The capacity of community on running soil and water conservation in Bangsri micro-catchment, Upper Brantas Watershed, Indonesia

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Abstract. In the Brantas watershed, the acceleration of development for public welfare is often used as an argument for the exploitation of natural resources. This activity causes the degradation of natural resources. To achieve a healthy watershed, community empowerment in a watershed is one of the main concerns of the Indonesia government and it is urgently needed. Community empowerment through a micro catchment is an innovation. In the first step of the effort, a capacity baseline of the community on implementing soil and water conservation is required. The baseline was obtained through household surveys using a questionnaire. The sample was selected using the proportional random sampling method. A small population of the sample used a hyper geometric distribution approach. The results of the baseline study indicated that the community was still dependent on their land resources. They generally understand the land degradation problem, however some communities still did not realize the importance of environmental protection. The reason for farmers does not apply the soil and water conservation was due to the lack of labour, the demand for economic needs for their livelihood and less funding to carry out soil and water conservation measures. The community could overcome land degradation through community groups and they expect technical assistance and subsidies. They need formed and functioned the Association of Micro-catchment Management. The communities also stated that they needed regular assistance in the management of land resources through field school.

1. Introduction
Landscapes in almost all watersheds in Java, Indonesia has changed considerably compared to that of over the past 50 or more years when soil conservation was first concerned as a part of the tradeoff between development and ecosystem protection [1,2,3]. Java with characterized by high population densities, large portions of the land are already intensively managed, and the remainder is increasingly receiving human interventions with the extent and severity of land degradation [4]. Land degradation is not only happening on the private land but also happen on the forest land. The past management of forest land, which does not take into account socio-economic and cultural variables, was increased management conflicts with communities in the forest margin. In Java, with a similar situation with other...
many countries worldwide, particularly in the developing countries, have increasingly trend for collaborative community forest management program [5]. This trend is encouraged by local and central government regulation, but also by international donors’ pressure [6]. The collaborative community forest management program is believed a more efficient approach to rehabilitee and to conserve the forests from the biological [7,8]. Socio-economic [9,10], and political perspective [11,12], rather than the centralized management made by governments [8]. In the private land, community field school programs are increasingly recognized for their efficacy in achieving smallholder agricultural improvements in areas such as soil and water conservation [13,14]. Therefore, the Minister of Forestry, Indonesia supported by UNDP introduced community empowerment through a micro watershed management approach to combine the collaborative community forest management program in forest area and community field schools’ program in private land [15].

Community empowerment through a micro watershed is an innovation. One of these activities was introduced through UNDP / GEF grant assistance in the form of Strengthening Community Based Forest and Watershed Management (SCBFWM) projects or better known as Community Based Watershed Management within 5 years (2010-2014) [15]. This project is expected to accelerate the efforts of Forest Rehabilitation and Watershed so that the watershed can function properly, as a production medium to fulfill various national development sectors and more importantly increase the income of local communities which will all lead to sustainable people's welfare. Understanding of this among various parties is still diverse. Therefore, it takes time to equalize perceptions among river basin managers.

Community empowerment in watershed management is a concern of the Indonesian government. This is evidenced by the inclusion of articles on community empowerment in watershed management in the legislation relating to watershed management, namely regulation No. 37 of 2014 related to soil and water conservation, and Government Regulation No. 37 of 2012 concerning about watershed management. Then in 2014, the Minister of Forestry also issued Forestry Minister's Regulation No. P.17 / Menhut-II / 2014 which specifically regulates the procedures for community empowerment in watershed management activities. Even before the issuance of these regulations, the government had also carried out watershed management activities that placed community empowerment as one of the main activities. These activities include Forest and Land Rehabilitation [16], the National Movement for Water Saving Partnership, Integrated Land Conservation Farming Development, and the development of Micro Watershed Model Areas [15].

The community empowerment efforts of watershed management are urgently needed. Community empowerment is an effort to enable and facilitate the community so that they can solve their needs and interests, and improve their standard of living by utilizing their resources [17,18,19]. The core of community empowerment is enabling and self-sufficient in society, thus emphasizing more on the autonomy of decision making from a community group based on the resources they have [18]. Based on the previous explanation, community empowerment should put more emphasis on the process of positive change that occurs and the improvement as well as sustainability of community empowerment. In practice, many community empowerment activities were not in accordance with the concept of community empowerment. Community empowerment was often trapped in the logic of the "project" which places more emphasis on results and administrative accountability such as the size of the budget, the number of activities carried out and the assistance provided [20,21]. Assistance as an effort to empower the community tends to be participation which is mobilized by material incentives, so that often it did not lead to community independence, but instead causes community dependence on the government, as well as other outside parties ('help me' mentality). Thus, community empowerment emphasizes the initiative and autonomy of decision making by the community. Therefore, [20] emphasize the importance of the learning process in empowerment to facility society towards sustainable change. As part of the community empowerment program through the Micro Watershed such as efforts to maintain the sustainability and natural resources are generally an important part of the program. Community empowerment that needs to be carried out in the preparation stage of the development of the Micro Watershed Management (Figure 1).
In the first step of the facilitation of community empowerment need baseline of the capacity of community on running soil and water conservation. This research is aimed to get the “picture” on the principles of the research direction, with research question namely: (1) what is the community's view on their land resource?, (2) does the community have the capacity to carry out soil and water conservation?; (4) does the community be able to manage natural resources continuously?; (3) does the community have the capacity to form and function the Micro Watershed Forum?.

2. Materials and Methods

2.1. Time and location
Baseline survey were carried out from March to August 2018. The main study area is located in the Upper Brantas Watershed, and focused in the Bangsri Micro Watershed (BMW), Malang Regency (Figure 2). The elevation of the BMW is between 429 m above sea level (asl) up to 2,271 m asl.

2.2. Sample of household
Data for assessment of the community empowerment program through the MBW that are linked to community conditions were obtained through household surveys. The survey was carried out using a questionnaire. The questionnaire for the baseline survey was made specifically with questions which were mostly closed questions in the form of questions which at the same time provided the choice of answers. The sample selection represented the community at the research location which was carried out on the head of the family using the proportional random sampling method. The number of respondents for each village was determined based on the number of households. The number of community samples representing the population in each village was determined based on the method of determining the sample with a small population using a hypergeometric distribution. The equation used to calculate the number of samples as follows:

\[ n = \frac{NZ^2pq}{(E^2(N-1) + Z^2pq)} \]

Where:
- \( n \) = number of samples that need to be taken
- \( N \) = number of population
- \( p \) dan \( q \) = population proportion
- \( z \) = confidence interval
- \( E \) = accuracy of sample proportions

2.3. Data processing and analyzing

The data obtained in this baseline survey were mostly nominal data. In this case, the form of data with a nominal scale was used to get the total value of each alternative answer given by the researcher as a response to the closed question submitted to the respondent. After obtaining the total value of each alternative the answers asked, a comparison of the total values was made, both between the alternative answers provided and the values obtained.

3. Results and Discussion

3.1. Profile of Bangsri Micro Watershed

3.1.1. Current land use

Distribution of land use in the BMW (Figure 3) covering an area of 2.985 ha, scattered in the area of Bromo Tengger Semeru National Park (TNBTS) and protected forests in the Indonesia State owned Forest Enterprise (Perum Perhutani) region with the majority vegetation were Pines (Pinus merkusii), puspa (Schima wallichii) and kaliandra (Calliandra calothyrsus) covering an area of 524 ha (18% of the total area of the BMW), Production Forest (HP) with predominantly Pines, Mahogany (Swietenia mahagoni) vegetation with understorey plants namely maize, chili and grass covering 222 ha (7%); community mixed gardens or agroforestry (AF) dominated by Sengon (Paraserianthes falcataria), Waru (Hibiscus tiliaceus), Mindi (Melia azedarach), Coconut (Cocos nucifera), Coffee (Coffea sp.), and Avocado (Persea americana) with grasses covering 962 ha (32%), bushes with Tithonia diversifolia, Chromolaina odorata, and Lantana camara, and bare land covering 271 ha (9%), dryland dominated by maize, chili crop and vegetables covering 385 ha (13%), rice fields with dominant commodities of rice, sugar cane and vegetables cover 20 ha (1%), and settlements covering 308 ha (10%). Based on the land use conditions, around 57% of the total area of BMW was an area of water catchment with natural forest land use in TNBTS, Perhutani and Agroforestry on community-owned land, which in theory is an ideal hydrological condition for Micro Watersheds with sustainable watershed management.
The main issue of BMW management are most area of TNBTS need to be maintained and improved its biodiversity and around 294 ha in the form of shrubs need effort for restoring forest functions through natural forest regeneration. In Perum Perhutani land, there is insufficient of Village Forest Community on implementing the collaborative forest management program (Figure 4).

**Figure 3**: Land use distribution in BMW

**Figure 4**: The diversity of understorey (including crops) under the tree (a) the land has been planted annual crops, (b) apply plastic mulch for annual crop below the trees, (c) reducing pine trees density to get a better light interception for annual crops, (d) over trimming pine trees.
In private land, seasonal and vegetable cultivation in hilly areas with sandy soil types has the potential to cause high soil erosion and landslides (Figure 5), sand mining (Figure 6), low carrying capacity in cattle development (Figure 7) and high demand firewood (Figure 8).

![Figure 5](image5.png)

**Figure 5.** The diversity of annual crops which have high erosion and landslide potential

![Figure 6](image6.png)

**Figure 6.** Sand mining and its effect to land degradation

![Figure 7](image7.png)

**Figure 7.** Energy needs for household use still rely on firewood

3.2. *Capacity of community on understanding of factor causing and impact of land degradation*

3.2.1. *Perception of understanding the importance of land resources*

In the BMW, the community believed that people's income depends on the utilization of the land in the village area (Figure 8). The income dependence of downstream community (DC) on the utilization of land in the village area was higher than the upstream community (UC). However, the dependence of UC income on the utilization of land in the Perhutani region was higher than DC. Community income was generally sufficient for daily family needs, where UC and DC stated agree to this. To assist the community for soil and water conservation activities, strong social capital has been owned by both UC and DC. They were convinced that degradation to land could be overcome by the community in a spirit of cooperation, where is the majority of UC strongly agree and the DC agrees. The UC agrees, while
DC was undecided / somewhat sure to know ways and be able to overcome land degradation. Another positive social capital was that UC has been accustomed to getting informal assistance between communities and formal assistance from local governments for soil and water conservation. However, DC who does not need soil and water conservation measures in their land, said they lack informal assistance between communities and lack formal assistance from the government.

![Figure 8. The community perception on land conditions.](image)

In the BMW, the community has not yet realized that environmental degradation in the rural areas and surrounding areas are getting worse (Figure 9). UC were aware that the problem of soil erosion has an impact on the welfare of rural communities, environmental degradations of local village communities, disrupting development for the welfare of the DC, and disrupt the environment of the people in the downstream area. This was less realized by DC.

![Figure 9. Perception of people's understanding of the importance of land and perception of the impact of soil erosion in people's lives.](image)

3.2.2. Perception on factors causing land and environment degradation

In BMW, the highest perception of UC and DC regarding biophysical factors causing land and environment degradation was due to natural factors, namely high rainfall (Figure 10). Disruption of recharge areas as a cause of land and environmental degradation in BMW, namely in the form of (a) forest degradations in TNBTS, (b) degradation of protected forests in Perhutani, (c) degradation of production forests in Perhutani, (d) the process of replanting in Perhutani forest area was not properly done, and (e) the lack of tight vegetation in agroforestry was doubtful by the UC and DC.
Figure 10. Community perception of biophysical factors related to catchment areas as a cause of land and environmental degradation.

In the BMW, the UC believed that the factors that cause biophysical degradation to the land and environment from the largest to the lowest were soil degradation due to the construction of soil roads path, landslides from steep cliffs, sloping land conditions and sand mining (Figure 11) respectively. DC did not recognize the causes of land and environmental degradation compared to UC, the largest cause to the lowest were sloping land conditions, damage to land due to road construction, landslides from steep cliffs, and sand mining respectively. For sand mining, the results of field observations indicate that sand mining contributes to the destruction of large areas of land in this region that lack the approval of the community.

Figure 11. Community perceptions of biophysical factors related to erosion vulnerability causing land and the environment degradation.

The economic factor of the community was also recognized as a contributing factor to land and environmental degradation (Figure 12). UC in the BMW argued and perceived that cause economic factors to the land and environment degradation from the largest to the lowest were (a) unclear profit sharing on Perhutani's land, (b) limited public funding for soil and water conservation, (c) funding for land use from outside the village for sand mining, (d) there were regular contributions to Perhutani by farmers, (e) there was no alternative economic development for the community, (f) there was no alternative income to meet the needs of life. For DC, economic factors for land degradation were different from UC, where (a) there was no alternative economic development for the community, and (b) there was no alternative income for fulfilling life needs and the other factor rather disagree by DC.
3.2.3. Perception of the impact of land and environmental degradation

The impact of land and environmental degradation was more recognized by DC than the UC (Figure 13). DC compared to UC were more aware that the impact of land and environmental degradation can have an impact on the decline in crop production, decrease in soil fertility, and disrupting forest sustainability. Land and environmental degradation further impacts on the uncomfortable village environment and disrupts the health of the community. This indicates that the impact of land and environmental degradation on the BMW has been felt by DC.

In terms of watershed hydrology, the impact of land and environmental degradation was also more recognized by DC than UC (Figure 14). DC compared to UC are more aware that the impact of land and environmental degradation can have an impact on reducing the flow of water sources for rural community drinking water, a decrease in flow rate river in the dry season, and reduced irrigation water. Land and environmental degradation further impacts floods in the downstream region and sedimentation of reservoirs along the river. This indicates that the increased awareness of UC regarding the hydrological impact of land and environmental degradation in the BMW still needs to be improved.
Figure 14. Community perception is viewed from the hydrological aspects of the impact of land and environmental degradation.

Similar perceptions were also obtained from the socio-economic aspects of the community. The impact of land and environmental degradation on socio-economic conditions of the community was also more recognized by DC than the UC (Figure 15). DC compared to UC were more aware that the impact of land and environmental degradation can have an impact on the decline of the welfare of rural communities, a decrease in the income of rural communities, and disruption of ecotourism development as well as economic disruption of the community. Land and environmental degradation further impacts on increasing social vulnerability and disruption of development activities for public welfare by the government. This indicates that increasing awareness of UC on the economic impact of the community due to degradation to land and the environment in the BMW still needs to be done.

Figure 15. Community perception in terms of socio-economic aspects of the impact of land and environmental degradation.

3.3. Capacity of community to participate on soil and water conservation in micro watershed management

3.3.1. Internal community capacity on Soil and water conservation

In BMW, the community only agreed and realized that (a) there was limited knowledge of the importance of soil and water conservation, and (b) lack of technical knowledge on soil and water conservation methods (Figure 16). Weak public awareness of the importance of conserve the environment, lack of counselling and technical assistance, and lack of mentoring in the implementation of Community-Based Forest Management (PHBM) were three factors which were only sufficiently agreed or even not agreed by the community as a cause of land degradation.
3.3.2. External capacity: local policy and wisdom
The weakness of the policy and the lack of functioning of local community wisdom as a cause land degradation and the environment were questioned by UC and also not agreed by DC (Figure 17). For the UC, they simply agreed or did not even agree that (a) the public aspirations were not paid attention by the government, (b) Unclear rules on forest land use in Perhutani, (c) weak enforcement of local and village government policies and rules, (d) absence of village regulations for saving the environment, (e) increasingly loss of local wisdom to protect the environment and (f) customary law did not play a role in regulating village life. For DC, they did not agree related with the aspects of (a) public aspirations lack attention from the government, (b) Unclear rules on forest land use in Perhutani, (c) weak enforcement of local and village government policies and rules, (d) absence of village regulations for environmental protection, (e) increasingly loss of local wisdom to protect the environment and, (f) customary law did not play a role in regulating village life.

3.4. Capacity of community to apply forest and land rehabilitation in micro watershed

3.4.1. Environmental management efforts: community independency on planning, implementing and monitoring and evaluation of soil and water conservation
The severity of environmental degradation around the village was perceived by the UC to be sufficient (Figure 18). The level of community activity for soil and water conservation activities in the community was at a sufficient level. Community independence to plan and carry out soil and water conservation activities as well as independence monitor the success of soil and water conservation at a sufficient level. This indicates that in the soil and water conservation activities the community still needs assistance.
3.4.2. Community independency in maintaining land hydrological functions
Positive capital in the BMW is that UC and DC argue that they are able to overcome land degradation problems, know ways to overcome land degradation and can carry out activities to deal with land degradation in a participatory manner (Figure 19). Likewise, the community believes that it is capable of being independently and participatory in monitoring environmental health.

3.5. Capacity of community on forming and functioning micro watershed forum

3.5.1. The cause of unexecuted soil and water conservation
The community's view around the village, they did not require maintenance of soil and water conservation was quite strong (Figure 20). The issue about sand mining occurs due to land potential for sand mining was purchased or owned / managed / controlled by people from outside the village was sufficiently recognized by UC, and less recognized by DC. The farmers has less compliance and skills were recognized by the UC and was less recognized by the DC. Soil and water conservation technology was recognized as difficult to implement by UC and DC. This showed that the community needs technical guidance. Soil and water conservation measures were carried out without the knowledge and needs of farmers recognized by UC and DC. The community (both UC and DC) still perceived that soil and water conservation is the government's duty.
Figure 20. Community perception of technical and social factors which not to be carried out by Soil and Water Conservation.

The statement "landowners are less concerned about land degradation" was agreed by the UC, but was not agreed by the DC (Figure 21). The farmers has lacks labor to work on soil and water conservation was more agreed by the UC than the DC. From the economic perspective of the community, the demand for economic needs by ignoring soil and water conservation was sufficiently acknowledged to be the cause of land degradation. The owner / cultivator acknowledges that he lacks the funding to carry out soil and water conservation actions. For the application of soil and water conservation, UC and DC expect assistance / subsidies.

Figure 21. Community perception of economic factors not to be carried out by Soil and Water Conservation

3.5.2. Institutional needs of the micro watershed forum and field school assistance
The community, both UC and DC, perceives that they still lack regular soil and water conservation counseling / assistance, both from Perhutani, Village officials and / Pemda, NGOs, and the private sector (Figure 22). UC perceived getting soil and water conservation training every year from the Land Rehabilitation and Soil Conservation Center (BRLKT), but DC saw less training. The community views that soil and water conservation training was very useful. The community perceived that until now there were no institutions in the community that collectively carry out soil and water conservation activities. The UC perceived rather less and the DC perceived lack of counseling / assistance services for soil and water conservation activities (Figure 23). Effective soil and water conservation activities were agreed upon by the community when approached with the management of Micro Watersheds. The right institution for soil and water conservation was stated by the community if formed and functioned by the Association for the Management of the BMW (Forum). For this reason, the UC and DC agreed to form and function the BMW Forum to improve the environment. Through the BMW forum, soil and water conservation planning was explained to be carried out in deliberation and community participation. Both the UC and DC also stated that they needed assistance in the management of the BMW through field schools.
3.6. Community need for natural resources management in micro watershed.

3.6.1. Environmentally economic community development

The UC and DC of the BMW perceived that the daily necessities of life today were sufficient to be fulfilled from the agricultural business on managed land (Figure 24). Non-farm activities (not related to agricultural forests: sand, ojek, etc.) did not support the lives of UC and DC. Off farm activities (suppliers’/ supply services / collectors) were also no more profitable than forest / land businesses. This indicates that the UC and DC of the BMW were very dependent on the land, both on land ownership and Perhutani forest land. The UC and DC of the BMW perceived that their livelihood was currently sufficient to pay attention to the aspects of forest / land / water conservation. UC and DC believed that their economy can be developed without having a negative impact on the environment. Facilitation of the development of Micro and Medium Enterprises in the agricultural sector was needed by UC and DC of the BMW.
Figure 24. Community perception about the needs of the family for the economic development of the community in harmony with the Environment.

Micro Watershed DC perceived that their life activities were mostly related to Forest areas in TNBTS, and DC were less associated with TNBTS (Figure 25). The UC perceived that Perhutani was not contributing enough income to meet family needs, and was very less associated with DC. For the fulfillment of daily needs, UC and DC with perceptions can be fulfilled from the results of gardens/livestock. In the last 10 years, there has been a perception that there has been a positive change in the economic activities of the UC and DC. Communities that work illegally both in the Perhutani/TNBTS area are less convinced by DC than by DC. It is worrying that UC and DC perceived that Perhutani/TNBTS Forests should function more as an economy than conservation.

Figure 25. Community perception about the linkages between family needs and forests.

The statement "Natural damaged forests will recover by themselves without remedial efforts" less agreed upon by UC and DC of the Bangsri Mikro Watershed (Figure 26). For this reason, it was necessary to have proper plan of forest management in the effort of Forest and Land Rehabilitation (RHL). On private land, well-planned mixed gardens are believed (UC and DC) will provide sufficient agriculture production. Ecotourism development was believed by UC and DC will have an impact on the economy and conservation. If sand mining is still used as an economic resource, UC and DC agree that sand mining needs to be managed properly so will not to damage the environment.
Figure 26. Community perception about the linkages between land rehabilitation and community economy.

4. Conclusion
The results of the baseline study indicated that the community was still dependent on land resources. The UC in BMW generally understands the land degradation problem, however, the downstream people did not realize their surrounding has serious land degradation problems. Both community group did not realize the importance of environmental protection. They believed that they are be able to overcome land degradation by being facilitated by the government or other stakeholders.

In the BMW, the majority of the people in upstream stated that the government attention on community aspirations were sufficient. The land degradation in the village was also conveyed by the majority of the UC that the law enforcement of government policies and regulations was still weak, and they stated that there were no village regulations governing the saving of the village environment. Both UC and DC stated that local wisdom and customary law were still operating in rural communities in managing the environment.

In the BMW, the community stated that they could overcome land degradation through community groups through participatory approach. However, the community did not have good knowledge and skills for soil and water conservation recognized by the UC and were less recognized by the DC. Soil and water conservation technology was recognized as difficult to implement. The communities still perceive that soil and water conservation was the task of the government. The reason of farmers do not apply the soil and water conservation was due to the lacks of labour, the demand for economic needs for their livelihood and less funding to carry out soil and water conservation measures. The community expect technical assistance and subsidies to overcome land degradation. The right institution for soil and water conservation measures (stated by the community) if it is formed and functioned by the Association of BMW Management (watershed forum). The communities also stated that they needed assistance in the management of the BMW through field schools.

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