Community-based adaptation for ecosystem disaster risk reduction in the Upstream Merawu Watershed, Indonesia

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Abstract. Forest conversion to agricultural land in the upstream area of Merawu watershed has changed the ecosystem composition and reduced the stability. Mass erosion and landslide occurred in the upstream and increased the ecosystem vulnerability. Tamansari and Penanggungan hamlets are prone to erosion, landslides and environmental pollution from intensive farming. Potatoes, cabbage, carrots, and chili are the main commodities planted, particularly in Penanggungan hamlet. Planting on the steep slope, intensive land mechanization and high intensity of pesticide spraying caused the area to be prone to ecosystem disasters such as erosion, landslides and environmental pollution. This study aims to determine the people's perceptions of ecosystem disasters and analyse the community adaptation and mitigation strategies. Community perceptions is analysed using Mann Whitney test, while adaptation and mitigation strategies using qualitative descriptive. The results showed that the upper Merawu watershed community’s perceptions varied greatly by knowledge and attitudes of the community. Knowledge is affected by the intervention of PT. Indonesia Power and Field Extension Officer. Community attitudes are influenced by the type of land use and commodities planted. Adaptation actions practiced by the community include water drainage cleaning, application of intercropping, crop rotation and agroforestry. Mitigation actions carried out by the community include the construction of drainage channels, terraces, embankments, and planting of wood plants (structural mitigation) while mitigation carried out by the government is more towards non-structural mitigation such as socialization and training, planting joint seedlings and the establishment of disaster resilient village (i.e., Destanta).

1. Introduction
Indonesia has several watersheds with critical conditions which increase every year. The Indonesian government has set 108 critical watersheds that must be immediately addressed in the Decree. 328 / Menhut-II / 2009. The handling is prioritized on 15 critical watersheds, one of which is the Serayu watershed. The Merawu watershed is one part of the upstream part of the Serayu watershed which is in one dominant district, namely Banjarnegara Regency, Central Java Province. Based on Regional Regulation No. 1. of 2004 concerning the Spatial Planning for Banjarnegara Regency, the upstream part of the Merawu watershed is a protected area that protects the local area and provides protection for the area below. These protections include regulating water systems, preventing landslides and floods, and controlling erosion. Based on its function, the use of land that is allowed in protected areas is processing land without tillage (zero tillage) by not doing logging [1].
The conversion of forest land into agricultural land in the upper reaches of the Merawu watershed from year to year has increased along with the increasing population. Agricultural cultivation techniques that pay little attention to conservation rules will also result in critical land. The planting technique carried out following the slope direction with intensive land processing will cause an increase in the amount of erosion which will affect soil fertility in the area. Land eroded in the upstream area will be carried away by the water during rain so it is feared that it will cause sedimentation in the middle and downstream areas. The Merawu Watershed contributes erosion to sediment from the Mrica Reservoir with an average of 10.41 mm/year. Apart from erosion, the Merawu watershed is an area prone to landslides. There have been many landslides that have occurred in this area including Tamansari and Penanggungan Hamlets [2]. Based on Banjarnegara District Regulation No. 11 of 2011 article 49 concerning Regional Spatial Planning, Banjarnegara is one of the Regencies whose entire area is prone to landslides.

Most of the community of Tamansari Hamlet and Penanggungan Hamlet depend mostly on agricultural products so that agricultural land is intensively processed for the production of potatoes and other agricultural products. In high slopes and unstable land, the community continues to use it as agricultural land with no proper soil and water conservation. Cultivation of agricultural crops without regard to conservation in the absence of processed terracing causes the soil and water conditions at the scene to be easy to move [3].

Efforts to improve the quality and productivity of agricultural products in Tamansari and Penanggungan Hamlets are inseparable from the use of pesticides to eradicate plant pests. This causes farmers to experience dependence on climax and fertilizer. Excessive use of pesticides can endanger the health of farmers and consumers, non-target microorganisms. According to the Central Java Forum for the Environment (Walhi) in a survey conducted by the Banjarnegara District Health Office in Central Java, from 217 farmers who were used as research samples, only 15 people, or about 7%, were proven to be free of pesticide poisoning. In addition, pesticides also cause soil pollution which can result in decreased soil fertility, soil erosion, and decreased productivity. Therefore, research is needed to find out "Community Adaptation and Mitigation Strategies in Ecosystem-Based Disaster Risk Reduction in the Upper Merawu Watershed, Banjarnegara Regency".

The aim of this research are:

1. Understanding the perceptions of the Tamansari and Penanggungan Hamlets communities on the ecosystem disasters risk reduction in the upstream Merawu watershed.
2. Analyzing adaptation and mitigation strategies of the Tamansari and Penanggungan Hamlets communities on the ecosystem disasters risk reduction in the upstream Merawu watershed.

2. Methods

2.1. Location
The study was conducted in 2 hamlets in the upstream Merawu watershed in Banjarnegara Regency, namely Tamansari Hamlet, Leksana Village, Karangkobar District and Penanggungan Hamlet, Penanggungan Village, Wanayasa District. Figure 1 is a map of the research location in Leksana and Penanggungan Village.
2.2. **Data**

Types of data used in this study are quantitative and qualitative data. The data sources used in this study consist of:

1. **Primary data**, which is data obtained directly from the field. Primary data from the field in this study include community perception questionnaire data and in-depth interviews with key informant sources.

2. **Secondary data**, namely data taken from several literature, searching data on the internet, data from the Banjarnegara District Disaster Management Agency (BPBD) and related agencies, sub-districts and village profiles, which are related to ecosystem disaster monitoring activities, with recording and interviews directly, map analysis and important notes from relevant agencies for completing research.

2.3. **Data Collection**

2.3.1 **Perception.** The sampling technique used is a probability sampling which provides the same opportunity or opportunity for each member of the population to be chosen as a sample, namely Simple Random Sampling. This technique is done randomly regardless of the strata that exist in the population [4]. The sampling formula used is the Slovin formula [5] by using Equation 1 as follows:
where,
\[ n = \frac{N}{N_e^2 + 1} \] (1)

\[ n = \text{Number of samples} \]
\[ N = \text{Number of population} \]
\[ e = \text{Precision used} \]

The precision used in determining the selected sample is 10%. The fewer the number of samples, the greater the level of error. The population used in this study was 265 families consisting of 160 families of Tamansari hamlet and 105 penanggungan hamlet families. The calculation of the sample as follows:

\[ n = \frac{N}{N_e^2 + 1} = \frac{265}{265(0.1)^2 + 1} = 72.6 = 73 \text{ KK} \]

The number of samples obtained based on calculations was 73 households. Determination of the number of samples for each hamlet carried proportionate random sampling by using Equation 2 as follows [6]:

\[ n_i = \frac{N_i}{N} \times n \] (2)

\[ n_i = \text{number of samples by stratum} \]
\[ n = \text{total sample of} \]
\[ N_i = \text{number of population by stratum} \]
\[ N = \text{total population entirely} \]

By the formula, the number of samples for each hamlet can be obtained as follows:

Tamansari Hamlet
\[ n_i = \frac{N_i}{N} \times n = \frac{160}{265} \times 73 = 44.0 = 44 \]

Penanggungan Hamlet
\[ n_i = \frac{N_i}{N} \times n = \frac{105}{265} \times 73 = 28.9 = 29 \]

2.3.2 Adaptation and Mitigation. The sampling technique used is purposive sampling method, namely sampling is limited to certain people who can provide the desired information because it meets the specified criteria. These criteria include getting to know the area, getting to know the community, being active in organizational activities, knowing the history of land development and experiencing direct impacts. Table 1 show the list of informants.

| No | Informant | Total |
|----|-----------|-------|
| 1  | Staff of BPBD Banjarnegara Regency | 2 Person |
| 2  | Government staff of Karangkobar District | 1 Person |
| 3  | Government staff of Wanayasa District | 1 Person |
| 4  | Head of Leksana Village | 1 Person |
| 5  | Head of Penanggungan Village | 1 Person |
| 6  | Heads of Penanggungan Hamlet | 1 Person |
| 7  | Heads of Tamansari Hamlet | 1 Person |
| 8  | The Neighbourhood Head | 4 Person |
| 9  | Field Extension Staff | 2 Person |
| 10 | Communities and Farmers | 16 Person |

| Total | 30 Person |

2.4. Data Analysis
2.4.1. Community Perception on Ecosystem Disasters. The analytical method used to analyze the community perceptions is quantitative descriptive. The statistical analysis model used is the Mann Whitney test using IBM SPSS Statistics 24 software. The presentation of quantitative data is presented in the form of a percentage which is then described for conclusions. Calculation of percentage is obtained from field data categorized on a measurement scale (Likert).

2.4.2. Community Adaptation and Mitigation Strategies. The method used to analyze the community adaptation and mitigation strategies is qualitative descriptive. The data analysis technique in qualitative descriptive research is done through data collection, data reduction, triangulation, data presentation and decision making or verification.

3. Results

3.1. Impacts of Ecosystem Disaster

Ecosystem disasters which include erosion, landslides and environmental pollution have an impact on communities around the upstream watersheds. Table 2 show the impacts of ecosystem disaster felt by the people of Tamansari and Penanggungan hamlets.

| Impact of Ecosystem Disaster | Tamansari | Penanggungan |
|-----------------------------|-----------|--------------|
|                             | Frequency | Percentage   | Frequency | Percentage |
| 1. Erosion                  |           |              |           |            |
| Soil fertility declined     | 16        | 36.36        | 8         | 27.59      |
| Soil damage                 | 10        | 22.73        | -         | -          |
| Plant growth less           | 3         | 6.82         | -         | -          |
| Sedimentation increased     | 1         | 2.27         | -         | -          |
| No impact                   | 14        | 31.82        | 21        | 72.41      |
| Total                       | 44        | 100          | 29        | 100        |
| 2. Landslides               |           |              |           |            |
| Crops damaged and crop failure | 38      | 86.36        | 24        | 82.76      |
| Land processing costs returned | 3       | 6.82         | 3         | 10.34      |
| Land difficult to cultivate | 3         | 6.82         | -         | -          |
| No impact                   | -         | -            | 2         | 6.9        |
| Total                       | 44        | 100          | 29        | 100        |
| 3. Environmental pollution  |           |              |           |            |
| Public health disrupted     | 2         | 4.55         | -         | -          |
| No impact                   | 42        | 95.45        | 29        | 100        |
| Total                       | 44        | 100          | 29        | 100        |

The biggest erosion impact felt by the people of Tamansari Hamlet was that soil fertility declined while people in Penanggungan Hamlet still did not felt the impact of erosion. Erosion can cause loss of top soil that is fertile and good for plant growth. The loss of soil layers that contain a lot of nutrients and organic materials will cause a decrease in the productivity of agricultural land. Erosion can also reduce the ability of the soil to absorb and hold water, increasing the amount of sediment that is rich in organic matter and nutrients. Soil treatment will produce loose soil which is needed for plant roots, but loose soil can lead to greater erosion if left for a long time. Therefore it is necessary to do soil tillage which can reduce the amount of erosion and loss of nutrients, for example with a conservation tillage system and minimum tillage [7].

The impact of the landslides felt by the Tamansari Hamlet community included damaged crops which caused crop failures and the high cost of processing land again because the land was buried by land. The biggest impact of landslides felt by the people of Tamansari Hamlet and Penanggungan was damaged
crops and crop failures. Related to environmental pollution, there are still many people in Tamansari and Penanggungan Hamlets who do not felt the impact of environmental pollution. Of the 44 Tamansari Hamlet respondents, only 2 respondents understood the impact of environmental pollution, which amounted to 4.55% while the 42 respondents did not understand the impact of environmental pollution, which amounted to 95.45%. Of the 29 respondents in Penanggungan Hamlet, all (100%) did not felt the impact of environmental pollution. This is due to the impact that occurs on a small scale so that the people are used to and feel less of the impact. Some farmers claim to feel dizziness and itching on the skin after spraying. But because the symptoms were not so disturbing that they were not too much at issue.

3.2. Perception of Ecosystem Disasters

Determination of the analysis used in perception is by normality test data. Data is said to be normally distributed if the Sig value is above 0.05 and the data is not normally distributed if the Sig value is below 0.05. The Mann Whitney U test is used if the significance value is below 0.05 and the Independent T-test is used if the Sig value is above 0.05. The results of the data normality test show that the data comes from populations that are not normally distributed (Sig below 0.05) so that the analysis carried out is by the Mann Whitney U test.

Mann Whitney U test analysis was used to determine whether there were differences in perceptions between Tamansari and Penanggungan Hamlets on erosion, landslides and environmental pollution. The Mann Whitney U test test consisted of 2 parameters, namely knowledge and attitude of the community towards erosion, landslides and environmental pollution in Tamansari and Penanggungan Hamlet. Table 3 show the results of the Mann Whitney U Test.

| Knowledge          | Sig   | Attitude | Sig  |
|--------------------|-------|----------|------|
| Erosion            | 0.000* | Erosion  | 0.203|
| Landslide          | 0.565  | Landslide| 0.000*|
| Environmental Pollution | 0.062* | Environmental Pollution | 0.097*|

**significant at the 1% level, * significant at the level of 10%

Based on the existing Mann Whitney test significant knowledge difference in erosion in Tamansari and Penanggungan Hamlets because the significance value is below 0.01, which is 0.000 (significant at the 1% level). This significant difference is influenced by several factors including information received and the presence or absence of coaching. In 2009, at Tamansari Hamlet, guidance was carried out to reduce land degradation by PT. Indonesia Power while in Penanggungan Hamlet there is no guidance yet. With this guidance, it will increase the public knowledge about erosion. In landslides, there is no significant difference in knowledge because the significance value is above 0.1 which is equal to 0.565. This is because each hamlet knows that landslides have often hit Banjarnegara areas so that the people of Tamansari and Penanggungan Hamlets are familiar with this.

Knowledge of environmental pollution in Tamansari and Penanggungan Hamlets has a significant difference because the significance value is below 0.1, which is equal to 0.062. This can be seen from the difference in intensity of spraying carried out. The difference in intensity is due to the different commodities planted by the people of Tamansari Hamlet and underwriting 1. The commodities planted by the people of Tamansari Hamlet include cabbage, mustard greens, chili, coffee while the Penanggungan Hamlet is mostly potatoes.

In terms of the attitude of the people of Tamansari Hamlet and Penanggungan on erosion there is no significant difference because the value of the Significance is above 0.1, which is equal to 0.203. This can be describes from the attitude carried out by the community towards erosion in each hamlet which is almost the same, among others, the making of drainage channels, the construction of terraces and the making of dikes. The attitude of the people of Tamansari and Penanggungan Hamlet towards landslides has a significant difference because the value of the Significance is below 0.05, which is equal to 0.000 (significant at the level of 5%). The Tamansari Hamlet community is better prepared than the 1st Insured
in terms of anticipation of landslides. This can be proven by different types of land use from the two hamlets. Tamansari Hamlet has agroforestry land use types while Penanggungan Hamlet is intensive agriculture. Agroforestry is a crop management system by combining agricultural crops with forestry (woody plants). This system can be applied to steep slopes to reduce the threat of landslides. According to Erfandi (2013), this system is considered appropriate because it has advantages in preventing landslides, namely being able to form soil organic matter, improve soil structure and make the soil more stable [8].

There is a significant difference in community attitude towards environmental pollution because the significance value is below 0.01, which is equal to 0.097 (significant at the level of 10%). Differences in community attitude are very relevant to differences in people's knowledge of environmental pollution. In addition, the commodities planted will also affect the spraying attitude carried out by the community so that the level of pollution caused will also be different. The community of Penanggungan Hamlet can be said to have more pesticide use compared to the people of Tamansari Hamlet because the commodities planted are potatoes. Potatoes are plants that are very susceptible to disease pests so that the pesticides used by the people of Penanggungan Hamlet are greater.

3.3. Adaptation and Mitigation

Strategies Adaptation strategies for each region vary depending on the environmental problems faced and the ability of the community to receive information, appreciate, and act in overcoming environmental challenges in order to reduce the risk of ecosystem disaster. Table 4 show the characteristics of the number of respondents based on the choice of adaptation strategies in reducing the risk of ecosystem disaster in Tamansari and Penanggungan Hamlet.

| Table 4. Adaptation Strategy of the Tamansari and Penanggungan Hamlet Communities |
|--------------------------------|-----------------|-----------------|
| Adaptation Strategy           | Tamansari       | Penanggungan     |
|                               | Frequency       | Percentage      | Frequency | Percentage      |
| 1. Erosion                    |                 |                 |
| Maintain the water channel    | 4               | 36.36           | -         | -               |
| Reduce the land mechanization | 1               | 9.09            | 1         | 9.09            |
| Intercropping                 | 3               | 27.27           | 2         | 18.18           |
| Mulch                         | -               | -               | 1         | 9.09            |
| No adaptation                 | 3               | 27.27           | 7         | 63.64           |
| Total                         | 11              | 100             | 11        | 100             |
| 2. Landslide                  |                 |                 |
| Land function                 | 1               | 9.09            | -         | -               |
| Intercropping                 | 3               | 27.27           | -         | -               |
| Cropping pattern              | 1               | 9.09            | -         | -               |
| Improve land and replanting   | -               | -               | 1         | 9.09            |
| Crop rotation                 | -               | -               | 2         | 18.18           |
| No Adaptation                 | 6               | 54.55           | 8         | 72.73           |
| Total                         | 11              | 11              | 11        | 11              |
| 3. Environmental Pollution   |                 |                 |
| Spraying using PPE            | 1               | 9.09            | 1         | 9.09            |
| Not spraying in the rainy season | 1       | 9.09            | -         | -               |
| Combining plant types         | -               | -               | 1         | 9.09            |
| No Adaptation                 | 9               | 81.82           | 9         | 81.82           |
| Total                         | 11              | 100             | 100       | 100             |
Based on the results of the calculation of the percentage of actions taken by the Tamansari Hamlet community in adapting to the erosion disaster, it is by cleaning the waterways before the rainy season (36,36%). This is done so that during the rainy season the water does not clog and can flow so it does not cause run off. The Tamansari Hamlet community did not take any action in adjusting to landslides and environmental pollution with a percentage of 54,55% and 81,82% respectively. This is influenced by the lack of perceived landslides and environmental pollution on a large scale so that people tend not to carry out adaptation actions. The impact faced by the community due to landslides is damaged crops and crop failures while for environmental pollution the community has not yet felt the impact. The impact of environmental pollution is not yet felt by the lack of knowledge that is owned by the community so that it is necessary to disseminate the characteristics of contaminated soil and water by pesticides, the dangers of pesticides and the correct intensity of spraying.

Based on interviews conducted, there were several people who adapted landslides, one of which was Mr. Hartono. The adaptation strategy that is carried out is by transferring the land that was originally agricultural land into agroforestry land. The types of plants sought are types of albisia or Sengon trees (Paraserianthes falcataria). The number of trees planted is 200 Sengon trees with between fields planted with chili. The marketing process for sengon wood is taken by wood buyers at prices that adjust the market. Based on the results of interviews with BPBD staff, it was recommended that the selected trees should be used for fruit instead of stems. For example, guava trees and coffee. The trees are able to hold the soil so that the soil is not prone to landslides.

The adaptation action that is also carried out is to change the cropping pattern which initially follows the direction of the slope to follow the direction of the contour. This was done by Mr. Sugi as the neighbourhood head in Tamansari Hamlet. The success of planting with a pattern following the contour direction will trigger other communities to change the pattern of planting carried out by the community. This shows that the Tamansari Hamlet community is very open to change and accepts new things.

The Penanggungan Hamlet community do nothing to adjust to erosion, landslides and environmental pollution. The Penanggungan Hamlet community has different characteristics from the Tamansari Hamlet seen from the crops it seeks. The majority of the people of Tamansari Hamlet plant agricultural crops and mix with wood plants (agroforestry) while the Penanggungan Hamlet community only cultivates agricultural crops (intensive farming). This is because the people of Hamlet Tamansari were more aware of protecting the environment compared to the people of Penanggungan Hamlet. In addition, the knowledge held by the Tamansari Hamlet community was superior to that of Penanggungan so that the treatment of erosion, landslides and environmental pollution was better. Abundant potato yields make it difficult for the people of Penanggungan to switch to other commodities. Potatoes have become a glorified commodity in Penanggungan Hamlet because the yield is abundant and marketing is easy. This is a homework for us to change the mindset of people who are more concerned with financial matters and less attention to the environment.

The adaptation suggested by the government apparatus to reduce the risk of erosion is to make terracing, which is equal to 62,5%. Field extension officers said that many people in Tamansari Hamlet had made terracing and planted timber compared to Penanggungan Hamlet community. The making of this terrace was carried out to reduce runoff or speed of land flow and increase water infiltration so as to minimize the risk of water erosion. The type of terrace made in the Tamansari Hamlet and Penanggungan land is the gulud terrace.

The act of adaptation to the landslide was to make a drainage system and plant timber plants where the second percentage was 37,5%. Making water drainage channels is intended so that the soil layer is not carried out by erosion and landslides during heavy rains. A good drainage system is equipped with rorak. Rorak is made to cut the contour so that water can flow down and planted with grass so that the soil is not easily eroded by surface flow.

In environmental pollution, the action taken is to replace species that are not prone to plant disease and soil stability (37,5%). The types that are not prone to plant disease are in addition to potatoes because potatoes are plants that are prone to pests, forcing farmers to use pesticides excessively to improve their productivity. Such types are for example cabbage, carrots, corn, coffee, chili etc. Soil stabilies are carried
out by crop rotation in the hope that the soil can be fertile again. In addition, soil stability can also be done by planting elephant grass. Elephant grass or vetiver interacts with the soil to form a composite material consisting of roots with high tensile strength and attached to the soil with smaller tensile strength so that it can nail the soil [9].

Mitigation strategies are efforts to address the causes of ecosystem disasters through actions that can reduce the risk of ecosystem disasters. The mitigation strategy does not only involve the community independently, but also can work with government officials. Table 5 show the characteristics of the number of respondents based on the choice of mitigation strategies in the reduction of ecosystem disaster risk in Tamansari and Penanggungan Hamlet.

### Table 5. Mitigation Strategy of the Tamansari and Penanggungan Hamlet Communities

| Mitigation Strategy                  | Tamansari | Penanggungan |
|--------------------------------------|-----------|--------------|
|                                      | Frequency | Percentage   | Frequency | Percentage   |
| 1. Erosion                           |           |              |           |              |
| Control waterways / channels and    | 6         | 54.55        | 3         | 27.27        |
| optimizing them                      |           |              |           |              |
| Develop terraces                    | 1         | 9.09         | 1         | 9.09         |
| Reduce tillage                      | 2         | 18.18        | 1         | 9.09         |
| Plant selection                     | 1         | 9.09         | -         | -            |
| Plant timber                        | -         | -            | 1         | 9.09         |
| Intercropping                       | 1         | 9.09         | 2         | 18.18        |
| Plant rotation                      | -         | -            | 1         | 9.09         |
| No Mitigation                       | -         | -            | 2         | 18.18        |
| Total                               | 11        | 100          | 11        | 100          |
| 2. Landslide                         |           |              |           |              |
| Develop embankments                 | 2         | 18.18        | 1         | 9.09         |
| Rehabilitation/ replanting          | 5         | 45.45        | -         | -            |
| Plant Direction on contours         | 1         | 9.09         | -         | -            |
| Develop drains                      | 1         | 9.09         | -         | -            |
| Plant rotation                      | 2         | 18.18        | 5         | 45.45        |
| Revegetation                        | -         | -            | 2         | 18.18        |
| No Mitigation                       | -         | -            | 3         | 27.27        |
| Total                               | 11        | 100          | 11        | 100          |
| 3. Environmental Pollution          |           |              |           |              |
| Reduce pesticides                   | 4         | 36.36        | 3         | 27.27        |
| Using manure                        | 1         | 9.09         | -         | -            |
| Matching soil and plant species     | -         | -            | 1         | 9.09         |
| No Mitigation                       | 6         | 54.55        | 7         | 63.64        |
| Total                               | 11        | 100          | 11        | 100          |

The form of mitigation strategy undertaken by the Tamansari Hamlet community in reducing erosion risk is by making waterways/channels and optimizing them by cleaning regularly, which is 54.55%. Making these drainage channels helps enlarge the absorption of water into the soil and accommodate eroded soil. The most common form of mitigation strategy carried out by the community in reducing the risk of landslides is by planting landslide prevention plants such as sengon, bamboo, coffee, elephant grass, and other plants that have a deep fiber root type. Bamboo have a very strong root rooting system and spread in all directions that can bind the surface of the soil so as to reduce the rate of erosion and landslides. These characteristics also allow bamboo to maintain a hydrological system that safeguards soil and water ecosystems, so that they can be used as conservation plants. Planting elephant grass can also increase the effectiveness of the terrace to reduce the level of erosion on steep land.
Coffee plants began to be cultivated by Sari Tani farmer groups starting in 2009 through PT Indonesia's Power Unit Business Mrica social responsibility program. The initiation of coffee plants to farmers in the upstream area is one of the efforts to overcome environmental degradation where PT Indonesia Power was faced with the problem of sedimentation in the Mrica reservoir. The high sedimentation in the Mrica reservoir is caused by a large amount of vegetable cultivation in the upstream area. The types of coffee planted are robusta and arabica coffee with sales in the form of wet and processed ground coffee.

In order to reduce the risk of environmental pollution, the community do nothing, which is equal to 54.55%. This is influenced by several factors, among others, that the community has not yet felt the existence of environmental pollution so that they feel that there is no need to do something as a step in the mitigation strategy. The community claims that the environment in which they live has not been polluted. This is because the impact felt by the community is still in a low level. The community feels that they can still enjoy clear water and fresh air so there is no need to mitigate environmental pollution. With the existence of this phenomenon, it is necessary to increase knowledge about the impact of pesticides through activities such as training.

In reducing the risk of erosion, the most common activity carried out by the people of Penanggungan Hamlet is to make waterways, which amounted to 27.27%. The majority of the people of Penanggungan Hamlet are farmers with the most sought-after species being potato plants. Potato plants (Solanum tuberosum L.) have growth and development characteristics that are influenced by soil quality, especially aerase and drainage which greatly influences tuber production. Poorly drained soil conditions will cause rotten potato tubers and lead to attacks of late blight by Phytopthora infestans which can cause a decrease in potato tuber production [10].

The form of mitigation strategy chosen by Penanggungan Hamlet community in reducing the risk of landslides is to carry out crop rotation (45.45%). Crop rotation is very useful in reducing the impact of surface runoff by water so that it can reduce the rate of soil erosion. Soil erosion can cause loose soil aggregates, reduced water absorption, closed soil pores and increased surface runoff so that heavy rains will trigger landslides. Plant rotation will also help when and how long the land will be rested. Crop rotation is usually carried out by the community one year 3 times by planting 2 times the season of potatoes and 1 time the season for other commodities (cabbage, carrots, chili etc.). The crop rotation pattern carried out by farmers is another potato-potato potato. Potatoes can usually be harvested 3-4 months after planting so that one year can plant 3 times.

Based on the results of interviews with the people of Penanggung Hamlet, they did not take any action in reducing the risk of environmental pollution, which amounted to 63.64%. This is because the people of Penanggungan Hamlet have not yet felt the effects of pesticides on environmental pollution. In addition, there is not much information stating that the area is a polluted area, causing people with low knowledge to be less aware of the signs of environmental pollution that have occurred.

The people of Penanggungan Hamlet usually spray regularly 2 times a week with excessive doses. With these doses it is very unlikely that no impact will occur. In addition, the types of pesticides used are species with high toxicity. Spraying that violates the rules results in adverse effects on the environment (water, soil and plants produced) and humans (poisoning, disability and death). The frequency of excessive spraying can also cause pests to become resistant. The thing that has begun to be felt by farmers is a decrease in soil fertility due to the use of pesticides. This condition can be seen from the decrease in land productivity. Unlike the old days where land with an area of 1 ha was able to produce 4 to 5 tons of potatoes, now only a range of 2 to 3 tons.

The mitigation action taken by the government apparatus for reducing erosion risk is the construction of water drainage channels (37.5%) while for landslides and environmental pollution the actions taken are socialization and training (37.5%). Socialization material is usually related to:

1. Disaster management policies (recognize signs of disaster)
2. Basic knowledge about disaster mitigation (what is mitigation and what should be done)
3. Risk reduction management (capacity building and training)
Socialization was also carried out by Field Extension Officers. Field Extension Officers usually conduct counseling 2 to 3 times a month with visits to several lands and communities. Counseling is carried out related to cultivation, handling pests, processing good land, how to cope with diseases both in plants and livestock as well as other obstacles facing the community. If there are regular meetings, extension agents are usually present to facilitate information exchange.

Based on the results of interviews about mitigation strategies in the community and government apparatus, the form of mitigation against erosion and landslides is to make drainage channels, terraces, reduce land processing, selecting types of soil according to soil conditions, intercropping, planting timber, crop rotation, changing cropping patterns, making dikes, socializing and training, forming resilient villages namely destanta, and planting shared seedlings. The form of mitigation carried out against environmental pollution is to reduce the use of pesticides, choosing the type according to soil conditions, planting polyculture, socializing and training, forming destanta, and planting seedlings together.

4. Conclusion
The upper Merawu watershed community’s perceptions varied greatly by knowledge and attitudes of the community. Knowledge is affected by the intervention of PT. Indonesia Power and Field Extension Officer. Community attitudes are influenced by the type of land use and commodities planted. Adaptation actions practiced by the community include water drainage cleaning, application of intercropping, crop rotation and agroforestry. Mitigation actions carried out by the community include the construction of drainage channels, terraces, embankments, and planting of wood plants (structural mitigation) while mitigation carried out by the government is more towards non-structural mitigation such as socialization and training, planting joint seedlings and the establishment of disaster resilient village (i.e., Destanta).

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