

Designing Soil and Water Conservation Activities in the Tinalah Sub-watershed

H Oktafiningsih¹ and A Kusumandari²

¹ Alumni of the Faculty of Forestry, UGM, Indonesia

² Senior lecturer at the Faculty of Forestry, UGM,

Indonesia, email: ambar_kusumandari@ugm.ac.id

Abstract. The Tinalah sub-watershed was degraded because of community activities that are not in accordance with conservation principles. The purpose of this study was to identify the forms of soil and water conservation techniques applied by the community in the Tinalah sub-watershed and to design soil and water conservation activities for watershed conservation in the Tinalah sub-watershed, Kulon Progo. Data collection was done by interview and observation methods. Data analysis was done using the SWOT model. The results showed that the majority of soil and water conservation techniques applied to upstream land were almost 2/3 mechanically and 1/3 combined vegetative and mechanical. In the middle watershed area, almost one hundred percent is a combination of mechanical and vegetative, while in the downstream area the majority is mechanical (75%). Based on the SWOT analysis, the activities in the context of implementing the conservation technique are: a. Providing assistance to members of farmer groups so that they can support agricultural activities carried out, b. Hold regular meetings between members of farmer groups so that the sense of cooperation is maintained and c. Develop a plan for soil and water conservation activities to protect the Tinalah sub-watershed ecosystem.

Keywords: land, degradation, SWOT, mechanical, vegetative

1. Introduction

The Tinalah sub-watershed area is an upstream of Progo watershed area that has experienced a decline in land quality. The decline in land quality is caused by several factors, one of which is the use of land by the community. The decline in land quality that occurs in the Tinalah sub-watershed area is land damage, cliff erosion, river sedimentation and flooding (Herwanto, 2013). Most of the land in the Tinalah sub-watershed area is used by the community to become land in the form of moor. Based on the research of Kuncoro and Gunawan (2015) of the majority of land uses carried out by the community in the Tinalah Sub-watershed, the use of upland land that has the greatest erosion potential is 74.59%. Erosion is one of the factors that cause landslides. Based on BPBD data for Kulon Progo Regency in 2017-2020, Samigaluh District experienced 272 landslides and Kalibawang District experienced 79 landslides.

According to Asdak (2010) and Naitkakin, et al. (2021) the sub-watershed consists upstream, the middle, and the downstream parts of the area. The upstream part of a sub-watershed has the main function as a conservation area to maintain the stability of the entire sub-watershed. As the upstream area of the Tinalah Sub-watershed which has the main function as a conservation area to protect the area below it, to reduce the level of landslide hazard in the Tinalah Sub-watershed.

The Tinalah sub-watershed is an upstream watershed that has the main function as a conservation area to protect the area below it. Most of the Tinalah Sub-watershed area is used by the community to become land in the form of moor. The use of this dry land can result in a decrease in land quality. This decline in land quality was marked by the occurrence of landslides around the Tinalah Sub-watershed (Kalibawang District and Samigaluh District) in 2017-2020. Based on the description above, this research needs to be done immediately.

The objectives of this research is: to identify the forms of soil and water conservation techniques applied by the community in the Tinalah sub-watershed and to design the soil and water conservation activities for watershed conservation in the Tinalah sub-watershed, Kulon Progo.

2. Material and Methods

2.1. Research site

Based on the calculation of the area of the sub-watershed using the ArcGIS software carried out by Vienastra (2018), it is known that this sub-watershed has an area of about 44.43 km².

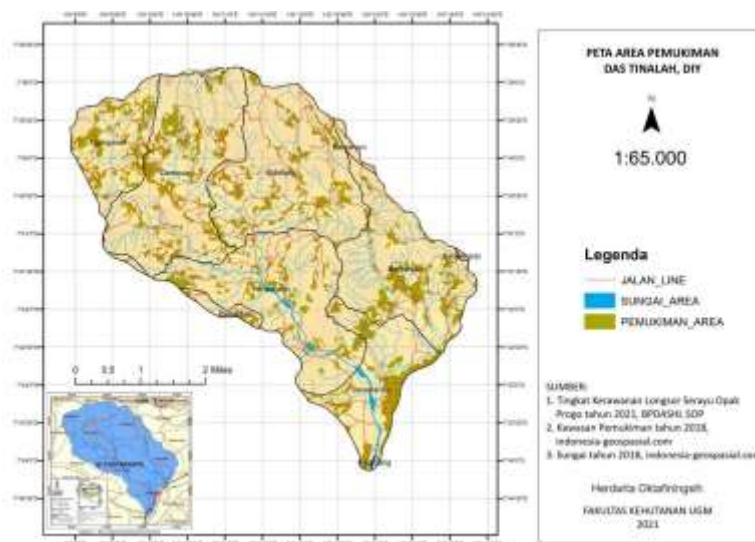


Figure 1. Location map of Tinalah sub-watershed

2.2. Research methods

2.2.1. Research materials and tools. The tools used for this research are:

1. A tape recorder to record the results of the interview
2. Questionnaire for respondent interview guidelines
3. Camera to document research data collection
4. Microsoft Excel software to process research data
5. ArcGIS software to create research maps

The materials used for this research are:

1. Administrative map of the Tinalah sub-watershed
2. Data on membership of forest farmer groups in the Tinalah sub-watershed

The data taken are primary data and secondary data. Primary data collection includes community characteristics, application of soil and water conservation techniques carried out by farmers, photos or field documentation at the research location. Secondary data collection includes membership data of forest farmer groups who cultivate land in the Tinalah sub-watershed.

2.2.2. Data Retrieval Method. The methods used for data collection in this study are qualitative methods and quantitative techniques, quantitative techniques are used in determining the number of respondents' samples. According to Moleong (in Pentury, 2017), qualitative research methods are research methods that can produce research data in the form of words that can be written from the object under study or the behavior of the object under study that can be observed. Data was collected by interview, field observation and taking documentation in the field.

Interviews were carried out in collecting research data by asking questions and answering questions between researchers and respondents which would then produce data that researchers used to answer the problems being studied. According to Bungin (in Setiawan et al, 2018), the interview is a series of question-and-answer processes between the researcher/interviewer and the respondent. Interviews were conducted in a structured way using a questionnaire that had been made by previous researchers. Interviews were conducted in Ngargosari Village, Purwoharjo

Village, and Gerbosari Village. Interviews were conducted by asking respondents about information on land owned, community knowledge about conservation, forms of conservation activities, and what factors encourage people to carry out conservation activities.

Interviews were also conducted with key informants who were local forestry extension workers at the research location as well as the heads of forest farmer groups in the research location. According to Mikkelsen (2011), interviews with key informants have the aim of obtaining more in-depth information about the particular topic being researched.

The next data collection was field observation where the research was conducted. Field observation is a technique of collecting data by visiting the research location and observing what is in the field. The purpose of collecting data is using observation techniques in the field to find out the actual conditions in the field (Widyaningsih, et al, 2021). Field observations in this study were carried out in Ngargosari Village, Purwoharjo Village, and Gerbosari Village.

Data collection in the form of documentation was also carried out at the research location. Documentation retrieval aims to support data from the results of interviews that have been conducted.

2.2.3. Data analysis method. The data that has been generated from data collection in the field will then be recapitulated and processed and presented in the form of descriptions, relationships between categories, tables and the like. Furthermore, data analysis will be carried out using the following methods: data categorization, SWOT analysis and descriptive analysis.

The data generated from data collection in the field will then be categorized regarding the forms of conservation activities carried out by the community and the factors that influence the community to carry out conservation activities. According to Moleong (in Sudaryanto et al., 2019), categorization in research is a step that needs to be done based on certain rules. Certain rules such as categories must be in accordance with the purpose of the research being carried out.

The data that has been categorized and processed will then be analyzed using the SWOT method. According to Syahrul (in Herawati et al., 2020), the SWOT method is a method used to analyze based on strengths (strengths), weaknesses (weaknesses), opportunities (opportunities), and threats (threats) which will later be used to develop strategies to achieve a certain goal. specific purpose.

The data obtained from the field in the form of soil and water conservation activities carried out by the community as well as the factors that influence the community to carry out conservation activities and the results of direct observations in the field will be analyzed descriptively. Descriptive analysis aims to describe the existing data..

3. Result and Discussion

3.1. Location and Area

The research location is in the Tinalah sub-watershed, Kulon Progo Regency. Administratively, the Tinalah sub-watershed covers three sub-districts in Kulon Progo Regency, namely Kalibawang District, Samigaluh District, and Nanggulan District and one sub-district in Magelang Regency, namely Borobudur District. Geographically, the Tinalah watershed is located at coordinates 110°07'30" east longitude - 110°15'00" east longitude and 07°37'30" south longitude - 07°45'00" south longitude. The Tinalah sub-watershed is one of the Menoreh highlands located at an altitude of 500-1000 m asl with an area of 4,955 ha (Kuncoro and Gunawan, 2015). The Tinalah sub-watershed has one main river, namely the Tinalah River that has a length of 13.02 km (Vienastra, 2018). The Tinalah sub-watershed has the following regional boundaries: the northern boundary is Magelang Regency, Central Java Province, the southern boundary is Girimulyo District, Kulon Progo Regency, the western boundary is Purworejo Regency, and the eastern boundary is Sleman Regency.

The Tinalah Sub-watershed area has tropical climate conditions with an average rainfall based on rainfall data at Kalibawang Post, Kenteng Post, and Samigaluh Post, which is 2660.65 mm/year. The average temperature condition based on data from the Tegal climatology post, in the Tinalah sub-watershed, is 21.88-24.68°C.

The Tinalah sub-watershed is a hilly area that stretches from north to south with the upstream area of the Tinalah sub-watershed having a complex incised structural hill. The Tinalah sub-watershed has rock types: the van Bemmelen Formation (andesite breccia), Jonggrangan Formation (layered limestone, marls, and tuffs), Nanggulan Formation (sandstones, marls,

limestone, tuffs, intercalated lignite, and conglomerates), alluvium, and colluvium. (Vienastra, 2018). This is influenced by the existence of the old Menoreh volcano in the mountains of West Progo. The type of soil in the Tinalah sub-watershed is dominated by Latosol and Grumusol soils (BPBD DIY).

The research location in the Tinalah sub-watershed has land use types, namely rice fields, fields, gardens, shrubs, reeds, and settlements. Table 1 shows the land use area in the Tinalah sub-watershed.

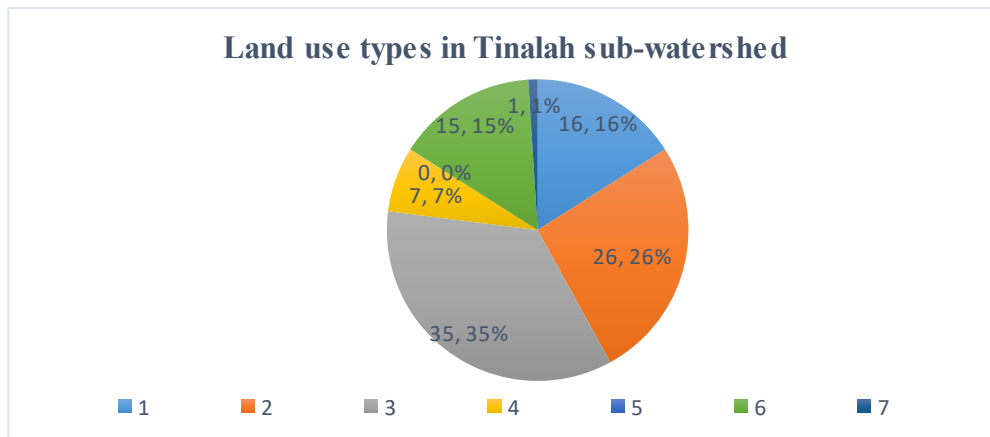


Figure 2. Land Use Areas in the Tinalah Sub-watershed

This research was conducted in the Tinalah sub-watershed, most of which are located in Kalibawang and Samigaluh sub-districts, Kulon Progo district. Most of the people in the Tinalah sub-watershed have a livelihood as farmers, each of whom owns arable land. The community for rice fields, dry land field, mixed planting, shrubs, grassland and settlements uses the area of Tinalah sub-watershed. The dominant land uses in the Tinalah sub-watershed are dry land fields, mixed planting and settlements.



a. settlements



b. dry land fields'



c. mixed planting

Figure 3. Some land uses in Tinalah sub-watershed

Soil and water conservation carried out by vegetative methods provide plants on the soil, which aims to reduce the speed of raindrops far directly into the soil. The people of Ngargosari Village who apply soil and water conservation using vegetative methods on their land plant *temulawak*, ginger, turmeric, and cassava plants to protect the soil from splashing rainwater. Collector. Communities who apply soil and water conservation using mechanical methods make waterways in the form of ditches in each planted block to prevent flooding on their land. A trench is made in each block, which is planted with a depth of 0.5 meters and a depth of 0.5 meters. In addition, the people of Ngargosari Village also implement soil and water conservation buildings in the form of making bench terraces on their land considering the condition of the land in the form of hills to prevent landslides from occurring.

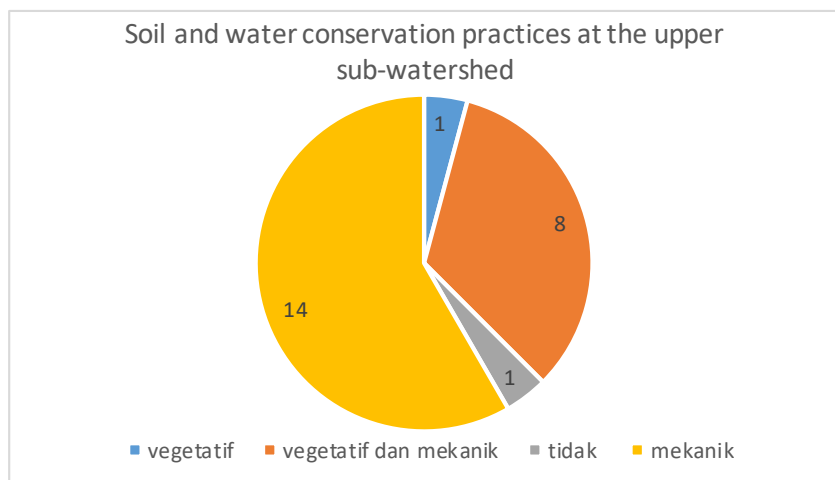


Figure 4. Soil and water conservation practices at the upper sub-watershed in Ngargosari village

Soil and water conservation activities to achieve success need was done by building cooperation between the government and local communities. This can be done by providing direction and counseling regarding soil and water conservation activities that can be carried out in each land. Most of the people in Ngargosari Village have participated in counseling activities about agriculture, in which there is counseling regarding efforts to prevent land problems that may occur, but not a few people have not received counseling about soil and water conservation activities. A total of 10 people from Ngargosari Village have received counseling on soil and water conservation and as many as 10 people from Ngargosari Village have never received counseling on soil and water conservation will be presented in the following diagram:

One method that can be used to convey the importance of carrying out soil and water conservation activities to the community can be done by the extension method. According to Rogers (in Purnomo et al., 2015) extension is an activity of providing innovation to a group in an interactive way that can provide changes in the mindset and actions of both the innovator and the target of counseling. The target of counseling in this research is the community of Ngargosari Village and the innovation provider in question is the relevant government. From the results of the study, both the people who received the counseling and those who did not, the majority had carried out soil and water conservation activities on their respective lands. This is because the land ownership of the Ngargosari Village community is carried out from generation to generation so that since the previous parents have made traditional soil and water conservation buildings, each of which functions well until now. So that it can be seen that one of the factors that influence the people of Ngargosari Village to carry out soil and water conservation activities in addition to providing counseling on soil and water conservation activities by the government is the legacy of soil and water conservation buildings inherited from generation to generation from their parents.

The results of data collection in the field can be used to analyze strategies for soil and water conservation activities that can be applied by the Ngargosari Village community based on factors such as strengths, weaknesses, opportunities, and threats. This strategic plan aims to describe what plans, steps, and considerations can be made to realize sustainable soil and water conservation activities.

From the description above, it can be seen that the majority of the people of Ngargosari Village join as members of forest farmer groups. The community of Ngargosari Village has also implemented soil and water conservation activities on their land so that the condition of the land in the Tinalah sub-watershed is still maintained. The implementation of soil and water conservation activities carried out by the community is motivated by hereditary factors from previous family members. However, it is necessary to carry out the role of relevant agencies to provide counseling regarding soil and water conservation activities. This is because there are still farmers who have not participated in soil and water conservation counseling activities.

3.2. Community Soil and Water Conservation Activities in Gerbosari Village

The middle part of the Tinalah sub-watershed is in Gerbosari Village. The people of Gerbosari Village

have various levels of final education. The majority of the Gerbosari Village community have the latest education, namely SMP, SMA, and SD. The number of people with the latest education in junior high school is 26 people, the community with the last education is high school as many as 12 people, and people with the last education are elementary school as many as 11 people.

Knowledge of soil and water conservation in the Gerbosari Village community is limited by knowledge of local wisdom. According to Hasrawaty, et al. (2017), local wisdom possessed by the community through several adaptation processes from environmental changes that have occurred from generation to generation, which produces a kind of mechanism that can be used to solve a problem. Therefore, the people of Gerbosari Village understand soil and water conservation not through theory but through practice to improve land with local wisdom that indirectly includes soil and water conservation activities.

Soil and water conservation activities can be carried out by several methods, namely vegetative methods, mechanical methods, and chemical methods. Soil and water conservation using the vegetative method can be done by providing cover crops that can reduce the speed of rainwater falling directly on the ground so that the possibility of erosion can be minimized. Soil and water conservation with mechanical methods can be done by constructing SWC buildings such as ditches and terraces. The majority of Gerbosari Village communities apply soil and water conservation with two combined methods, namely the vegetative method and the mechanical method. The number of people who apply soil and water conservation methods and people who have not applied soil and water conservation methods are presented in the following graph:

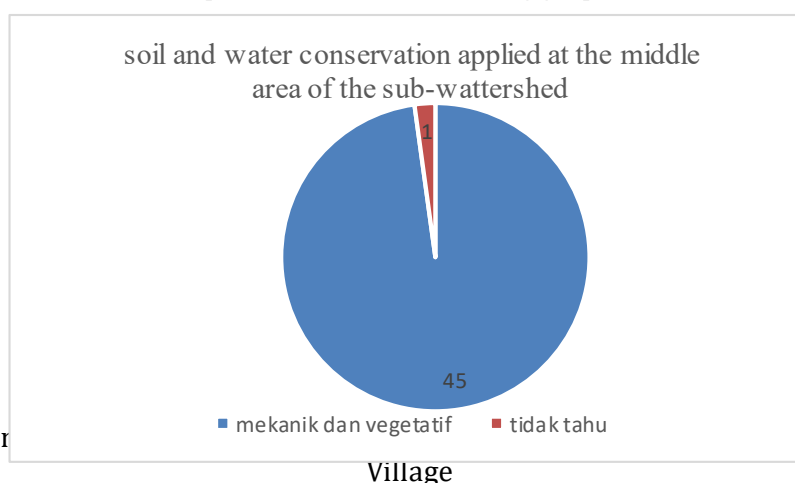


Figure 5. Soil and water conservation applied in Gerbosari Village

The application of soil and water conservation by the people of Gerbosari Village is carried out using two methods, namely the vegetative method and the mechanical method. People who apply this mechanical method are characterized by making ditches and building terraces. According to Deng et al, 2021, terrace buildings on sloping land have the advantage of reducing runoff, controlling erosion and increasing crop yields. According to Yurisinthae, 2021, the construction of a ditch aims to reduce the use of water according to the needs of plants and also to become a source of water for the land. The application of soil and water conservation using the vegetative method is carried out by farmers by planting cover crops such as annual crops or plants that produce tubers.

According to Subagyo et al, 2003, Ground cover plants are planted on dry land and cover the entire soil surface. The people of Gerbosari Village who apply soil and water conservation in the form of terraces and ditch waterways are motivated by the legacy of their previous parents, while the people who apply soil and water conservation with the vegetative method are planting ground cover plants that produce tubers and seasonal crops with the aim of increase farmer s' income from their crops.

One aspect of efforts to convey knowledge about conservation activities can be done by providing counseling to the community. The majority of the Gerbosari Village community have participated in soil and water conservation community services. A total of 37 people have never attended soil and water conservation counseling, while 9 people have attended soil and water conservation counseling activities.

3.3. Community Soil and Water Conservation Activities in Purwoharjo Village

Purwoharjo village is located in the lower reaches of the Tinalah sub-watershed. According to Jusmy

(2019), the downstream part of the sub-watershed functions is usually used for the use of water by the community in meeting their daily needs. The residents of Purwoharjo Village have various levels of education, namely elementary, junior high, and high school. The people of Purwoharjo Village who have the latest elementary education as many as 1 person, the people who have the latest junior high school education as many as 8 people, and the people who have the last high school education as many as 3 people

The people of Purwoharjo Village, who mostly work as farmers, mostly have arable land. The treatment of soil and water conservation on farmers' arable lands needs to be known to support the stability of the ecosystem in the Tinalah Sub-watershed and prevent land damage. Land use combined with soil and water conservation efforts will support a sustainable Tinalah sub-watershed ecosystem. As many as 11 people have implemented soil and water conservation on their land, while 1 person has not implemented soil and water conservation on their land.

Communities who apply soil and water conservation on their land are a form of inheritance from their previous parents. This indirectly causes the community to implement soil and water conservation. The legacy of soil and water conservation by previous parents is beneficial for the community because the community does not need to build soil and water conservation buildings from scratch.

Soil and water conservation can be done by several methods, namely mechanical methods, vegetative methods, and chemical methods. The people of Purwoharjo Village mostly apply soil and water conservation using mechanical methods and a combination of vegetative and mechanical methods. There are 9 people in Purwoharjo Village who apply mechanical methods for soil and water conservation on their land, while 3 people who apply a combination of vegetative and mechanical methods. Data regarding the types of soil and water conservation carried out by the people of Purwoharjo Village will be presented in the following diagram:

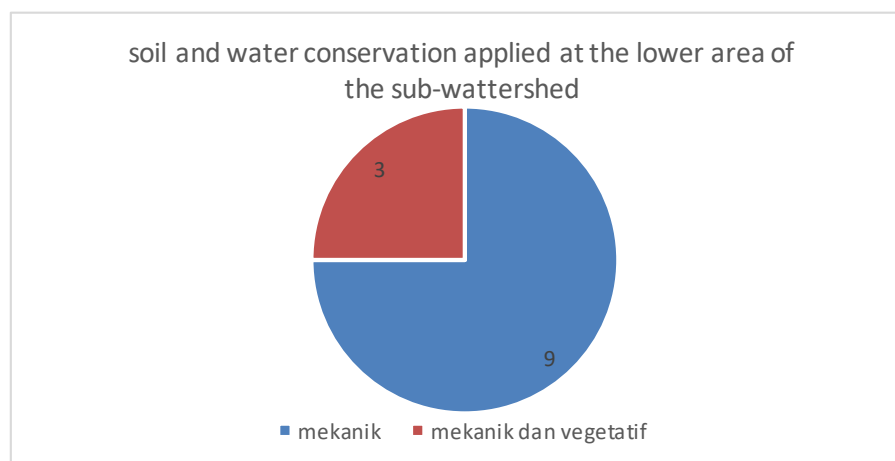


Figure 6. Soil and water conservation applied at the lower area of the sub-watershed in Purwoharjo village.

According to Arsyad (2014) soil and water conservation can be done by several methods, namely soil conservation by vegetative methods, mechanical methods, and chemical methods. The people of Purwoharjo Village who apply soil and water conservation using mechanical methods are characterized by making waterways and terracing. The purpose of making aqueducts is so that the flow of water on the land can flow smoothly so as to prevent flooding in the land and making terraces on sloping land to reduce the length of the slope to reduce the speed of surface runoff. The application of soil and water conservation by the people of Purwoharjo Village uses a combined method of vegetative and mechanical methods characterized by making terraces and providing cover crops to reduce the risk of the soil being exposed to rainwater directly.

Knowledge of the importance of implementing soil and water conservation by the community can be provided through the provision of counseling. Counseling on soil and water conservation is given to the community through several methods, one of which is holding meetings with members of farmer groups.

Table 1. Internal Factor Analysis Strategy (IFAS) and External Factor Analysis Strategy (EFAS)
Purwoharjo Village Community

IFAS EFAS	<i>(Strength)</i> • The majority of the people of Purwoharjo Village actively join forest farmer groups • The majority of the people of Purwoharjo Village have implemented KTA on their land for generations • The people of Purwoharjo Village know about soil and water conservation • The people of Purwoharjo Village have a culture of mutual cooperation to help each other if problems occur in the land • The people of Purwoharjo Village not only plant agricultural crops but also plant forestry staples. S-O Strategy Providing assistance to members of farmer groups so that they can support their agricultural activities Holding regular meetings between members of farmer groups so that the sense of cooperation is maintained Develop a plan for soil and water conservation activities to protect the Tinalah sub-watershed ecosystem	<i>(Weakness)</i> • Many people have never attended counseling on KTA • Land use downstream of the Tinalah sub-watershed is mostly gardens and rice fields • The government's role in providing counseling is less than optimal • There are people who join KTH but are less active in the KTH organization W-O Strategy Improve coordination between farmers and relevant government in handling soil and water conservation extension Increase outreach activities to members of forest farmer groups regarding soil and water conservation activities Provide input to farmers not to convert their land into rice fields as a whole so that the existence of forestry plants remains
	<i>(opportunity)</i> • People who become members of KTH get a membership card • Land problems rarely occur on farmer's land • Increasingly updated agricultural tools S-T Strategy Provide direction to farmer groups to plant woody plants in areas with steep slopes In order to reduce the potential threat of erosion and landslides, it can be done by maintaining forestry staple crops Provide assistance for farmer members who apply for financial assistance to carry out land improvements.	W-T Strategy Holding regular meetings between farmer groups and relevant agencies that handle soil and water conservation activities Increase the number of forest farmer group members

4. Conclusions

1. The forms of soil and water conservation techniques applied to the upstream land are the majority, almost 2/3 are mechanical and 1/3 are vegetative and mechanical combinations. In the middle watershed area, almost one hundred percent is a combination of mechanical and vegetative, while in the downstream area the majority is mechanical (75%).
2. Based on the strengthens and Opportunity (S-O) strategy, the activities for the application of the KTA technique includes 3 activities. First, assisting members of farmer groups so that they can support agricultural activities carried out. Secondly, hold regular meetings between members of farmer groups so that the sense of cooperation maintained and the third is develop a plan for soil and water conservation activities to protect the Tinalah sub-watershed ecosystem.

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