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TECHNICAL REPORT

Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed

September 2017 – August 2019

Watershed Management Technology Center

Research, Development and Innovation Agency

Ministry of Environment and Forestry of Indonesia

September 2019

BASIC INFORMATION

Project Title (ID)	Development Participatory Management of Micro Catchment at The Bengawan Solo Upper Watershed
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 agency(s) (if any)	-
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SUMMARY

The upstream watershed area has a strategic role as a recharge area for the downstream area. The upstream watershed area which is in an area with hilly, mountainous and steep-sloped topography requires proper management that paying attention to the soil and water conservation principles. Upstream watershed management on an operational scale (micro watershed) is very difficult to do because of the many stakeholders involved. Therefore participatory-collaborative and integrated management between parties become a suitable choice to be implemented in the upstream watershed area.

The objective of this project was to develop participatory management of micro catchment based on community participation and stakeholder collaboration, considering the soil and water conservation principles. The well managed micro catchment may improve environmental services such as water sustainability and land productivity, as well as community welfare. The project is located in Naruan Micro Catchment (NMC), upstream part of Keduang Watershed, The Upper Bengawan Solo River Basin. Administratively, NMC is located in Wonogiri and Karanganyar Districts, Central Java, Indonesia. The micro catchment is divided into three villages i.e Bubakan, Wonorejo, and Wonokeling.

This technical report presents all activities carried out in the whole year of the project (September 2017 to August 2019). Six outputs and 14 supporting activities targeted in AWP1 and AWP2 have been achieved.

At the end of the project, several points can be concluded. Micro catchment management planning activities need to start with gathering baseline data on the characteristics of the watershed, followed by participatory planning and building collaborative commitment of the parties. The implementation of micro watershed management is done through vegetative and civil technique soil conservation measures, and community empowerment. Management activities (vegetative and civil technique) have impacted the ecological aspects i.e improved land cover and control erosion, and socio-economic aspects of the community i.e increasing farmers' knowledge in soil and water conservation, positively changing in perception and motivation to implement soil and water conservation as well as predicted improving the household economy through the added value of wood and fruit crops in agroforestry patterns at the end of the cycle of perennial crops. To ensure the sustainable management of micro watersheds, the active role of related parties is needed through the management model produced by this project, namely the "Participatory and Sustainable Micro Watershed Management Model".

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ABBREVIATION AND ACRONYMS

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

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I. PROJECT OVERVIEW

In the field, the implementation of watershed management is complicated. This is due to the many parties involved, which have their interests that may not be aligned with each other. Moreover, their activities may not on the right targets because it is not based on the actual and factual field condition. Until now, the integration of watershed management is still very difficult to do, so it can be said that watershed management has not been successful. Instead of improving the condition of the watershed, land degradation frequently occurs in the watershed due to mismanagement. It is showed by the more degraded watershed in the list that needs to be restored. Therefore, it is necessary to integrate the management of various sectors from upstream to downstream by considering the various interests, biophysical and socio-economic existence. Action research at the operational scale is necessary to develop demonstration plots of micro watershed management employing participatory and collaborative management based on the principles of soil and water conservation. The resulted demonstration plots may be used as an example of proper watershed management. This project is located in Naruan micro-catchment, upstream part of Keduang Watershed, The Upper Bengawan Solo River Basin. This site has a strategic role because it is in the catchment of Multipurpose Reservoir of Gajah Mungkur (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 power plant. The micro- catchment also became a national priority target areas of rural development and integrated watershed management.

Preliminary studies have been conducted in 2015 and 2016, including the identification of issues/problems in the main study area. The main issue in the study area is soil erosion, which contributes to the high rate of sedimentation in MRGM. This may due to land use that is not under its capability. An open-minded community that is willing to support soil and water conservation activities is one of the social capitals. Other potential capital is the supportive government officials from the village level until the district level.

Participatory management plans for the area have already been arranged. The plan draft contains the indicative area that should be rehabilitated as well as community development plans and coordination mechanisms between the parties. The next stage of the activities include: building commitment among actors of watershed management to support effective participatory management, formulation of integrated participatory

management for micro catchment scale, development of conservation and rehabilitation demonstration plots, building community awareness toward micro watershed management, as well as building the M&E performance of micro catchment, landscape and households scale.

The project is expected to (1) improve the quality of the environment by increasing forest cover, so as 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.

The goal of the project is to build a successful watershed management model under soil and water conservation principles at the operational level (micro catchment). This model may be used as an example for the Institute of Watershed Controlling and Protection Forest (BPDASHL SOLO), and other institutions associated with watershed management, from the planning, implementation to M&E processes. 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.

This technical report presents all activities carried out the whole year of the project (September 2017 to August 2019). Six outputs and 14 supporting activities targeted in AWP1 and AWP2 have been achieved. A full description of the project activities will be presented in Chapter 2.

II. IMPLEMENTATION PROGRESS, ACHIEVEMENT AND IMPACTS

The objective of this project is to develop participatory management of micro- catchment based on soil and water conservation principles. Output 1 and 2 have been conducted as the preliminary studies, including the identification of issues/problems in the main study area, as well as participatory management planning. All of the project activities that have been done to achieve these goals are:

A. Output 1. Potential and vulnerability of micro catchment (already obtained, 2015)

1. Land use capability (LUC) and vulnerability toward degradation

LUC analyses show that most the area has high LUC class i.e V, VI and VII with limitation of soil erosion and gradient (Figure 1.) The higher the LUC class the designation of its use will be more limited. LUC V-VII is not suitable for seasonal crops, it is only suitable for grassland, agroforestry, and forestry. It is more than 56% of the area is of VIg class and 42% are of VIIg. Approximately 56% of the area is used not under its LUC classes (Figure 2).

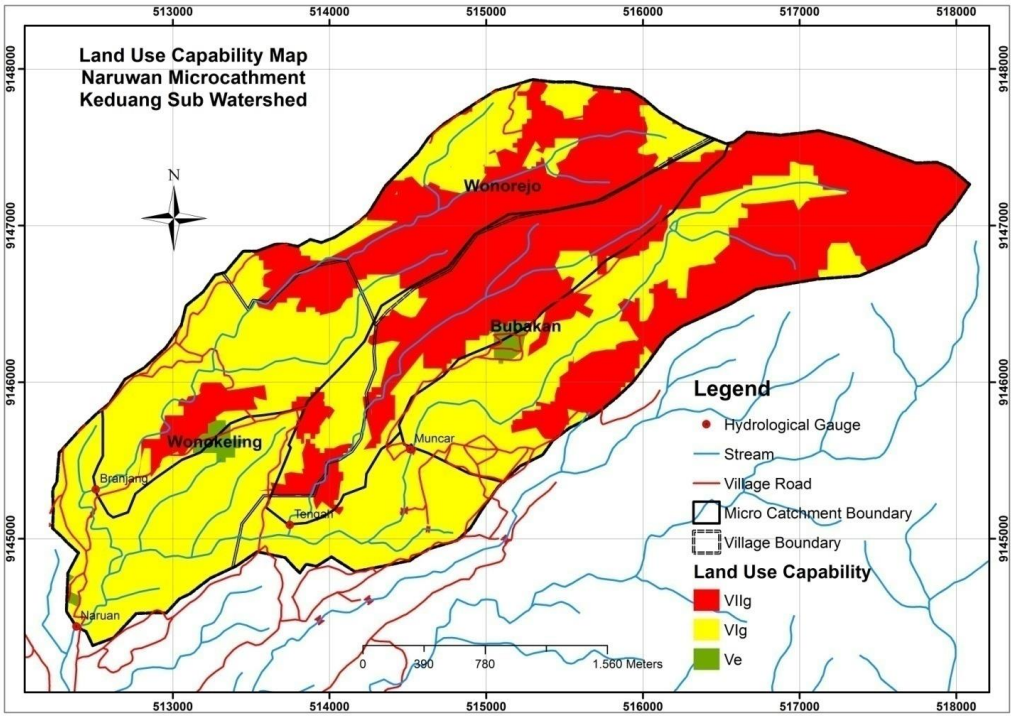


Figure 1. LUC Map of Naruan Micro Catchment

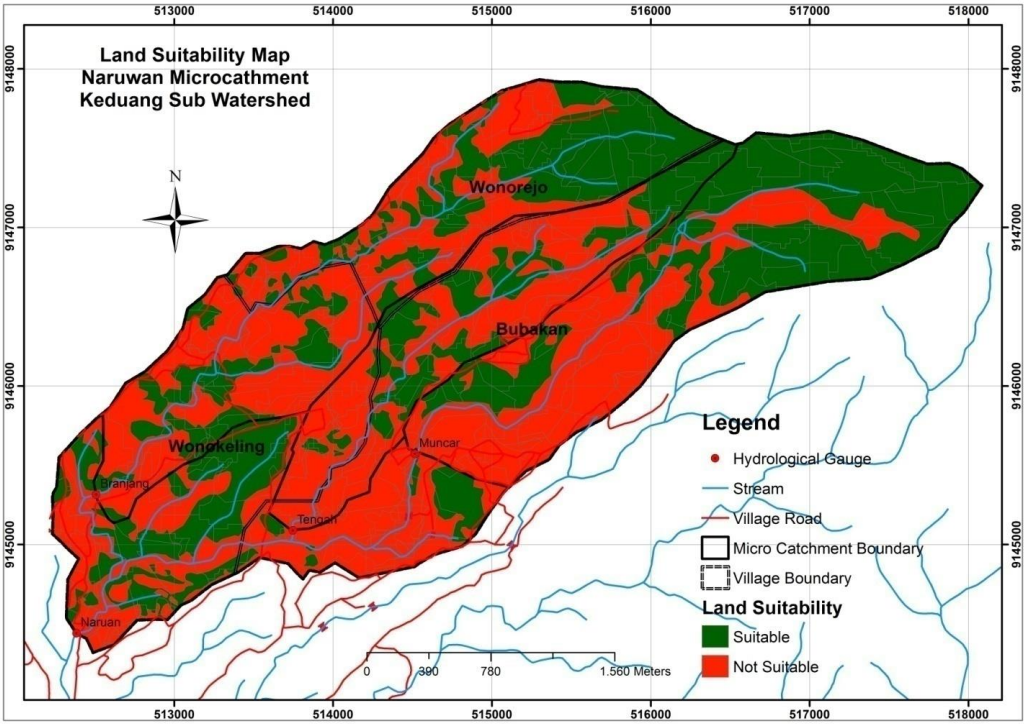


Figure 2. Distribution of land suitability in the study area

Incompatibility land uses may lead to negative impacts which are indicated by the presence of severe and very heavy erosion rates (Table 2). Most of the area is the potential to be exposed to very severe (52%) and severe erosion rates (21%) (Figure 3).

Table 1. Soil Erosion Rate in Every LUC Classes

Erosion Rate	Suitablity of LUC					
	Suitable		Not Suitable		Total	
	ha	%	ha	%	ha	%
VS	185,54	19,39	317,15	33,14	502,69	52,52
S	122,67	12,82	83,88	8,76	206,55	21,58
M	91,53	9,56	85,90	8,97	177,42	18,54
L	13,52	1,41	43,83	4,58	57,35	5,99
VL	5,60	0,58	7,51	0,79	13,11	1,37
Total	418,85	43,76	538,27	56,24	957,12	100,00

Keterangan: VS = Very Severe , S = Severe, M = Moderate,
L = Low and VL = Very Low (Anonim, 1995)

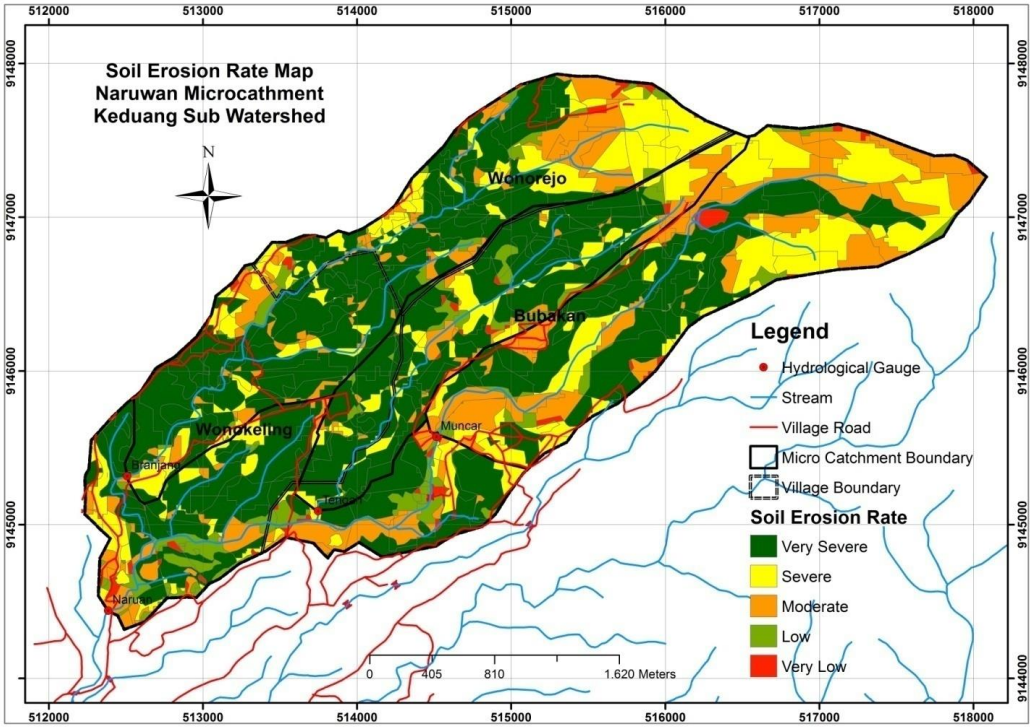


Figure 3. Soil erosion rate map of the study area

Base on the land suitability and soil erosion rate it can be concluded that the study area is vulnerable to degradation since the area is dominated by the very steep slope (>45%) with monthly and annual rainfall of 2,979 mm and 365 mm respectively. These two factors (slope and rainfall) potentially cause a severe erosion rate. The appropriate land uses should be selected base on this biophysical condition.

2. Landslide vulnerability

Landslide vulnerability analyses show that 64,2% and 35,8% of the area are slightly vulnerable and not vulnerable (Figure 4).

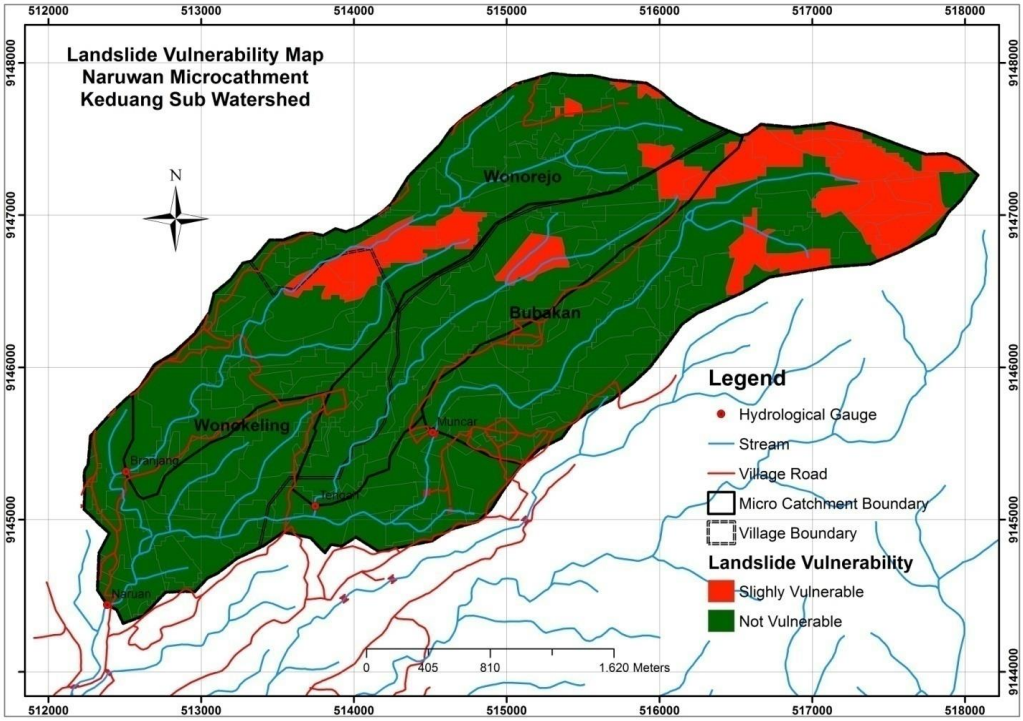


Figure 4. Landslide vulnerability map of the study area

3. Water quality vulnerability

   In quality, the three tributaries that flow in the Naruan micro catchment show a good flow continuity throughout the year. The results of the water quality evaluation show that in general the condition of water in the dry season (not rain) in good condition, which is characterized by many parameters (Physics-chemical-biology). The value is below the required threshold required by regulation (PP No 82/2001). All parameters meet the standard quality of water class I to IV, except COD parameters which are not meet the water class I standard. Class I is classified as suitable for drinking water.

4. Socio-economic and institutional vulnerability

   Social conditions of society as follows.

   a. Community has a good understanding of the quality of the land and upstream-downstream linkages in a watershed

   b. Community conservation behavior have not been good, because many have not applied cropping pattern according to conservation rules on steep slopes. However, the community has a willingness to undertake land rehabilitation.

c. The level of trust in the community is quite strong, making it easier to mobilize the community to cooperate

The economic condition of the community is relatively well demonstrated by the ability of the community to fulfill its needs, housing conditions and facilities owned. Existing community institutions, such as farmer groups and conservation groups, have not optimally played a role in conservation efforts. However, village governance has supported conservation efforts.

B. Output 2. Micro catchment management plans (already developed, 2016)

1. Proposed vegetative soil conservation method

   Agroforestry as a global rehabilitation plan was proposed to be applied in the area (micro catchment scale), this method was selected based on the FGD. Three designs of agroforestry were selected i.e:

   a. Surjan: Small blocks of perennial timber plants with small blocks of seasonal crops
   b. Full timber, especially in the very steep area
   c. Tumpang sari: a mixture of perennial timber plants with under-canopy seasonal crops Proposed mechanical soil conservation methods

   Based on the ground survey in the micro catchment, it was found that several points have to be rehabilitated with civil engineering methods. The points were distributed in three villages.

Table 2. The proposed civil engineering construction

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

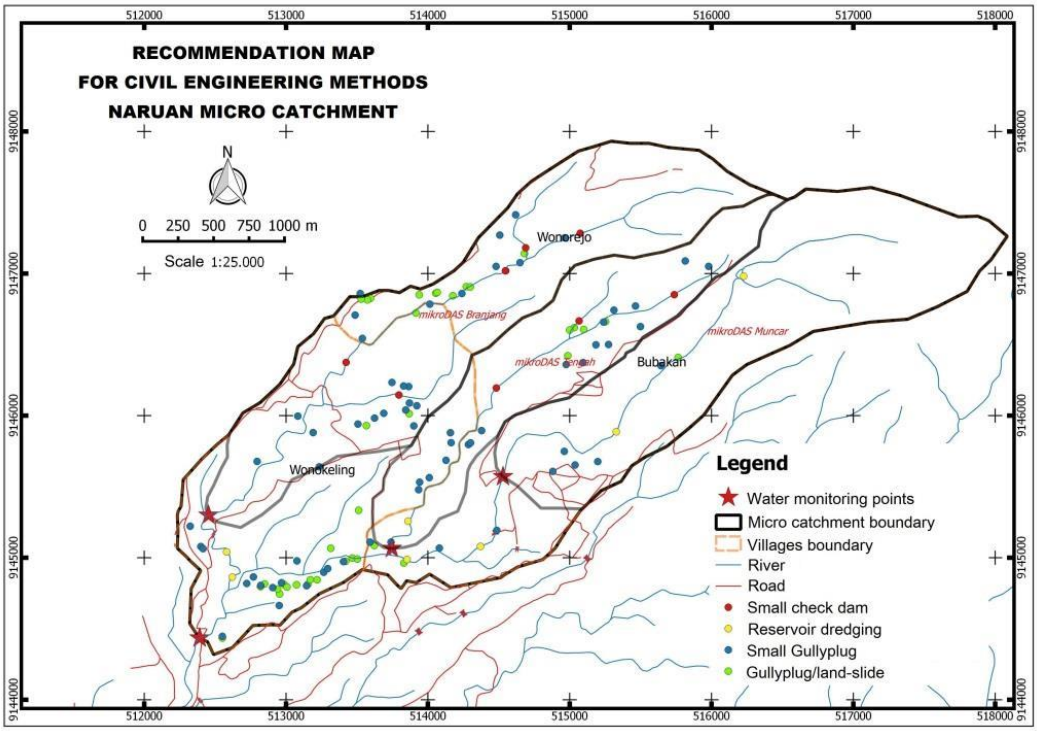


Figure 5. The distributions of points have to be rehabilitated with civil engineering methods in micro catchment scale

2. Global proposed community empowerment, institutional strengthening, and inter-sectoral coordination program at micro catchment scale

Empowerment begins with increasing awareness and knowledge, both on potential and weaknesses that exist in the way they utilize the land. Some activities that can be done include:

a. Community empowerment

- Improving inter-personal, group, and inter-village communication
- Increasing knowledge on the best land management practices and impacts management of activity on the environment
- Increasing knowledge of the group to motivate the members
- Increasing the knowledge related to market development
- Learning how to use suitable technology
- Strengthening institutions of village level

Institutional strengthening among others can be done with awareness and connectivity between elements of institutions, actors, and interested parties. Other activities that can be undertaken include comparative studies and learning from established institutions, human resource capacity training, infrastructure, and infrastructure development to support organizational development, regular meetings with other stakeholders and others

b. Coordination among agencies / sectors

Watershed management will work well if there are coordination and alignment between institutional interests or parties, between central or district parties, interests between the government and the community, as well as the interests of the community and the community, including the involvement of the stakeholder community, the owner community or the watershed resources management community. Therefore, to coordinate various activities and institutions, there needs to be an institutional coordination form so that the goal of micro catchment management (pilot) can be achieved.

C. Output 3. Increased stakeholders commitment for effective participatory management of micro catchment

Community support and participation of the stakeholders are urgently needed in watershed management. Equal perception and understanding related to general watershed management as well as soil and water conservation are essential among stakeholders. This equal understanding can be achieved through Focused Group Discussion (FGD). Topics of discussion are problems that emerge in the area.

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

The FGD amongst farmers has been held in three villages (Wonorejo, Wonokeling, and Bubakan). FGD in each village was conducted two times. Since this was the first meeting, it was preceded by meeting the village head or elders to ask for their permission, introduce the project activities, and the team as well. Besides that, preliminary contact with villagers has already been established before the meeting.

The participants of the first FGD were landowners or tenants, village apparatus, community leaders, farmer group managers and other communities representing hamlets in the village concerned. This FGD was conducted to deliver an overview of the project activities, some basic understanding related to soil and water conservation, and watershed management principals. The materials were delivered by team members from WMTC. The detailed topics were:

a. The overview of the APFNET's projects and introduction of watershed management (by Dr. Agung Budi Supangat MSc).
b. Upper watershed biophysics characterization and soil and water conservation measures (by Dr. NiningWahyuningrum. MSc)
c. Community participation in soil and water conservation measures (by Dr. Dewi Retna Indrawati MSc)
d. The role of community institution in the upper watershed management (by Ir. Syahrul Donie MSc)
e. The economic value of land management in the upper watershed (by Ir. Purwanto. MSc)

After the presentation, a discussion was held with the communities. There were question and answer sessions related to the presented topics. Besides, there was also an introduction to the second stage FGD.

The second FGD was conducted to facilitate farmers in understanding the material that has been delivered, characterizing the agriculture field condition, understanding their/its problems, determining their expectation and improving this condition. The participants were grouped based on their land closeness (extent). Considering that the discussion group was formed based on the area expanse so the number of participants in each group was different. Besides, the number of groups formed also varies depending on the condition of the area expanse. Before the group discussion began, two consultants who are lecturers of Sebelas Maret University presented materials on soil and water conservation techniques in the upper watershed and the understanding of the socio-economic conditions of the community.

From the second FGD, it can be collected some facts concerning the community perception about their land conditions, expectation and efforts to overcome the existing problems. The summary of the second FGD results were:

a. Community perception of their land conditions

- In general, their agriculture land is situated in the sloping area approximately more than 45%.
- The dominant cultivated plants are maize, cassava, ginger. Besides perennial plants such as albizia and avocado are sparsely planted in small amounts and commonly in the boundary of the land tenure.
- Surface erosion quite large, gully and riverbank erosion exist in several locations.

b. Expectation

- Improving cropping patterns and improving soil fertility to increase yields
- Reducing soil erosion and preventing gully enlargement
- Extension on how to improve soil conditions and increase income
- Cattles support to provide manure and increase income

c. Efforts to overcome the existing problems

- Cultivating the land based on its specific condition and putting manure or other organic fertilizers
- Applying the cropping pattern with a combination of seasonal and perennial crops (agroforestry).
- Fixing the existing terraces and planting grasses in its risers
- Preventing gullies enlargement by applying gabion made of wires or bamboos

(a)

(b)

(c)

Figure 6. FGD in 3 villages; (a) Wonokeling, (b) Wonorejo, and (c) Bubakan

Besides the preliminary FGDs with the community, the FGDs were also conducted with stakeholders to build a common understanding of the importance of integrated watershed management. This FGDs had been facilitated by Baperlitbang (District Planning, Research, and Development Agency) and had been directed by the project team. The FGDs were conducted in two districts (Karanganyar and Wonogiri). The participants of the discussion were:

- District government (Baperlitbang and Local Sectoral Institutions/OPD), province institution i.e. BPUSDATARU (Center of Public Works, Water Resources and Spatial Planning of Bengawan Solo River), and BPH (Forest Management Center) Region IX
- State technical institution i.e. BPDASHL Solo and BBWS BS (Bengawan Solo River Basin Organization)
- NGO (Non Government Organisation) i.e. Forum DAS (Watershed Forume) and Persepsi
- Private sectors i.e. PT. Hijau Lestari
- State Company i.e. PDAM (District Water Services) and Perhutani (State-owned Forest Company), Perum Jasa Tirta I (National Water Services Company)
- Village representatives

The team presented: (1) the conditions of the NMC and the activities to be undertaken for its management, and (2) the importance of coordination and the role of the parties in integrated watershed management. Every stakeholder informed their programs and activities that potentially supporting the integrated watershed management in the area.

(a) (b)

Figure 7. The first institutional FGD (a) Wonogiri District, and (b) Karanganyar District

2. Activity 3.2. FGD to design participatory micro catchment management plan

Designing the participatory watershed management plan was done through FGDs to capture the aspirations of the community so that they can play an active role. The third FGDs were conducted in three villages and were held in two stages. The first stage was conducted in the field to discuss general biophysical conditions of the participant's land and obtained a basic overview of the economic, cultural and institutional conditions of the community related to land management and environment. In the second stage, communities were guided to design land management that are suitable for soil and water conservation efforts. The proposed management plan is presented in Annexes 1, 2 and 3.

The land management plans on that annexes were made as the material in the second institutional FGD. The second institutional FGD entitled "Socialization of Participatory Land Management Plans and Supporting Parties in Its Implementation". The team informed the participatory land management plan prepared by the community. The discussion was held to gain support in implementing the design according to the duties and functions of each party especially for the locations outside the demonstration plots. There were potential supports from several agencies such as: (1) seedlings of tree plants from PDAM, Jasa Tirta I, and BPH; (2) soil and water conservation of civil technique from BPUSDATARU and BPDASHL Solo; (3) livestock from Marine, Fishery and Livestock Services; and (4) support from forest extension agents. The potential support of each party in Karanganyar and Wonogiri are presented in Tables 1 and 2.

(a) (b)

Figure 8. The second institutional FGD (a) Wonogiri District, and (b) Karanganyar District

Table 3. The potential institutional support in NMC management resulted from FGD in Karanganyar District

No.	Instituions	Forms of support	Follow up actions	Explanation
1	BPUSDATARU	Check dam in tributaries (stream)	Coordination with operation and maintenance chief section.	Karanganyar and Wonogiri Districs
2	District Secretariat	There are direct budget from district government based on the proposed activities.		
3	BPDASHL Solo	Civil techniques structure for stream protection Seedling in Wonokeling in 2016 and Wonorejo in 2017		In 2018
4	Agriculture, Estate and Forestry Services	There are ginger seedling available in 2017	Coordination with plantation section to certain the execution and its location	
5	BPH	In 2018, Perennial seedling will be distributed to Wonorejo, 30% of them are MPTS		Information from forest extension agent All the seedling must be directly taken from Semarang
		BPH is available to support pernnial seedling such as albizia. teak. mahagony and MPTS (parkia, durio, casew, and bay leaf/laurel)	Project proposal to BPH for 2018	
6	Environmental Services	Environment services has existing water conservation activities with forest farmer groups	Project proposal for 2018	The selected plants is the permanent plants wich are always exist for long periods
8	Regional Dissaster Management Services (BPBD)	Champaign for disaster responsive village and for early warning system		related to disaster-prone village activities
9	Marine, Fishery and Livestocks Services	Budget available from Central Government to fisheries procurement	Project proposal	In 2018 the activities only for fish seed center
			- Communication and direct - Correspondence with the Livestock Sector	Potential fodder source

Table 4. The potential institutional support in NMC management resulted from FGD in Wonogiri District

No.	Instituions	Forms of support	Follow up actions	Explanation
1	Jasa Tirta I	Perennial seedlings based on WMTC proposal in 2017	Controling and coordinating the action related to the types and distribution of the seedlings.	Not all types of seeds requested can be fulfilled
		Opportunity for cooperation projects	Comprehensive projects proposal including budget sharing.	
2	PDAM	Albizia plantation around the spring in December 2017	Coordination with PDAM and local communities	Follow up of the intitutional FGD in October 2017 and local government project proposal.
3	Environmental services	Infiltration wells establishment and community empowerment in waste treatment (trash bank)	Project proposal from local gorvernment for 2019 activities.	Finding and directing others activities to be held in Bubakan
4	Marine. Fishery and Livestocks Services	Spreading fish seed at Muncar Dam in December 2017 as the follow up October 2017 FGD		
		Bubakan has potential for fisheries and livestock development	Project proposal from farmers group or village-owned company	
5	BPBD	It will be endeavored to carry out activities at the research sites according to its function	Coordination with the institution	
7	BPDASHL Solo	In 2016-2017, there were certain activities in Bubakan such as 10.000 albizia plantation, 35 infiltration wells, 5 unit dam, and 5 unit gully plugs.	Coordination with BPDASHL Solo for the implementation and location	Information from forest extension agent
8	Agriculture, Estate and Forestry Services	There are 14.000 coffee seedlings available	Coordination to certain the location and its execution	Information from forest extension agents

D. Output 4. Formulation of integrated participatory management of micro-catchment

1. Activity 4.1. FGD to develop participatory demonstration plots

The next step of micro catchment development was carried out through FGD to detail planning the demonstration plots. The participants of the discussion were communities/farmers whose land was selected as the location for the construction of plots which will be referred to as plot participants or field partners (FP). The selection of land used as a demonstration plot was the result of the analysis of the third FGD and field review which have been done beforehand.

During the discussion in three villages, FPs were directed to develop the detailed planning of sustainable land management demonstration plot, besides that they were also informed the reasons and criteria for land selection which among others had to lie in one stretch. The summary of the FGD in every village was:

a. Wonokeling

- Current conditions of the area are generally cultivated by seasonal crops such as maize and cassava. Some have also been planted with perennial trees such as albizia and limpaga, but there are also currently in a state of abandoned or without plants.
- The planting patterns chosen by the FPs were mixed or full of perennial trees, 61.54% was mixed pattern while 38.46% was full perennial trees. FPs who chose the full pattern was the farmers whose land is currently abandoned.
- The spacing of perennial trees for mixed pattern is 4 m x 4 m while for full pattern is 3 m x 3 m.
- The perennial trees that all participants chosen was albizia, as for the type of Multi Purpose Tree Species (MPTS) such as parkia, durio and avocado selected by 53.85% of FPs, and 46.15% of FPs chose a combination of parkia and durio.
- The ratio of woody trees and MPTS is 60:40 for the land with the slope more than 45% and 70:30 for the relatively flat area.
- Contribution of the parcipants in developing the demplot were labor and manure

- There were gully found in the area extending from upper right to lower left of the plot.

b. Wonorejo

- Current conditions of the area is that 60% occupied by seasonal crops such as maize and cassava, 23.33% are cultivated by seasonal crops and perennial trees on the boundary of the land tenure or spread irregularly, 6.67% have been overall planted by timber trees and 10% are abandoned.
- The planting patterns chosen by the FPs are mixed (86.67%) and full patterns (13.33%). The FPs whose land is abandoned chose full pattern.
- The spacing of perennials trees for mixed pattern is 4 m x 4 m, while for full pattern is 3 m x 3 m.
- The perennial trees albizia was selected by 70% of FPs, combination of albizia and limpaga was selected by 16.67% of FPs, and 13.33% of FPs chose combination of albizia and burflower, as for the type of MPTS, 96.67% of FPs chose the type of avocado and durio, while 3.33% chose only avocado.
- The ratio of perennial trees and fruit trees is 70:30
- Contribution of the FPs in developing the demonstration plot were labor and manure

c. Bubakan

- Current land condition is mostly (42.86%) cultivated with seasonal crops such as maize and cassava mixed with timber plantations on the boundary of the land tenure or spreading irregularly, 28.57% is cultivated only seasonal crops, 14.29% have been planted with woody plants overall and 14.29% is the abandoned land area.
- The planting patterns chosen by the FPs were mixed, full and surjan (striped planting). The mixed pattern was chosen by most of the FPs (64.29%), the full pattern was chosen by 28.57% of the participants, and 7.14% of the FPs chose surjan.
- The spacing of perennials trees for mixed pattern was 4 m x 4 m, while for full pattern was 3 m x 3 m.

- The type of woody trees chosen by all FPs was albizia, the MPTS chosen by the FPs were durio, avocado and cacao. The 85.71% FPs chose the combination of durio and avocado, 7.14% chose only avocado while 7.14% chose cacao.
- The ratio of perennial trees and MPTS is 70:30
- Contribution of the parcipants in developing the demplot were labor and manure

The FPs' land area in each village was targeted to be ± 10 ha so that the total target area of demonstration plots in the NMC is ± 30 ha. The number of FP in each village is different because of the difference in their existing land tenure. The selected FPs in each village are in Table 3 below and the summary of the detailed plan is in Annexes 4, 5 and 6.

Table 5. The selected FPs of each village

BUBAKAN		**WONOKELING**		**WONOREJO**			
1	Sadiko	1	Kardi	1	Diman	15	Sami
2	Sahit	2	Sido Warni	2	Kamto	16	Sarto
3	Samino	3	Sido RT-Templek	3	Lanjar	17	Semin
4	Ngali	4	Kadi	4	Marijo	18	Setu
5	Wiji	5	Sidi	5	Marimin	19	Simin
6	Sono Wiji/ Karsono	6	Dimin	6	Marno-Suwito	20	Sini
7	Tardi	7	Dwi	7	Paidi	21	Slamet
8	Sarman	8	Kasno	8	Pupon (Kisut)	22	Sonogiman
9	Satimin	9	Mbah Sawi	9	Paino (Kisut)	23	Sugeng
10	Paiman	10	Samidi	10	Parni (Kisut)	24	Sukimin (Gondang)
11	Wagiyo	11	Samijo	11	Pardi	25	Sular
12	Marmo/Wagiman	12	Cipto Wiyono	12	Parmin	26	Suliyem
13	Tarno	13	Giman	13	Parno	27	Wanto
14	Sukini	14	Marimin	14	Saidi		

(a)

(b)

(c)

Figure 9. FGD of participatory management planning in (a) Wonokeling, (b) Wonorejo, and (c) Bubakan.

A joint FGD was conducted in Wonorejo to strengthen the commitment of the FPs and stakeholders related to the demonstration plots development in the three villages. During the joint FGD, the research team clarified and reconfirmed the FPs' land area, chosen pattern and plant types. Besides that, it was formulated and signed the right and obligation of each party (Annex. 8.). This agreement is used as one of the tools to monitor the implementation of field activities.

Figure 10. Joint FGD to formulate detail planning of demonstration plots in Wonorejo

2. Activity 4.2. Workshop with all stakeholders

The workshop with the parties was held on April 26, 2018, at the WMTC office (Figure 6). The workshop was aimed to formulate the role of relevant institutions in supporting the sustainable management of NMC. Therefore the theme of the workshop was "The Role of The Parties in Supporting The Sustainability Management of Naruan Micro Catchment". The participants of the workshop were 30 peoples, consisting of related parties in the management of the upstream of Solo Watershed, especially in the NMC. Participants included representatives of village officials, the districts, provincial and central government, forestry extension agents, NGOs, and representatives of FPs.

During workshop, three papers were presented as discussion material, i.e.:

a. "The Role of The Local Government in Supporting The Management Activities of The Upper Solo River Basin", presented by Baperlitbang Wonogiri District
b. "Forest and Land Rehabiltiation (FLR) Program in the Upper Solo Watershed", presented by BPDASHL.
c. "Management of NMC: Activities, Status and Future Expectations", presented by APFNet project team.

The workshop formulated the agreement signed by 5 institutions as representative of workshop participants, i.e.:

a. Head of WMTC (on behalf of The executing ageny of APFNet project)
b. Head of BPDASHL Solo (on behalf of The Central Government/MEF)
c. Head of BPH Region IX (on behalf of The Central Java Province Government)
d. Head of Bapperlitbang Wonogiri District (on behalf of The Distric Government of Wonogiri)
e. Head of Bapperlitbang Karanganyar District (on behalf of The District Government of Karanganyar)

The contents of the agreement are:

a. In the management of micro catchment, comprehensive planning is needed, starting from problem identification, implementation up to M&E, as well as involving stakeholders from the central government, provinces, districts to local communities.

b. Relating to point 1, WMTC has begun participatory watershed management efforts in the NMC, Keduang Sub-Watershed by creating a management plan at an operational scale involving the local community and stakeholders from the village level to the central level.

c. Out of 957.0 ha of NMC area, ± 50 ha demonstration plot has been developed involving ± 100 landowners, BPDASHL Solo, Perum Jasa Tirta I, PDAM Wonogiri District and donor (APFNet).

d. Considering the limitations in basic tasks and functions of WMTC and budget, other parties must support the sustainability of the NMC management under their duties and responsibilities.

e. The potential support from each party starting from the central government to the village is in Table 6.

Table 6. The potential support from each party

1.	Central government		
	a. BPDAS HL Solo	:	- Support in preparing the technical design of watershed management at the site level by involving other parties. - Support in implementing soil and conservation measures by vegetative and civil technique methods through the provision of seeds of perennials trees and KBR, development of infiltration wells, gully plugs, medium and small check dams..
	b. BBWS Bengawan Solo	:	- Support community in land rehabilitation and water conservation through GNKPA program.
	c. WMTC	:	- Monitor demonstration plots and their impacts. - Deliver watershed management technology. - Support research results related to watershed management - Provide up to date information on the results of

			watershed management research
2.	Provincial Government	:	
	a. BPH Region IX	:	- Provide extention related to watershed management efforts - Provide guidance and assistance for community empowerment - Conduct FLR activities according to the budget available
	b. BPUSDATARU Bengawan Solo	:	- Develop soil and water conservation construction such as check dams and water infiltration wells
3.	District Government	:	
	a. Baperlitbang	:	- Support and coordinate OPD for the allocation of their activities in the NMC through both local government and GNKPA activities - Facilitate integrated planning on soil and water conservation in the village level
	b. Services related to environment	:	- Conduct water conservation measures such as conservation of springs and the construction of water infiltration wells - Provide community empowerment in environmental conservation such as waste bank campaign
	c. Services related to livestock	:	- Provide facility and assistance in the development of livestock for the use of grass which has been developed as a form of soil conservation measures.
	d. Services related to plantations		- Develop woody-based estate plantation (e.g coffee and cocoa)
	e. BPBD		- Socialization for disaster-aware communities and early detection of disasters
4.	BUMN/BUMD		
	a. Perum Jasa Tirta I		- Allocate CSR fund in the form of material (for example seeds of perennial trees, conservation structures) and the form of cooperation with various parties for conservation activities both vegetative and civil technique
	b. PDAM		- Allocate CSR fund for reforestation programs in catchment areas
5.	Local Government		- Provide guidance and supervision to the community in the implementation of activities
6.	Local Community		- Provide human resources, land and community self-reliance for the implementation of activities

All parties will jointly endeavor to realize demonstration plots of participatory management of micro catchment.


Figure 11. Stakeholders workshop in WMTC office

The original formulation is presented in Annex 10.

E. Output 5. Demonstration plot of conservation farming and watershed rehabilitation

The detailed plan resulted from Activity 4.1 was then be applied in the field. Before the development of the plots there were some activities must be done, such as field survey and mapping.

1. Activity 5.1. Determining the site of demonstration plots

Field measurement with GPS (Global Positioning System) was carried out to determine the area of demonstration plots. Tracing the boundaries of the land was done with the help of the FP. The measurement results were then be mapped and identified its physical characters such as the current type of land use, slope, and cropping pattern as well as the landowner's name. The land tenure area of each participant was different, so the number of FP for each village was different. The list of the participants in each village are in Table 4. The area listed in the table is the flat area. Because the demonstration plots have an average slope of about 25 degrees or approximately 55%, then the area needs to be corrected which is divided by the cosine of 25 degrees. So the total area demonstration plots are approximately 30.0 ha. Layout of the location are presented in Figures 12, 13 and 14.

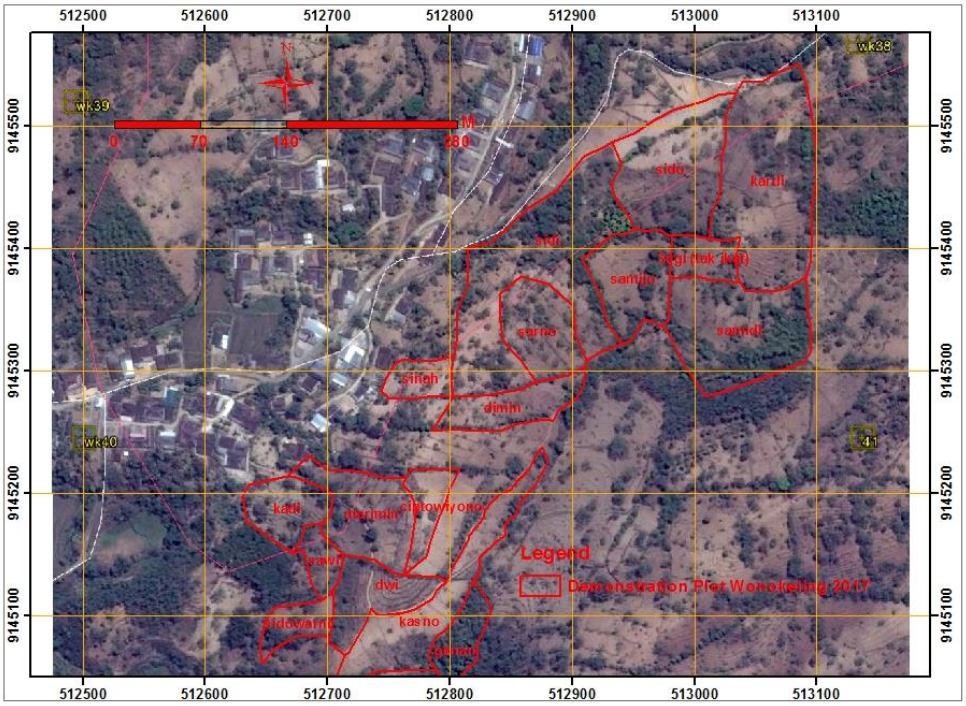


Figure 12. Layout of demonstration plot in Wonokeling

Table 7. The list of FPs in each village and their land areas

Wonorejo		Bubakan		Wonokeling	
Land Owners	**Area (ha)**	**Land Owners**	**Area (ha)**	**Land Owners**	**Area (ha)**
Diman	0.469	Ngali	0.652	Ciptowiyono	0.186
Kamto	0.247	Paiman	0.816	Dimin	0.325
Lanjar	0.093	Panut	0.274	Dwi	0.372
Marijo	1.077	Sadiko	0.471	Giman	0.211
Marimin	0.158	Sahid1	0.484	Kadi	0.295
Marno-Suwito	0.351	Sahid2	0.173	Kardi	1.212
Paidi	0.09	Samino1	0.500	Kasno	0.637
Paino (1&2)	0.186	Samino2	0.250	Marimin	0.532
Pardi	0.086	Sarman	0.706	Samidi	0.871
Parmin	0.136	Satimin	0.995	Samijo	0.474
Parni	0.05	Sonowiji	0.774	Sawi	0.137
Parno	0.062	Sukini	0.502	Sidi	1.370
Pupon	0.175	Tardi	0.837	Sido RT.	0.806
Saidi	0.45	Tarno	0.718	Sidowarni	0.172
Sami	0.137	Wagiman	0.951	Sinah	0.161
Sarto	0.174	Wagiyo1	0.452	Sarino	0.420
Semin	0.164	Wagiyo2	0.572		
Setu	0.297				
Simin	0.081				
Sini	0.101				

Slamet (1&2)	0.259				
Sonogiman	0.224				
Sugeng	0.107				
Sukimin G.	0.180				
Sular	1.316				
Suliem	0.120				
Wanto	0.505				
Sukimin K.	0,210				

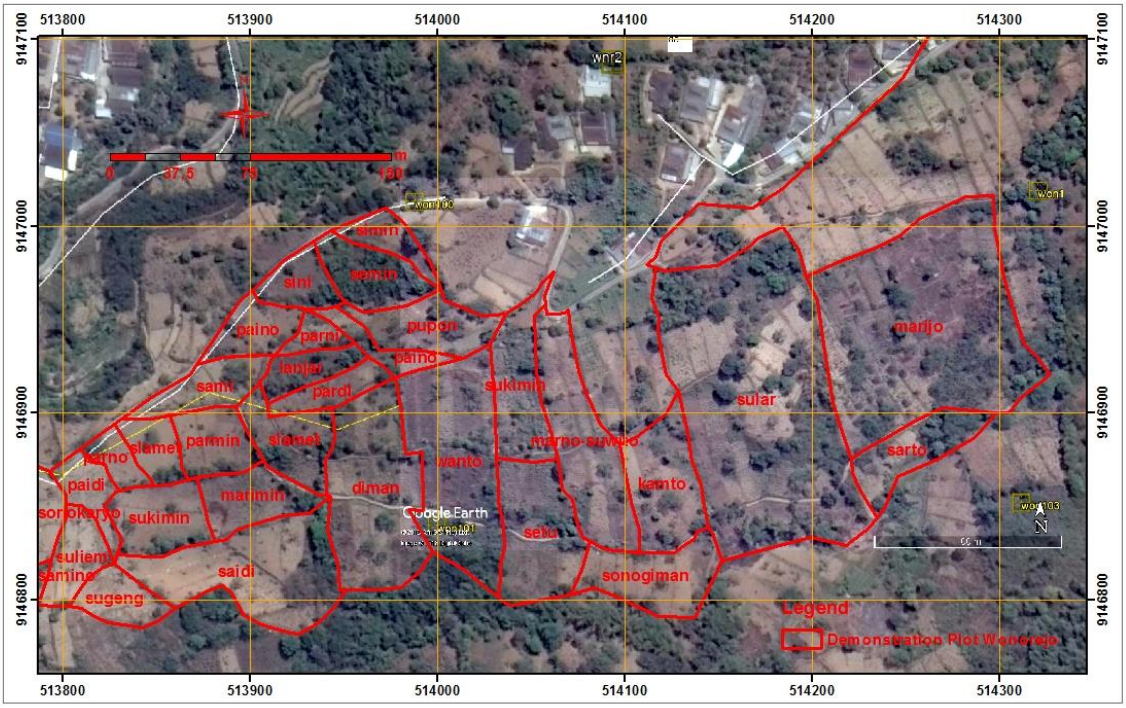


Figure 13. Layout of demonstration plot in Wonorejo

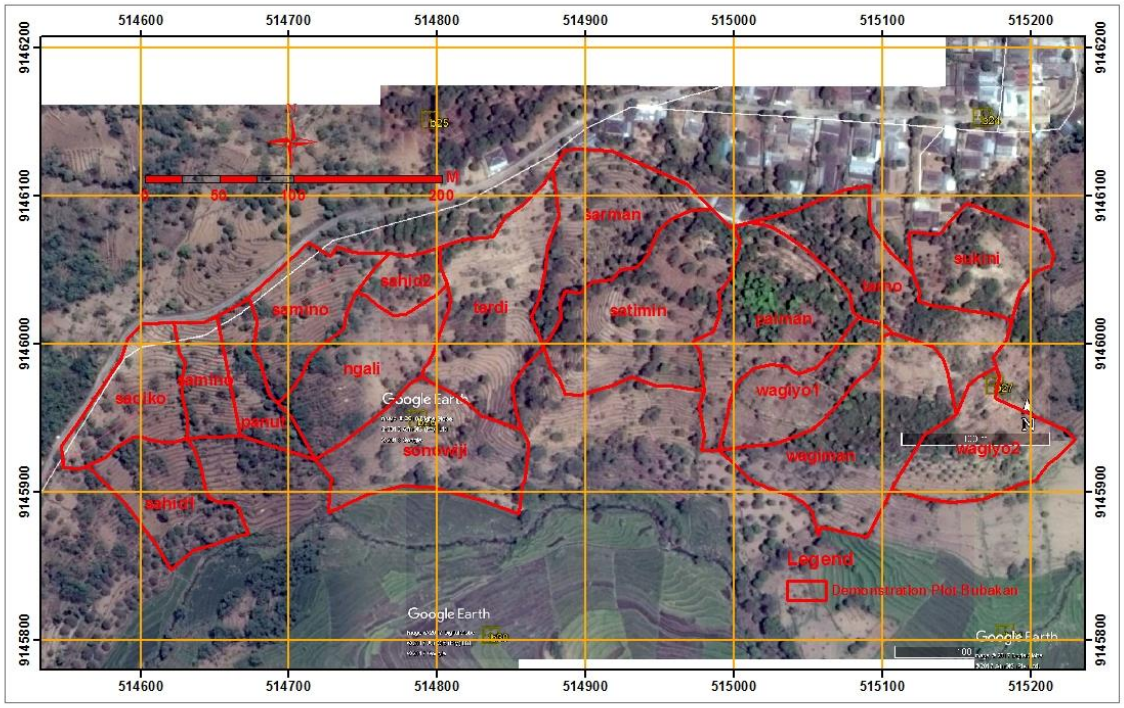


Figure 14. Layout of demonstration plot in Bubakan

2. Activity 5.2. Applying vegetative soil conservation measures

Soil conservation using the vegetative method was done with a pattern such as output of the Activity 4.1. The preliminary condition of the area can be seen in Figure 10. The number of perennial seedlings were distributed according to the area of land owned and spacing. Seedlings distribution was done after the FPs dig the planting hole and prepared manure. The type of distributed trees were: albizia, limpaga, durio, parkia, and avocado (Figure 16). Planting grass on the risers and in the drainage was done independently by the FPs. The research team monitored the planting activities until all the seedlings were planted in the field based on the design. This vegetative conservation through the demonstration plots was the essential activity of NMC management, thus its success must be achieved. It is expected that the undertaken treatment will impact the performance of micro catchment. Locations of the plots in the field can be identified by looking at the nameplate as shown in Figure 17.

However, monitoring of each stage of activities has been conducted by the research team. Seedlings delivery was monitored by the research team so that seedling can be assuredly received by each FPs, as well as monitoring on planting to ensure that all

seedlings are planted in the field according to the design. One week after the seedlings were delivered to the farmer group, the research team checked the planting of the seedlings. The seedlings condition on a month after planting can be seen in Figure 18.

Figure 15. Initial land conditions before planting

Figure 16. Performance of agroforestry plant seedlings

Figure 17. Nameplate of demonstration plots in each village

Albizia Avocado Durio Parcia

Figure 18. Plant performance 1 month after planting

3. Activity 5.3. Applying civil technique soil conservation measures

One of the problems in the NMC is the large number of gully erosion caused by further erosion as a result of the poor land management by the community. Gully erosion is often found in the boundary of farmland, both on dry land and home garden even on residential. If the gully erosion is not addressed, it will be very detrimental to the community. This erosion aside from being a source of sediment in the downstream region also reduces the productivity of agriculture land.

In reality, gully erosion is often overlooked by the community. This is because no one is responsible because the location is at the boundary, besides that it is also due to a lack of mastery and knowledge of its mitigation technique. It is recognized that under certain conditions the cost of overcoming gully erosion is expensive, especially on large-scale. However, in relatively small gully erosion, it is expected that the community can contribute to overcoming it. Therefore the role of the government is very much needed in providing examples of gully erosion prevention techniques. The condition of several gullies in the project location is as in the figures below.

The construction of gully erosion control is aimed not only to overcome the enlargement of the gully and to control sedimentation rate but also as a demonstration site for the community on how to cope with the gully erosion. Therefore, 34 planned erosion control structures consist of several types and shapes,

including small check dams, small gully plugs, and head structure. The building materials used are in the form of stone (cemented stones), gabion and bamboo (which are expected to grow). With these examples, it is hoped that the community can take advantage of this knowledge to be applied in their land. Therefore, in carrying out the construction, the labor force used is the landowner and the surrounding communities.

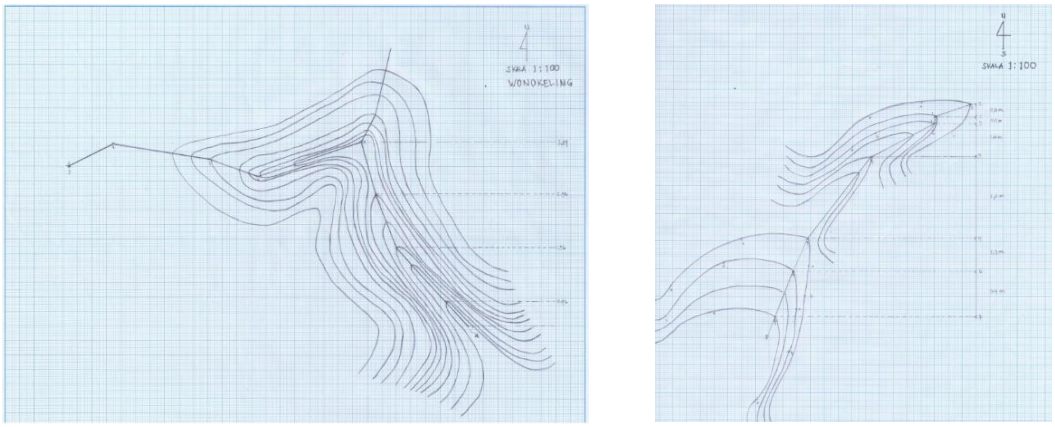
(a) Wonokeling Village

(b) Bubakan Village

(c) Wonorejo Village

Figure 19. Gullies conditions in several location of The NMC

Applying a civil engineer method for soil conservation measures starts with terrestrial measurements that were taken to measure the height of a point, which will then be analyzed to draw contour lines. From these contour lines, it will be determined the points/locations of the constructions. The construction of gully erosion control will be determined by the shape and size of the gully and the volume of flow and the type of soil. Another important factor is the placement between constructions. Constructions placement must be serial to optimize its functions. The gully control is carried out thoroughly with the arrangement of construction from the head of the gully to its toe.



(a) Wonokeling Village (b) Wonorejo Village

Figure 20. Example of contour lines resulted from terrestrial measurement, the basis of gully control construction

The type of material used in the construction of a gully control building was based on the type of gully, the availability of the material in the field such as bamboo, stone, gabion, palm fiber and other supporting building materials such as sand and cement. SGP made of bamboo was placed in small gully/stream, while cemented stone or gabion were placed in gully/stream.

After determining the exact location, the next step is measuring the flow dimensions, as a basis for determining the type and size of the building. Measuring the dimensions of this flow includes stream width, bank height, and other dimensions as a basis to designs the construction. From the soil profile measurement, then the gully control constructions were designed (Figure 22.). These measurements are also used to plan the budget.

The execution was carried out in November 2018, which involved landowners and surrounding communities. The development process can be seen in Figure 5.

Figure 21. Measurement of gully dimensions by making a soil profile

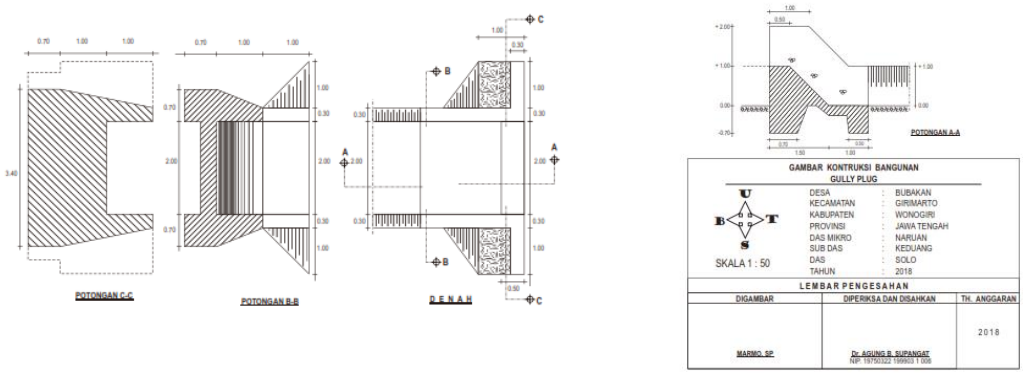


Figure 22. Example of gully control designs

Figure 23. The gully control development process in Wonokeling Village

During the project period, 35 gully erosion control buildings were built, spread across 3 villages, namely Wonorejo (28 units), Wonokeling (5 units) and Bubakan (2 units). The distribution and building specifications in each village are presented in Table 8.

Table 8. Locations and specification of gully control construction

No.	Locations	Structural types	Materials	Unit
1.	Wonorejo Village	Small Gully Plug (SGP)	Bamboo	22
		Gully Plug (SGP)	Cemented stones	2
		Small Gully Plug (SGP)	Gabion	2
		Small Check Dam (DPn)	Bamboo	1
		Small Check Dam (DPn)	Cemented stones	1
2.	Wonokeling Village	Small Gully Plug (SGP)	Bamboo	1
		Gully Plug (SGP)	Cemented stones	2
		Head Structure (HS)	Bamboo	1
		Small Check Dam (DPn)	Cemented stones	1
3.	Bubakan Village	Small Gully Plug (SGP)	Cemented stones	1
		Small Check Dam (DPn)	Cemented stones	1
		Total		35

The community and surrounding landowners participated in SGP development. During the development process, it is hoped that it will become learning material to increase their knowledge which can eventually be applied to their land independently. In the short term, it is expected that gully control may reduce the rate of gully enlargement moreover the rate of sedimentation can be restrained, while in the long term it is expected that gully control can improve land production function.

(a) (b) (c)

Figure 24. Types of gully control technique (a) Bamboo (b) Spesi (cemented stones); (c) Gabion

(a) (b)

Figure 25. Small check dams in Bubakan (a) and Wonokeling Village (b)

(a) (b)

Figure 26. Gully plugs in Bubakan (a) and Wonokeling Village (b)

(a) (b)

Figure 27. Serial gully controls from head to toe in Bubakan Village (a) and Wonokeling Village (b)

After it finished, the construction has shown its functions, especially in resisting the sedimentation rate (Figure 9). In this figure, it can be seen that the pool of the dam was full of sediment, which in turn is expected to stabilize the stream flow so that its destructive energy can be minimized.

Figure 28. After small check dam was completed (a), it collected sediment (b)

F. Output 6. Enhanced community awareness in management of micro catchment

Output 6 is supported by Activities 6.1 and 6.2. which are focused on improving the field partner knowledge. Activity 6.1 is an extension for field partners, while Activity 6.2 is an excursion to farmer groups that have implemented an integrated farming system.

1. Activity 6.1. Community extension related to conservation farming system

   Extension was carried out through assistance and training. Training was held in three villages namely Bubakan Village, Girimarto Sub District, Wonogiri District, and Wonokeling and Wonorejo Villages, Jatiyoso Sub District, Karanganyar District. Training was carried out in 3 days (a day for each village). The training was attended by FPs in each village. This training is intended to support land rehabilitation, as well as soil and water conservation.

   Training given to FPs for supporting land rehabilitation was mainly about the importance of using organic fertilizers to maintain land conditions. Currently, FPs have used cow manure as organic fertilizer, but the cow manure is still used conventionally without being processed, so it takes time to become a fertilizer that is ready for use. FPs have not yet processed the cow manure into organic fertilizer, because the people do not know how to process it or the benefits of cow manure which is processed into organic fertilizer. Therefore, FPs were trained to make organic fertilizer from cow manure. They also were explained the benefits and advantages of cow manure which was processed into organic fertilizer compared to those which were only used as conventional fertilizer. This is expected to motivate the community to optimally process and utilize livestock manure.



(a) Wonorejo (b) Wonokeling (c) Bubakan

Figure 29. The process of making organic fertilizer from cow manure

FPs were also trained to make organic pesticides made from spices, microorganisms, and cow urine. This is intended to eliminate FP's dependence on chemical pesticides

so that their farming is environmentally friendly, and the community can use local materials in their farming business. In this training process, the FPs were very actively involved both in the practice of making fertilizers and pesticides as well as in discussion. Besides, assistance was provided for the maintenance of demonstration plots through personal communication, such as guiding FPs on how to fertilize plants properly.

(a) Wonorejo (b) Wonokeling (c) Bubakan

Figure 30. Training on making organic pesticides and liquid fertilizers from spices and cow urine

The extension topic on soil conservation has been carried out along with the construction of civil techniques conservation through self-management scheme. This project will be finished in August 2019, while the community still needs further assistance to be able to implement land rehabilitation and soil conservation efforts independently. For the continuity of guidance and assistance to the community, the team has involved extension agents in extension activities.

Training to make a small gully erosion control building made from bamboo was conducted in Wonorejo Village. The aim of the training is for farmers to have the knowledge and ability to independently build erosion control gaps on their land. The existence of small gaps in the form of grooves at the boundaries of land ownership is often not handled by government programs, so the community must be able to exercise control early on. The training was attended by all FPs from 3 villages namely Wonorejo, Wolokeling, and Bubakan. The activity also involved assistants from field forestry extension workers and was attended by village officials. The activity began with the delivery of the theory of the concept of making small gully plug buildings made from bamboo and continued with practice in the field.

Figure 31. Training on making bamboo based soil conservation construction on small gully control

2. Activity 6.2. Excursion to farmland which applying integrated farming system

The problems faced by people in the NMC in land use include diversification of cultivated agricultural commodities and the absence of post-harvest processing to provide added value. Cropping patterns are seasonal, and the division of seasons using the traditional season calculation method, which is divided into "mongso" (planting season) 1, 2 and 3. Single commodities in each season are applied in their cropping pattern. Moreover, the commodities in one season with commodities in other seasons are economically not well integrated. This cropping patterns do not benefit the community where the results obtained are not optimal. From the conservation aspect, the pattern does not provide maximum protection. In mongso 1 and 2, land cover is dominated by seasonal crops, perennials trees, and grass while in the third mongso, land cover is only perennial trees such as albizia and fruit trees (MPTS), while the lower strata plants are almost non-existent.

Another problem is the lack of institutional development of the farmer groups. This is indicated by the weakness in obtaining information about the timber market so that it often gets low revenue from its businesses. The integration of on-farm farming with livestock has not been well developed. As a result, the livestock business scale is still relatively small even though it is relied upon as a source of additional household income.

Based on the above problems, it is necessary to increase FP's knowledge and references through comparative study. The target locations of the comparative study are villages that already have community groups succeeded in developing integrated farming, which includes seasonal farming, forestry, animal husbandry and processing of farming products as well.

Excursion was held in 2 locations. Initially, the objects will be visited are an integrated farming system in Magelang District, and livestock management in Sukoharjo District, Central Java. However, the two objects were no longer active, so the location of the excursion was transferred to Klaten, Boyolali and Surakarta Districts. Excursion was carried out in two stages with different objects. Each stage was attended by 30 FPs from three villages namely Wonorejo, Wonokeling, and Bubakan. Through these arrangements, FPs who took part in the first phase comparative study had different experiences with who participated in the second stage, so that they were expected to be able to share information.

The objects of the first phase of the comparative study were integrated community forest in Sukorejo Village, Musuk Sub District, Boyolali District and integrated livestock farming in Mundu Village, Tulung Sub District, Klaten District, Central Java Province.

Trip 1: Klaten and Boyolali Districts

a. Integrated community forest in Sukorejo Village, Musuk Sub District, Boyolali District

Excursion activities in integrated community forest farmer groups began with sharing information about the Ngudi Utomo community forest farmer groups presented by the leader of the farmer group and continued with discussions with FPs. The Ngudi Utomo community forest farmer group was formed on 12 May 2014. Several

problems were underlying the formation of the Ngudi Utomo community forest farmer groups, namely: 1). the marketing of timber from community forest products is still dependent on middlemen so that the price of timber is low; 2) the performance of existing farmer groups is not optimal, and 3) community forests do not have eco-label so that timber from community forest products does not have a high market value.

The establishment of Ngudi Utomo community forest farmer group is expected to overcome these problems. In its development, the Ngudi Utomo farmer group was assisted by NGO "Arupa" from Yogyakarta. Besides, there are several incentives provided by the government in the form of seedling aids and extension.

Figure 32. Discussion about integrated community forest in Sukorejo Village

The members of the Ngudi Utomo community forest farmer group are 754 people with 367.07 ha of community forest area spread over two villages namely Pagerjurang and Sukorejo Villages, Musuk Sub District, Boyolali District. The main commodity of community forest is albizia (Paraserientes falcataria). In 2015, this farmer group also succeeded in establishing a network with a wood processing company (Abiyoso Trading Business in Boyolali District). In this case, the Ngudi Utomo farmer group had made a contract as a wood supplier to Abiyoso Trading Business, so that the farmer group could directly sell the logs to those company. Thus, members of farmer groups obtain higher prices of timber than other community forest farmers. Ngudi Utomo community forest farmer groups have also succeeded in developing plant nurseries, cultivating mushrooms and marketing organic fertilizers.

b. Integrated livestock farming in Mundu Village, Tulung Sub District, Klaten District

Comparative study activities in livestock farmer groups began with sharing information about the Margo Mulyo livestock farmer group presented by the leader of the farmer group and continued with the visit to several integrated cow farm activities. The first visit was to see the silage making process. The purpose of making silage is to preserve fodder as a feedstock in the dry season and to improve the quality and nutrition of animal feed. During this visit, one member of the Margo Mulyo farmer group explained how to make silage starting from the composition of the materials used, the manufacturing stage, the method of storage and the usage techniques.

Figure 33. Overview of how to make silage for animal feed

The second location visited was the location of composting. Therefore, one of the FPs from Wonorejo Village stated that the composting that had been taught by the WMTC research team was better than that because it was through a fermentation process so that the compost yield was more crumb. This shows that FPs have understood the training material received from the research team.


Figure 34. Discussion about how to make organic compost fertilizer

The next visit was to the location for making biogas. At that location, FPs were given an explanation of the process of handling manure to be used as biogas, the size of biogas tank, utilization of biogas and utilization of biogas waste. The construction of biogas in Mundu Village was carried out using arisan which was social gathering to collect funds regularly to be used alternately. In this case, participants did not receive funds but in the form of a biogas installation. Biogas is used as fuel for cooking, thereby saving fuel costs. Besides, slurry which is biogas waste can still be used as organic fertilizer.


Figure 35. Explanation of the process of making biogas from livestock manure

The fourth visit was to see the process of making local microorganisms (MOL). FPs received an explanation of the process of making MOL. Materials for making MOL are easily obtained. The MOL can be used as fertilizers and pesticides organic which

can improve soil structure and increase soil organic matter, as well as reduce farming costs.

The last visit was to see products from cow's milk that had been processed into bath soap, caramel, and chips. However, FPs were more interested in making silage, building biogas installations, making MOL, and making compost. This is related to the characteristics of the livestock they have.

Figure 36. Explanation of how to make MOL

Trip 2: Boyolali and Surakarta Districts

a. Integrated farming systems in Banyuanyar Village, Ampel Sub District, Boyolali District

The first visit was made to the farmer group "Ngudi Utomo" located in Banyuanyar Village, Ampel Sub District, Boyolali District, Central Java. This farmer group has succeeded in developing integrated farming that combines agriculture, forestry, livestock, and culinary tourism. This system has succeeded in increasing the economy of group members and has managed to control the role of middlemen on prices, especially coffee products.

The activity begins by looking at the part of integrated agricultural land. The expanse of land was tightly covered by perennial trees, plantation trees and forage crops (grass). The cropping pattern applied was agroforestry which combines perennial trees, plantations trees, and forage crops. This system allowed canopy stratification, namely upper, middle and lower canopy. The top canopy was formed by albizia, medium canopy by coffee and bottom canopy by grass (king grass). According to the head of

the group, the previous pattern more towards monoculture, especially albizia. At that time, albizia were planted rather tightly so that other plants did not grow. On the other hand, around the village also developed local types of coffee, called coffee jackfruit. This type of coffee that has a jackfruit aroma has been developed since the Dutch era and is very popular among the surrounding community. The price of coffee was not competitive at that time, therefore they replaced it with albizia. Based on the experience and knowledge gained from extention that coffee can grow under albizia, members of the farmer group agreed to develop coffee, and also developing dairy cattle. Finally, the combination of the three types of plants was successfully developed in Figure 37.

Figure 37. Visit to community forest land: agroforestry patterns between albizia and coffee plantations

In the next visit, participants were invited to see how to maintain dairy cattle. Not only caused by the appropriate environmental conditions (temperature), the development of dairy cattle in the area is also supported by the availability of sufficient fodder and market price. It is also supported by the existence of a group that manages product marketing so that it can guarantee price stability. At present, the farmer groups already have several productive dairy cows, which can produce 15-20 liters of milk every day for each cow. This milk production is sold to the Joint Indonesian Milk Cooperative (GKSI = *Gabungan Koperasi Susu Indonesia*) branch of Boyolali, and some are taken by milk consumers in Solo and its surroundings.

Figure 38. Visit to a dairy farm at Banyuanyar Village

To increase the added value of milk products, farmer groups also process cow's milk into dairy products such as yogurt, ice cream, and crackers. Currently, these dairy products are sold at the nearest market. If milk supply is stable, dairy products are targeted to be marketed to supermarkets in the surrounding district/city. By the existence of dairy farming and milk processing, the source of income for group members will vary, not only from agricultural products but also from livestock. The development of this livestock business will encourage people to maintain the grass and other fodder types.

Figure 39. A visit to a dairy farm: discussions and examples of cow's dairy products

The next object is the making of silage, which is a form of fodder derived from fermented grass (Figure 40). Silage is higher in nutritional value than the nutritional value of fresh grass. It is also more durable so that it can become a stock of fodder in the dry season because in the dry season fodder production usually decreases.

Figure 40. Silage for the supply of animal feed in the dry season

On this occasion, it was explained about the process of making good silage and knowing the characteristics of its nutritious. The quality of silage is characterized by a fragrant of grass, moist but not contain water, and not moldy. The poor silage is characterized by hot temperatures, which are sometimes smoky.

Figure 41. Explanation about cultivation of dairy cows farming by speaker

The last visit was to see the "coffee shop" of the Ngudi Utomo farmer group. The establishment of this coffee shop is to increase the added value of the coffee product. Previously, coffee was only sold in the form of dry beans, both on the market and taken directly in the garden. The benefits obtained by the community are not reasonable and sometimes valued at low prices. To increase the value of coffee, the coffee beans are processed and packaged in attractive packaging, besides that they are also sold in the coffee shop in the form of coffee served by trained baristas.

Figure 42. The participants took pictures in front of the "Coffe Shop" of the Ngudi Utomo Farmers' Group

b. Honey bee farm in Pucangsawit Village, Jebres Sub District, Surakarta City

The second location is honey bee farm, located in Pucangsawit Village, Jebres Sub District, Surakarta City, Central Java. Mr. Muhammad Arifin, the owner and keeper of the honey bee farm gave a speech while Mr. Yusriah Arifin explained how to breed Apis cerana and Apis trigona laeviceps. It was explained how to know the types of bees, build colonies, provide bee feed and ways to harvest honey. In the NMC, the honey bee has the potential to be cultivated because of its environmental conditions and the availability of bee feed. This is due to the large number of flowers from local plants that grow in the home garden and the dry fields. From the presentation, the participants were very enthusiastic and very interested in developing bees, because the requirements needed are available in their villages such as bamboo, flower plants, and marketing facilities.

Figure 43. Speaker Mr. Arifin explanationed of the concept of bee cultivation

Figure 44. The participants enthusiastically discuss with the speaker

G. Output 7. M&E of watershed performance within the scale of micro catchment, landscapes, and household

Since the treatment in demonstration plots are expected to affect the micro-catchment performance, monitoring before and after the treatments is necessary. M&E activities at the beginning of the project were aimed at 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. M&E data includes aspects of water management, land, as well as socio-economic and institutions. In this activity, data collection was specific to the location of the demonstration plots and the FPs in each village, except for the aspects of water and sediment yield that carried out at the outlet of catchment.

1. Activity 7.1. Water yield and sedimentation monitoring

   Hydrological monitoring was carried out at 4 points. These points were the outlet of NMC and 3 tributaries namely Branjang, Anget, and Muncar rivers (see Figure 45.). Data collected in hydrological monitoring were rainfall, discharge, total runoff, and sediment yield. The results of monitoring in the project period are presented in Table 9.

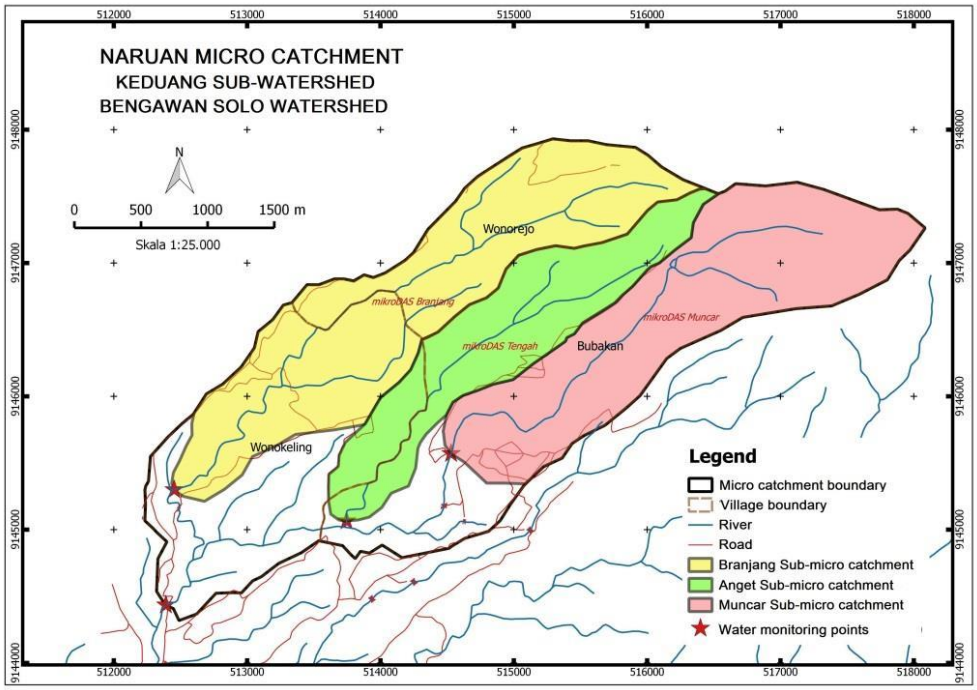


Figure 45. Hydrological monitoring points of NMC

Table 9. Hydrological data of NMC

Small river cathment	Catchment area (ha)	Rainfall (mm)	Discharge (m^3/sec)	Total runoff (mm)	Sediment (ton/ha)
Branjang	307.16	4089	78.8	2215.9	72.6
Anget	172.36	2915	52.1	2610.0	12.8
Muncar	282.17	5002	361.4	11164.1	354.8
Montong (Outlet of NMC)	957.13	4546	860.2	7455.8	584.2

Remarks: Reporting period of August 2017 - July 2019 (2 years)

The data showed an average amount of high annual rainfall (2,272 mm/yr), as well as an average annual discharge of 214.5 m3/s. Based on water monitoring for 2 years (reporting August 2017-July 2019), it showed that from an average rainfall of 4,545 mm, produced an average total runoff of 7,011.0 mm and an average sediment yield of 327.2 tons/year. Total runoff is greater than rainfall due to base flow addition during the dry season (zero rainfall). This gives the conclusion that the hydrological condition at the project site in good condition.

The monthly distribution of discharge and rainfall for each catch is presented in Figure 46.

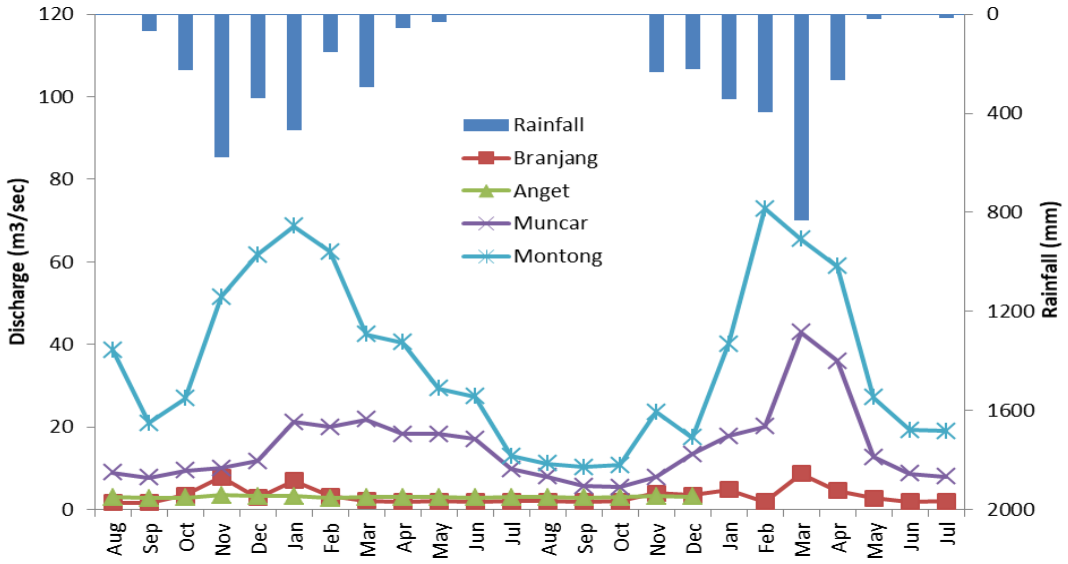


Figure 46. Monthly distributions of rainfall and discharge

Based on Figure 46, it can be seen that the wet months occurred between October and May, while the dry months occurred between June and September. This is also shown by the condition of monthly fluctuations in river flow (discharge).

The monthly data distribution has not shown any relationship between the activities of the project with the hydrological condition in the NMC. Of the NMC area wich almost 1,000 ha, it has been developed vegetative plots of less than 50 ha starting at the end of 2016, as well as several technical civil structures to controlling small gully erosion. In the micro catchment scale, these are classified as small activities and the hydrological impact has not been seen at the catchment outlet. However, on the onsite scale (plot), the impact of activities could be seen on erosion control, as discussed in Activity 7.2.

2. Activity 7.2. Land evaluation

   a. Soil erosion rate

      When viewed from the slope map derived from the DEM analysis, the plot location generally has a slope of 24-45%, but from the direct measurement, the actual slopes are in general more than 45%. The average slope of the demonstration plot of each village is 67%, 48% and 51% for Bubakan, Wonokeling, and Wonorejo, respectively. The plots are dominated by inceptisol

soil type which has deep effective soil depth (>90 cm). It is found that the K value is 0.26 based on soil texture analysis obtained from the previous study. Rainfall stations in Bubakan and Gondang noted that in 2017 and 2019 an average annual and monthly rainfall intensity are 2044 mm and 185 mm. Land cover types are generally seasonal crops with contouring planting systems and ridge terraces. Based on these biophysical characteristics, soil loss can be predicted. Using USLE (Universal Soil Loss Equation) it is found that in general all the spots are suffered from heavy soil lost (143 ton/ha/yr). It is expected that by the end of the project, the canopy cover of albizia will intensively protecting soil surface and will reduce soil loss.

By the year of 2023 (5 years after planting), the demonstration plots are expected to become mix garden (a combination of wood, fruit and seasonal crops) so that the C factor will improve and may reduce soil erosion rate. The previous C value (dry field) is 0.64 and it will decrease into 0.2 (Asdak, 2002), which significantly reduces the total soil loss by approximately one-third (Table Annex 7).

(a) (b) (c)

Figure 47. The conditions of agroforestry land (a) initial condition; (b) 1.5 years after planting; (c) 3 years after planting

b. Soil organic matter (SOM)

The impact of increased SOM on agroforestry demonstration plots (plants aged 19 months) has not been seen significantly compared to the original land (seasonal crops), which are 3.08% and 3.07% respectively. Significantly increasing in SOM was seen after 3 years planted (plot year 2016), which rose to 4.03%. However, this value is still far below the SOM on forest land which is 5.34% (Figure 48).

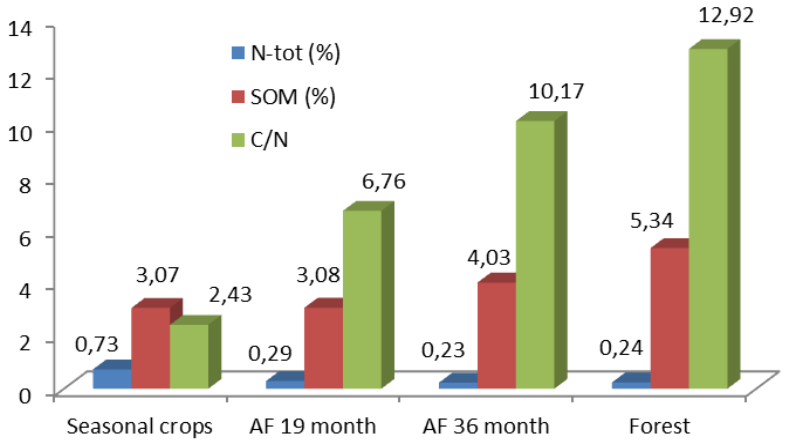


Figure 48. Increased SOM due to agroforestry development

c. Plant growth

Land evaluation activities include measuring the growth parameters of albizia, as well as maintaining plants, namely fertilizing and replanting. The second additional fertilizing activity carried out in December 2018 (10 months after planting). The types of fertilizer used are NPK + Za, without the addition of pesticides such as at the first stage of fertilization.

Figure 49. The activity of chemical fertilization on demonstration plot

Re-planting was only carried out to substitute the dead perennial tree (albizia). The seedlings came from the BPDASHL-Solo's and Perum Jasa Tirta I (PJT-1) nursery. The seedlings from the BPDASHL Solo were allocated for the APFNet's demonstration plots in each village, while PJT-I seedlings were applied in

APBN's demonstration plots in Wonorejo Village. The allotment of seedlings is carried out following the proportion of the land area of each FP, and considering the number of the dead plants in the field.

Figure 50. Substitution planting of the dead albizia plants

The measurement was carried out in August 2018, November 2018, April 2019 and August 2019 and the measured parameters were the height and diameter. Data collection was carried out on three blocks, namely blocks of cultivated land, bare land (abandoned), and Solomon albizia. Cultivated block is the area of albizia planted in the area of seasonal cropping land, while bare land block is albizia planted in the abandoned land overgrown with shrubs. Solomon albizia block is a block of Solomon albizia trees in the cultivated land. The size of each block is approximately 20 m x 20 m. The measurement of each block was repeated 3 times and located in three villages. The highest growth in height and diameter of plants is found in the Solomon albizia block. Visually, Solomon albizia shows faster growth compared to the local albizia species. In general, Solomon albizia shows better performance than that of local albizia (Table 10 and Table 11)

Table 10. The height growth of albizia and Solomon

	Wonokeling			Wonorejo			Bubakan		
Height (m)	Cultivated	Solomon	Abandoned	Cultivated	Solomon	Abandoned	Cultivated	Solomon	Abandoned
August 2018	128,3	140,4	74,2	121,2	182,3	124,8	111,9	168,6	102,9
November 2018	127,0	145,6	78,9	131,0	211,2	141,2	126,1	173,8	110,4
April 2019	159,4	195,4	90,3	180,4	287,2	229,4	218,8	231,3	125,4
August 2019	225,0	249,3	107,9	253,8	379,8	347,7	296,3	279,8	221,0

Table 11. The diameter growth of albizia and Solomon

	Wonokeling			Wonorejo			Bubakan		
Diameter (mm)	Cultivated	Solomon	Abandoned	Cultivated	Solomon	Abandoned	Cultivated	Solomon	Abandoned
August 2018	12,0	15,5	9,6	10,9	22,7	14,4	11,6	19,0	9,6
November 2018	12,1	15,1	9,8	11,8	25,9	17,3	13,8	19,8	10,6
April 2019	15,6	18,2	12,1	16,2	34,8	23,7	23,6	23,9	11,9
August 2019	22,9	24,1	12,1	24,5	34,8	35,5	33,3	29,2	20,5

(a) (b)

Figure 51. The performance of Solomon albizia (a), and local albizia (b)

In general the performance of Solomon is better compared to that of local albizia, the best height performance found in Wonorejo (Figure 51 and Figure 52).

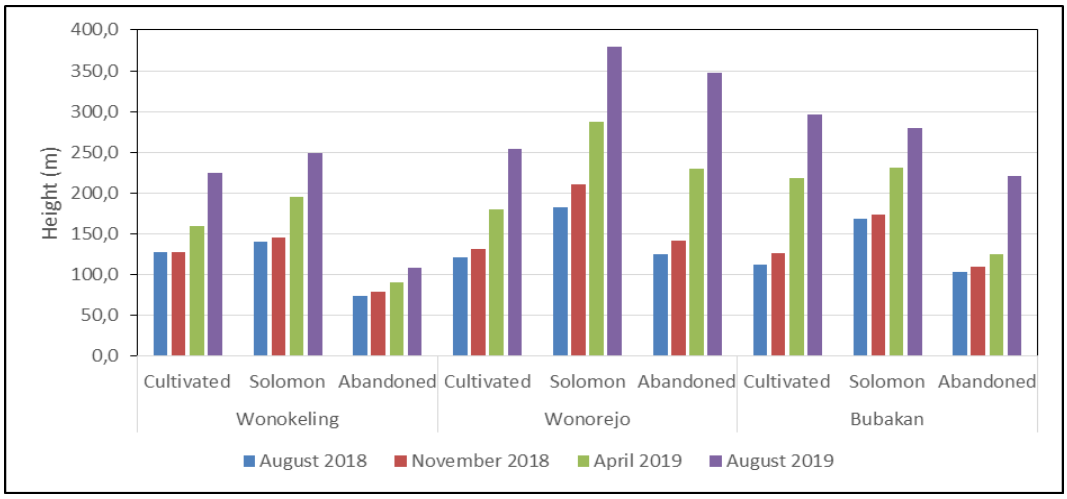


Figure 52. The height growth of albizia and solomon

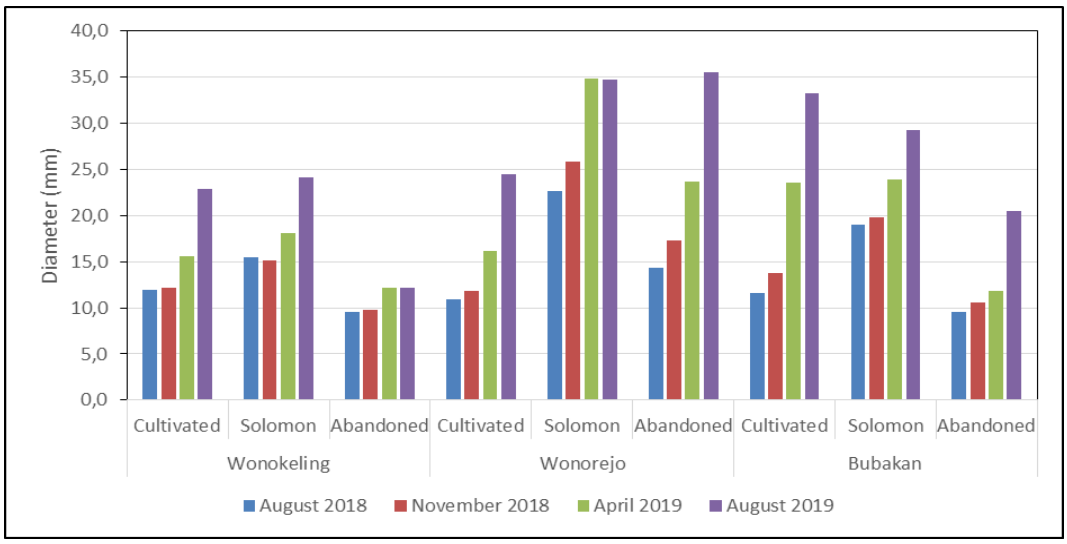
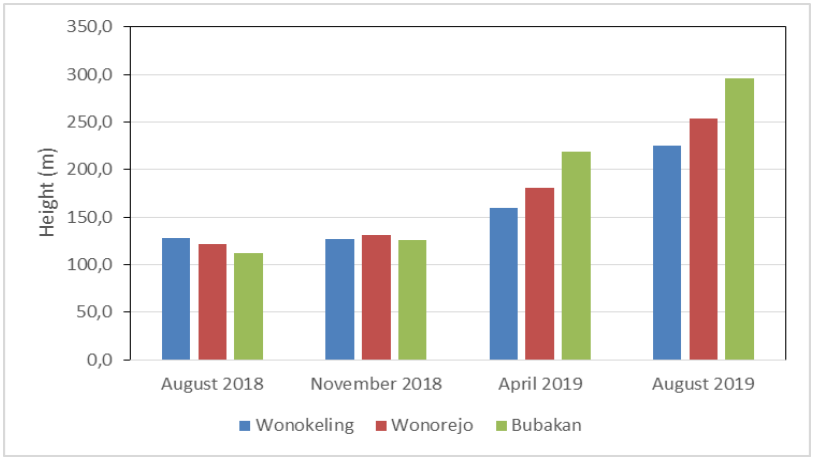


Figure 53. The diameter growth of albizia and solomon

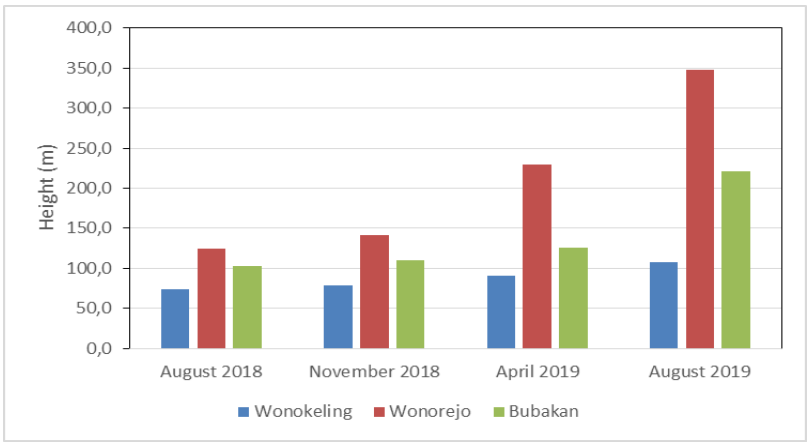
During the dry season, many MTPS died, especially Durio. Watering and giving litter and other vegetation residual materials can be used to maintain soil moisture so that plant death can be avoided. For example, in Bubakan Village (on Samino's land), wells and water supply pipes have been installed to meet water needs during the dry season. The use of mulch from crop residues was applied to durian and avocado plants on Sarman's land.

The highest height growth of albazia in the cultivated block was found in Bubakan village (Figure 53-a) followed by height growth in Wonorejo and

Wonokeling. However, the highest growth of albazia in the abandoned block was found in Wonorejo (Figure 53-b).



(a)



(b)

Figure 54. The height growth of albazia in the cultivated (a) and abandoned (b) land

Table 12. The percentage of living Albizia in Bubakan

No.	Name	Existing land cover types	Slope (%)	Spacing	The percentage of living Albizia (%)
1	Sadiko	Abandoned land, land preparation for cassava plantation	65	4x4	70
2	Sahit	Maize, cassava, beans, albizia, suren (from bud with random pattern)	55	4x4	10
3	Samino	Crops and vegetables	75	3x3	20
4	Ngali	Maize, cassava, albizia	75	4x4	60
5	Wiji	Abandoned land	70	3x3	25
6	Sono Wiji/ Karsono	Maize, cassava	25	4x4	30
7	Tardi	Maize, cassava, suren etc, (sparce)	75	3x3	40

8	Sarman	Albizia	60	4x4	70
9	Satimin	Maize, albizia, suren (abandoned for 2 years)	82	4x4	40
10	Paiman	Maize, cassava	80	4x4	20
11	Wagiyo	Maize, cassava	85	4x4	12
12	Marmo/ Wagiman	Mixed garden (0,15 ha abandoned)	75	3x3	20
13	Tarno	maize, cassava, suren etc, (partialy abandoned)	69	4x4	0
14	Sukini	maize, cassava, ginger, suren and albizia (sparce)	70	4x4	10

Table 13. The percentage of living Albizia in Wonokeling

No.	Name	Existing land cover types	Slope (%)	Spacing	The percentage of living Albizia (%)
1	Kardi	Grasses	35	3x3	60
2	Sido Warni	Albizia	45	4x4	10
3	Sido RT (Templek)	Maize, cassava	35	4x4	10
4	Kadi	Maize, avocado	55	4x4	40
5	Sidi	Maize, cassava, albizia, grasses, partially abandoned	40	4x4	15
6	Marimin	Maize	60	4x4	50
7	Dimin	Maize	60	4x4	50
8	Dwi	abandoned for 2 years	55	4x4	70
9	Kasno	Maize, cassava	65	4x4	20
10	Mbah Sawi	Maize, cassava	45	4x4	10
11	Samidi	Maize, cassava, albizia	35	4x4	30
12	Samijo	Abandoned	45	4x4	50
13	Cipto Wiyono	Maize	55	4x4	20
14	Giman	Albizia	50	3x2	80
15	Sinah	Maize, cassava	50	4 x 4	50
16	Sarino	Maize, cassava	40	4 x 4	30

Table 14. The percentage of living Albizia in Wonorejo

No.	Name	Existing land cover types	Slope %	Spacing	The percentage of living Albizia (%)
1	Simin	Maize, cassava	25	4x4	0
2	Semin	Abandoned, Suren (sparce)	35	4x4	60
3	Sini	Abandoned	45	4x4	10
4	Pupon	Maize, cassava	45	4x4	0
5	Paino	Maize, cassava	45	4x4	0
6	Parni	Maize, cassava	55	4x4	10
7	Lanjar Lukman	Ginger, maize, albizia, suren	60	4x4	0
8	Pardi	Maize	70	4x4	0

9	Suliyem	Ginger, maize, cassava	25	4x4	10
10	Sugeng	Maize, chili	40	4x4	40
11	Paidi	Chili	15	4x4	10
12	Parno	Maize, cassava	35	4x4	20
13	Slamet	Maize, cassava, ginger, suren	60	4x4	80
14	Sami	Sweet potatoes, maize, cassava	35	4x4	60
15	Sukimin Gondang	Maize, cassava, suren	80	4x4	70
16	Marimin	Maize, mixed garden	45	4x4	15
17	Parmin	Cassava, ginger, teak, suren	40	4x4	70
18	Saidi	Maize, cassava	35	4x4	30
19	Diman	Maize, cassava, ginger,	65	4x4	10
20	Prayitno/wanto	Abandoned	72	4x4	50
21	Setu	Maize	60	4x4	40
22	Marno	Maize	80	4x4	20
23	Sonogiman	Maize, cassava, ginger, beans	55	4x4	80
24	Kamto	Maize, cassava, albizia, suren, ginger	80	4x4	30
25	Sular	Abandoned	75	3x3	70
26	Marijo	Albizia	80	4x4	30
27	Sarto	Maize, ginger, banana, beans	70	4x4	60

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

   a. Evaluation of economic characteristics of demonstration plot

      The economic parameters used to plan and monitor the activities of the NMC project are based on the parameters and standards of the National Monitoring and Evaluation of Watershed Areas (Minister of Forestry Regulation No. P.04 / 2009). These parameters consist of: population dependence on land, income levels, land productivity, and environmental services. These parameters consist of: population dependence on land, income levels, land productivity, and environmental services. Dependence on land is the percentage of land-based household income to total household income. The level of income is the average per capita income compared to the poverty line in the universal region (Regency). Land productivity is the tendency for land productivity to decrease or increase. Environmental services are environmental services produced in a watershed. In detail the results of monitoring economic parameters are presented as follows:

1. Dependence of the population on land

A survey of sources of population income indicates a decrease in land dependence from 2017-2019 (Table 15).

Table 15 Sources of income of farmers in each village in 2017 and 2019

No.	Villages	Sub District (District)	Income Source										Total Income (House Hold/Yr in Rp)
			Land-Based						Merchandise (Rp)		Remittance (Rp)		
			Cash Crops (Rp)		Cattle (Rp)		Wood (Rp)						
			2017	2019	2017	2019	2017	2019	2017	2019	2017	2019	
1.	Wonorejo	Jatiyoso (Karanganyar)	3,579,000	1,345,333	1,349,327	1,195,833	1,654,347	1,675,453	1,526,087	10,800,000	1,358,695	928,571	9,467,456
2.	Wonokeling	Jatiyoso (Karanganyar)	10,646,776	5,276,250	3,787,455	2,750,000	10,400,000	10,453,045	2,875,455	9,000,000	2,395,455	3,084.375	30,105,141
3.	Bubakan	Girimarto (Wonogiri)	6,144,314	1,785,900	9,980,833	3,360,000	5,772,222	5,876,333	6,000,000	13,200,000	5,050,000	3,500,000	32,947,369
Average			5,774,204	2,802,494	4,268,425	2,435,277	4,634,007	6,001,610	3,057,047	11,000,000	2,605,823	1,477,218	20,339,506
Percentage of total income (%)			28.4	11.8	21.0	10.3	22.8	25.3	15.0	46.4	12.8	6.2	100

Based on Table 15, population dependence on land, farmer's household income from annual crops. Farmer's household income from annual crops, cattle and remittance has declined during 2017-2019. However, revenues from timber sales and trading activities have increased. Revenue from timber sales increased from 22.8% to 25.3% while trading activities increased from 15.0% to 46.4%. The change in sources of income from the land base to the trade and the mobility of the people migrated to the city, so the uncultivated land was planted with trees as household savings as well as a way to conserve sloping lands. The growth of timber plants is considered to be an increase in bank savings as the saying "Wong Kutho Nyelengi Duwit", "Wong Ndeso Nyelengi Uwit" (Urban People Saving Money, Rural People Saving Trees" (Purwanto, 2018).

In detail, the highest source of income for the population in the area comes from seasonal crops, followed by timber, and income from livestock raising. The cropping pattern applied is agroforestry. The pattern aplied trees, vegetable, other seasonal crops and herbs. The types of tree planted are: albizia, limpaga, pinus, teak, burflower, jackfruit and needle-wood tree, while vegetables and seasonal crops planted are maize, cassava, cabbage,

peas, tobacco, carrot, velvet bean, green bean, tomato, chive, mustard, sweet potatoes, etc. Ginger and turmeric are types of herb planted under trees. There are no similar planting patterns among farmers. This depends on the experience of each farmer and the estimated prices and marketing opportunities of the products.

During 2017 and 2019 in three villages the income from trading has increased. This shows that their people have the potential to be equipped with the knowledge to trade and migrate abroad. They trade outside the area (Jakarta, Tangerang, Dumai, Papua, etc.) generally trade meatballs and herbs. This finding is also in accordance with the results of the study of Purwanto et al (2017) which states that in the communities around Meru Betiri National Park, trading and remittance from family members contribute to high household income. In this condition, the community should be encouraged to plant mixed gardens and then be left trading outside the region. According to information from the community, if the land is planted with sengon with a spacing of 3 x 3 m, the number of plants is 1,111 seeds/ha. At the end of the cycle (6 years) approximately 400 trees can be sold. If the selling price of plants is Rp. 200,000 per tree, the farmer's income will reach approximately Rp. 80,000,000. If the avocado is planted with 6 x 6 m planting lines, the number is 277 seedlings. If the seedlings come from grafting seeds and can grow until they bear fruit, according to the experience of farmers in Wonorejo, one tree can generate income of Rp. 1,500,000. If the number of avocado trees that grows and produces 200 trees, the farmers will get an additional income of approximately Rp. 300,000,000 per year. As a reference, the results of a study presented by Shofiandi (2016) concluded that (1) the structure of agroforestry farmers' income in Sumber Agung Kelurahan came from agroforestry in the amount of Rp 11. 675.317,07 (68,67%, and and non-agroforestry businesses amounting to Rp 5,327,804.88 (31.33%), (2) The distribution of income of agroforestry farmers in Sumber Agung Village tends to be evenly distributed among farmers, with a gini ratio of 0.4, (3) The poverty level of agroforestry farmer families in Sumber Agung Village on average is in the near poor and poor category, which is 60.97%.

For the development of conservation farming businesses that are linked to farmers' income sources (Table 15), it is better to develop community forests in Wonokeling and silvopasture in Bubakan. Besides, at the household level, the development of conservation agriculture needs to be done through the planting of fast-growing species of timber so that every 6-7 years can be harvested. For business development outside the village, it is necessary to carry out entrepreneurship training by related institutions such as the Trade Office, Vocational Training Centers, etc.

2. Land Productivity

Based on interview and FGD with FPs, the productivity of seasonal crops is relatively constant. It means that there is no significant decline. However, FPs know that their land is experiencing erosion especially in sloping land. Erosion that has no effect on the productivity of seasonal crops may due to sufficient fertilizer input for its growth. The decline in productivity occurs in albizia due to the attack of "karat puru" (gall) caused by the fungus Uromycladium sp. Until now there has been no effective fungicide to eradicate the gall. The advice given to FPs is that they have to cut the infected leaves or twigs then burned or buried it. In 2019, farmers experience a decrease in productivity due to the long dry season. This causes water shortages so that plant growth is disrupted and productivity is low. Farmers also know that their land is experiencing erosion, especially on sloping lands. Besides caused by a long dry season, the decline in productivity is also caused by attacks of "karat puru" (gall) on albizia caused by the fungus *Uromycladium sp.*

3. Environmental Services

Environmental services derived from the area are irrigation and drinking water, sediment retention and recreation. PDAM of Wonogiri District gets water supply from Muncar dam in Bubakan Village. Besides as a supplier of drinking water and irrigation the Muncar dam is also a place of recreation. In addition, Gandri check dam which is located in Wonokeling is able to capture sediment so that it does not flow to the downstream areas.

b. Community participation

In accordance with the objectives of the project, community participation in NMC management is measured by community understanding and perception of soil and water conservation activities, community involvement in activities, and the follow-up. Observation and in-depth interviews with FP's in three villages were conducted to determine community participation (Bubakan, Wonokeling dan Wonorejo). The results of observations showed that there ware FP's that the percent of living plant more than 50% (albizia and avocado), and FP's whose the percent of living plant less than 50%. Therefore, in-depth interviews were conducted with several FP's, whose land represented both conditions of the plant.

1. FP's perception of soil and water conservation

   FP's involvement in the project has been carried out since the preparation, planning, and implementation of activities. Through this process, the community increasingly understands the importance of soil and water conservation efforts. FP's understands that the land must be cultivated with perennial crops. Some FP's stated that the perennial crops should not be cut down, so they propose several species that have economic value and can be harvested without being cut down. The FP's have also realized the importance of civil technique soil conservation in controlling erosion on their land.

   In addition, community perceptions on soil and water conservation efforts were also influenced by FP's satisfaction with the project. FP's stated that the activities carried out were very interesting because the FP's as land managers were actively involved in planning stage (selection of patterns, species and spacing), the quality of perennial crop seedlings (albizia, limpaga, avocado, durio, and parkia) was good, and the community was given fertilizer for plant maintenance.

   Although the FP's understand the importance of soil and water conservation efforts, the FP's still consider economic factors in their land management. This can be seen from the selection of mixed patterns (perennial and seasonal

crops), the spacing of 3x3 m or 4x4m, and the selection of species. The FP's chose mixed crop patterns with wide spacing so that they can still plant seasonal crops under storay. Thus, the land still produced before perennial crops can be harvested. The perennial crop species that are chosen, whether wood or fruit has a market opportunity and a good price.

2. FP's participation in project implementation

   In general, the FP's actively participated in project implementation. This can be seen from the community involvement in several activities as follows:

   - All FP's participated in land preparation, organic fertilizer contribution, and perennial crop planting. However, there was one of FP's who fully got assistance from the project team.
   - FP's participation in perennial stand tending is relatively high; both for participants with high and low crop survival rates. This was demonstrated by the efforts of the FP's to provide additional fertilizer for perennial crops when they fertilized maize. Some FP's even buy seedlings to replanting dead plants, or just take care of stumps in the fields.
   - The FP's generally have planted grass on the land because it was used to feed the livestock. However, the plantation was only on the land boundary so that it has not been able to fully support soil conservation efforts on agricultural land.
   - Almost all of FP's were enthusiastically involved in the extension activities (training in making fertilizers, pesticides and civil technique soil conservation from bamboo), and excursion conducted by the project team because they gained knowledge through these activities.

3. Follow up by FP's

   FP's participation in soil and water conservation efforts was not only through FP's involvement in project implementation, but it must be followed up by the community independently. In the case of perennial crops, FP's will continue to cultivate their land with perennial crops. However, there are some opinions relating to species selection. In general, FP's intend to cultivate albizia because of its economic value and market opportunity. However, there are obstacles in the form of gall attacks, so FP's expect information to eradicate gall. There are some FP's who want to try other

species such as limpaga or jabon, but they need its market information. Even though the FP's has cultivated woody plants independently, there are many people who still expect aid from the government, especially for MPTS seedling.

Training materials for making organic fertilizers and pesticides have not been applied because of time availability, so it is more efficient to buy it. In Wonorejo Village, participants did not practice it because there were no places available, so they hoped that there would be an effort to move the community to make it collectively. Regarding soil and civil technique conservation from bamboo, there are participants from Wonokeling Village who want to practice this technique, but in general, the FP's still hopes for assistance to make it, even if it is only for a part of the material. This fact shows that the community mindset that leads to participation mobilized by aid has not been fully changed. This is because they have been conditioned to rely on assistance in carrying out land rehabilitation and soil and water conservation.

c. Local and stakeholder institutions supports

The social action or role taken by the Institute will determine the sustainability of the results achieved by the project. For the Naruan project, institutional support is expected to come from three parties, namely from local (village) institutions, local government agencies and central government agencies, by applicable laws and regulations. Local government, including the village head with his apparatus and the head of the hamlet, which has the task of fostering village communities, including fostering farmer groups in his area. Local government support mainly comes from the Provincial Forestry Service of Central Java (Dinas Kehutanan Propinsi) with Forestry Service Branch (Cabang Dinas Kehutanan, CDK) and extension workers, while central government support comes from the relevant Technical Implementation Unit (UPT), including BPDASHL Solo.

The results of the study showed that the support of village institutions and stakeholders reached 218 out of 300 maximum values (Table 16). The achievement of this value is in the medium category. Of the three villages, two of them reached a high category with a value of 250, and one village reached a value of 150. Two

villages that achieved a high value and category were Wonokeling Village and Wonorejo Village. The form of support provided by the two Village Institutions is in the form of policies that actively encourage group leaders and members to develop the examples provided by the project. This encouragement is given not only to the farmer groups involved in the project activities but also to other farmer groups. Even for Wonorejo Village, the Village Head instructed all village officials to jointly see and study these examples, which then developed activities by the conditions of the area.

From some examples of project activities, the most important and very possible activities to be continued and developed by the community are planting activities, especially Albizia, installation of bamboo gully control, and composting techniques for manure. All three examples of these activities are technically and financially feasible to be carried out by the community. For Wonokeling Village, for example, the farmer (Mr. Sariman), nongroup members, has begun to develop livestock manure composting techniques, because he has seen and felt the benefits of the technique. Likewise, the head of the APFnet group (Mr. Giman) and his members plan to develop techniques to overcome the erosion of the ravine with bamboo plants in other ravine locations. Therefore, for the village head's authority to develop project results to be even greater, the village head hopes that the project results will soon be handed over to the village administration officially.

Table 16. Village institutions support

No	Instituions	Perception1		Perception2		Attitude		Respons		∑Value	Category
		Score	Weight	Score	Weight	Score	Weight	Score	Weight		
1.	Wonokeling Village	3	10	3	15	3	25	2	50	250	High
2.	Wonorejo Village	3	10	3	15	3	25	2	50	250	High
3.	Bubakan Village	3	10	3	15	1	25	1	50	150	Low
	Average									218	Moderat
	Remarks	Know = 3 Do not = 1		Useful = 3 Useless = 1 Abstain = 2		Developing = 3 Mantaining = 2 Abstain =1		Actively developing = 3 Actively suppoting =2 Passive = 1		Klasifikasi dukungan: 100-166 = Low 167- 233 = Moderate 233-300 = High	

Remark: Data analysis, August 2019

As can be seen in Table 15 that the Bubakan village government support is still low (score 150). At the time of the survey, the village administration had not yet taken action and had not yet determined its attitude towards the results of the project, even though the village government agreed that the results of the project would be beneficial to the people in the area. This is thought to be due to the lack of confidence in the village administration of their ability to carry out according to the example given. For Bubakan Village, the variety of activities is not much. For example, the gully control building, the model built in this village is a speci model made of cement which is relatively expensive and uses technology that is quite complicated for the community. Likewise, the growing power of plants in this village is relatively lower compared to the other two villages. This makes village officials unable to determine their attitudes and actions, except if they all come from the government.

Following Weber's theory of rationality year 1864 that a person's actions do not arise suddenly, but appear as a result of positive perceptions and attitudes from stimulants. Johnson (1994) asserted that a person's actions towards an object will be determined by his attitude and view of the object. Whereas someone's view of an object will be determined by the results of their interpretation of the stimulus that enters their brain to bring up the definition of something. Finally, someone will act and construct their behavior or actions following the definitions that appear at that time. Therefore, for the village of Bubakan it is still necessary to increase the intensity and variety of pilot activities so that village officials have choices.

Next is the support of local and central government. The support of the local and central government is considered very positive for the Naruan project. This is evidenced by what is done by extension workers who live in three study villages. As a follow-up to the project, Jatipuro sub-district extension staff began in 2019 to facilitate village nurseries, which used funds from the Provincial Government's KLHK Office in Wonokeling Village and Wonorejo Village. This village garden production will be used to develop the results of the APFnet project. Production of seedlings to be produced is planned to reach 1 million trees/fruit trees and Albizia each village. Likewise, BPDAS Solo has also planned to build as many technical civil activities in the three villages.

d. Business group supports

The survey shows that in the three villages have developed several business/economic institutions, which are ready to encourage the progress of timber farming. These institutions include "Wood Trader", "Sawmills", and "Seed Breeder" (Table 11). Wood traders, especially albizia wood are found in all three villages. The largest number of wood traders is in Bubakan. This agent is growing along with the growth of timber-based business. The existence of this wood traders will make it easier for FPs to sell their wood products to the market. It is hoped that it will encourage the FPs to maintain their woody plants. In addition, sawmills are found in Wonokeling and Bubakan. Although the number is still small and has not increased, the existence of this agent may help farmers in timber business. Seed breeders are needed by the community, especially when farming is carried out independently at its own expense. However, until now this type of business does not yet exist in the project village, but it can be found in other villages/sub-districts.

Table 17. Local economic institutions related to timber developed in three villages

Village	Wood trader		Sawmill		Seed breeder	
	Amount	Trend	Amount	Trend	Amount	Trend
Wonokeling	3	Increase	2	Constant	0	0
Wonorejo	10	Decrease	0	0	0	0
Bubakan	15	Increase	2	Constant	0	0

Source: Primary data, 2018

Figure 55. One of the activities of albizia wood traders in Bubakan

Other business that can support the development of timber business are livestock. Livestock is developed along with the development of grasses planted under the stands of albizia. The description of livestock development in the three villages is presented in Table 12.

Table 18. The description of livestock in the three villages

Villages	Average livestock per respondent		Livestock feed	
	Cow	Goat	Origin	Feed condition
Wonokeling	1.9	5.4	Land own	Abundant-sufficient
Wonorejo	1.2	5.4	Land own	Sufficient
Bubakan	1.9	2.0	Land own	Sufficient

Source: Primary data, 2018

H. Output 8. Final report and disseminations

1. Activity 8.1. Meeting to share the project outcomes

At the end of the project, two meetings were held, namely a stakeholder workshop to socialize the outcomes of the FGD to discuss the results of project activities. The workshop was held on July 31, 2019, in the WMTC office with the theme "Participatory and sustainable micro watershed management model". The workshop aims to convey the results of project activities to the parties, discussion of the micro watershed management model, as well as the sustainability mechanism of Naruan Micro Watershed management. The workshop was attended by 40 participants, including the project team, project consultants, steering committee, researchers and stakeholders involved in the project activities, as well as some local reporters. The workshop resulted in the formulation of an agreement between the parties for collaborative management in the upstream Solo River Basin.

FGDs are conducted before the preparation of the final report. The FGD activities were held on August 28, 2019, at the WMTC office. The purpose of the FGD is to present the final results of the project activities and have a discussion with the consultant team and the internal M&E team to obtain input for improvement. The results of the FGD will be used as input in the preparation of the complete report at

the end of the project period. The FGD was attended by 20 participants, including the project team, project consultant and personnel of the internal evaluator from WMTC.

Figure 56. Workshop to share the project outcomes with stakeholders

Figure 57. FGD meeting to discuss the project result

2. Activity 8.2. Formulating final report and developing dissemination materials

   There are two kind of documentation materials namely photos and videos. These documentation presented in each activities and wrapped in CD or flash disk. The dissemination of the project activities in the form of leaflets and posters. There are 6 leaflet and 4 posters topics (*in Indonesian*) that have been compiled, i.e.:

   Leaflets:

   - Making organic fertilizer from manure
   - Making organic pesticides from local raw materials
   - Developing community participation in micro-watershed management
   - Bamboo, an economical solution for controlling small gully erosion
   - Water monitoring in micro-catchment scale
   - Land capability analysis in micro-catchment planning

   Posters:

   - Land capability analysis in micro-catchment planning
   - Water monitoring in micro-catchment scale
   - Developing community participation in micro-watershed management
   - Bamboo, an economical solution for controlling small gully erosion
   - Utility of livestock wastes

All of leaflets and posters master are presented in annex part of Completion Report.

III. CHALLENGES, ISSUES AND PROJECT RESPONSES

The objective of this project is to develop participatory management of micro catchment based on soil and water conservation principles. Therefore, participation becomes the keyword in the construction of the pilot plots. Participation is the active engagement of people in decision-making processes. It is about communities having access and control over common resources and about giving voice to those who are disadvantaged and excluded. It is also about the right to engage in these processes from planning to evaluation. Participating parties are not only the community but also the other parties. Participatory development brings many challenges. Among them is the risk that engagement stops at the end of a project. There is a need to ensure that processes are ongoing and empowering for those involved. There are some obstacles in every level of implementation, i.e community and institutional levels as well as technical level.

A. Community level

The community participation in every stage of the management planning process is very good. This can be seen from (1) the FPs presence in each FGD, (2) the community awareness to their land condition, and (3) public awareness about the need for sustainable land management and soil conservation efforts. The community is aware that the current land management is not appropriate that causes increasing erosion and sedimentation and decreasing soil productivity. This awareness is shown in the design of demonstration plots which include perennial crops (timber and fruit) as well as mechanical structure for soil conservation. Community participation is also demonstrated by the willingness to contribute labor and manure in the implementation. However, this level of participation did not occur during design implementation. They did not follow and obey the signed agreement. This condition can be seen from several occurrences, for instance:

- There are FPs who had not finished making the planting hole and planting the distributed seedling until the agreed deadline.
- The application of spacing that was not following the pattern that has been designed. It was found that some of FPs planted in closer spacing and the planting was done only on land boundaries

These condition are caused by three factors:

- The availability of labor

  In the three villages, some residents migrate out of the villages. They go to another city to make a living for long and/or short term. Some of them will go home when planting season. Most of them are productive males. That is why the labor will be less in a certain period.

- Land tenure

  Farmers who have narrow land and which make agriculture the main source of income tend to hesitate to plant timber on their farms. They are worried that their seasonal crops will be disrupted. Apart from that, they are also worried because timber plants require a relatively long time to be harvested. Therefore, they only plant perennial trees only in the boundary.

- The existing landcover types

  FPs whose land currently covered by seasonal crops tend to be reluctant to plant perennial trees because they are not willing to lose the yield from seasonal crops to get timber yield in a relatively long time.

The effort already made to overcome the problems are, for instance: (1) giving financial support for labor to plant, (2) building intensive communications with FPs and leaders to motivate them in implementing the design, and (3) monitoring their activity periodically.

Besides, from the social baseline data two problems can interfere community participation in NMC management, namely:

- FPs mindset

  The community mindset that relies on the aid to participation

  has not been fully changed. This is because they have been conditioned to rely on assistance in carrying out land rehabilitation and soil and water conservation. To change this mindset, the community was also asked to contribute to the project implementation in providing manure and labor.

- The presence of forestry extension agent

  Forestry extension agents should actively assist FPs in land rehabilitation and soil and water conservation activities. However, most of the FPs did not notice forestry extension agents' existence. This is as a result of the lack of extension activities in their working area. For this reason, the research team continues to strive in building communication with forestry extension agents and involving them in the project activities.

B. Multy-stakeholders level

Participation of the parties has been built since the early stages of activities through FGD. In the discussion phase, the participation of the parties in Wonogiri and Karanganyar is quite good. Each party conveys activities of its institute that have the potential to support the management of the NMC. Although there were already parties that have supported activities in this project, many still can not be executed. It was due to some obstacles, such as: (1) the availabe seedling types are not suitable with the need, (2) the quality of given seedling did not meet the standards, and (3) The bureaucracy in the requesting of aid or cooperation is not simple.

To overcome these obstacles, the steps taken include: (1) building the intensive communication with relevant agencies that have the potential to support the implementation of activities, and (2) assisting the community in preparing aid proposals and fasilitating the communication between FPs and donors.

C. Technical level

Technical obstacles that have been faced by FPs in the development of perennial crops are controlling gall (*Uromycladium sp.*) and transportation cost. Gall could attack seedlings up to trees (Figure 58). The attack of the gall is massive and deadly. If one of the plants is attacked, another plant will be attacked quickly. This condition will result in financial losses. Up to now, FPs still found the difficulties in controlling gall which are mostly stated by FPs in Wonokeling Village (Table 19). To overcome these obstacles FPs still need assistance from the government through related agencies, especially in the supply of pesticide.

Table 19. Technical obstacles and expectations on the government's role

Obstacles	FP in every village (%)				expectations on the government's role
	Wonokeling	Wonorejo	Bubakan	Average	
Disease control	100	76	43	73	• Pesticide stocks • Disease control techniques • Construction of infrastructure for woods transportation
Transportation cost	0	8	21	10	

Source: Primary data (2018)

Figure 58. Gall (Karat Puru) that attacks albizia stem

Another obstacle faced by FPs in the development of perennial crops is the expensive transportation cost of log from the field. Land conditions that are steep and far from road access cause expensive transportation cost. It will reduce profit received by FPs. Therefore the government is expected to provide adequate infrastructure for reducing transportation cost.

D. Some lesson learned

Carrying out the activities in MYR2, there were several problems which mostly have been overcome so that the planned targets could be implemented. Some important notes on this matter include: (1) community participation, (2) counseling and

training, (3) application and adaptation of new ideas that are suitable with local conditions, and (4) follow-up for sustainability management of the NMC.

(1) Community participation

Most of the civil technique construction are located in areas far from the road, making it difficult to reach by vehicles. This happens because the gullies are distributed in the middle remote area. Due to these constraints, there must be extra costs for transporting materials to the location so that it become more costly. To reduce costs, it is required community participation and modification of building materials. Participation can be in the contribution of labor. The building material can use local materials such as bamboo and other materials that have similar functions. The independence of the community will be very beneficial especially with the skills to use local materials.

(2) Counseling and training

Counseling and training on the construction of soil conservation buildings must be carried out intensively so that they can independently address conservation issues on their land by using local materials at low cost. During the implementation, not all of the farmers involved had a positive response which among others was shown by the lack of enthusiasm for work. This can happen because they feel they cannot get direct benefits since they are not the land owner. Addressing this problem, approaches have been made to key figures such as group leaders, village officials, extension agents and leaders in the community to mobilize their participation.

(3) Application and adaptation of new ideas suitable with local conditions

From the field trips, participants got knowledge of some farming practices that provided great benefits, but in applying them, it was necessary to adjust to the conditions in their environment. Group discussions need to be conducted to identify the potential and constraints of each participant. FPs played an important role in the discussion by facilitating and giving input so that the results of the discussion could be applied by them.

(4) Follow-up for sustainable management

From the basic data, it can be seen that the problematic locations such as gullies, landslides and erosion are distributed evenly in the NMC. Of the many problematic locations, only a small portion can be overcome through this project activity. The

project will end in 2019, while there are still many locations that must be handled. As stated in myr1, there is still a sectoral ego in development activities (watershed management). Stakeholders only focus on their task and function. In the framework of future sustainable management for the NMC, communication and co-coordination among stakeholders needs to be done regularly and well organized. Baperlitbang can be a facilitator for this activity so that each stakeholder can communicate their activities. Specifically for the NMC, the follow-up of the agreements signed in the 2018 FGD can be carried out. Furthermore, a cooperation agreement will be made between WMTC and BPDASHL Solo regarding management of the NMC. The NMC can be used as a show window of partitionative-collaborative management.

IV. PROJECT MANAGEMENT

A. Organization and personnels

In accordance with those listed in AWP1, the organization of the implementation of this project consists of project staffs, project steering comittee, project consultants and external auditor. The details of each personnel are as follows:

a. Project staffs
   1. Dr. Agung Budi Supangat (Forestry, Hydrologist) as a Project Director
   2. Dr. Nining Wahyuningrum (Forestry, Soil and Water Conservation, Mapping/GIS)
   3. Dr. Dewi Retna Indrawati (Community Development Scientist)
   4. Syahrul Donie, MSc. (Rural Sociologist)
   5. Purwanto, MSc. (Forestry, Natural Economic Scientist)
   6. Bambang Subandrio, BSc. (Researcher Assistant)
   7. Dody Yuliantoro, BSc. (Researcher Assistant)
   8. Edi Sulasmiko, BSc. (Researcher Assistant)
   9. Wika Ardianto (Researcher Assistant)

b. Project Steering Committee
   1. Ir. Sudayatna, M.Sc (PSC Chair), Secretary Director General of BP2SDM (replace the posisition of Ir. A Wikan Hartati)
   2. Dr. Sylvana Ratina, Secretary Agency of FORDIA
   3. Ir. R. Gunawan H. Rachmanto, M.Sc., Head of WMTC (replace the posisition of Dr. Nur Sumedi)

c. Project consultants
   1. Dwi Priyo Arianto, Ph.D. (Expert in Soil and Water Conservation)
   2. Dr. Sapja Anantanyu (Expert in Social, Economic and Institution)

d. External auditor

   It has been designated two local external editors for each project year, namely:

   (1) Rachmad Wahyudi Public Accountant, with business licence No. 1423/KM.1/2016 from The Ministry of Financial of Republic Indonesia,

December 20,2016. The address of this Public Accountant is Jl. Cipto Mangunkusumo No. 3A, Surakarta, Central Java, Phone: +62-271-718999. (For Project Year 1).

(2) Wartono & Partners Public Accountant, with business licence No. KEP-292/KM.6/2003 from The Ministry of Financial of Republic Indonesia, August 13, 2003, updated with practice permission No. KEP-106/KM.1/2013. The address of this Public Accountant is in GRAHA NINO, Jl. Ahmad Yani No. 335, Manahan, Solo, Central Java, Phone: +62-271-736403; 713615; 7000505. Fax.: +62-271-736403. (For Project Year 2).

B. Communication and coordination

There are two types of communication used with stakeholders. The first type uses official correspondence and the second type uses social media, such as WA (Whats App), phone and SMS (Short Message Services). Communication through social media was conducted between the research teams with FPs and extension agents. Communication using official correspondence was done with stakeholders such as Institute of Watershed and Protection Forest (BPDASHL) Solo, the village government (Wonokeling, Wonorejo, and Bubakan) and local governments at the excursion locations.

Some official letters have been issued, such as, a letter containing the notification of the implementation of research activities, the implementation of the FGDs, both at the village and district. Village level FGDs were conducted three times in each village, including the joint FGDs of the three villages. Communication using social media is done in discussions and communication between teams, both researchers and researcher assistants. This is intended to facilitate and accelerate the course of the fellow team members' information. Personal communication is also done between team members and related stakeholders via email and phone. This personal communication is usually done with people who are responsible in their field and already known personally. Direct communication between research teams, farmers, FPs and village apparatus is also done by way of discussion in the field.

Communication was also conducted with other other institution who are in charge in the similar projects, such as the National Campaign for Water Conservation Partnership

(GNKPA). The APFNet research team utilized the GNKPA meeting to convey the progress of the project activities.

Communication using various communication media mentioned above is quite effective and efficient to convey information and progress of the project. At the village and demonstration plot level, the research team informed the activity plan in line with the annual work plan to the farmer group and village apparatus while the progress of the activities was delivered by the farmer group and village apparatus in each village to the research team. Through FGD in the district level, information about this project can be understood by relevant stakeholders and some have already participated.

C. Monitoring, evaluation and dissemination

Monitoring and evaluation of midterm projects have been done by BP2SDM and FORDIA on May 2018 and July 2019. The evaluation conducted by the two agencies aims to monitor the overall implementation of the project in accordance with the duties and the responsibility of BP2SDM and FORDIA in the Project Agreement. Both agencies are responsible for directing WMTC in the implementation of the project so that it is in accordance with the project proposal. In addition, they also supervise the implementation of the project based on feasibility and efficiency budget in accordance with financial administration rules.

The results of M&E conclude that the implementation of project activities is in accordance with the stages of the plan in AWP1. Each stage of the activity has been carried out properly. The physical conditions in the field are also in accordance with the Mid Year Report (MYR1) that has been prepared previously..

Comments and advices from BP2SDM are:

1. The participatory watershed management demonstration plot is a good model to be applied by the implementing agency (BPDASHL). Therefore, publication is needed in a workshops to disseminate the result at the end of the project by inviting the main user, BPDASHL from all over Indonesia.

2. Dissemination of results is also needed in a communication forum between forestry researchers, trainers and extension agents (FKPWP) in the form of

workshop, so that the results of this project can be adopted as teaching and counseling materials by forestry lecturers and extension agents.

Comments and advices from FORDIA are:

1. Based on the criteria and indicators that have been established, it is expected that the implementation activities carried out can truly answer technical problems in the field such as changes in land cover, land suitability and erosion index.
2. In the implementation of NMC management, the project team's creativity is needed in developing local natural resources based on non-land, and involving the community, such as the development of propolis bees which has the potential to increase community income.

Figure 59. M&E activities by BP2SDM and FORDIA on May 2018

Figure 60. M&E activities by BP2SDM and FORDIA on July 2019

After conducting monitoring and evaluation of project activities, BP2SDM disseminated the results through a Discussion forum between forestry researchers, trainers and extension agents (FKPWP), on September 20-21, 2018 in Surakarta. The workshop was conducted with the theme "Increasing the capacity of functional human resources in the development of participatory micro watershed management". The results of the workshop will be followed up by BP2SDM through the efforts of (a) Preparation of Participatory Micro Watershed Management Assistance Modules; and (b) preparation of Curriculum, Syllabus and learning modules for Participatory Micro Watershed Management Development.

Figure 61. Discussion forum between forestry researchers, trainers and extension agents

Based on the evaluation by the FORDIA team on May 2018, it has been suggested that there is need alternative ways to develop non land-based community activities, such as honey bee farm. The development of bees is suitable with the surrounding environmental of the NMC. The recommended beess are "Klanceng bee" or *Apis trigona*. The advantages of this kind of bees are relatively easy to be cultivated, suitable for highland areas and has a high economic value. FPs have gained knowledge about this bees

cultivation technique during excursion activities. It is expected that with the development of honey bees, it can reduce land-based economic activities and can be a source of income for FPs in the NMC. Therefore, in the next activity, team will buy some "bees stup" (bees colony seedlings) for pilot projects in each village by involving several FPs in the NMC.

The training on bee cultivation was then followed up with the development of bee species in the target villages. Each group of demonstration plot farmers received 5 bee hive boxes as a model to be managed together. The bee box was strategically placed in a place where there were potential for bee food, especially from flowering plants. It is expected that the bee cultivation can be one of the additional non-land businesses that can provide additional income to farmers from the honey harvest.

Figure 62. Implementation of bee cultivation from species *Trigona sp.*

D. Miscellaneous

Based on FGD conducted in three villages, it had been agreed upon several duties and obligations between APFNet research team, FPs and villages staff. The obligation of APFNet research team is to arrange a document of management plan, to provide means

of infrastructure for soil and water conservation measurement (i.e. seedling, fertilizer, and raw material of civil engineering structure for soil and water conservation). Villages staff play a role as mediator among stakeholders while farmers must provide labor, manure and social arrangement for the success of this project.

There are two institutions that have been able to contribute in this project obtained from the instituional FGD in October 2017. The JasaTirta I and BPDASHL Solo contributed to the provision of seedlings for the community outside the APFNet demonstration plot. The process was preceded by correspondence and proposal submission. The Jasa Tirta I provided seedlings for Bubakan community/farmers which are not FPs while the seedlings from BPDASHL Solo was planted in Wonokeling and Wonorejo.

Table 20. The number of seedlings provided by Jasa Tirta I

No.	Species	Amount of seedling
1.	Paraserianthes falcataria	2,000
2.	Toona sureni	400
3.	Persea americana	300
4.	Durio zibethinus	750
5.	Cofea robusta	100
6.	Areca catechu	50
Total		3,600

In the activities, some goods and services that have been purchased include:

a. Procurements (5 units laptop, 2 units external hard disk, 1 unit printer, 2 units voice recorder and 1 unit drone).
b. Material for demonstration plots development (seedling include albizia, durio, avocado, limpaga, parkia, 3 unit billboards, labor cost: 120 mandays). The number of each seedling types is presented in Table 21.
c. Office operational cost include paper, tonner, cartridge, and orderner
d. Dissemination materials: seminar kit, banner and sticker

Table 21. The number of seedlings for demonstration plots

No.	Seedling Types	Spesification	Volume
1	Albizia	Minimum height 60 cm	130,000 plc
2	Limpaga	Minimum height 50 cm	150 plc
3	Avocado	Minimum height 50 cm	4,850 plc
4	Durio	Minimum height 60 cm	500 plc
5	Parkia	Minimum height 80 cm	100 plc

V. CONCLUSIONS

1. Micro watershed management planning activities need to start with gathering baseline data on the characteristics of the watershed, followed by participatory planning and building collaborative commitment of the parties
2. Based on the participatory plan, 30 ha of agroforestry plots have been built, and 35 units of technical civil structures for gully erosion control in 3 villages
3. Community empowerment efforts were carried out through farmer group training activities covering 3 topics and comparative studies to several integrated agricultural centers, to support soil and water conservation efforts
4. Management activities have impacted the ecological and socio-economic aspects of the community. Ecologically, agroforestry plot development activities have improved land cover and control erosion, but in the project term, there has not been any visible hydrological impact at micro watershed outlets (runoff and sedimentation). In socio-economic terms, activities have an impact on increasing farmers' knowledge in watershed management and soil and water conservation. There is a change in perception and motivation to implement soil and water conservation, and it is predicted that it will improve the household economy through the added value of wood and fruit crops in agroforestry patterns at the end of the cycle of perennial crops
5. To ensure the sustainable management of micro watersheds, the active role of related parties is needed through the management model produced by this project, namely the "Participatory and Sustainable Micro Watershed Management Model"

Annex 1. The proposed land management plans of Wonokeling Village

Group	Slope	Vegetation Combinations					Mechanical structure (terraces, drainage system, gully structure)	Contribution	Expectation
		Pattern	Vegetation Types						
			Annual trees	MPTS	Crops	Understory			
I	> 45	Mix, Full annual trees	albizia	avocado, parkia, durio, cacao, mango	maize	ginger, grasses	Dranage , gabion	Land and labor	Cattle subvention
	< 45	Mix	albizia, limpaga	Same as above	maize, rice plants	ginger, grasses, turmeric	Dranage , gabion	Land and labor	Cattle subvention
II	> 45	Mix	albizia, limpaga	avocado, parkia, durio, cacao, longan, breadfruit, cempedak	maize	ginger, grasses, turmeric	Drainage	Labor, manure, grasses, pesticides	Cattle subvention and fertilizer
	< 45	Mix	albizia, teak	Same as above	maize, rice plants	ginger, grasses, turmeric	Drainage	Labor, manure, grasses, pesticides	Subvention of Cattle and fertilizer
III	> 45	Mix	albizia, teak	avocado, parkia, durio, cacao, coffee	maize	ginger, turmeric	Gabion	Labor	Subvention of cattle, fertilizer, grasses and fish germ
	< 45	Mix	albizia, jabon	avocado, parkia, durio, cacao, coffee	maize, rice plants	ginger, turmeric	Gabion	Labor	Subvention of cattle, fertilizer, grasses and fish germ
IV	> 45	Mix, Full annual trees	albizia	parkia, durio	maize, cassava	ginger, turmeric, grasses	Gabion	Labor, manure and cassava	Subvention of cattle, fertilizer, grasses and fish germ
	< 45	Mix	albizia	parkia, durio	maize, cassava	ginger, turmeric, grasses	Gabion	Labor, manure and cassava	Subvention of cattle, fertilizer, grasses and fish germ

Annex 2. The proposed land management plans of Wonorejo Village

Group	Slope	Vegetation Combinations					Mechanical structure (terraces, drainage system, gully structure)	Contribution	Expectation
		Pattern	Vegetation types						
			Perennial crops	MPTS	Seasonal Crops	Understory			
I	> 45	Mix, Full annual trees	albizia, limpaga	avocado, durio	maize	ginger	Drainage, Gabion	Labor, manure, and mantainance	Cattle subvention
	< 45	Mix	albizia	avocado, durio			Drainage, Gabion	Labor, manure, and mantainance	Cattle subvention
II	> 45	Mix	albizia, jabon, limpaga	avocado, durio	maize, vegetables, tobacco	ginger, grasses cardamom	Drainage, small gully plug and bench terraces	Labor, manure, grasses, pesticides	Cattle subvention
	< 45	Mix		avocado, durio	maize, vegetables, tobacco	ginger, grasses, turmeric, cardamom	Drainage, small gully plug and bench terraces	Labor, manure, grasses, pesticides	Cattle subvention
III	> 45	Mix, Full annual trees, Surjan	albizia, jabon, limpaga	avocado, durio	maize, chili	ginger, cardamom	Ridges terraces	Labor	Cattle subvention haul roads
	< 45	Mix, Full annual trees, Surjan		avocado, durio		ginger, cardamom	Ridges terraces	Labor	Cattle subvention haul roads
IV	> 45	Mix	albizia, limpaga, jabon	avocado, durio, parkia	maize	ginger	Draiange and grasses	Labor and manure	Seed plants
	< 45	Mix		avocado, durio, parkia	maize	ginger	Draiange and grasses	Labor and manure	Seed plants

Annex 3. The proposed land management plans of Bubakan Village

Group	Slope	Vegetation Combinations					Mechanical structure (terraces, drainage system, gully structure)	Contribution	Expectation
		Patterns	Vegetation types						
			Perennial Crops	MPTS	Seasonal Crops	Understory			
I	> 45	Mix, Full annual trees,	albizia, limpaga	durio, avocado	maize, cassava	ginger, galangal	Terraces gully plug	Labor, manure	Cattle subvention
	< 45	Mix, Full annual trees,	albizia, limpaga	durio, avocado	maize, cassava	ginger, galangal	Terraces	Labor, manure	Cattle subvention
II	> 45	Mix, Full annual trees,	albizia	durio, mango, orange, cengkeh	maize, cassava	ginger, grasses	Drainage	Labor, manure	Cattle subvention, and manure
	< 45	Mix, Full annual trees,	albizia	durio, mango, orange, cengkeh	maize, cassava	ginger, grasses	Drainage	Labor, manure	Cattle subvention, and manure
III	> 45	Full annual trees,	albizia	avocado, durio	-	ginger, galangal, taro, grasses	Gully plug	-	Cattle (cow) subvention, and manure
	< 45	Full annual trees,	albizia	avocado, durio	-	ginger, galangal, taro, grasses	Gully plug	-	Cattle (cow) subvention, and manure

Annex 4. The detail of participatory management planning of Wonokeling Village

No.	Name	Existing land cover types	Slope	Selected pattern	Perennial plants	spacing	Ratio (perennial:crops)	MPTS	Constribution	Gully
1	Kardi	reed grasses	<45	Full	albizia	3x3	Sloping area (60:40) Flat area (70:30)	parkia, durio, avocado	Labor, manure	
		maize, cassava etc		Mix	albizia	4x4				
2	Sido Warni	albizia	<45	Mix	albizia	4x4		parkia, durio, avocado, cacao	Labor, manure	
3	Sido RT (Templek)	maize, cassava	<45	Mix	albizia	4x4		parkia, durio, avocado	Labor, manure	Gully detected
4	Kadi	maize, avocado		Mix	albizia	4x4		parkia, durio, avocado	Labor, manure	
5	Sidi	maize, cassava, albizia, grasses, partially abandoned,	<45/ >45	Mix	albizia	4x4		parkia, durio, clove	Labor, manure	Gully detected
		abandoned		Full	albizia				Labor, manure	
6	Marimin	maize	>45	Mix	albizia	4x4		parkia, durio	Labor, manure	
7	Dimin	maize	>45	Mix	albizia	4x4		parkia, durio	Labor, manure	
8	Dwi	abandoned for 2 years	>45	Full	albizia				Labor, manure	
9	Kasno	maize, cassava		Mix	albizia	4x4		parkia, durio (clove)	Labor, manure	Gully detected

10	Mbah Sawi	maize, cassava		Mix	albizia	4x4		parkia, durio, avocado	Labor, manure	
11	Samidi	maize, cassava, albizia	<45	Mix	albizia	4x4		parkia, durio	Labor, manure	
12	Samijo		<45	Full	albizia			parkia, durio, avocado	Labor, manure	
13	Cipto Wiyono	maize	>45	Mix	albizia	4x4			Labor, manure	
14	Giman	albizia		Full	albizia	3x2		Parkia, durio	Labor, manure	Gully detected

Annex 5. The detail of participatory management planning of Wonorejo Village

No.	Name	Existing land cover types	Slope	Selected pattern	Perennial plants	spacing	Ratio (perennial:crops)	MPTS	Constribution	Gully
1	Simin		> 45	Mix	albizia, limpaga	4x4		avocado, durio		
2	Semin	limpaga	> 45	Full	albizia, jabon			avocado, durio		
3	Sini	abandoned	> 45	Full	albizia, jabon			avocado, durio		
4	Pupon	maize, cassava	> 45	Mix	albizia	4x4		avocado, durio		
5	Paino	maize, cassava	> 45	Mix	albizia	4x4		avocado, durio		
6	Parni	maize, cassava	> 45	Mix	albizia	4x4		avocado, durio		
7	Lanjar Lukman	ginger, maize, albizia, limpaga	> 45	Mix	albizia, limpaga	4x4		avocado, durio		
8	Pardi	maize	> 45	Mix	albizia	4x4		avocado, durio		
9	Suliyem	ginger, maize, cassava	> 45	Mix	albizia	4x4		avocado, durio		
10	Sugeng	maize, chili	> 45	Mix	albizia	4x4		avocado, durio		
11	Paidi	chili	> 45	Mix	albizia	4x4		avocado, durio		
12	Parno	maize, cassava	> 45	Mix	albizia	4x4		avocado, durio		
13	Slamet	maize, cassava, ginger, limpaga	> 45	Mix	albizia, limpaga	4x4		avocado, durio		
14	Sami	sweet potatoes, maize, cassava	> 45	Mix	albizia	4x4		avocado, durio		
15	Sukimin Gondang	maize, cassava, limpaga	> 45	Mix	albizia	4x4		avocado, durio		

16	Marimin	maize, mixed garden	> 45	Mix	albizia	4x4		avocado, durio		Gully detected
17	Parmin	cassava, ginger, teak, limpaga	> 45	Mix	albizia	4x4		avocado, durio		
18	Saidi	maize, cassava	> 45	Mix	albizia	4x4		avocado, durio		Gully detected
19	Diman	maize, cassava, ginger,	> 45	Mix	albizia, limpaga	4x4		avocado, durio		Gully detected
20	Prayitno	Abandoned	> 45	Full	albizia			avocado, durio		
21	Setu	maize	> 45	Mix	albizia	4x4		avocado, durio		
22	Marno	maize	> 45	Mix	albizia	4x4		avocado, durio		
23	Sonogiman	maize, cassava, ginger, beans	> 45	Mix	albizia, limpaga	4x4		Avocado		
24	Kamto	maize, cassava, albizia, limpaga, ginger	> 45	Mix	albizia	4x4		avocado, durio		
25	Sular	Abandoned	> 45	Full	albizia, jabon	3x3		avocado, durio		Gully detected
26	Marijo (Warni, Sinto, Darti)	albizia	> 45	Mix	albizia	4x4		avocado, durio		Gully detected
27	Sarto	maize, ginger, banana, beans	> 45	Mix	albizia, jabon	4x4		avocado, durio		Gully detected

Annex 6. The detail of participatory management planning of Bubakan Village

No.	Name	Existing land cover types	Slope	Selected pattern	Perennial plants	spacing	Ratio (perennial:crops)	MPTS	Constribution	Gully
1	Sadiko	Abandoned land, land preparation for cassava plantation	<45	Mix	albizia	4x4	70:30	coffee, cacao	Labor, manure	Gully detected betwen Sadiko and Samino's
2	Sahit	maize, cassava, beans, albizia, limpaga (from bud with random pattern)	<45	Mix	albizia	4x4	70:30	avocado	Labor, manure	Gully detected, continuation from Sadiko and Samino's
			<45	Mix	albizia	4x4	70:30	avocado	Labor, manure	
3	Samino	(crops dan vegetables)	<45	full	albizia	3x3	70:30	avocado, durio	Labor, manure	
4	Ngali	maize, cassava, albizia	<45	surjan	albizia	4x4	70:30	avocado, durio	Labor, manure	
5	Wiji	Abandoned land		full	albizia	3x3	70:30	avocado, durio	Labor, manure	
6	Sono Wiji/Karsono	maize, cassava	<45	Mix	albizia	4x4	70:30	avocado, durio	Labor, manure	
7	Tardi	maize, cassava, limpaga etc, (sparce)	>45	full	albizia	3x3	70:30	avocado, durio	Labor, manure	
8	Sarman	albizia (3x3 m)		Mix	albizia	4x4	70:30	avocado, durio	Labor, manure	Gully detected
9	Satimin	maize, albizia, limpaga (abandoned for 2 years)		Mix	albizia	4x4	70:30	avocado, durio	Labor, manure	
10	Paiman	maize, cassava		Mix	albizia	4x4	70:30	avocado, durio	Labor, manure	

11	Wagiyo	maize, cassava	>45	Mix	albizia	4x4	70:30	avocado, durio	Labor, manure	
12	Marmo/Wagiman	mixed garden (0,15 ha abandoned)		full	albizia	3x3	70:30	avocado, durio	Labor, manure	
13	Tarno	maize, cassava, limpaga etc, (partialy abandoned)		Mix	albizia	4x4	70:30	avocado, durio	Labor, manure	
14	Sukini	maize, cassava, ginger, limpaga and albizia (sparce)		Mix	albizia	4x4	70:30	avocado, durio	Labor, manure	

Annex 7. Prediction of erosion in agroforestry plots at the beginning of planting and at the end of crop rotation

Bubakan Village

No.	Name	Area (ha)	Monthly Rainfall (mm)	R	Slope (%)	LS	Soil Type	K	Land Cover 2017	Land Cover 2023	C 2017	C 2023	Land Management	P	Erosion 2017 (ton/ha/yr)	Erosion 2023 (ton/ha/yr)
1	Ngali	0.7	201	838.3	75	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
2	Paiman	0.8	201	838.3	80	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
3	Panut/Wiji	0.3	201	838.3	70	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
4	Sadiko	0.5	201	838.3	65	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
5	Sahid1	0.5	201	838.3	55	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
6	Sahid2	0.2	201	838.3	60	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
7	Samino1	0.5	201	838.3	75	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
8	Samino2	0.2	201	838.3	65	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
9	Sarman	0.7	201	838.3	60	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
10	Satimin	1.0	201	838.3	82	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
11	Sonowiji	0.8	201	838.3	25	3	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	25.26	7.89
12	Sukini	0.5	201	838.3	70	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
13	Tardi	0.8	201	838.3	75	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
14	Tarno	0.7	201	838.3	69	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
15	Wagiman	1.0	201	838.3	75	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
16	Wagiyo1	0.5	201	838.3	85	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
17	Wagiyo2	0.6	201	838.3	55	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73

Wonokeling Village

No.	Name	Area	Monthly	R	Slope	LS	Soil	K	Land Cover	Land Cover	C 2017	C 2023	Land	P	Erosion 2017	Erosion 2023
		(ha)	Rainfall (mm)		(%)		Type		2017	2023			Management		(ton/ha/yr)	(ton/ha/yr)
1	Ciptowiyono	0.2	201	838.3	55	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
2	Dimin	0.3	201	838.3	60	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
3	Dwi	0.4	201	838.3	55	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
4	Giman	0.2	201	838.3	50	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
5	Kadi	0.3	201	838.3	55	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
6	Kardi	1.2	201	838.3	35	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
7	Kasno	0.6	201	838.3	65	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
8	Marimin	0.5	201	838.3	60	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
9	Samidi	0.9	201	838.3	35	9,8	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
10	Samijo	0.5	201	838.3	45	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
11	Sarino	0.4	201	838.3	40	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
12	Sawi	0.1	201	838.3	45	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
13	Sidi	1.4	201	838.3	40	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
14	Sido	0.8	201	838.3	35	9,8	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
15	Sidowarni	0.2	201	838.3	45	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
16	Sinah	0.2	201	838.3	50	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73

Wonorejo Village

No.	Name	Area (ha)	Monthly Rainfall (mm)	R	Slope (%)	LS	Soil Type	K	Land Cover 2017	Land Cover 2023	C 2017	C 2023	Land Management	P	Erosion 2017 (ton/ha/yr)	Erosion 2023 (ton/ha/yr)
1	diman	0.5	201	838.3	65	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
2	kamto	0.2	201	838.3	80	17	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
3	lanjar	0.1	201	838.3	60	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
4	marijo	1.1	201	838.3	80	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
5	marimin	0.2	201	838.3	45	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
6	marno-suwito	0.4	201	838.3	80	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
7	paidi	0.1	201	838.3	15	1,5	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	12.63	3.95
8	paino	0.1	201	838.3	45	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
9	paino	0.1	201	838.3	45	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
10	pardi	0.1	201	838.3	70	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
11	parmin	0.1	201	838.3	40	9,8	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
12	parni	0.1	201	838.3	55	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
13	parno	0.1	201	838.3	35	9,8	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
14	pupon	0.2	201	838.3	45	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
15	saidi	0.5	201	838.3	35	9,8	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
16	sami	0.1	201	838.3	35	9,8	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
17	sarto	0.2	201	838.3	70	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
18	semin	0.2	201	838.3	35	9,8	inseptisol	0.26	Annual crops (Abandoned)	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
19	setu	0.3	201	838.3	60	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
20	simin	0.1	201	838.3	25	3	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	25.26	7.89
21	sini	0.1	201	838.3	45	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
22	slamet 1	0.1	201	838.3	35	9,8	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
23	slamet 2	0.2	201	838.3	60	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
24	sonogiman	0.2	201	838.3	55	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
25	sugeng	0.1	201	838.3	40	9,8	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
26	sukimin1	0.2	201	838.3	32	9,8	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	82.51	25.78
27	sukimin2/sukino	0.2	201	838.3	80	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
28	sular	1.3	201	838.3	75	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73
29	suliem	0.1	201	838.3	25	3	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	25.26	7.89
30	wanto	0.5	201	838.3	72	17	inseptisol	0.26	Annual crops	Mix garden	0.64	0.2	Ridge terrace	0.06	143.12	44.73

Annex 8. Agreement about right and obligation of each party in the demonstration plots development (in Indonesian)

KESEPAKATAN BERSAMA ANTARA PENELITI, PETANI, KETUA KELOMPOK DAN APARAT DESA DALAM PEMBANGUNAN PLOT PENGELOLAAN LAHAN LESTARI DAS MIKRO NARUAN

Untuk memperlancar pencapaian tujuan pembangunan Plot Pengelolaan Lahan Lestari DAS Mikro Naruan, maka diadakan kesepakatan antara lain:

I. Tim Peneliti

A. Kewajiban

1. Menyediakan bibit tanaman keras baik kayu maupun buah seperti sengon, suren, alpokat dan durian sesuai dengan rancangan yang telah disepakati
2. Menyediakan pupuk NPK untuk tanaman keras sesuai dengan pola yang telah disepakati
3. Mengupayakan obat untuk pemeliharaan tanaman sengon
4. Memberikan bantuan untuk konservasi tanah pada lahan hamparan secara terpadu
5. Memberikan bimbingan dan pengetahuan kepada masyarakat/petani peserta terkait dengan pengelolaan lahan lestari
6. Memantau setiap tahapan kegiatan Pembangunan Plot Pengelolaan Lahan Lestari DAS Mikro Naruan, baik terkait aktivitas anggota kelompok maupun pertumbuhan tanaman keras
7. Melakukan koordinasi dengan perangkat desa berkaitan dengan perkembangan pembangunan plot.

B. Hak

1. Menerima informasi dan laporan perkembangan plot dari petani peserta dan koordinator
2. Mengingatkan dan menegur petani peserta apabila melalaikan kewajibannya (tugas-tugasnya terkait pengelolaan plot).

II. Masyarakat/Petani Peserta

A. Kewajiban

1. Membuat cemplongan sebelum dilakukan pembagian bibit dan penanaman
2. Menyediakan pupuk kandang dan menaburkan dalam cemplongan sebagai pupuk dasar.
3. Menanam tanaman keras yang sudah disediakan Tim Peneliti pada lahan yang sudah disepakati bersama.
4. Melakukan konservasi tanah (menanam rumput) baik pada lahan masing-masing atau secara terpadu dalam hamparan
5. Memelihara tanaman keras dan upaya konservasi tanah yang sudah disepakati.
6. Melakukan penyulaman tanaman keras secara swadaya sebagai bagian dari partisipasi masyarakat dalam Pembangunan Plot
7. Menghadiri pertemuan-pertemuan yang dilakukan terkait dengan pembangunan plot.
8. Melaporkan perkembangan plot, khususnya tanaman keras kepada Tim Peneliti
9. Tidak melakukan kerjasama atau kemitraan dengan pihak lain pada lahan yang digunakan untuk Pembangunan Plot Pengelolaan Lahan Lestari DAS Mikro Naruan
10. Selalu melakukan koordinasi dengan koordinator yang telah ditunjuk

B. Hak

1. Mendapat bantuan bibit tanaman keras yaitu sengon, suren, alpokat dan durian sesuai kesepakatan
2. Mendapat bantuan pupuk NPK untuk pemupukan tanaman keras
3. Mendapat bimbingan dan pengetahuan dari Tim Peneliti terkait pengelolaan lahan secara lestari
4. Memperoleh seluruh hasil panen tanaman baik kayu maupun buah-buahan.

C. Koordinator Masyarakat/Petani Peserta

A. Kewajiban

1. Mengkoordinasi masyarakat/petani peserta terkait kegiatan Pembangunan Plot Pengelolaan Lahan Lestari DAS Mikro Naruan
2. Menampung dan menyampaikan saran dan informasi dari petani peserta kepada Tim Peneliti
3. Menyampaikan informasi dan perkembangan kegiatan kepada Tim Peneliti

4. Mengingatkan petani peserta apabila tidak melakukan kewajibannya dengan baik.

B. *Hak*
1. Mewakili petani peserta dalam acara pertemuan di tingkat kabupaten dan pertemuan lainnya

D. Perangkat Desa

A. *Kewajiban*
1. Melakukan koordinasi dengan Tim Peneliti apabila ada kegiatan lain yang akan dilakukan pada lokasi Pembangunan Plot Pengelolaan Lahan Lestari DAS Mikro Naruan
2. Melakukan pemantauan perkembangan kegiatan agar tercapai tujuan kegiatan.
3. Mengingatkan kepada koordinator dan petani peserta apabila tidak melakukan kewajibannya

B. *Hak*
1. Mendapat informasi dari Tim Peneliti berkaitan dengan perkembangan Pembangunan Plot Pengelolaan Lahan Lestari DAS Mikro Naruan

Demikian kesepakatan ini dibuat dan ditanda tangani untuk digunakan srbaik-baiknya

Di tandatangani di Wonorejo, tanggal 4 Januari 2017

Tim Peneliti (Agung)

Koordinator Petani Peserta

1. Desa Bubakan (Marmo)
2. Desa Wonokeling (Kadi)
3. Desa Wonorejo (Wanto)

Perangkat Desa

1. Desa Bubakan (subur)
2. Desa Wonokeling (Giman)
3. Desa Wonorejo (Tarjo)

Annex 9. Local, commercial and scientific names of each seedling types

Local	Commercial	Scientific
Alpokat	Avocado	Persea americana
Buncis	Green bean	Phaseolus vulgaris
Cabai	Chili	Capsicum sp.
Cempedak	Cempedak	Artocarpus integer
Cengkeh	Clove	Syzygium aromaticum
Coklat	Cacao	Theobroma cacao L
Durian	Durio	Durio zibethinus
Jabon	Jabon/kadam	Anthosephalus cadamba
Jagung	Maize	Zea mays
Jahe* emprit	Ginger	Zingiber officinale
Jati	Teak	Tectona grandis
Jambu mete	Cashew	Anacardium occidentale
Jeruk	Orange	Citrus sp.
Kapri	Pease	Pisum sativum
Kapulaga	Cardamom	Amomum compactum
Kelengkeng	Longan	Dimocarpus longan
Kopi	Coffee	Coffea sp.
Koro	Velvet bean	Mucuna pruriens
Kubis	Cabbage	Brassica oleracea
Kunyit	Turmeric	Curcuma domestica Val.
Lengkuas	Galangal	Alpinia galanga
Loncang	Chive	Allium fistulosum
Mahoni	Mahogany Tree	Swietenia mahagoni
Mangga	Mango	Mangifera indica
Mindi	Chinaberry	Melia azedarach
Nangka	Jackfruit	Artocarpus heterophyllus
Padi Gogo	Upland rice	Oryza sativa L
Petai	Parkia	Parkia speciosa
Pisang	Banana	Musa paradisiaca
Puspa	Needlewood Tree	Schima wallichii
Sawi	Mustard	Brassica juncea
Sengon	Albizia	Paraserianthes falcataria
Suren	Limpaga	Toona sureni
Sukun	Breadfruit	Artocarpus altilis
Salam	Indonesian bay-leaf	Syzygium polyanthum
Singkong	Cassava	Manihot utillissima
Talas	Taro	Colocasia esculenta

Tembakau	Tobacco	Nicotiana tabacum
Ubu Jalar	Sweet Potato	Ipomea batatas
Wortel	Carrot	Daucus carota

Annex 10. Agreement of the stakeholders workshop (in Indonesian)

RUMUSAN WORKSHOP
"PERAN PARA PIHAK DALAM MENDUKUNG KEBERLANJUTAN KEGIATAN PENGELOLAAN DAS MIKRO NARUAN"
Surakarta, 26 April 2018

Memperhatikan arahan kepala BPPTPDAS, paparan Bappeda dan Litbang Kabupaten Wonogiri tentang Peran Pemerintah Daerah dalam Mendukung Kegiatan Pengelolaan DAS Solo Bagian Hulu, paparan BPDASHL Solo tentang Program RHL DAS Solo Bagian Hulu, dan paparan Tim Peneliti BPPTPDAS tentang Pengelolaan DAS Mikro Naruan: Status Kegiatan dan Harapan ke Depan, serta diskusi para pihak pada tanggal 26 April 2018 di kantor BPPTPDAS, dirumuskan sebagai berikut.

1. Dalam pengelolaan DAS Mikro diperlukan perencanaan yang komprehensif dimulai dari identifikasi masalah, implementasi sampai dengan monitoring dan evaluasi serta pelibatan para pihak mulai dari pemerintah pusat, propinsi, kabupaten sampai dengan masyarakat.
2. Berkaitan dengan point 1, BPPTPDAS telah memulai upaya pengelolan DAS secara partisipatif di DAS Mikro Naruan, Sub DAS Keduang dengan membuat rencana pengelolaan dalam skala operasional yang melibatkan masyarakat dan para pihak terkait mulai tingkat desa sampai tingkat pusat.
3. Dari wilayah DAS Mikro Naruan seluas ±957 Ha sudah dilakukan pembangunan demplot seluas ± 50 Ha yang sampai saat ini telah melibatkan ± 100 petani pemilik lahan, BPDASHL Solo, Perum Jasa TIrta I, PDAM Kabupaten Wonogiri dan Lembaga Donor (APFNet).
4. Mengingat adanya keterbatasan BPPTPDAS baik secara tupoksi maupun anggaran, maka diperlukan dukungan para pihak untuk keberlanjutan pengelolaan DAS Mikro Naruan tersebut sesuai dengan tupoksi masing-masing pihak.
5. Potensi dukungan dari masing-masing pihak mulai pemerintah pusat sampai desa sebagai berikut.

1.	Pemerintah Pusat		
	a. BPDAS HL Solo	:	- Fasilitasi dalam penyusunan rancangan teknis pengelolaan DAS tingkat tapak dengan melibatkan para pihak terkait. - Fasilitasi implementasi kegiatan baik vegetatif antara lain melalui penyediaan bibit tanaman keras dan KBR, maupun sipil teknis seperti pembuatan sumur resapan, Dpi, DPn, dan gully plug.
	b. BBWS Bengawan Solo	:	- Memfasilitasi komunitas dalam rehabilitasi dan konservasi air sesuai dengan program GNKPA.
	c. BPPTPDAS	:	- Monitoring plot percontohan dan dampaknya - Fasilitasi teknologi pengelolaan DAS - Dukungan hasil penelitian dalam bidang-bidang yang berkaitan dengan pengelolaan DAS
2.	Pemerintah Provinsi	:	
	a. BPH Wilayah IX	:	- Penyuluhan berkaitan dengan upaya pengelolaan DAS - Pembinaan dan pendampingan untuk pemberdayaan masyarakat - Kegiatan RHL (vegetatif dan sipil teknis) dalam pengelolaan DAS sesiuai dengan anggaran yang tersedia
	b. Balai Pusdataru Bengawan Solo	:	- Pembuatan bangunan konservasi seperti check dam di anak sungai, resapan air dll
3.	Pemerintah Kabupaten	:	
	a. Baperlitbang	:	- Fasilitasi koordinasi OPD untuk alokasi kegiatan di DAS Mikro Naruan baik melalui kegiatan pemerintah daerah maupun kegiatan GNKPA - Fasilitasi integrasi kegiatan konservasi tanah dan air dalam perencanaan desa
	b. Dinas LH	:	- Kegiatan konservasi air seperti upaya konservasi mata air dan pembuatan sumur resapan

			- Pemberdayaan masyarakat dalam pelestarian lingkungan seperti kegiatan bank sampah
	c. Dinas terkait peternakan	:	- Fasilitasi dan pendampingan pengembangan ternak untuk pemanfaatan rumput yang telah dikembangkan sebagai salah satu bentuk konservasi
	d. Dinas terkait perkebunan		- Program pengembangan tanaman perkebunan berbasis kayu (misal: kopi dan kakao)
	e. BPBD		- Sosialisasi untuk masyarakat sadar bencana dan deteksi awal kebencanaan
4.	BUMN/BUMD		
	a. Perum Jasa Tirta I		- Alokasi dana CSR dalam bentuk materi (misal: bibit tanaman keras, bangunan konservasi) maupun dalam bentuk kerjasama dengan berbagai pihak untuk kegiatan konservasi baik vegetatif maupun sipil teknis
	b. PDAM		- Alokasi dana CSR untuk program penghijauan di daerah tangkapan
5.	Pemerintah Desa	:	Pembinaan dan pengawasan terhadap masyarakat dalam implementasi kegiatan
6.	Masyarakat	:	SDM, lahan dan keswadayaan masyarakat untuk implementasi kegiatan

6. Para pihak secara bersama-sama akan berupaya mewujudkan percontohan pengelolaan DAS mikro Naruan secara partisipatif.

Surakarta, 26 April 2018

1. BPDASHL Solo (Pemerintah Pusat) .....
2. BPH Wilayah IX (Pemerintah Povinsi) .....
3. Bappeda dan Litbang Kab. Wonogiri .....
4. Baperlitbang Kab. Karanganyar .....
5. BPPTPDAS Solo .....