Communities conservation activities to support sustainable land use of upstream Merawu Watershed

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Abstract. Land use in the upstream Merawu watershed is dominant with agroforestry and intensive agriculture. Poor land management and conservation might lead to land degradation and affect the function of land use in the upstream area. This study aims to find out the community conservation activities which support and maintain the function of land use as a recharge area and protect the downstream. We used a qualitative method in the form of interviews at two locations representing dominant land use in the upstream Merawu watershed, agroforestry in Leksana Village, and intensive farming in Penanggungan Village. We analyzed the data descriptively, supported by field observation and literature studies. We found that the form of conservation activities and its triggers in land management were different. Leksana’s community tended to do the agroforestry system, combined with terracing, contour strip cropping, organic mulch, and organic fertilizer as their local wisdom to maintain the land function. Penanggungan community’s conservation activities were based on the crops they grow, mostly potato, that needed to be planted perpendicular to the slope, using plastic mulch and chemical substances. They believe that the agroforestry has a negative impact on their crops while crop rotation and manual plowing using hoe are their remaining conservation activities to maintain the land function. The results prove that Leksana’s community is still considering conservation activities in their land management while Penanggungan’s community is not, due to the crops’ needs and economic factors.

Keywords: Conservation activities, upstream area, sustainability, agroforestry, intensive farming

1. Introduction
Watershed is a natural ecosystem that is intact from upstream to downstream with functions to accommodate, store, and drain water that comes from rainfall to lakes or the sea naturally, the boundary on land is a topographic separator and the boundary at sea to the area irrigation which is still affected by land activities. Watersheds can be classified based on land conditions and the quality, quantity and continuity of water, socioeconomic, investment in water structures and spatial use. At present, the Serayu watershed is one of the priority watersheds to be restored based on land conditions, hydrology, socio-economic, investment, and development policy in the region so that priority should be given in handling it. The pressure on the upstream Serayu watershed is enormous, especially by the agricultural sector which shows that the utilization is not functioning properly [1].
Each watershed is completely divided into sub-watersheds [2]. The Merawu watershed is part of the upstream Serayu watershed and has a high level of vulnerability to landslides [2]. The unstable condition of the Merawu watershed is exacerbated by the use of land as agriculture which is a contributor to the community's economy and has the potential to cause erosion [3].

The upstream area has the function of conserving and balancing the ecosystem that is managed to maintain the watershed's environmental conditions from being degraded [4]. Based on these functions, the upstream area should be left as is without significant intervention. However, people who live in the upper reaches of the Merawu watershed use the land to meet their needs from the agricultural sector.

Merawu watershed is located in Banjarnegara District which consists of 20 sub-districts, two of which are in the upstream area of the Merawu watershed, namely Karangkobar and Wanayasa Districts [5]. At present, the upstream area of the Merawu watershed has two dominant land use activities, namely intensive agriculture and agroforestry. Both activities are practiced by the people from Leksana Village, Karangkobar District who represent agroforestry land use and Penanggungan Village community, Wanayasa District who represents land use for intensive agriculture. Communities in both villages have relatively homogeneous characteristics. They depend on agriculture as farmers and their main job, have a relatively similar level of education and grow the main commodities in the form of vegetables [5].

Land use that is not in accordance with the function of the upstream area allows land degradation that will affect the area below. This is not only due to physical characteristics [6] but also due to poor land management systems [7]. Every agricultural system that is applied will be related to land management activities that are applied. The intended activity can be in the form of conservation techniques using vegetation, engineering, mechanical, and chemical methods which are applied based on certain considerations in terms of ecological, economic, and social aspects of the area. Although agriculture in the upstream region tends to cause land degradation, it is not possible to get rid of such activities, so land management activities are needed to support sustainability and reduce the negative impact on upstream watershed functions.

There are not many studies relating to land use in the upstream area of the Merawu watershed, which is one of the causes of land degradation [7]. While poor land management and uncontrolled changes in resource use will affect upstream functions and environmental balance including hydrological processes in it and increase the risk of erosion, landslides and other land disasters [6]. A social approach to the community is needed to determine the considerations used by the community in managing land and the elements of conservation activities in it. Sustainable land use will support upstream watershed functions so social research needs to be done on conservation activities undertaken by the community to support upstream watershed functions sustainably. Based on these facts, this study aims to identify the factors that influence conservation activities carried out by the community and formulate a strategy of conservation activities by the community to support the sustainability upstream function of the Merawu watershed.

2. Material and Methods

2.1. Time and Location
This research was conducted in Tamansari Hamlet, Leksana Village, Karangkobar Sub-district representing the agroforestry land use and Penanggungan Hamlet, Penanggungan Village, Wanayasa Sub-district representing intensive farming. Field observations were carried out in September - October 2018. Data collection was carried out in February - August 2019.

2.2. Data Collection Method
This research used quantitative methods using tools, such as voice recorder, camera, laptop, stationery, Ms. Excel software, village administrative maps, and questionnaires. The object of this research was the farming community in both villages. The sampling technique was done by accidental sampling while the data collection was done by interviews using questionnaires as the instruments. The
determination of respondents was carried out using the Slovin’s formula. Respondents in this study were 20 people/households in each hamlet out of the total HHs. The number was considered to be representative because of the community profile in both locations that have high homogeneity.

2.3. Data Analysis
Data obtained from the results of the interview was tabulated with software Ms. Excel and analyzed by several methods. Gap analysis was carried out to determine whether conservation activities practiced guarantee sustainability. The determination of conservation activity strategies to support the Merawu watershed upstream function was carried out by quantitative SWOT analysis which later was analyzed descriptively.

3. Results and Discussion
There are two dominant land uses in Merawu watershed, namely agroforestry and intensive agriculture. Both of these patterns are a form of change in the use of forest land into agricultural land that is developing up to this day. Communities in Leksana Village, Karangkobar Subdistrict apply agroforestry land use for agriculture and the community in Penanggungan Village, Wanayasa Subdistrict apply intensive farming. Agroforestry is a conservation effort that emphasizes ecological aspects compared to intensive agriculture oriented towards production and economic sustainability. Both patterns of agriculture have advantages and disadvantages to each. The productivity of intensive farming systems is higher than agroforestry systems so that the application of intensive farming systems is increasing [8]. But in terms of ecological and conservative, intensive agriculture is even more harmful compared to agroforestry patterns.

![Figure 1. Agroforestry in Leksana Village (left) and Intensive Farming in Penanggungan Village (right)](image)

3.1. Factors that influence conservation activities by the community
Different agricultural practices in the two locations encourage diversification in terms of commodities and how to cultivate agricultural land. Leksana villagers, who still practice agroforestry, tend to cultivate their land by prioritizing the ecological aspects of the land, which in its processing, the community always plants staple crops without removing the surrounding trees. This is manifested in several activities in the form of strip cropping/intercropping, planting trees on the edge of the land to strengthen the soil, and planting trees among the main crops. Another case with the Penanggungan Village community that cultivates their land with intensive farming. They tend to think that the presence of trees disturbs the potatoes and vegetables as their main crops. In consequence, they minimize or eliminate the presence of trees on their land. This can be seen from the small number of people who still practice planting trees in their fields, where only a small portion of the community still plants trees along the border (Figure 1).
Figure 2. Factors that influence community’s conservation activities in Leksana Village (left) and Penanggungan Village (right)

The difference in land management activities in the two locations is influenced by many factors, namely economic, political, socio-cultural, education, and science and technology. Most of the community conduct the land management activities based on local knowledge from their parents as well as local wisdom that has been practiced for a long time. These factors underlie almost all types of activities in the Leksana and Penanggungan Village, ranging from making terraces, contour directional planting, use of organic fertilizers and mulch, intercropping, agroforestry, crop rotation, making mounds, weaving, soil reinforcement, and plowing. In addition to local knowledge, education factors such as training and counselling, also underlie some activities such as intercropping, using organic fertilizer, and planting trees. Another factor was the type of commodity that affected the way of land management, especially in Penanggungan Village. The potato commodity underlies contour perpendicular planting intended to escape the water, reduction of trees that inhibit the entry of sunlight, and crop rotation as an effort to rest the soil. The type of the potato also requires the community in Penanggungan Village to intensify agriculture in terms of the use of chemical fertilizers and pesticides in relatively large quantities over a long period. In addition, the knowledge gained from farmers in other regions such as Batur, Dieng, and Bandung which is identical to the vegetable commodity is also a strong factor for the community, especially in Penanggungan Village in intensifying agriculture and starting to leave hereditary practices. The demands and market prices are also influencing the way of land management in the form of intensification in Penanggungan Village and the tendency to land expansion in Leksana Village.

Based on the results of interviews and direct observation, the people of Leksana Village tend to continue maintaining the presence of trees through vegetative conservation activities in the form of agroforestry. Local knowledge about the importance of trees for land remains firmly held by the Leksana Village community. The community has always known hereditary knowledge about trees that hold an important role in their land. The community know the importance of trees in maintaining water availability, preventing erosion and landslides, and to be a promising long-term deposit. The existence of hereditary knowledge is the main factor of the agroforestry patterns practiced by Leksana Village community.

3.2. Formulate a strategy of conservation activities by the community to support the sustainability upstream function of the Merawu watershed

Land use in the upstream area as agriculture certainly does not support the sustainability of the upstream watershed function. Although agriculture in the upstream Merawu watershed has an impact on land degradation, agriculture that has become the main source of the community does not need to be eliminated, so land management activities are needed to support sustainability and increase the negative impact on upstream watershed functions. Based on the survey results, it is known that the people in the second location have a sufficient understanding of their location located in the area, as well as the consequences. Activities undertaken by the community are not impossible apart from the
aim of increasing agricultural production but must also support land use and upstream functions that are supported.

![Figure 3](image)

**Figure 3.** Forms of conservation activities carried out by the community of Leksana Village (left) and Penanggungan Village (right)

Not only to maintain the production and agriculture sustainability, the conservation activities are also done by the community to reduce the negative agricultural impacts in the upstream area. The conservation activities such as terraces making, contour directional planting, and agroforestry patterns which are one of the vegetative conservation activities are mostly carried out by the HASaw Merawu community (Figure 3). Conservation activities found at the study site were the use of organic fertilizers and mulch in Leksana Village, ground cover plants (cover crops), crop rotation (crop rotation), and intercropping (intercropping). Some of the benefits from the vegetative methods are the ease of application, preserved environment, erosion and surface runoff prevention, soil properties improvement from increasing plant organic matter, and increase of added value for farmers from by-products.

4. Conclusion

The form of conservation activities and its triggers factors in the two villages were different. Leksana’s community tended to do the agroforestry system, combined with terracing, contour strip cropping, organic mulch, and organic fertilizer as their local wisdom to maintain the land function. Penanggungan community’s conservation activities were based on the crops they grow, mostly potato, that needed to be planted perpendicular to the slope, using plastic mulch, and chemical substances. They believe that the agroforestry has a negative impact on their crops while crop rotation and manual plowing using hoe are their remaining conservation activities to maintain the land function. The results prove that Leksana’s community is still considering conservation activities in their land management by doing the vegetative conservation strategies while Penanggungan’s community is not, due to the crops’ needs and economic factors.

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Acknowledgement

The authors would like to thank Mr. Hatma Suryatmojo, Mrs. Ngadisih, and Mrs. Lies Rahayu for their encouragement and fruitful discussion on this research. Authors also thank all of the research team that’ve been helping us during the data collection, analysis, and through all of the process. Without our team this work would not have started, progressed, or ended.