in phase of before and after implementations. M&E activity at the beginning of the project is aimed in collecting baseline data that were considered as preliminary data before treatment, while M&E at the end of the project is intended to evaluate the impacts of activities/treatments on the performances of the NMC.

The management M&E will be conducted by the two agencies namely BP2SDM and FORDIA who are responsible for directing WMTC in the implementation of the project. This activity aims to monitor the overall implementation of the project in accordance to the project proposal. In addition, they also supervise the implementation of the project based on feasibility and efficiency budget in accordance to financial administration regulation.

7. Dissemination and Sustainability

Outputs of the project that will be communicated are: 1) The stakeholder's awareness to the problems of NMC, 2) Participatory planning process of Micro Catchment management, 3) Stages of management activities of NMC, 4) Implementation of Naruan Micro Catchment management such as development of demonstration plot and community empowerment, 5) Monitoring and evaluation of the performance of NMC management (Annex A-6).

Base line data of demonstration plots will be presented in the form of leaflet and others which contains the vulnerability of land and hydrological, also social, economic, and institutional conditions. Participatory planning process of Micro Catchment management will be communicated through APFNet and WMTC Websites, social media and leaflets. The planning of NMC management will be documented in the form of book and distributed to APFNet and stakeholders for instance BP2SDM, BPDASHL, BAPPEDA, farmer groups etc. Leaflets, newsletters, and APFNet and WMTC Websites will be used to share implementation process of NMC management (community empowerment and demonstration plot development), while monitoring and evaluation of the performance of NMC management will be informed through leaflets, blogs and APFNet Website. All documents will be supported with photos, videos and maps. At the end of every fiscal year, technical books report are made and will be distributed to the focal point, high level institution, and main related institutions.

Target audience of the communications are: focal point (BP2SDM), Directorate General PDASHL, public who interested on soil and water conservation and watershed management, local governments, students with subjects on environment, forestry, or civil engineering concentration, etc.

At the end of the project, a model of NMC management, which is properly planned, participatory implemented, and well monitored, will be obtained. Institutional of NMC management is also build during the project implementation. For the sustainability of NMC management, community are expected already have self-reliance in applying water and soil conservation, also in social, economic and institutional development. Besides of that, WMTC will conduct a workshop with stakeholders and hand over responsibility of demonstration plot management to local government i.e. Wonogiri and Karanganyar Districts. However, WMTC will continue the research activities.

Project outputs will also be disseminated and published in various forms of media publications. Scientific papers are published in the media of journals and conference proceedings. Outputs in the form of thematic technical/ methods are disseminated in the form of a technical guide book or scientific reading book.

8. Guarantee System

8.1 Human Resources

Human resources with different expertise will required to run the project. Every expert has different responsibilities as follows.

Table 2. The project staff and managements

No	Name	Expertise	Responsibilities	Duration of employment
1.	Dr. Agung Budi Supangat	Forestry; Watershed Hydrology	Project coordinator & formulator for operational activities. National Expert for activities: 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 4.1, 5.1, 5.2	Full time
2.	Dr. Nining Wahyuningrum	Forestry; Soil & Water Conservation; Mapping (GIS)	National Expert for the implementation and execution of activities: 1.1, 1.2, 2.1, 2.2, 2.3, 3.3, 4.2, 5.1, 5.2	Full time
3.	Purwanto, M.Sc.	Forestry; Natural Resources Economic	National Expert for the implementation and execution of activities: 1.1, 1.2, 2.2, 2.3, 3.2, 4.3, 5.1, 5.2	Full time
4.	Dr. Dewi Retna Indrawati	Community Development	National Expert for the implementation and execution of activities: 1.1, 1.2, 2.2, 2.3, 3.2, 4.3, 5.1, 5.2	Full time
5.	Dody Yuliantoro, B.Sc.Ag (Administration Staff)	Forestry; Having background in financial works at least 3 years	Researcher Assistant; Assisting Project Coordinator in project financial matters, evaluate and record the budget related the program execution; Prepare progress report.	Full time
6.	Bambang Subandrio, B.Sc.F (Project Secretary)	Forestry; Having background in secretariat works for at least 5 years	Researcher Assistant; Assisting the Project Coordinator on day to day administration activities, filling document, preparing data and draft report outline; Prepare progress report.	Full time
7.	Edi Sulasmiko, B.Sc.Ag	Forestry	Researcher Assistant	Full time
8.	Wika Ardianto	Forestry	Researcher Assistant	Full time
9.	National consultant	Soil & water conservation	Giving assistance and advice in project implementation in accordance with their expertise	Part time
10.	National consultant	Social economic	Giving assistance and advice in project implementation in accordance with their expertise	Part time

8.2 Material Resources

The table below describes the material that the WMTC can provide in connection with the project's activities, as well as the material proposed to be fulfilled in Phase II.

Table 3. Kinds of material resources supporting project activities

No.	Type of equipment materials	Number	Remarks
Equipment provided by WMTC			
1	Office/secretariat	1	WMTC's stuff
2	Vehicle	2	WMTC's stuff
3	Automatic water level recorder (AWLR)	2	WMTC's stuff
4	Portable weather station	1	WMTC's stuff
5	GPS (Global Positioning System)	2	WMTC's stuff
6	Personal computer	5	Purchased in the Phase I
7	Drone	1	Purchased in the Phase I
8	Printer	1	Purchased in the Phase I
Equipment proposed to be purchased by project			
1	Camera DSLR	1	To support documentation activities
2	Handycam	1	To support documentation activities
3	Laptop	2	To support mapping activities (GIS analysis) & digital hydrologic data analysis
4	Mobile projector	1	To support meeting activities
5	AWLR	2	To support water monitoring system
6	ARR (Automatic Rain gauge Recorder)	2	To support water monitoring system

8.3 Policy and Regulation

The legal basis for implementing watershed management activities in Indonesia is Government Regulation No. 37 of 2012, which provides guidance and norms in managing a watershed. As for the operational level, Director General of Land Rehabilitation and Social Forestry's Regulation No. P.15 of 2009 concerning Micro Catchment Management regulates the procedures for integrated management of various sectors from upstream to downstream by considering various interests, biophysical and socio-economic conditions in a narrow area in the upper watershed. Both regulations are in line with a higher legal regulation, namely Decree No. 37 of 2014 concerning Soil and Water Conservation.

The project location (NMC), located in upper-side of Keduang Sub Watershed, is the upstream of Bengawan Solo River Basin which is one of 108 priority watersheds that should be restored in the National Medium-Term Development Plan (RPJMN) of Indonesia in period of 2015-2019, and continued in period of 2020-2024. Bengawan Solo River Basin also includes in 4 super-priority watersheds in Indonesia that should be restored related to the national issues of highly erosion rate at upstream and flooding at downstream. Based on the Wonogiri District RPJM, the Keduang Sub-watershed is one of the 3 priority sub-watersheds (Keduang, Wiroko, and Upper Solo) in the MRGM catchment area, which experiences high levels of

erosion-sedimentation triggered by land use that neglects the rules of soil and water conservation.

This project supports the national priority of food sovereignty and rural and rural region development, especially in the Priority Program of Natural Resources Management and Sustainable Environment. Activities of the project are following the priority activities of MEF namely (1) irrigation rehabilitation, upper watershed rehabilitation, dam and small dam development, and (2) strengthening the capacity of rural communities and indigenous peoples in the utilization of natural resources, environmental management, and appropriate technology.

8.4 Organizational Capacity

The project implementation requires cooperation from some institutions as supporting and executing partners. These institutions are not only from central but also local government (regency, districts, and village), private sectors, and local community. The role of each institution as follows.

Table 4. The related stakeholders of project and their responsibilities

No	Stakeholders	The role in the project
1.	WMTC of Solo (researcher)	The project proponent; The institution under FORDIA The leading institution in the project implementation
2.	BP2SDM	Focal point; Users of the project result
3.	BPDASHL Solo	Part of the project implementation from planning, implementation, monitoring and evaluation, and supervision. Users of the project result and technology
4.	Local community/farmer groups	Target groups; Operational implementer of project activities
5.	District and Village Government	An intermediary institution between research team with community
6.	Regional Planning and Development Agency (Bappeda/Baperlitbang), of Wonogiri and Karanganyar District	A regional planning agency that involve in planning of integrated participatory management of micro catchment to be synchronized with Bappeda work plan.
7.	Local Sectoral Institutions in Wonogiri and Karanganyar District	Local technical institutions that involve in the project implementation from planning to evaluation in accordance with their job descriptions
8.	Government Technical Institutions	Part of the project implementation from planning, implementation, monitoring and evaluation, and supervision; Users of the project result and technology
9.	Extension agents in Wonogiri and Karanganyar District (Under The Provincial Forest Services Institution)	An intermediary agents between research team with community; Community assistant during the project implementation from planning up to the project evaluation
10.	Private sectors	Financial contributor in project implementation through Corporate Social Responsibility activities; Business partners in agricultural product marketing

Chart of stakeholder role in every step of project implementation is presented in the figure below.

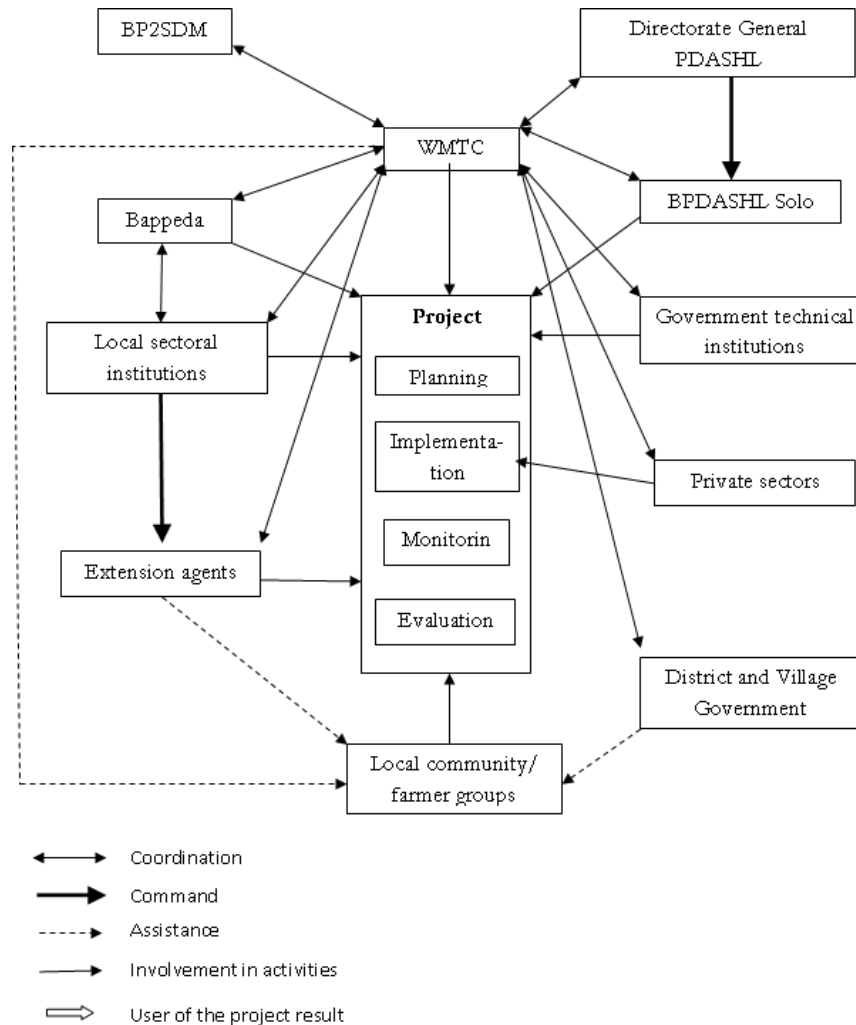


Figure 1. Organizational chart of stakeholder's role in project implementation

9. Risk Assessment

Participatory management is the management that involves all stakeholders. In this concept, the parties must be proactive and be able to determine for themselves the role they will take, including the risk (positive or negative) that they will encounter. Some of the risks that will arise and how to resolve it as follows:

(1) Equality of the parties

In participatory management, equality of all parties is a must. It is very often that participation turns into mobilization while volunteer engagement becomes forced participation. Sometimes researchers and also other stakeholders often impose the will to farmers, so farmers become powerless. To resolve this issue, all stakeholders must be well informed about the subject, the

two-way communication line should be developed so that a fair decision can be made to accommodate the interests of many parties. For those who have not agreed, they may be given sufficient time and not to be forced.

(2) The involvement of the parties

Often the parties are still doubtful to accept the given innovation. This will lead to the involvement of the parties less than the maximum. This problem can be solved by providing the opportunity to stakeholders to play an active role in the planning, implementation, and monitoring-evaluation phases. Further, the farmer communities will be encouraged to enhance their capabilities and knowledge, through training and excursion to the regions with the same physical conditions which have already introduced sustainable agriculture.

(3) Natural disasters

Risks that may occur are natural disasters, such as landslides, drought, pests and diseases, looting, etc. To anticipate this situation, the communities are prepared to be independently able to repair and maintain the demonstration plots, assisted by the project team during the project.

(4) Continuity of Funding

Financing is one element that is crucial, both in its adequacy and sustainability. Therefore, from the beginning it is necessary to build commitment to the community that the financing of this project is only an incentive to support independent soil and water conservation.

Annexes:

Annex A – Attached tables

Annex A-1 Basic information of project sites

Project is located in NMC, upstream part of Keduang Watershed, The Upper Bengawan Solo River Basin. This site has a strategic role because it is in the catchment of the MRGM. The MRGM was built in 1970 which serves as the Solo River flood control, sediments storage, as well as providers of agricultural raw water to the downstream area. At the beginning of construction, the reservoir has a maximum capacity to store sediment by 120 million m³ (assuming the rate of sedimentation in the reservoir is an average of 2 mm/yr).

Among the six catchments in MRGM, Keduang Watershed becomes the greatest sediment contributor to this reservoir, so Keduang Watershed becomes one of the priority watersheds that should be handled in upper Solo River Basin management. Many studies reported that there are severe soil erosion and sedimentation. Solo River Basin is one of the 108 priority watersheds that should be restored in medium-term development plan (RPJM) of 2015-2019, and it is also included in 4 super priority watersheds that should be restored until the year of 2024.

In the context of socio-economic development, the project area includes the Karanganyar and Wonogiri Districts, Central Java Province, Indonesia. These districts are the priority targets of national development of rural and rural region development (*Pembangunan Desa dan Kamasan Perdesaan*) through land productivity improvement by the development of an integrated conservation farming (agriculture-forestry-livestock), which involves the local economic potential and natural resources that exist in the village, as well as community capacity building (empowerment).

Annex A-2 Location of field activities

Administratively, the Naruan Micro Catchment (NMC) is located in two districts, namely Karanganyar and Wonogiri Regency. The overall area of the NMC is 957.12 ha. Based on administrative areas, NMC covers 3 villages, namely Wonokeling, Wonorejo, and Bubakan Villages. The area of each village is presented in Table 5.

Table 5. Administrative region of NMC

Village Name	Sub District	District	Area (ha)
Wonokeling	Jatiyoso	Karanganyar	288.88
Wonorejo	Jatiyoso	Karanganyar	174.90
Bubakan	Girimarto	Wonogiri	493.34
Total area (NMC)			957.13

There are 3 tributary streams in the NMC that converge before reaching the outlet. Thus in NMC, there are 3 smaller catchments, namely Branjang, Anget, and Muncar. At the outlets of each catchment, an automatic water level logger and peilscal monitor is installed. The proportion of the area of each catchment area is presented in Table 6, while the pictures of each catchment can be seen in Figure 2.

Tabel 6. The area of the NMC based on its tributaries

Tributaries name	Catchment area	
	(ha)	(%)
Branjang	307.16	32.09
Anget	172.36	18.01
Muncar	282.17	29.48
Downstream NMC	195.44	20.42
Total (NMC)	957.13	100.00

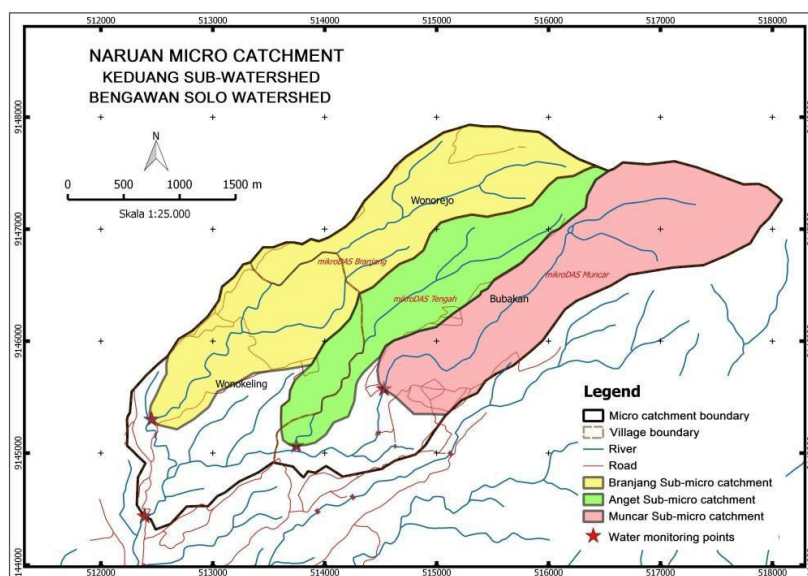


Figure 2. Hydrological monitoring points of NMC

Annex A-3 Project logical framework

Items	Intervention logic	Objectively verifiable indicators of achievement ⁵	Sources of information and means of verification ⁶	Assumptions ⁷
Goal	To build a model of successful watershed management in accordance with soil and water conservation principles at the operational level (micro catchment scale)	<ul style="list-style-type: none"> - Improved implementation of watershed management at the operational level - Improved environmental services provided by catchment - Improved related regulation 	<ul style="list-style-type: none"> - Demonstration plots - Project report - Documentations: photos and video 	FP's, local government and relevant stakeholders consistently support the implementation of project results
Objectives²	To implement micro catchment management by improving the available plan and extending the impact area	<ul style="list-style-type: none"> - Increased number of forest cover - Increased number of soil and water conservation practices - Increased community skill and participation in land rehabilitation and soil conservation - Adopted participatory planning of micro catchment - Well established coordination across institutions 	<ul style="list-style-type: none"> - Demonstration plots - Project report - Documentations: photos and video 	FP's and all relevant stakeholders willing to participate in the project implementation
Expected outputs³ Output 1	Detailed participatory land management plan for the demonstration plot	<ul style="list-style-type: none"> - Detailed planning of demonstration plots for each land ownership - Planning of civil technique soil conservation measures 	<ul style="list-style-type: none"> - Project Report - Documentations of FGD - Planning documentations 	<ul style="list-style-type: none"> - Strong support from stakeholders - Local community willing to participate

Items	Intervention logic	Objectively verifiable indicators of achievement ⁵	Sources of information and means of verification ⁶	Assumptions ⁷
Activity 1.1.	- Focus Group Discussion (FGD) to develop participatory demonstration plot	- FGD	- Documentation - Reports	- Local community actively participate during the FGD - Support from village government
Activity 1.2.	- FGD among stakeholders to support the implementation of activities	- FGD	- Documentation - Reports	- All parties actively participate during the FGD
Output 2	Demonstration plot of conservation farming and watershed rehabilitation	- Delineated demonstration plot border including its attributes - Vegetative soil and water conservation measures in the form of agroforestry - Civil technique soil and water conservation measures in the form of small check dam, gully plug, and head structure	- Project Report - Field survey report - Documentations: photo and videos	- Strong support of involved institutions - Local community willing to participate - Catchment areas is accessible for data collection
Activity 2.1.	Determining the site of demonstration plot	- Demonstration plot sites	- Project Report - Field survey report - Documentations: photos, videos, and maps	- FP's are willing to participate by providing their land and labor - Support from village government
Activity 2.2.	Applying vegetative soil conservation measures	- Vegetative soil conservation measures	- Demonstration plots - Documentations: photo and videos	
Activity 2.3.	Applying civil technique soil conservation measures	- Civil technique soil conservation measures	- Demonstration plots - Documentations: photo and videos	

Items	Intervention logic	Objectively verifiable indicators of achievement ⁵	Sources of information and means of verification ⁶	Assumptions ⁷
Output 3	Enhanced of farmers' skill and income through on-farm and off-farm activities	<ul style="list-style-type: none"> - Improved FP's skill in honey bee farming - Increased community's ability in processing agricultural yields - Improve communities skill in managing the environment 	<ul style="list-style-type: none"> - Project Report - Documentations: photos and videos 	<ul style="list-style-type: none"> - Strong support of involved institutions - Local community willing to participate
Activity 3.1.	Development of apiculture	<ul style="list-style-type: none"> - FP's learns apiculture techniques 	<ul style="list-style-type: none"> - Honey bee colonies are available - Documentations: photos and videos 	<ul style="list-style-type: none"> - Cooperative works between relevant stakeholders and project team
Activity 3.2.	Training to improve farmer's skill in processing agricultural yields for higher value-added products	<ul style="list-style-type: none"> - FP's are able to process several types of agricultural products for higher value-added products 	<ul style="list-style-type: none"> - Reports - Documentations: photos and videos 	
Activity 3.3.	Training to improve farmer's skill in processing household and agricultural waste	<ul style="list-style-type: none"> - FP's are able to utilize household and agricultural waste 	<ul style="list-style-type: none"> - Reports - Documentations: photos and videos 	
Output 4	Information on the impacts of the demonstration plots of conservation farming and watershed rehabilitation	<ul style="list-style-type: none"> - Increased water yield, and decreased sedimentation - Enhanced land cover - Decreased soil erosion rate - Increased SOM (Soil Organic Matter) - Increased community income - Improved community behavior in soil and water conservation 	<ul style="list-style-type: none"> - Project Report - Field survey report - Documentations: photos and videos 	<ul style="list-style-type: none"> - Local community willing to participate - Strong support from involved institutions - Catchment areas is accessible for data collection

Items	Intervention logic	Objectively verifiable indicators of achievement⁵	Sources of information and means of verification⁶	Assumptions⁷
Activity 4.1.	Water yield and sedimentation monitoring	- Precipitation, river discharge, sediment discharge, and water quality data	- Field data	- Local community willing to participate
Activity 4.2.	Land evaluation	- Land cover, soil erosion, soil fertility, and crops yield data	- Field data	- Catchment areas is accessible for data collection
Activity 4.3.	Evaluation of economic and social aspect on land management	- Benefit cost of farming system, community income, community participation, and farmer group activities data	- Field data	
Output 5	Recommendation and policy brief of the best agroforestry model	- The best agroforestry models recommended - Policy brief	- Project report - Documentations: photos and videos	- Strong support from stakeholders
Activity 5.1.	Internal meeting to discuss and formulate the best agroforestry model	- Formulation of the best agroforestry model - Policy brief of the best agroforestry model	- Documentations - Reports	- Strong support from stakeholders
Activity 5.2.	Workshop to share and discuss the project results	- Feedback from stakeholder and consultant	- Documentations - Reports	

Annex A-6 Communication strategy template

Communication strategy

Objectives	Target audience	Key message	Communication tools	
			Products/Tools	Media/Channels/Activities
Project objective				
1. To implement micro catchment management by improving the available plan and extending the impact area, based on community participation and stakeholder collaboration, considering the soil and water conservation principles	Focal point: BP2SDM; High level stakeholders: PDASHL; Local governments; Public interested in watershed management and soil and water conservation; students and scientist who learn environment subject, forestry, civil engineering, etc,	Management of micro catchment based on soil and water conservation principles	Well managed micro catchment, Research finding, and success story of the project, accompanied with photos and videos	APFNet Website, WMTC Website Leaflet, Poster, Final Report, blog, newsletters, etc,
Communication objectives				
1. Stakeholders aware of the problems of NMC	Focal point: BP2SDM; High level stakeholders: PDASHL; Local governments; Public interested in watershed management and soil and water conservation; students and scientist who learn environment subject, forestry, civil engineering, etc,	Problems encountered in managing NMC	Information related to problems in managing NMC, methods to solve the problems; Publication paper (Journal & proceedings)	Leaflet, APFNet Website, WMTC Website, Journal, Conferences
2. Stakeholders find out Participatory Management Planning of NMC	Focal point: BP2SDM; High level stakeholders: PDASHL; Local governments; Public interested in watershed management and soil and water conservation; students and scientist who learn environment subject, forestry, civil engineering, etc,	NMC Participatory Management Planning	Information of NMC participatory Management Planning; Publication paper (Journal & proceedings)	Newsletters, Leaflet, and book, Journal, Conferences

Objectives	Target audience	Key message	Communication tools	
			Products/Tools	Media/Channels/Activities
3. Stakeholders find out the stages of NMC Participatory Management	Focal point: BP2SDM; High level stakeholders: PDASHL; Local governments; Public interested in watershed management and soil and water conservation; students and scientist who learn environment subject, forestry, civil engineering, etc,	The stages of Participatory Management	Information about the stages of Participatory Management; Publication paper (Journal & proceedings)	News letters
4. Stakeholders find out final result of NMC Participatory Management	Focal point: BP2SDM; High level stakeholders: PDASHL; Local governments; Public interested in watershed management and soil and water conservation; students and scientist who learn environment subject, forestry, civil engineering, etc,	Final result of NMC Participatory Management	A model of Well Managed Micro Catchment and final report; Publication paper (Journal & proceedings)	Newsletter, Report, Journal, Conferences
5. Stakeholders able to monitor and to evaluate NMC Management	Local government, BPDASHL Solo, WMTC	Methods to monitor and to evaluate, criteria, and indicators of well managed micro catchment	Hand book, leaflet; Publication paper (Journal & proceedings)	Book, leaflet, Journal, Conferences

Annex A-6 Communication strategy template

Work plan and budget for communication strategy

Activities (what)	When	Who	Estimated budget (APFNet's grant)
Development and production of communication tools/products	January – April 2022	Researchers Team	-
Pretesting of tools/products	May 2022	Researchers Team	-
Production of tools/products	June 2022	Printing Agency	-
Dissemination of tools/products	2021 – 2022	Researchers Team	2,070
Monitoring and evaluation	January – June 2022	Researchers Team	-
Etc.			

Annex A-6 Communication strategy template

Monitoring and evaluation of communication strategy

Communication objectives	Success indicators	What information to collect	How to collect information	Who will collect the information	When to collect information
1. Stakeholders aware of the problems of NMC	Changes in stakeholder knowledge of potential land degradation in the NMC	The parties' knowledge of potential of the vulnerability of land, hydrology, social economic and institutional conditions	FGD and survey	WMTC team	2020
2. Stakeholders find out Participatory Management Planning of NMC	Stakeholder involvement in the planning process of micro catchment management	Attendance of FGD participant, note of FGD, Reports and documentation	Recording and discussion	WMTC team	2020
3. Stakeholders find out the stages of NMC Participatory Management	Stakeholder involvement in each stage of implementation of micro catchment management	Information about the stages and activities of Participatory Management	Recording and discussion	WMTC team and stakeholders	2020-2022
4. Stakeholders find out final result of NMC Participatory Management	Changes in attitudes and behavior of the parties in the activities of micro catchment management	Information of impacts on soil and water conservation activities conducted by stakeholders	Desk analysis, survey, and interview	WMTC team and local community	2021-2022
5. Stakeholders able to monitor and to evaluate NMC Management	Changes in the knowledge and skills of the parties in M&E activities	Information of M&E results in each of criteria, and indicators	Survey and analysis	WMTC team, local community, and stakeholders	2022

Annex B – Project sites maps
Annex B-1 Location map

The NMC is located in the upstream of Keduang Watershed, The Upper Bengawan Solo River Basin.

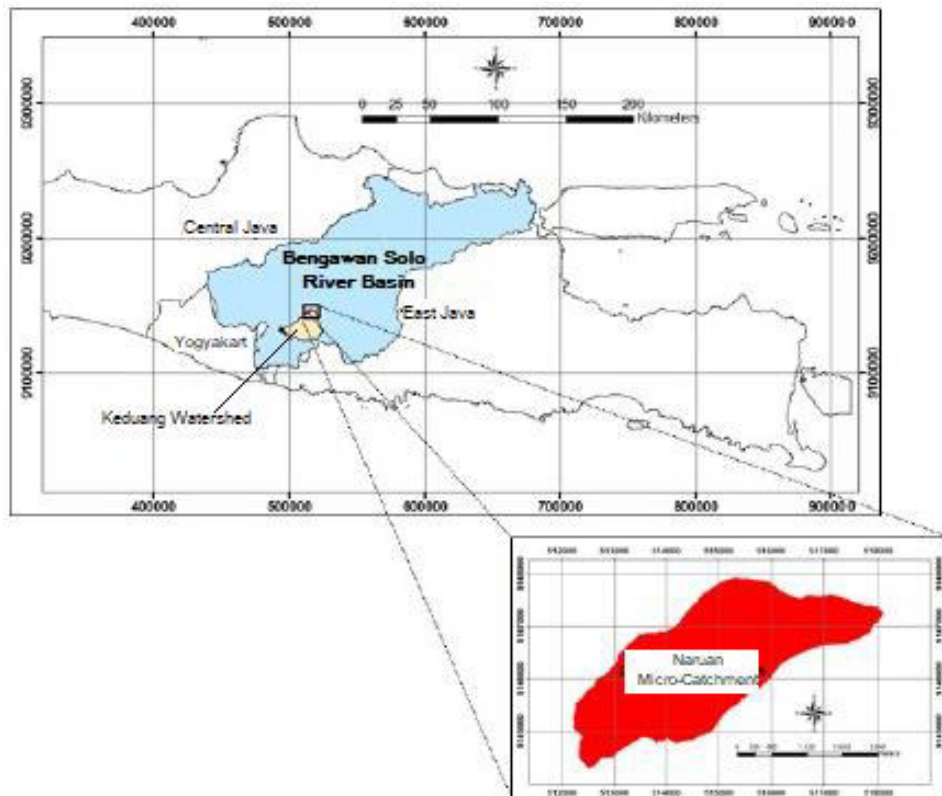


Figure 3. Project sites map

Annex B-2 Forest/vegetation distribution map

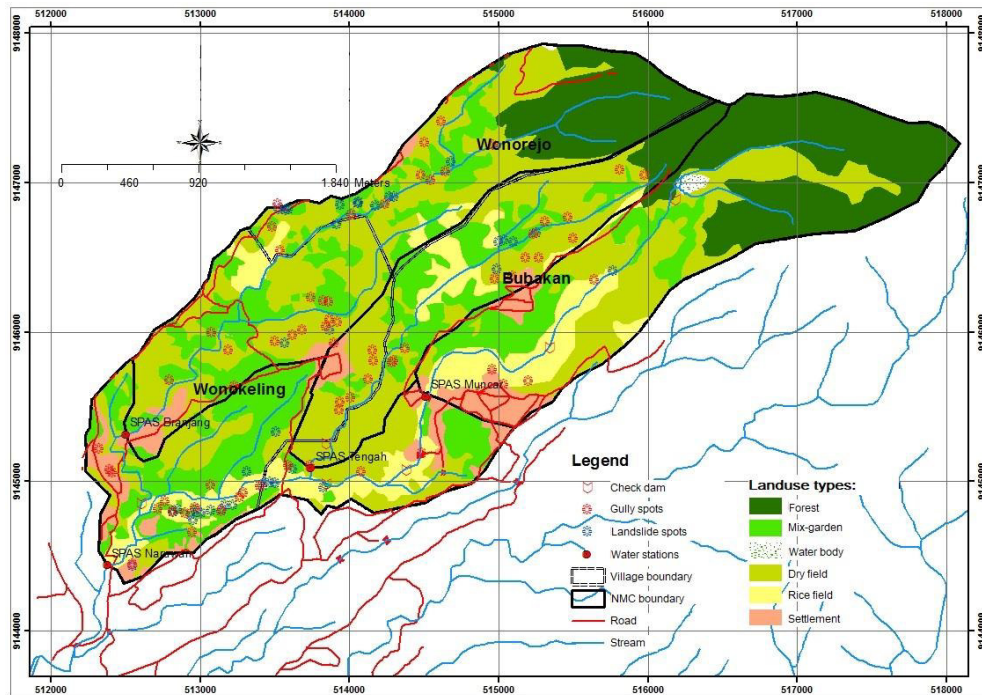


Figure 4. Land use map of NMC

Tabel 7. Land use types and their area in NMC

Land use types	Area (ha)	
	(ha)	(%)
Forest	192,56	20,12
Mix-garden	224,10	23,41
Settlement	65,94	6,89
Rice field	102,16	10,67
Water body	2,19	0,23
Dry field	370,18	38,68
Total	957,13	100,00

Annex C – Detailed implementation plan of project activity

Maps of potential area for activities of rehabilitation in each village of the NMC are presented below. Activities will be focused on locations with land covers of dry fields and mix-gardens. The map also shows the locations that have been rehabilitated through agroforestry activities in the project phase I. Agroforestry as a global rehabilitation plan was proposed to be applied in the area. Three designs of agroforestry were selected i.e: (a) “Surjan”, a small blocks of timber plants with small blocks of seasonal crops; (b) “Full timber”, especially in the very steep area; and (c) “Tumpang sari”, a mixture of timber plants with under-canopy seasonal crops.

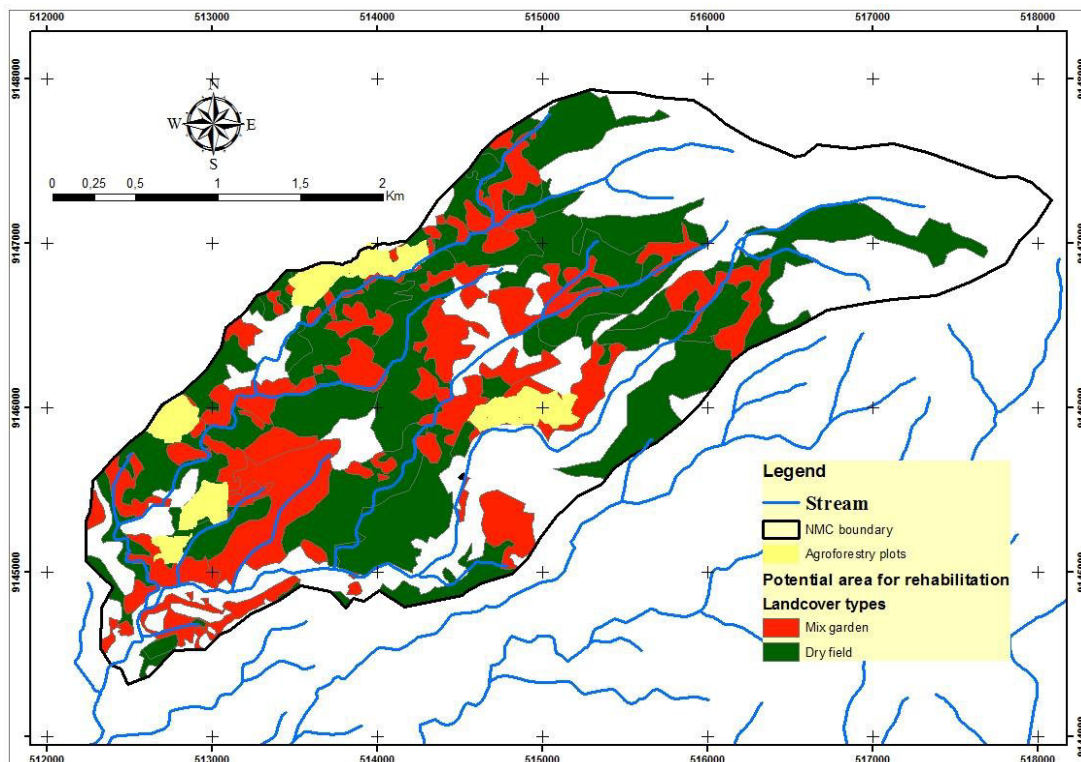
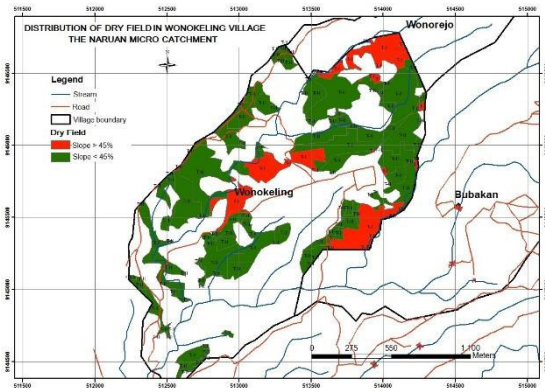
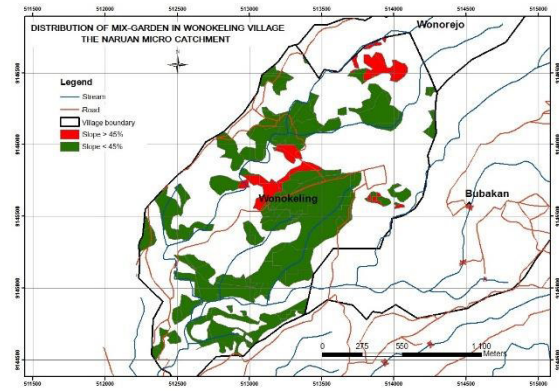


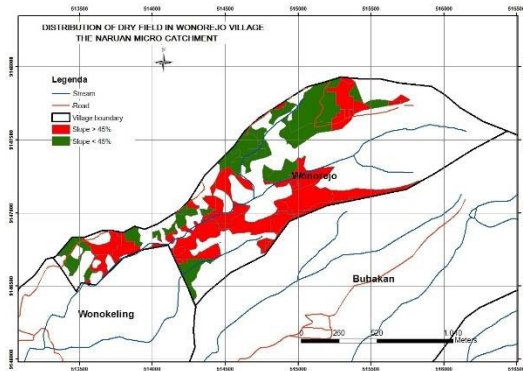
Figure 5. Maps of potential area for vegetative rehabilitation activities



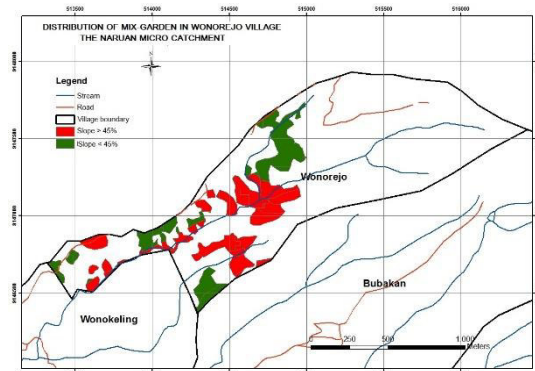
Dry field in Wonokeling Village



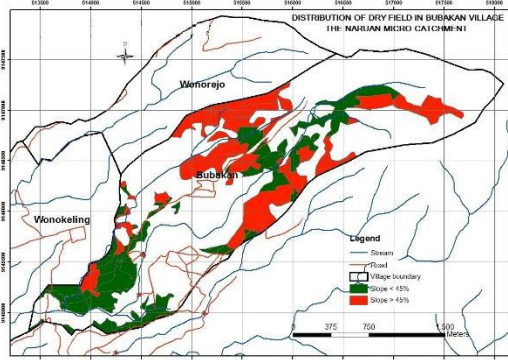
Mix-garden in Wonokeling Village



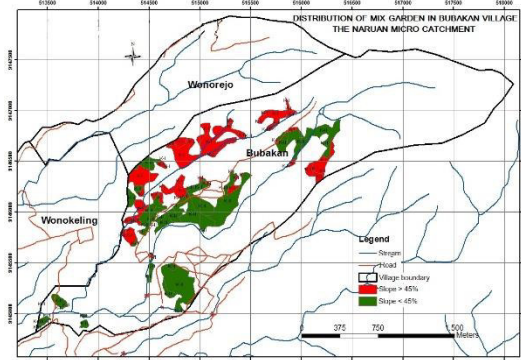
Dry field in Wonorejo Village



Mix-garden in Wonorejo Village



Dry field in Bubakan Village



Mix-garden in Bubakan Village

Figure 6. Detail maps of potential area for vegetative rehabilitation

Based on the ground survey, it was found that several points have to be rehabilitated using civil engineering methods (Table 8.). The points were distributed in three villages. Among the points, a number of 35 gully erosion control buildings have been built spreading across 3 villages during the Phase I, namely Wonorejo (28 units), Wonokeling (5 units) and Bubakan (2 units). Those buildings include Small gully plug, Gully plug, Small check dam, as well as Gully head structure.

Table 8. The proposed civil engineering construction

Activities	Bubakan	Wonokeling	Wonorejo
Small check dam	2	1	1
Medium check dam	1	1	1
Small gully plug	22	35	10
Landslide preventions structure	11	16	10
Terraces rehabilitation	Need detailed measurements in the field		
Drainage and drop structure			
Dredging dam	1	4	2

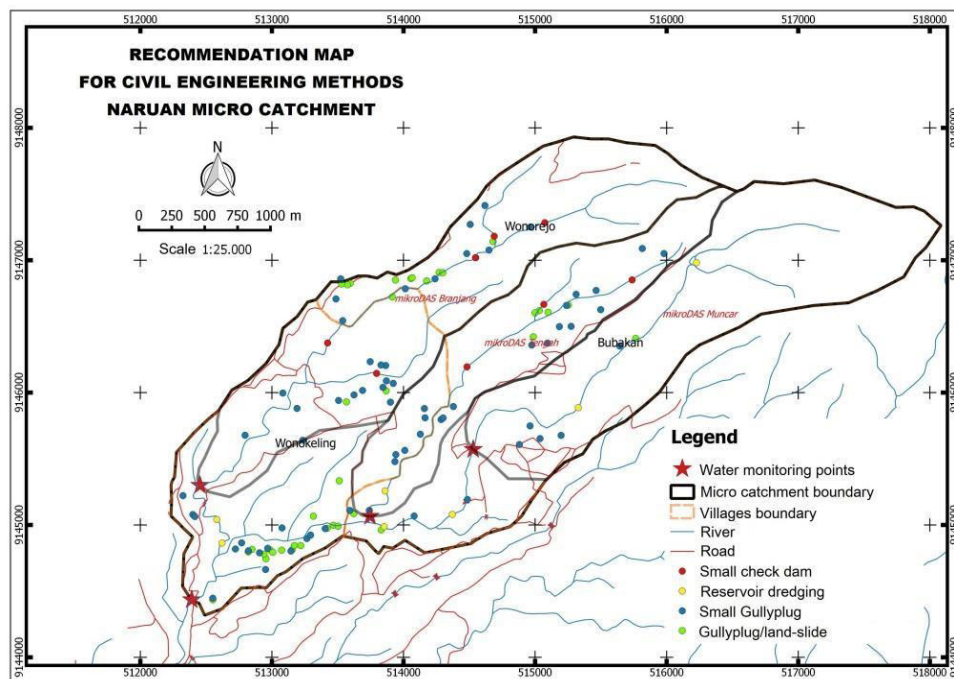


Figure 7. The distributions of points have to be rehabilitated with civil engineering methods in micro catchment scale