Participatory Mapping for Community-Based Watershed Management, Lesson Learn from Central Java and West Nusa Tenggara

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Abstract. The rehabilitate degraded watersheds efforts at the national level tends to ineffective, due to the lack of synergy between stakeholders and community involvement. This paper aims to give an idea that planning for rehabilitation of degraded watersheds can be started from the community level, through the involvement of the community in spatial planning. It can be done by integrating watershed and administration unit with participatory mapping method. From two locations in Central Java and West Nusa Tenggara, it shows that participatory mapping could be implemented as a method to identify existing land use, land cover and finding the problem in their environment. Furthermore, spatial planning can be developed together by the community in different village but in the same watershed area.

1. Introduction
Indonesian government's efforts to address the degraded watershed have been conducted since 1970, through a variety programs at national or local level. However, the results have not shown a significant improvement in watershed performance. The number of degraded watersheds increased from 22 watersheds in 1970 to 36 watersheds in the 1980s and since 1999 to 60 watersheds [1]. The situation shows that the watershed management hasn’t been effective and targeted. Therefore, it needs an evaluation both from planning, implementation, and the involvement of stakeholders to the sustainability of watershed functions. In 2012, the Government of Indonesia issued Government Regulation (PP) No. 37 of 2012 concerning watershed management as an effort to accelerate the rehabilitation of 108 critical watershed priorities in Indonesia.

The success of integrated watershed management depends on stakeholders’ participation and their ability to make decisions, there is a need to establish which stakeholders should take part in the design and implementation of integrated watershed management [2]. The role of stakeholders on the integrated watershed management needs to be improved. Stakeholders can be involved to overcome watershed issues in the Upstream section (Land tenure security, Lack of access to forest resources), Midstream (Soil erosion on farmland, River bank erosion), and Downstream (Loss of livestock due to earlier cattle rustling) [2]. Each stakeholder could provide roles and functions that are aligned with the objectives. At the local level, the role of the community should be encouraged as the main actor in planning and action to reduce land degradation in watershed units with participatory mapping method. Participatory mapping put communities as mapping subject at their areas; they performed as plan maker for developing their own region [3]. Its approach could provide opportunity for all stakeholders to
address environment issues and improved the ability of the communities in understanding the village environment spatially [4][5].

Watersheds are very desirable units for planning because they are physical features where throughout the landscape function as a geographical basis for political boundaries. As a planning unit, the watershed transcends political boundaries [6]. Problem in watershed management is the watershed boundaries are not same as administrative boundaries. Hence, the management becomes cross the administrative area. The scope of the administrative area can include provinces, districts, sub-districts, villages, according to the area of the watershed to be managed. At the local (village) level the role of the community is limited by the smallest administrative unit that can be from the village level to the hamlet. So, at the local level watershed management can be done for Micro Watershed units. They can also provide a complete data that will be useful for making an action plan [7].

The purpose of this paper is to find out how the role of the community in spatial planning in the village administration can be developed into a watershed unit as part of the implementation of community-based watershed management. In the future, the community involvement at local level in administrative unit also can be managed in the watershed unit and the activities undertaken can support watershed management more optimally.

2. Materials and Methodology

2.1. Study Area

This research was a part of a community-based watershed management program. The locations were Sumber Rejo Village, Pekasiran Village, Pesurenan Village, and Gembol Village Pekasiran District in Banjarnegara Regency which is located in the Tulis Watershed. Another location was Sesaot Village, Narmada District in West Lombok Regency which is located in the Jangkok Watershed (Figure 1).

![Tulis Watershed and Jangkok Watershed](image_url)

*Figure 1. Research Area (Tulis and Jangkok Watershed)*
2.2. **Data and Methods**

Participatory mapping activities carried out through the following steps e.i. identify the degraded watershed, determine village and build community based organization, make a training on topic participatory mapping, data processing from community into GIS format, overlay with degraded watershed map, develop action plan and determine priority program. Data and tools were used in this activities are GPS Handheld, paper, whiteboard, ballpoint, base maps in scale 1:25,000.

3. **Result and Discussion**

3.1. **The Role of Community in Land Use Mapping**

Local knowledge of their environment can be used to complement existing formal data sets, to inform planners and policy-makers, and to empower residents to envision improvements of their environment that is changes over time and will vary within a community [8]. At the local level, people have better knowledge and depth of information about their home geographical conditions than the outsider. Knowledge and information are the result of a long period of interaction with the environment. Each people have different information, depending on how the interaction process. So that the accumulation of information from several individuals will produce more valuable information, complete and updated.

Historically, local communities have a considerable influence on the development or change of the environment process around their homes. Thus, spatial information owned by the community is a source of information as material for future spatial planning.

![Figure 2. Sketch Map of Sesaot Village, Narmada Village, West Lombok District](image)

Participatory mapping tries to collect and agglomerate all of these local knowledges of these different people to create a high-resolution composite map, and allow indigenous communities to conduct local decision making and resolve conflict using spatial illustration [8] [9]. It can also be used as a tool to suggest alternative management strategies for natural resources, as a tool for conflict
resolution in disputes related to land, natural resources, and/or territory, and as a tool for improved collaborative natural resource management and for cross-sectoral territorial planning [10].

The results of mapping participatory process in Sesaot Village, Narmada District, Central Lombok, shows that the community is able to describe the patterns of land use in its area (Figure 2), which is presented in the land use structure map. The land use type consists of forests, mixed agro forestry patterns on HKM land, owned gardens, rice fields, rivers, highways, important building infrastructure such as village head offices, schools, settlements, and other public facilities. Distributed entities in the area describe the form of activity and the social culture of the local community.

3.2. Integrated Spatial Planning in Watershed and Administrative Unit

Watersheds affect the daily lives of many citizens and provide a powerful wall of protection for economic development [5]. In the watershed management framework, the role of the community in spatial planning at the village level becomes potential and strategic in optimizing the rehabilitation of degraded land and rehabilitated watersheds at a smaller level. Watersheds covering one or more administrative areas at the village level should be used as base for spatial planning. Two or more villages can arrange the same planning if the area is in same watershed. With the integrated planning at the village level, it is expected that watershed management from upstream to downstream can be started from the smallest watershed unit or the 1st order of river.

![Figure 3. Integrated Model of Watershed Management and Administrative Boundaries](image)

Tulis Watershed (Figure 3a) is located on two administration area, Banjarnegeara and Wonosobo Regency. Based on regulation SK. 328/Menhut/2009, Tulis Watershed was included in 108 priority
degraded Watershed. On upper area of watershed, there is a very intensive agricultural land use and it gave contribution to highly erosion rate which reaching to 400 ton/ha/years. Hence, on regional scale spatial planning of Tulis Watershed should be part of Government of Banjarnegara and Wonosobo Regency effort.

Furthermore, in a local scale, the effort to rehabilitate Tulis Watershed can be downgraded into Sub Watershed Unit. Putih and Dolok Sub Watershed located in upper area of Tulis Watershed covered four villages, namely Sumber Rejo, Pekasiran, Pesurenan, dan Gembol (Figure 3b). Based on participatory mapping activities, it can be inferred that land use in the region dominated by agriculture land with potatoes as the main commodity.

From the framework that watershed as an ecosystem from upstream to downstream, then the pattern and activities of the community in Pekasiran Village will affect the Pesurenan Village and Gembol Village which are located in the lower sub-district of Dolok. Whereas in the Putih Watershed activities in Pekasiran Village will affect to Sidomulyo, Pasurenan Village, and part of the Gembol Village in the lower area. The high rate of erosion in the Putih and Dolok Sub Watershed will affect the soil fertility due to reduced organic layer in top soil, and then reduce productivity of agricultural land. The runoff will increase along with the reduction of permanent vegetation cover and the accumulation of surface runoff from the upstream (Pekasiran and Sumberrejo Village) will contribute to flooding at downstream area (Gembol and Pesurenan Village).

The synergy between the communities of Pekasiran, Sumberejo, Gembol, and Pasurenan Villages is needed, especially in determining areas for the functions of protection, cultivation, and settlements based on the ability of the land and its existence in one White and Dolok sub-ecosystem. The protected function area needs to be determined to improve the water system in the watershed and ensure the sustainability of the springs used by the community in the four villages. Areas with aquaculture functions are very important to be managed together, given the condition of land that is very sensitive to erosion, with the application of soil and water conservation techniques that are in accordance with slope conditions and soil types. Finally, areas with settlement functions must be determined by considering population rates, economic activities, and locations that have a high risk of natural disasters. The results of the synergy of spatial planning above can be integrated into the village medium-term development plan (RPJMDes).

4. Conclusion
The role of the community in spatial planning at local unit (village unit as administration basic) potentially can be integrated into watershed unit, by combining planning in one village with another in one watershed with a river order 1 or 2. Communities have a role in providing and presenting information on land use patterns in their regions as sources in future spatial planning. Integration of that planning at the village level in one watershed unit from upstream to downstream can be optimized to improve 108 Priority Watersheds in Indonesia.

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