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SOIL CONSERVATION AND PHYSICAL ASPECTS OF FARMING BUSINESS LAND COMPATIBILITY IN THE GARANG RIVER FLOW REGION OF CENTRAL JAVA PROVINCE, INDONESIA

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ABSTRACT
Watershed Garang constitutes one of the rivers which have its happening potency erosion. Observations in territorial upstream and Watershed Garang center. Handle about problem erosion gets bearing with its understanding reducing and farmer about soil conservation tech implement suitably specifically for the farming farm on a slope that different. Method observation to utilize the survey's method and sample take utilizes *quota sampling.* The main research is for understanding soil conservation practice suitability on the farming farm that has a slope that variably. Yielding observational some types of soil erosion trigger soil conservation at Watershed Garang as makings of unidirectional water discharge channel bevels and terrace makings on a farming farm on to slope>30%. Need soils conservation shaped modification in particular mechanical trick conservation at Watershed Garang.

KEY WORDS
Watershed Garang, soil conservation, farming farm, slope.

Soil erosion is one example of environmental damage. Garang watershed as an area with high rainfall has the potential for erosion. Erosion is the event of moving or transporting parts of the soil from one place to another by natural media (Arsyad 1989). Erosion is an event that reduces the surface of the land by the flow of water, wind, ice, or others by geological forces including processes such as creep due to gravity or the decomposition and removal of soil or rock by water, wind, ice and gravity (Brady, 1990).

Intensive erosion on agricultural land causes a decrease in farm productivity, where a linear decline in farm productivity will be followed by a decrease in farmer welfare (Sudaryono, 2009;Mujiyo *et al.* 2018). The utilization of land for agriculture and non-agriculture without proper management can cause land damage and decrease land productivity (Osok *et al.* 2018). The conversion of forest land into other land use areas is realized to cause many problems such as erosion, decreased soil fertility, erosion, extinction of flora and fauna, floods, droughts, and even global environmental changes, and these problems are getting more severe from time to time in line with the narrowing of the area forest (Dinata, 2020). Erosion is an event of moving or transporting soil material from a place, namely the upper slope by natural media, in this case, water (Malinda *et al.* 2020), then deposited in lower areas as sedimentary material or deposits (Rahmayanti *et al.* 2020).

Soil erosion is the gradual movement and transport of the topsoil by different agents, especially water and wind. Erosion and mass movement cause long-term damage. Soil loss due to erosion is a global problem, especially affecting natural resources and agricultural production (Ramadhani *et al.* 2020;Syahputra *et al.* 2020;Wariunsora *et al.* 2020;Widiatmoko *et al.* 2020). The worldwide average rate of soil erosion is estimated to be between 12 and 15 tonnes/ha per year (Yusuf *et al.* 2020;Andarwati *et al.* 2021), which means that every year the soil surface is estimated to be lost about 0,90–0,95 mm of soil (Aisyah *et al.* 2022). Accelerated erosion often wreaks havoc as a result of environmental damage. This can cause major losses such as floods, droughts, or decreased soil productivity (Andriana *et al.*

2021;Fadhil *et al.* 2021). This is because the parts of the soil that are washed away or displaced are much larger than the rate of soil formation (Nugraha *et al.* 2021;Wahjunie *et al.* 2021).

The area zone that has the potential for erosion, the Garang watershed area is divided into three parts. First, the upstream area is the place where the erosion material release occurs. Second, the middle area is the place where the transport of erosion material occurs. Third, a downstream area is a place of deposition of material in the form of sediment from erosion that comes from the upstream and middle areas of the Garang river basin. To reduce surface runoff and increase infiltration rates as a cause of erosion, soil conservation activities are carried out by farmers in the upstream and middle areas of the Garang river basin on paddy fields, fields, and yards with different slopes.

The selection of appropriate soil conservation measures following the slope of the farmland does not cause an acceleration of the rate of erosion. In addition, efforts should be made to provide farmers with an understanding of the factors that accelerate erosion. Soil conservation is the placement of each plot of land in a way of use according to the ability of the soil and treating it according to the necessary conditions so that there is no damage to the soil (Arsyad, 1989). Sartohadi (2012), states that soil conservation or soil preservation is defined as a series of efforts to utilize soil resources in such a way that it does not cause an acceleration of the rate of erosion.

Garang watershed is a watershed located in Central Java Province consisting of 3 sub-watersheds, namely Kripik, Kreo, and Garang which originate in Ungaran District, Semarang Regency. Geographically, the Garang watershed is located at 423760 mT–437449 mT and 9204461 mU–9231680 mU zone 49 S on the UTM projection. Based on the geographical location of the Garang river basin, it receives sunlight and large rainfall intensity so that the process of rock weathering and surface soil erosion is continuous and fast throughout the year.

METHODS OF RESEARCH

The research method used is the survey method. The survey of the physical aspects of the Garang river basin includes the slope. The slope of slope is a factor that needs to be considered in soil conservation activities carried out by farmers in cultivating agricultural land. There are two stages in the research, namely:

Stage I. dividing the research location into two regional units, namely the upstream region and the middle region. The unit of analysis in determining the sample is the erosion hazard level consisting of erosion hazard level classes, namely very light, light, moderate, heavy, and very heavy erosion.

Stage II. Determination of the population of farmers, namely the heads of farmer families who carry out soil conservation activities in the selected village sample, is carried out using a quota sampling technique based on differences in the area where respondents carry out soil conservation activities. The number of samples is 300 respondents who represent the total population of farmers from 20 sample villages that carry out soil conservation activities.

The consideration of taking a sample of 300 respondents is based on the following considerations:

a) Represent farmers who carry out soil conservation activities in farming areas with different TBE;

b) Represent farmers who cultivate farming land with different slopes of farming land.

RESULTS AND DISCUSSION

Farmers in the Garang river basin practice soil conservation on farmland with different slopes of farming land. There are three types of soil conservation carried out by farmers in the Garang river basin, namely: soil conservation by vegetative, mechanical, and chemical methods. These three types of soil conservation are not strictly separated and complement

each other between one type of soil conservation and other types of soil conservation. Soil conservation activities carried out by farmers in the Garang river basin aim to reduce the risk of erosion. The erosion hazard can be reduced by reducing the runoff rate and increasing the surface water infiltration rate. Types of soil conservation carried out by farmers are presented in Table 1.

Table 1 – Types of soil conservation activities carried out by farmers in various types, farmer's land in the Garang river basin

No	Types of Soil Conservation	Business Land					
		Ricefield		Moor		Yard	
		Total (person)	(%)	Total (person)	(%)	Total (person)	(%)
1	Terrace strengthening plants	134	52.5	96	70.5	14	41.1
2	Crops across the slope	189	74.1	104	76.4	11	32.3
3	Seasonal crop rotation	105	41.1	44	32.3	5	14.7
4	Grass planting SPA	119	46.6	26	19.1	6	17.6
5	Use of mulch	125	49.0	33	24.2	5	14.7
6	Use of manure	170	66.6	79	58.0	17	50.0
7	Annual plant planting	81	31.7	95	69.8	23	67.6
8	Construction of conservation buildings	131	51.3	95	69.8	9	26.4
9	Conservation building maintenance	210	82.3	96	70.5	12	35.2
10	Cross-slope tillage	202	79.1	105	77.2	16	47.0

Source: Primary data analysis results, 2022.

Facts show that farmers in the Garang river basin carry out soil conservation mechanically, vegetatively, and chemically. Soil conservation practices are carried out on paddy fields, fields, and yards on various types of slopes. Vegetative soil conservation in the form of:

- Terrace strengthening plants. The terraces made by farmers to prevent soil erosion are planted with terrace strengthening plants. Planting terrace reinforcement plants aim to prevent the terrace from being easily eroded due to splashing rainwater. Types of terrace strengthening plants in the form of elephant grass, gamal, cassava, and legumes. Grass and legumes are very effective in preventing soil erosion because they have an intensive root system and can bind water;
- Cross-slope planting is planting parallel to the contour and cultivated with a fairly dense cropping pattern. Cross-slope planting aims to cut off the surface runoff of rainwater so that the eroded soil becomes smaller. Cross-slope planting is carried out on paddy fields and dry fields with a slope of 5% - 10%. The effectiveness of planting parallel to the contour of the slope with a slope of > 3% - 8%. Types of crops planted by farmers in the form of corn, beans, and cassava on beds or mounds made across the slopes;
- Crop rotation is a method of regulating cropping patterns to plant land maximally throughout the year to produce food and soil organic matter derived from the remains of weathered green plants. It is carried out on dry land and rainfed rice fields on a slope of 0% - 30%. The type of crop is a combination of two types of crops, namely corn with cassava, corn with peanuts, or intercropping between corn, cassava, and peanuts. The combination of this type of plant aims to streamline the use of farming land, especially on narrow farming land. Besides that, these types of plants are a source of food and income for farmers;
- Planting grass in sewers is carried out sewers with simple construction. Aims to avoid the concentration of runoff that can damage the surface of the soil it passes through and channel runoff that has the potential to cause erosion to the appropriate water disposal. Both sides of the sewer are planted with grass;
- Giving crop residues (mulch) is a conservation technique that is easy to implement and benefits farmers in terms of investment costs. Giving mulch aims to prevent rainwater splashes, and reduce surface runoff so that soil surface erosion is small.

Giving rice straw mulch can reduce the amount of soil erosion. Kurnia (1996), giving rice straw mulch can reduce soil erosion by 86% - 98% compared to using other plant residues. Dixon and Hufschmid (1993), explained that applying mulch can reduce crop production costs by 64% due to a decrease in the level of erosion hazard and a decrease in soil nutrient loss, and an increase in farm productivity;

- Cross-slope tillage. This type of conservation aims to cut surface runoff so that the erosion that occurs is small. The advantage of cross-slope tillage is the formation of a runoff barrier that allows greater water absorption and prevents soil transport (Arsyad, 2000). Farmers who carry out soil conservation activities with the type of cross-slope plant conservation for paddy fields;
- Planting annual plants is useful for holding rainwater from falling directly on the ground. Planting annual plants serve to reduce the kinetic energy of raindrops so that the braking power of rainwater on the soil surface is small and the soil is not easily eroded;
- Chemical soil conservation in the form of using manure can increase soil fertility and improve soil physical properties. Farmers in the Garang river basin use manure in combination with chemical/organic fertilizers in the form of urea and TSP;
- Mechanical soil conservation in the form of building construction and maintenance of soil conservation buildings. The construction of sewerage is not very effective because it is made in the direction of the slope which accelerates the occurrence of soil erosion. For farming land with unstable soil types and having a slope of 30%, terrace making is still effective. Making bench terraces on slopes up to > 30% is not very effective. Bench terraces are suitable for farming land with a slope of up to 30% (Suripin, 2004). Making terraces in the Garang river basin is carried out on rice fields and dry fields with a slope of 10%-60%.

Soil conservation studies are all farmer activities to prevent the loss of the soil surface layer and increase productivity. Soil conservation activities in the Garang river basin are carried out on farmland on different slopes. The potential for erosion on farming land with different slopes is the basis for carrying out soil conservation activities. The erosion potential based on the difference in slope in the Garang river basin is divided into four categories, namely low, medium, high, and very high.

Table 2 – Potential for the erosion of rice fields in the Garang river basin

Slope (%)	Erosion Potential	Soil Conservation
0 - < 5	Light, medium, high, and very high	Simple construction bench terraces drain, and infiltration wells and the use of mulch
5 - < 10	Medium, high, and very high	Simple construction bench terrace, terrace strengthening plant planting
10 - < 30	High and very high	Simple construction bench terrace, terrace bracing plant, cross slope planting
< 30	High and very high*	Terrace bench, sewer

*Note: * Rainfed rice field.*

Table 3 – Potential erosion of upland business land in the Garang river basin

Slope (%)	Erosion Potential	Soil Conservation
0 - < 5	Light, medium, high, and very high	Sewers, infiltration wells, and the use of mulch
5 - < 10	Medium, high, and very high	Use of mulch, planting of annual crops, crop rotation
10 - < 30	High and very high	Planting in the direction of the slope, the use of mulch
< 30	High and very high	Drainage. Planting of annual crops, use of mulch, and crop rotation

Erosion of light, medium, high, and very high categories can occur in all agricultural land in the Garang river basin in the upstream and middle regions. Mild erosion on dry land indicated the presence of surface erosion that eroded the soil surface layer but there was a

process of formation of trench erosion and the formation of a trench with a depth of ± 8 cm. Moderate erosion is characterized by the presence of ditches due to surface runoff scouring with a depth of ± 30 cm. Drainage channels on dry land covered by sediment and exposed source rock indicate high erosion potential on farmland. Very high erosion formed trench erosion and deep erosion channels on upland business land which caused the lower soil layer to erode due to the concentration of runoff.

Table 4 – Potential erosion of home gardens in the Garang river basin

Slope (%)	Erosion Potential	Soil Conservation
0 - < 5	Light, medium, and high	Planting annual crops, sewers, and infiltration wells
5 - < 10	Medium, high, and very high	Annual crop planting and sewerage
10 - < 30	High and very high	Annual crop planting and sewerage
< 30	High and very high	Drainage in the direction of the slopes, annual crops, use of mulch, and crop rotation

Source: Primary data analysis results, 2022.

Several types of vegetative and mechanical soil conservation in the Garang river basin have not been effective in reducing the danger of erosion in rainfed rice fields, fields, and yards with slopes of 10% ->30%. Farmland on slopes between 5->30% has the potential for moderate, high, and very high erosion. Conservation of bench terrace soil on paddy fields on slopes >30% is not very effective as an effort to reduce erosion. In addition, the drainage channel on the dry land and yard has become a trigger for high soil erosion.

The slope of the farming land in the Garang river basin affects the potential for erosion. Erosion occurs on business lands with different slopes. The level of danger of mild erosion occurs in upland business areas with a slope of 0 - 5%, while heavy and very heavy erosion occurs in dry fields and rainfed rice fields with slopes of 25% ->40%. The potential for erosion in the Garang river basin occurs in the upstream and middle areas of the land slope from class I (0-8%) to class IV (> 30%) with the type of land for farming upland, rainfed rice fields, and yards. The level of light erosion hazard (R) is 19.07 tons/ha/yr on slopes I and 50.69 tons/ha/year on slopes II and 304.2 tons/ha/yr on slopes III. The level of erosion hazard is moderate, large soil loss is between 61.24 tons/ha/year to 147,71 tons/ha/year located on slopes I, II, and III. The level of danger of severe erosion (B) is large, between 14,77 tons/ha/yr to 334 tons/ha/yr. It is located on the slopes of I.III and IV. Very heavy erosion hazard (SB) large soil loss between 95.78 tons/ha/year to 884.59 tons/ha/year located on the slopes I, II, III, and IV (Suharini. (2001).

To increase the effectiveness of the type of soil conservation in the Garang watershed, it is necessary to modify the existing conservation types. Modifications can be made for mechanical conservation, especially the construction of sewers and terrace repairs by planting crops on farmland with a slope of > 30%. The construction of sewers can utilize local materials such as bamboo, wood, and stone in addition to being cost-effective and safe, and more effective than making a permanent sewer. For farming land with unstable slopes, prevention of soil erosion, making terraces can be combined with planting types of plants that have strong roots and do not damage the terraces and soil surface and have economic value.

CONCLUSION

Based on the results of the analysis of the potential for erosion and the physical aspects of the land for several farmer farms in the Garang river basin, it can be concluded as follows:

- The potential for erosion in the Garang river basin can occur on rice fields, fields, and yards that have been conserved;
- The potential for erosion that occurs in the Garang river basin in various farming lands with different slopes and categorized into four types of potential, namely mild, moderate, heavy, and very heavy erosion;

- Mechanical soil conservation has not been effective in reducing the potential and rate of erosion on farmland in the Garang river basin;
- It is necessary to modify the form of soil conservation on agricultural land with the potential for heavy and very heavy erosion in the form of the use of local materials and does not require large costs.

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