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Structuring of Catchment Area and Sediment Management in Selorejo Reservoir in a Sustainable Manner

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Abstract:- The gross reservoir capacity of Selorejo Reservoir in 2019 has decreased to 29.73 million m^3, or 47.72% of the planned gross reservoir capacity due to sedimentation. Decreased reservoir capacity leads to reduced water allocation for energy generation (PLTA), fulfillment of irrigation in the dry season and ability to control floods in the rainy season. The analysis of the potential for land erosion used in this study is using the USLE (Universal Soil Loss Equation) method. Sedimentation management strategy in Selorejo Reservoir is by structuring the catchment area and managing sediment in the reservoir in a sustainable manner. The sedimentation potential that occurs in Selorejo Reservoir catchment area is 609,328.60 m^3/year. The structuring strategy implemented in the catchment area to support the sustainability of the function of Selorejo Reservoir is expected to reduce the potential of sediment by 580,000 m^3 by planning sediment control buildings, critical land rehabilitation, and sediment dredging at TokolSabo Dam. The sediment management strategy applied in selorejo reservoirs to support the sustainability of reservoir function is to dredge sediment by 200,000 m^3/year, and the need for good management related to dredging activities, spoilbank preparation, hauling and utilization of sediment material.

Keywords:- *sedimentation, catchment area, reservoir, sustainable.*

I. INTRODUCTION

Selorejo Dam is in the Konto river flow which Selorejo Dam is located Selorejo Hamlet, Pandansari Village, Ngantang Subdistrict, Malang Regency, East Java Province. Transverse and stem the flow of the Konto River which is a tributary of the Brantas River. The main functions of Selorejo Dam are for hydroelectric power plants (hydroelectric power plants) and irrigation. Construction was completed in 1970 with a gross capacity plan of 62.30 million m^3. The gross reservoir capacity of Selorejo Reservoir in 2019 has decreased to 29.73 million m^3, or 47.72% of the planned gross reservoir capacity. Decreased reservoir capacity leads to reduced water allocation for energy generation (PLTA), fulfillment of irrigation in the dry season and ability to control floods in the rainy season. This happens because of siltation at the bottom of the reservoir caused by land erosion in the upstream part of the reservoir so that it has the potential to increase sedimentation rate. (PJT I, 2019).

The catchment area in Selorejo Reservoir is divided into three Sub-CA, namely: Sub-CA Konto, Kwayangan and Pinjal with a total area of 23,671.28 ha. Land cover in Selorejo Reservoir catchment area based on the Ministry of Environment and Forestry is divided into: secondary dry land forests, industrial crop forests, settlements, dry land agriculture, mixed dry land agriculture, shrubs/ shrubs, open land and water bodies. The land cover has a direct effect on the large potential for erosion and sedimentation process. Catchment area with good land cover is expected to reduce the potential for erosion and sedimentation. Conversely, the potential for erosion and sedimentation can increase due to the transfer of land functions, uncontrolled land use.

Erosion is an unavoidable natural event. Not all rain that reaches the surface of the ground will seep into the ground, some will seep through the surface. This surface runoff is one of the factors in the process of erosion and sedimentation. As a result, sediment material carried by the process will settle and cause siltation in the downstream riverbed to reservoirs. Sedimentation is a serious problem in the management of reservoirs that how to overcome it is not easy.

Kironoto B.A. (2010) argues that the situation can cause reduced reservoir reservoirs due to sediment deposits. The increasing volume of sediment deposits, the operation of the reservoir may not be able to be done due to effective reservoirs that have been exhausted. Given the number of reservoirs that can't be functioned because of sediment problems, the need for sediment management efforts in the reservoir so that it is guaranteed the sustainability of the reservoir function.

Putra D.A. et al (2019) explained that the guarantee of watershed maintenance can be achieved assuming every management movement is carried out with reference to guidelines that combine the alignment between benefits and protection as follows: 1) improvement of water management system, 2) control of soil degradation that occurs in order to improve slope stability, 3) increase farmers' crop yields, and 4) further develop community behavior towards preservation activities in to control the impact of flood runoff.

Efforts to protect and preserve catchment area and its reservoirs become a must, so that the sustainability of the function and benefits of reservoirs or dams can be achieved. Design of conservation / control of sediments that enter the reservoir and structuring the catchment area with a comprehensive approach as a direction in achieving optimal resource utilization. Prevent ecological damage and expand conformity between existing activity spaces. Considering these conditions, it is necessary to be studied related to the arrangement of catchment area and sediment management in

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Selorejo Reservoir in a sustainable manner so that past failures are not repeated.

II. METHODS

A. Potential Land Erosion Methods USLE (Universal Soil Loss Equation)

Of the several methods for predicting the magnitude of surface erosion, the USLE (Universal Soil Loss Equation) or PUKT (General Equation of Soil Loss) developed by Wischmeir& Smith (1978) is the most common method used to estimate the magnitude of erosion (Asdak, 2002). Mathematically the USLE equation is expressed by:

$$A = R \times K \times LS \times CP$$

with:

A = Potential for land erosion (ton/ha/year)
R = The erosion factor of rain
K = Soil erodibility factor
LS = Slope factor and slope length
CP = Plant management and land closure factors

a) Rain Erosivitas Index (R)

The erosion factor of rain is defined as the number of units of rain erosion index in a year. The erosional equation of rain according to Lenvain is as follows (Department of Forestry, 2009):

$$R = 2{,}21 \times (\mathrm{Rain})_m^{1{,}36}$$

with:

R = Indekserosivitascurahhujantahunan rata-rata
$(\mathrm{Rain})_m$ = Monthly rainfall(cm)

b) Erodibility Index (K)

According to Sutapa (2010) the erodibility factor of soil is the ability / resistance of soil particles to the process of peeling and transferring soil due to the kinetic energy of rain. The erodibility value of the soil does not depend only on topographic factors, slope slopes and the consequences of human treatment. Other influential factors are soil texture, aggregate stability, infiltration capacity, soil organic and non-organic material content.

Soil erodibility (K) factors indicate the resistance of soil particles to the peeling and transport of these soil particles by the presence of kinetic energy of rainwater. The magnitude of soil erodibility or resistance is also determined by soil characteristics such as soil texture, soil aggregate stability, infiltration capacity, and soil organic and chemical content. The characteristics of the soil are dynamic, always changing therefore the characteristics of the soil can change with the change in time and land cover or land system.

c) Slope and Slope Length Factors (LS)

Slope length and slope are the two topographic properties that most affect surface flow and the magnitude of erosion that occurs (Arsyad, 2010). Therefore, the longer a slope will be the more the volume of soil carried and the steeper the slope of the slope, the faster the surface flow transports the soil.

Slope length (L) is measured from an area at ground level where erosion begins to occur to the location of deposition, or in areas where the flow of ground surface water enters the channel / river. Slope length (L) and steepness (S) values in analysis are usually calculated simultaneously as slope slope factors (LS).

d) Factors of Crop Management and Land Closure (CP)

Sarminingsih (2018) states that the crop management index (C) can be interpreted into the ratio of eroded land in a type of plant management on a plot of land to land that is eroded on the same land without any plants. The value of C for a type of plant management depends on the type of plant, combination, density distance, harvest period and rotation of planting. The crop processing index (P) is the ratio of eroded soil to a type of land management to eroded land on the same land without land management or soil conservation. The value of P is determined by human intervention in land such as terraces, grooves, land management and so on.

The amount of CP value is determined based on the diversity of land cover forms in the field.

B. Sediment Delivery Ratio (SDR)

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The comparison between sediments measured in outlets and erosion on land is commonly called the Sediment Transport Ratio or Sediment Delivery Ratio (Suripin, 2002). SDR is a very complex process, not only the broad function of the watershed but the characteristics of the watershed affect the value of SDR.

The extent of SDR is determined based on the influence of the area of the watershed on the ratio of sediment transport. The Sediment Delivery Ratio (SDR) value used in this study refers to decree No. 346/Minister of forestry-V/2005.

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No.	Watersheds Area(Ha)	Sediment Delivery Ratio (%)
1	10	53
2	50	39
3	100	35
4	500	27
5	1.000	24
6	5.000	15
7	10.000	13
8	20.000	11
9	50.000	0,85
10	2.600.000	0,49

Table 1**:** The Impact of Watersheds on Sediment Delivery Ratio (SDR)

Source: decree No. 346/Minister of forestry-V/2005 on Criteria for Determining the Priority Order of Watersheds

The value of SDR can also be obtained using the Equation Boyce, 1975 namely (Varadilla S.R. et al, 2020):

$$SDR = 0{,}41 \times A^{-0{,}3}$$

with:
SDR = sediment delivery ratio
A = Watersheds Area (Ha)

C. *Potential Sedimentation Rate*

The magnitude of the potential sedimentation rate value in the watershed is calculated using the Weischmeier & Smith equation, as follows:

$$S_{pot} = E_{akt} \times SDR \quad (4)$$

with:
S_{pot} = Potential sedimentation (tons/years)
E_{akt} = actual erosion (tons/year)
SDR = sediment delivery ratio

D. *Classification of Erosion Hazards*

The USDA (*United States Department of Agriculture*) has established the classification of erosion hazards based on the rate of erosion produced in tons/ha/year, can be seen in Table 2.

Depth of Soil Solum (cm)	**Erosion Hazard Class (ton/ha/yr)**				
	I	**II**	**III**	**IV**	**V**
	<15	**15 - 60**	**60 - 180**	**180 - 480**	**> 480**
a. Deep (> 90)	VL	L	M	W	VW
b. Medium (60-90)	R	M	W	VW	VW
c. Shallow (30-60)	M	W	VW	VW	VW
d. Incredible shallow <30)	W	VW	VW	VW	VW

Table 2: Classification of Erosion Hazards

Source: Sarminingsih, 2018
Information:
VL = Very Light,
W = Weight,
L = Light,
VW = Very Weight,
M = Medium

E. *Erosion Control and Sedimentation of Reservoirs*

Controlling erosion and sedimentation that occurs in reservoirs can be done by tackling erosion as a source of sedimentation and dredging to improve the effectiveness of reservoir function due to sedimentation.

- Tackling Surface Erosion

Efforts to overcome the occurrence of surface erosion can be done in 2 (two) ways, namely:

- ✓ The way vegetation or biotechnical is to prevent damage and repair vegetation surface cover land, so as to reduce the affected erosion.
- ✓ Civil engineering (construction).

- Sediment Transport Control

Sediment transport is very influential on changes in river morphology, in principle controlling sediment transport is to ensure that sediment can be carried away to certain places that are not detrimental.

- Sedimentation Control in the River

Sedimentation control in river flows is intended to ensure the occurrence of deposition in desired places.

- Reservoir Sedimentation Control

Sedimentation that occurs in the reservoir cannot be avoided, so it is necessary to take direct steps by dredging or by way of flushing.

F. *Sediment Mitigation Strategies*

Efforts to protect and preserve reservoirs in watersheds based on the directive of the Minister of PUPR Regulation No. 27 of 2015 on Dams can be done by:

- Maintenance of the continuity of the function of the catchment area.
- Supervision of land use in catchment areas.
- The creation of erosion and sedimentation control buildings.
- Control of soil processing in the upstream area of the reservoir.
- Increased awareness, participation, and empowerment of owners of interest in the preservation of reservoirs and their environment.

Based on the directive of the Minister of PUPR Regulation No. 27 of 2015 and the change, namely the Regulation of the Minister of PUPR No. 6 of 2020 on Dams in the utilization of space in reservoir puddles can only be done to:

- Tourism activities.
- Sports activities.
- Aquaculture of fisheries.
- Floating solar power plant.

Utilization of space in the reservoir puddle area is done by paying attention to:

- Dam safety.
- Function of the reservoir.
- Social, economic, and cultural conditions of each region.

Water damage.

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III. RESULTS

A. *Land Erosion*

Based on the results of the analysis that has been done, the potential for land erosion that occurs in the Selorejo Reservoir Catchment Area is as follows.

No.	Erosion Class	Unit	Year	
			2018	2020
1	<15 ton/ha/year	ha	3.757,49	4.005,15
2	15-60 ton/ha/year	ha	5.800,63	5.869,37
3	60-180 ton/ha/year	ha	3.676,82	3.607,49
4	180-480 ton/ha/year	ha	6.303,76	5.795,23
5	>480 ton/ha/year	ha	4.132,58	4.394,04
	Total	**ha**	**23,671.28**	**23,671.28**
	Average Erosion	**ton/ha/year**	**235,91**	**242,32**

Table 3 Erosion Potential in Selorejo Reservoir Catchment Area

Source: Analysis Results

Based on **Table** 3, There was an increase in land erosion from 2018 to 2020 that occurred in the Selorejo Reservoir Catchment Area. The average erosion potential in 2018 of 235.91 tons/ha/year increased to 242.32 tons/ha/year in 2020, which there was an increase of 6.41 tons/ha/year.

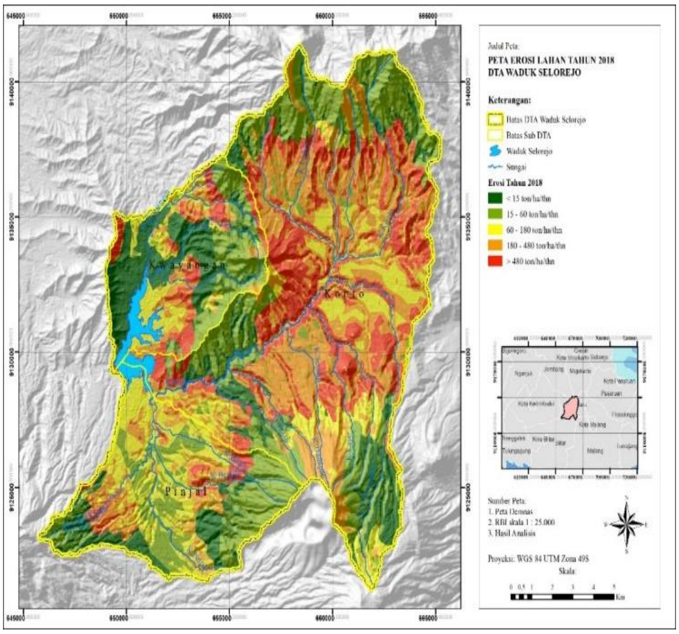

Fig. 1: Land Erosion Map in Selorejo Reservoir Catchment Area in 2018

Source: Analysis Results

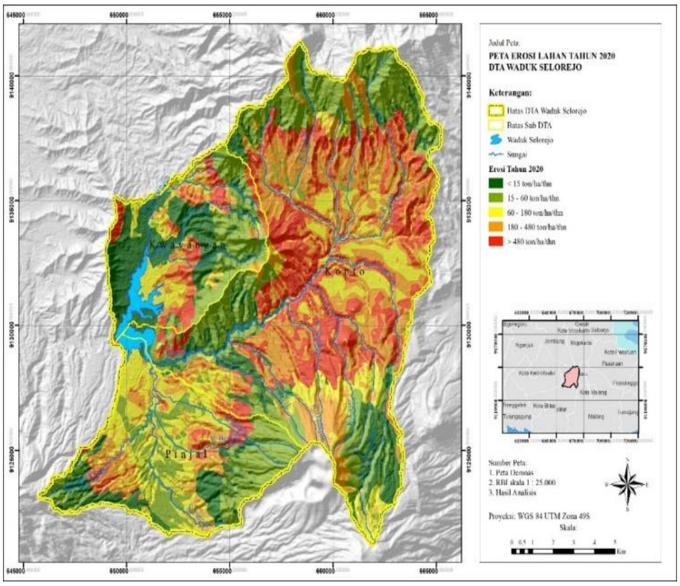

Fig. 2: Land Erosion Map in Selorejo Reservoir Catchment Area in 2020

Source: Analysis Results

B. *Reservoir Capacity*

Selorejo Reservoir is located in the Selorejo Reservoir Catchment Area and holds water from its catchment area through Konto River, Kwayangan and Pinjal.

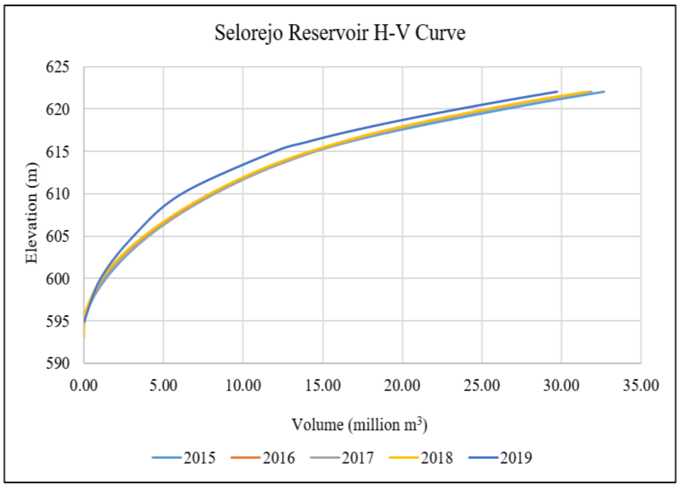

Fig. 3: Selorejo Reservoir H-V Curve 2015-2019

Source: Analysis Results

The results of the evaluation of the selorejo reservoir volume showed that within four years there was a decrease in volume of 2.92 million m^3 coupled with dredging that had been done by 708,600 m^3 so that the average sediment volume was obtained by 0.77 million m^3/year. The sedimentation treatment plan at Selorejo reservoir is expected to maintain the age for the reservoir up to > 100 years in terms of utilization.

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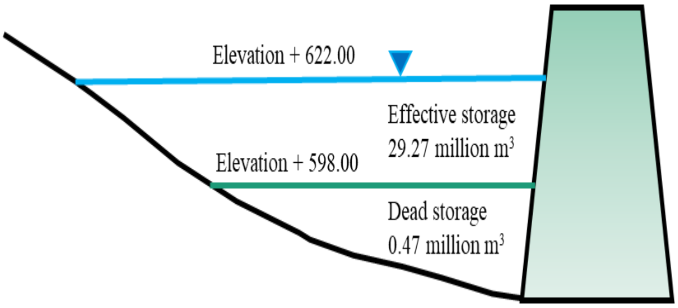

Fig. 4: Selorejo Reservoir Reservoir Capacity 2019

Source: Analysis Results

C. Sedimentation in Reservoirs

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Sedimentation in Selorejo Reservoir is reviewed from two conditions, namely based on erosion potential in the catchment areaand the results of bathymetry measurements of reservoir. The sedimentation potential that settles in selorejo reservoir is 609,328.60 m^3/year, while based on the results of bathymetry measurements the volume of sediment is 765,519.99 m^3/year.

No.	Sub Catchment Area	Area (km^2)	Average Erosion (ton/ha/yr)	Sediment (m^3/yr)
1	Konto	146,73	377,25	446.434,49
2	Kwayangan	40,09	182,81	85.379,66
3	Pinjal	49,89	166,90	77.514,44
	Total	**236,71**	**726,96**	**609.328,60**

Table 4: Sedimentation Potential of Selorejo Reservoir

Source: Analysis Results

Based on Table 4, The largest sediment potential in Selorejo Reservoir comes from KontoSub Catchment Areawith a total of 446,434.49 m^3/year.

D. Dredging of Reservoir Sediment

In sediment dredging activities for sedimentation control in reservoirs there are several important things to support this activity, including tool preparation and spoilbank preparation. The needs of the tool are adjusted to the conditions and targets of dredging in the reservoir. Dredging that has been done in 2015-2019 as much as 708,600 m^3.

Such dredging needs to consider the spoilbank location and its capacity. There are seven spoilbanks in Selorejo Reservoir. One location has been disabled, spoilbank D and six locations are still functioning, although capacity has been reduced a lot from the initial planning. Spoilbank locations in Selorejo Reservoir can be covered in **Fig.** 5.

Fig. 5: Spoil bank Locations in Selorejo Reservoir

Source: Reservoir Reservoir Capacity Study and Sedimentation Management of Brantas River Region PJT I, 2019

No.	Spoil bank	Spoil bank Dredging and Management Scheme						Description
		Capacity	Capacity 2019 (m^3)	Filling (m^3)	Hauling (m^3)	Embankment Elevation (m^3)	Capacity end of 2020 (m^3)	
1	A dan C	90.000	25.000		75.000		100.000	Last filled in 2018
2	B	240.000	47.000	47.000			-	Last filled in2019
3	Tepus 1	13.000	-		60.000	60.000	120.000	Last filled in 2018
4	Tepus 2	227.000	53.400	53.000			400	Last filled in 2019
5	Kebun Jambu Kecil	44.000	-		44.000		44.000	Last filled in 2018
6	KebunJambu Besar	171.000	101.000	100.000			1.000	Last filled in 2019
7	D	40.000	20.000				20.000	Turned Off
	Total	**925.000**	**246.400**	**200.000**	**119.000**	**60.000**	**285.400**	

Table 5: Spoil bank Management in Selorejo Reservoir in 2020

Source: Reservoir Reservoir Capacity Study and Sedimentation Management of Brantas River Region PJT I, 2019

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Based on table 5, Sediment dredging activities in Selorejo Reservoir in 2020 is 200,000.00 m3. The dredging volume takes into account the existing spoil bank conditions as well as the capacity of tool capabilities in Selorejo Reservoir. Over time spoil bank volume will decrease and need to be carried out hauling activities or looking for and adding new spoil bank locations.

IV. DISCUSSION

One of the efforts to protect and preserve the reservoir is to control sedimentation in the reservoir, with the aim of maintaining the reservoir in order to maintain the existence, sustainability and maintain the function of the reservoir against damage or disruption caused, both by natural forces and human actions. Therefore, it is necessary to manage the utilization of reservoirs if there is a change in space in the reservoir due to sedimentation or other utilization. The management of the reservoir aims to determine the utilization of appropriate areas in the reservoir. Joint actions between sectors need to be applied in the arrangement of catchment areas and sediment management in Selorejo Reservoir in a sustainable manner.

A. Regional Planning Strategy in Selorejo Reservoir Catchment Area

The sedimentation potential that settles in Selorejo Reservoir is 609,328.60 m^3/year. The right strategy in the arrangement of the catchment area is expected to reduce the amount of erosion that occurs in the future. Efforts to protect and preserve reservoirs in catchment areabased on the directive of the Minister of PUPR Regulation No. 27 of 2015 on Dams can be done by:

- Maintaining the function of the catchment area;
- Land use supervision in catchment areas;
- Construction of sediment control structures;
- Control of land management in upstream areas;
- Preservation of reservoirs and the surrounding environment by instilling awareness and concern for the community.

The results of the analysis showed that there was an increase in land erosion from 2018 to 2020 that occurred in the Selorejo Reservoir Catchment Area. Increased potential for land erosion in the last two years by 6.41 tons/ha/year. The increase is due to the change of land from forest areas to dry land agriculture, rice fields and settlements. Forest area decreased by 1,449.43 ha or by 6.12% of the total area of Selorejo Reservoir Catchment Area.

The strategy of structuring the area in the catchment area (DTA) of Selorejo Reservoir is divided into two, namely:

a) Preventive handling strategies

- Sediment control building planning in the form of sabo dam, check dam, sand pocket, gully plug and others.

  The function of this building is expected to be able to withstand sediment in the upstream reservoir, so that the volume of sediment entering the reservoir can be controlled in hopes of increasing the useful age of the reservoir. The priority of planning and building check dams is in KontoSub Catchment Areawhere the most sediment contributes to Selorejo Reservoir. Check dams are planned and built-in rivers that are predicted to experience high sedimentation due to the large potential for land erosion, namely in Konto River, Ledok, Cobanrondo, Lajar, Serang and Dadapan. Planning in Konto River is the construction of 2 (two) sabo dam/check dam and 2 (two) sand pocket (PJT I, 2018), while in Ledok River, Cobanrondo, Lajar, Serang and Dadapan are proposed each with 1 (one) check dam. The planned capacity for each building is 50,000 m^3.

  The next plan is the construction of check dams each amounting to 1 (one) with a capacity of 50,000 m^3 in Pinjal and KwayanganSub Catchment Area. The total planned sediment control building is 11 (eleven) with the total volume of sediment that can be retained at 550,000m^3. These developments need good maintenance and management, especially related to dredging management with the aim to maintain check dams to maintain existence, sustainability and maintain building functions.

- Critical land rehabilitation

  Based on land cover maps and erosion rate analysis, greening/rehabilitation of critical land can be done in areas of open land cover/vacant land so as to reduce the level of land erosion that occurs in reservoir watershed. Greening recommendations in the form of productive plants such as fruits with a total of 5,000 trees every year (PJT I, 2018). Efforts that can be done next is to socialize land conservation and include local communities in terms of preventing erosion.

- Control of land transfer functions

  Land transfer can be prevented by tightening regulations on land use in the catchment areaarea based on the Malang Regency RTRW Regulation 2010-2030.

b) Corrective handling strategies

Tokol Sabo Dam is located at the upstream part of Selorejo Reservoir, the current condition of the volume of sediment that is exposed to the sabo dam storage is approximately 600,000 m^3 (full). Based on the availability of infrastructure facilities, recommendations for sediment dredging that can be done amount to 15,000 m^3 by 2020. The sediment material is mostly sand, gravel and rocks that have economic value if managed properly.

Dredging of sediment in sabo dam is not necessarily only done by the manager. MSME groups (micro, small and medium enterprises) can be involved in efforts to help reduce sediment volume in TokolSabo Dam. Recommended dredging target of 15,000 m^3/year, so that sabo dam can be functioned sustainably and improve the economy of the surrounding community.

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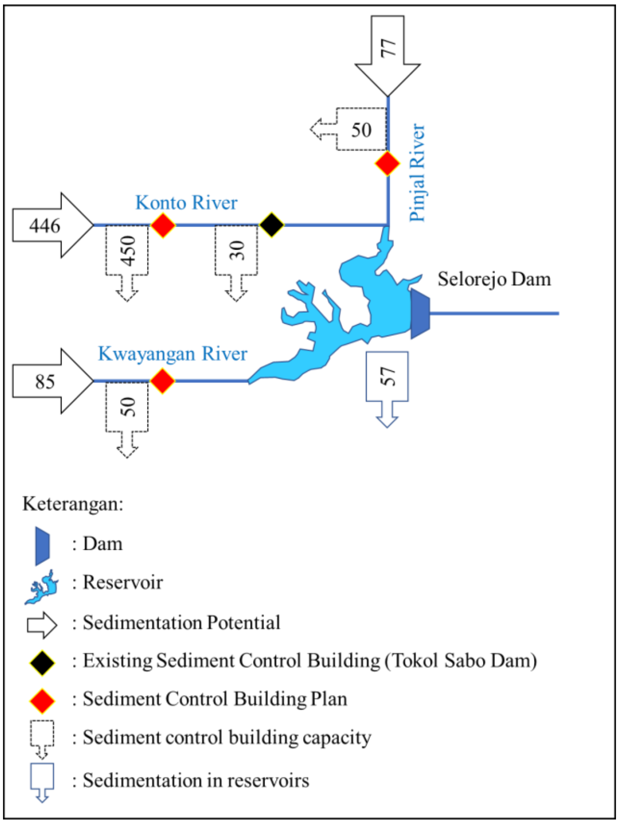

Fig. 6: Sediment Balance in Selorejo Reservoir Catchment Area (units in thousand m^3)

Source: Analysis Results

Based on **Fig.** 6, Sediment control building planning in Selorejo Reservoir Catchment Area is able to reduce the potential for sediment that settles in the reservoir by 580,000 m^3 at the beginning of its construction. Sustainability of sediment control building functions to be considered, so that in the coming years there needs to be regular dredging activities in each of these buildings.

B. Sediment Management Strategy in Selorejo Reservoir

Handling of sediment by dredging is done when the amount of sediment that settles in the reservoir has exceeded the normal limit set. These activities are in the form of sedimentation dredging in reservoirs and sedimentation in the dam intake line.

Things to consider at the time of the disposal of sediment material from the reservoir are:

- Availability of tools;
- Areas that are used as dumps;
- Distance of waste;
- Environmental issues.

Based on the results of analysis and availability of dredging tools, as well as the final spoilbank capacity of Selorejo Reservoir in 2021 of 265,400.00 m^3, dredging can be done at 200,000.00 m^3. Great hope, dredging activities can extend the life for Selorejo Reservoir. This activity needs to be supported by good sediment management, so that the limitations of spoilbank capacity and emptying time/hauling can be optimized.The need for new innovations related to sediment management to accelerate the compaction of sediment material in spoilbanks in order to be carried out immediately.

No.	*Spoilbank*	Initial Capacity	Year 2021			Year 2022			Year 2023			Year 2024			Year 2025			Capacity end of 2025
			Capacity	Filling	*Hauling*	Capacity	Filling	*Hauling*	Capacity	Filling	*Hauling*	Capacity	Filling	*Hauling*	Capacity	Filling	*Hauling*	
1	A dan C	90.000	100.000	100.000		-			-		90.000	90.000	90.000		-			-
2	B	240.000	-			-		120.000	120.000	100.000		20.000			20.000		100.000	120.000
3	Tepus 1	113.000	120.000	100.000		20.000			20.000		110.000	130.000	110.000		20.000			20.000
4	Tepus 2	227.000	400			400		150.000	150.400			150.400		20.000	170.400	170.000		400
5	Kebun Jambu Kecil	44.000	44.000			44.000	44.000		-			-		44.000	44.000	30.000		14.000
6	Kebun Jambu Besar	171.000	1.000			1.000		100.000	101.000	100.000		1.000			1.000		100.000	101.000
	Total	**885.000**	**265.400**	**200.000**	-	**65.400**	**44.000**	**370.000**	**391.400**	**200.000**	**200.000**	**391.400**	**200.000**	**64.000**	**255.400**	**200.000**	**200.000**	**255.400**

Description:

Units of volume in m^3

Sb. A dan C : Last filled in 2018
Sb. B : Last filled in 2019
Sb. Tepus 1 : Last filled in 2018
Sb. Tepus 2 : Last filled in 2019
Sb. Kebun Jambu Kecil : Last filled in 2018
Sb. Kebun Jambu Besar : Last filled in 2019

Table 6: Spoilbank Management in Selorejo Reservoir Year 2021 – 2025

Utilization of sedimentary waste is not limited if the soil repair is done correctly. Alternative utilization of sedimentary results is selected with consideration:

a. Geotechnical characteristics of sedimentary crowding;
b. Needs of the local community;
c. Economic viability;
d. Environmental impact of the use of disposal sites.

Utilization of the results of the crowd becomes an alternative in overcoming the problem of the availability of dumping sites for hauling sediment material. This alternative is expected to help the process of sustainable sediment management in Selorejo Reservoir, as well as can improve the economy of the community around the reservoir.

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The target of utilization of sediment material 200,000.00 m^3 of hauling results can be done in the following ways:

- Increase in agricultural land
  Use for agriculture from sedimentary soils aimed at:
  - Changing or repairing less productive soil to increase crop production.
  - Increase land surface cover on farmland especially along Konto River and tributaries that have low productivity.

- Reclaimed land
  The high need for heap material is good for private housing, housing, parks and other buildings. Sediment material here is proposed/utilized for heap soil in settlements and cities around reservoirs.

- Ceramic/tile/brick products
  Sediment material can be used and used as clay bricks, hollow bricks, brick paving, tiles, ceramic products made of clay and so on. The purpose of making this product is to increase the value of sediment material so that it has a higher economic value as well as give the surrounding community opportunities to get new livelihoods.

V. CONCLUSIONS

Based on the condition of sediment problems in Selorejo Reservoir Catchment Area and in Reservoir, as well as the results of analysis that has been done, the following conclusions were obtained:

1. The sedimentation potential that occurs in Selorejo Reservoir Catchment Area is 609,328.60 m^3/year. The structuring strategy applied to the catchment area to support the sustainability of the function of Selorejo Reservoir can reduce the potential of sediment that settles in the reservoir by 580,000 m^3 at the beginning of its construction, including:
   a. The design of sediment control structures in the Konto, Pinjal and Kwayangan subcatchment area consists of eleven buildings with a target sediment capacity of 550,000 m^3.
   b. Critical land rehabilitation and control of land transfer by greening in the form of productive plants such as fruits with a total of 5,000 trees every year. This strategy needs government support in the framework of fostering and mentoring the awareness of the surrounding community on the importance of sustainability in the Catchment Area.
   c. Sediment dredging efforts at TokolSabo Dam amounted to 30,000 m^3 by involving local MSME to support the sustainability of building functions.

2. Annual real sedimentation occurs in Selorejo Reservoir based on bathymetry measurements of 765,519.99 m^3/year. Sediment management strategies implemented in selorejo reservoirs to support the sustainability of reservoir functions are by dredging sediment by 200,000 m^3/year, and the need for good management related to dredging activities, spoilbank preparation, hauling and utilization of sediment material.

REFERENCES

[1.] Arsyad S. 2010. Conservation of Land and Water. IPB Inpres second edition, Bogor.
[2.] Asdak C. 2002. Hydrology and Watershed Management. Gajah Mada University Press, Yogyakarta.
[3.] Department of Forestry. 2009. Regulation of the Minister of Forestry of the Republic of Indonesia No. P.32/MENHUT-II/2009 on How to Use the Forest and Watershed Rehabilitation Engineering Plan (RTkHL-WATERSHED). Jakarta: Department of Forestry.
[4.] Kironoto B.A. 2010. Management of Reservoir Sedimentation in the Context of Sustainable Water Resource Development. Inaugural Speech of the Professor's Office. Faculty of Engineering Gajah Maja University, Yogyakarta.
[5.] Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 27/PRT/M/2015 on Dams.
[6.] Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 6 of 2020 on Changes to the Regulation of the Minister of Public Works and Public Housing No. 27/PRT/M/ 2015 on Dams.
[7.] Perum Jasa Tirta I. 2018. Integrated Sedimentation Treatment Study at Sengguruh Reservoir, Sutami-Lahor, Wlingi, Lodoyo and Selorejo.
[8.] Perum Jasa Tirta I. 2019. Study of Reservoir Reservoir Capacity and Sedimentation Management of Brantas River Region.
[9.] Son of D.A., S.P. Utama, R. Mersyah. 2019. Community-Based Natural Resource Management in The Conservation Efforts of Lubuk Langkap Watershed, Suka Maju Village, South Bengkulu Regency. Journal of Natural Resources and Environmental Management Research, Volume 8 Number 1, April 2019. ISSN: 2302- 6715.
[10.] Sarminingsih A. 2018. Study of Land Use Changes against the Level of Erosion Hazards in dengkeng watershed. Journal of Precipitation: Communication Media and Environmental Engineering Development, Vol. 15 No. 2 September 2018. Faculty of Engineering, Diponegoro University, Semarang.
[11.] SK. No. 346/Menhut-V/2005 on Criteria for Determining the Priority Order of watersheds.
[12.] Suripin. 2002. Preservation of Land and Water Resources. Publisher Andi Offset, Yogyakarta.
[13.] Sutapa I. 2010. Analysis of Erosion Potential in Watersheds (WATERSH) in Central Sulawesi. Smartek Journal, Vol. 8. No. 3. Civil Engineering Faculty of Engineering Tadulako University, Palu.
[14.] Varadilla S.R, E. Noerhayati, A. Rahmawati. 2020. Study of Waste Restoration for Selorejo Reservoir with Erosion and Sedimentation Approach. Journal of Civil Engineering/Vol. 8. No. 5 – February 2020/ISSN 2337-7739. Civil Engineering Faculty of Engineering, Malang State University, Malang.
[15.] Wischmeier W.H. & D.D. Smith. 1978. Predicting Rainfall Erosion Losses A Guide to Conservation Planning. Washington DC: Goovernment Printing Off