ISSN printed: 977-2354901

Sedimentation of Karang Mumus River Basin: Climate Factors

Penny Pujowati[#1], and Yazid Ismi Intara [2]

[#1,2]*Department of Agro-Technology, Faculty of Agriculture Mulawarman University*.
Email: pjwati@yahoo.com; izmi_6@yahoo.com

Received: 24 March 2014 Accepted: 29 September 2014

Abstract *- Karang Mumus river basin broadly 32196,3 ha is river basin in east Kalimantan with first priority of damage level, present in there have marginal area with width of 9106 ha. Phenomenon the happening of flood is referred as besides resulted from precipitation intensity that go down hard relative, also at the same time sustained by back-flow (back water) water runoff from the Mahakam River that is being up to scratch high tide in part of downstream Samarinda city region. Based on erosion data on 2000 and 2002, sediment yield that happened in Karang Mumus river basin had big improvement. On 2000, the obtained sediment yield is 1,010,976.3 tons/year becomes 2,819,698.4 tons/year on 2002. The improvement is 1,808,722.1 tons or around 178.9%. Sediment yield prediction by 2008 is 8,245,864.7 tons/year, with assumption that land utilization and cover in Karang Mumus river basin is not change. This is occurred because of many factors that influence sediment yield at one particular river basin. Meanwhile, also existence of contribution runoff surface that high relative and velocity of soil erosion as the sediment source at river that to river basin Karang Mumus*

Keywords *—sedimentation, river basin, flood, climate, soil erosion*

I. INTRODUCTION

The changing of something happened at the area will have an effect on other area. Landscape changing activity is including change activity of land use arrangement which done in river basin of upstream area (Hardjowitjitro 1981). That is not will only give impact in area which the place of area changing (river basin of upstream area), but also will give impact in downstream area into form changing of the fluctuation of discharge and sedimentation transport and material dissolved in other water flow system (Sunborg, 1983). Indicating that above description in upstream bio-geological physics area and river basin of downstream area has interrelationship.

Karang Mumus river basin broadly 32196,3 ha is river basin in east Kalimantan with first priority of damage level, present in there have marginal area with width of 9106 ha (Timpakul, 2007).

Increasingly broadness the marginal area and the rainfall height intensity causes often happened floods disaster in Karang Mumus river basin, especially in downtown of Samarinda city. The biggest floods disaster happened on July 31th 1998. In 2008, the floods was happened mostly rain downwards with rapid intensity. The floods phenomenon which happened by resulted from rainfall was had rapidness intensity of relative, also at the same time sustained by flow back or back water which overflow from Mahakam River. That condition was being of high tide in part of region downstream at Samarinda city. On other hand, runoff contribution existence was high level of large and speed of erosion which come from river basin Karang Mumus area as source of sedimentation or superficiality at base river (DPU, 2003). Phenomenon the happening of flood is referred as besides resulted from precipitation intensity that go down hard relative, also at the same time sustained by back-flow (back water) water runoff from the Mahakam River that is being up to scratch high tide in part of downstream Samarinda city region.

The science of hydrology processes in river basin ecosystem is very useful for natural resources development especially water (Jones, 1997). Hydrology system has a close relation to erosion in water capture area and sedimentation in the river stream of those water capture area. According to Asdak (2007), sediment is a result of erosion process, either surface erosion, ditch erosion, or other types of land erosion. Sediment generally precipitates underside foothills, in flood pond area, in aqueduct, river, and dam.

The changing of cover pattern and land use was affected at potency degradation area of Karang Mumus river basin. That condition was caused occur of watershed reduction area or water absorption area as inhibitor the happening of floods. Study to climate factors also must earlier study to be able to anticipated bad consequence from every year climate condition. The objectives of the research are to analyze the sedimentation of Karang Mumus river basin based climate factor

II. MATERIAL AND METHOD

Location of research was Karang Mumus river basin area (Figure 1); Mahakam Hilir sub river basin. Geographically; Karang Mumus river basin lays in 0°19'28,93" - 0°26'54,72" South Latitude and 117°12'06,24" - 117°15'4127" East Longitude. Execution of Research in field: February until March 2008

Administratively, Karang Mumus river basin resides in region of Samarinda city and Kutai Kartanegara district region. Delineate of area Karang Mumus river basin contains a) part of upstream Karang Mumus river basin included into Kutai Kartanegara district region (Muara Badak District); b) centered

Karang Mumus river basin included into Samarinda city region (Samarinda Utara district); c) part of downstream Karang Mumus river basin included into Samarinda city region (small part of Samarinda Ulu district and small part of Samarinda Ilir district).

Based on delineate, the wide of Karang Mumus river basin was 32196,3 ha. The biggest area percentage from total area of Karang Mumus river basin was region of Samarinda Utara district, which broadly 27780,0 ha (86,3%).

The climate data that utilized in this research is the precipitation data and the air temperature during 10 the last years (1998 – 2007) that noted at Meteorology and Geophysics Station Samarinda. The result of climate data analysis can be seen at Table 1.

Table 1. The result of climate data analysis Karang Mumus river basin during 1998 - 2007

Year	Temperature (^{0}C)			Precipitation (mm)		Month Amount		
	Maks	Min	Mean	Amount	Average	dry	damp	wet
1998	29,8	26,8	28,2	1.851,9	154,3	3	1	8
1999	27,4	26,4	26,9	2.684,0	223,7	-	-	12
2000	27,6	26,4	26,9	2.584,2	215,4	-	-	12
2001	27,5	26,7	27,2	1.913,3	159,4	1	1	10
2002	27,9	27,1	27,5	1.676,9	139,7	1	2	9
2003	27,8	26,9	27,4	2.347,3	195,6	1	2	9
2004	28,5	27,1	27,5	2.591,5	216,0	3	-	9
2005	28,5	26,9	27,5	2.550,4	212,5	1	2	9
2006	28,1	26,8	27,4	1.964,7	162,2	1	2	9
2007	28,3	26,9	27,5	2.453,7	204,5	-	1	11
Average	28,1	26,8	27,4	2.259,9	188,3	1,1	1,1	9,8

Source: Processed from Meteorology and Geophysics Agency Samarinda, 2007

Based on precipitation data and air temperature analysis, it is known that the annual mean precipitation of Karang Mumus river basin is 2,259.9 mms, the monthly mean precipitation is 188.3 mms, and the monthly mean air temperature is 27.4^{0}C, the highest mean air temperature is 28.1^0 C and the lowest mean air temperature is 26.8^0 C.

Based on the precipitation data on 1998 – 2007, the climate of Karang Mumus river basin is the A climate type according to Schmidt and Ferguson classification system, with dry month to wet month ratio is 11.22%. The A climate type marking out a dripping wet area with tropical rain forest vegetations. The dry month definition is if the monthly precipitation <60 mms, the wet month if the monthly precipitation >100 mms, whereas if the precipitation condition range on those both value is named damp month.

The climate condition in the research location that has high precipitation, high monthly mean air temperature, and dry season that relatively shorter than rain season has a potency to speed up the wash process of soil alkali and clayey soil colloid elements until forms Ultisols, Entisols, and Inceptisols soil type. In consequence, if land cover happens on open field or a few cover crop of research location, then the climate condition can speed up the erosion process and increase sedimentation (Lootens, and Lumbu, 1986).

Material applied was the data of; bio-physic, Indonesia earth aspect map, and satellite image. Type, unit, source, usefulness, and approach of analysis from visible research data at Table 2. Equipment applied during research was include into unit of computer, compass, scanner, Arc-View version 33, and digital camera.

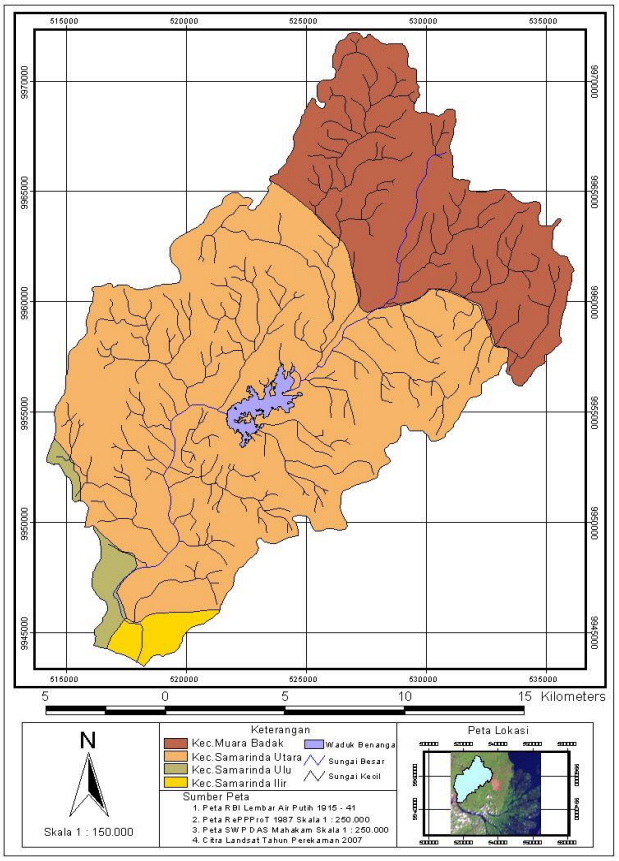

Figure 1. Location research map

Table 2. Types, units, sources, uses, and analysis approach of research data

No.	Type of data	Unit	Year	Source	Uses	Approach
1.	Location	m^2	2003	Survey, Government	Position with other locatior	
2.	Climate					
	- Rain fall	mm	1992-2007	BMG	Land use modification	Land suitability
	- Temperature	^{o}C	1998-2007	BMG	Land use modification	Land suitability
	- Humidity	%	2007	BMG	Land use modification	Land suitability
	- Solar radiation	%	2007	BMG	Land use modification	Land suitability
	- Evaporation	mm	2007	BMG	Land use modification	Land suitability
3.	Geology	-	2003	Balitbangda	Land use modification	Land suitability
4.	Type of soils	-	2003	Survey, Balitbangda	Land use modification	Land suitability
5.	Topography					
	- Slope	%	2003	Survey, Balitbangda	Land use modification	Land suitability
	- Altitude	m dpl	2003	Survey, Balitbangda	Land use modification	Land suitability
6.	Vegetation	-	2003	Survey	Land use modification	Land suitability
7.	Land use and land cover	-	2003	Survey	Land use modification	Land suitability
8.	Land suitability from field system (modification from FAO)	-	2004	GIS and cartography laboratory, Soil science, Unmul	Land use modification	Land suitability
9.	Sedimentation	-	2000 and 2004	BP DAS Mahakam	Sustainable indicator	Evaluation of sedimentation

ISSN printed: 977-2354901

Sediment source that indigenous to River Basin is erosion from agriculture land, landslide, and river bank erosion. Level of sediment that produced by a River Basin indicates that at that River Basin area is already happened land degradation.

To evaluate level of sedimentation that happened in Karang Mumus River Basin is used erosion data and sedimentation that obtained from Research and Region Development Agency of Samarinda, Management Agency of Mahakam River Basin and literature of erosion data supporter and other sedimentation. Total value prediction sediment is obtained using equation sediment delivery ratio (SDR). Sediment delivery ratio (SDR) is comparison value between total sediment that transported by river water run-off and total erosion land at one particular River Basin (Asdak, 2007).

SDR Equation is as follows.

$$SDR = \frac{\text{Total sediment that produced by a River Basin (ton/year)}}{\text{Total erosion land that happened at one particular River Basin (ton/year)}}$$

If level of sediment result is predicted from equation SDR above, will be obtained total equation sediment as follows:

Total sediment (ton/year) = SDR (Total erosion land (ton/year)

Procedure that must be done before total value prediction sediment is it is first must know in SDR from each sub River Basin and land erosion mean value that happened at River Basin. In this research, level of value SDR in calculation of sediment result determined by using estimation SDR that made by River Basin Agency of Mahakam.

III.RESULT AND DISCUSSION

The main river flows on Karang Mumus river basin is Karang Mumus River. Karang Mumus River with 34.7 km length is a water source to support life of Karang Mumus river basin society, now the function is decrease, even it is often generate a danger flood and source of disease. Floods that happened on Samarinda city, a few days before the end of in 2008, can be seen at Figure 3.

Figure 3. Flood on Samarinda city

There are sub-river basins on Karang Mumus river basin area, that are Pampang, Ulu, Lantung, Siring, Jaya Mulya, Muang, Betapus and Ilir sub-Karang Mumus river basin (Balitbangda, 2002). The runoff water from Karang Mumus River and its sub-river basins flows through Benanga dam, hereinafter run off water from Benanga dam flows to the Karang Mumus main river into Samarinda city and finally to the Mahakam River. Based on the pattern of river stream network (river system), Karang Mumus River has dendritic pattern. The dendritic pattern characteristic is its run off movement of the river water is relatively quick from upstream to downstream or lower course of a river basin (Balitbangda, 2002).

Sediment yield is a rate of sediment that originated from water capture area erosion that measured at a time period and a certain area. Based on the evaluation result, sediment yield in Karang Mumus river basin can be seen at Table 3.

Table 3. The sediment yield in Karang Mumus river basin

Sub-river basin	Width (ha)	SDR	Soil erosion (ton/thn)		Sediment result (ton/thn)	
			2000	2002	2000	2002
Karang Mumus Ulu	6.926,8	0,127	1.649.271	4.599.956,3	209.457,4	584.194,4
Lantung	1.274,8	0,153	303.530	846.570,5	46.440,1	129.525,3
Pampang	6.925,5	0,127	1.648.961	4.599.092,9	209.418,1	584.084,8
Siring	1.804,3	0,153	429.604	1.198.201,3	65.729,4	183.324,8
Jaya Mulya	2.109,8	0,153	502.344	1.401.078,1	76.858,5	214.364,9
Muang	1.980,0	0,153	471.438	1.314.880,4	72.130,0	201.176,7
Betapus	2.444,0	0,153	581.916	1.623.013,9	89.033,2	248.321,1
Karang Mumus Ilir	8.000,0	0,127	1.904.800	5.312.648,0	241.909,6	674.706,3
Total	31.465,2		7.491.863	20.859.441,5	1.010.976,3	2.819.698,4

Source: Processed from Hardwinarto (2000), Balitbangda (2002), and BPDAS-MB (2004).

Based on erosion data on 2000 and 2002, sediment yield that happened in Karang Mumus river basin had big improvement. On 2000, the obtained sediment yield is 1,010,976.3 tons/year becomes 2,819,698.4 tons/year on 2002. The improvement is 1,808,722.1 tons or around 178.9%. Sediment yield prediction by 2008 is 8,245,864.7 tons/year, with assumption that land utilization and cover in Karang Mumus river basin is not change. This is occurred because of many factors that influence sediment yield at one particular river basin.

One factor that influence sediment rate is the biophysics factor of Karang Mumus river basin. Climate, soil type, slope inclination, and vegetation have important role to sedimentation-erosion process (Park, 1992). Climate Condition in research location with wet tropical climate type can speed up the process of rock decay and ground forming. In other hand, a soil type that pertained sensitive to erosion and erosive also becomes one cause of sedimentation rate. The danger level of sedimentation-erosion becomes bigger if those soil types have big level of slope inclination (Guyot et al., 2007). As with vegetation structure, the wider open field and coppice without ground cover vegetation can improve sedimentation-erosion potency. Other causal factor is the existence of human activity conducted in Karang Mumus river basin that regardless the rules of earth and water conservation.

According to Walling (1983):, not all erosion land on the surface of water capture area will come up to the investigation plot. Some of that erosion land will be deposition in the ground zero hollows, in foothills, and other sediment relocation forms. In consequence, the rate of sediment yield is usually vary follows the physical characteristic of river basin.

The happening of 8,245,864.7 tons/year sediment transport in Karang Mumus river basin to downstream area will cause superficiality on dam, river, and irrigation

channel, also form new land in peripheries and delta of rivers. Thus, sedimentation process can give an advantage and disadvantage impact. It called advantageous if in a certain degree the existence of sediment current to downstream area can add land fertility and form new cultivation land in the downstream area. However, when at the same time the current of sediment can also degrade the water quality and superficiality of water body in Karang Mumus river basin.

Phenomenon the happening of flood is referred as besides resulted from precipitation intensity that go down hard relative, also at the same time sustained by back-flow (back water) water runoff from the Mahakam River that is being up to scratch high tide in part of downstream Samarinda city region. Meanwhile, also existence of contribution runoff surface that high relative and velocity of soil erosion as the sediment source at river that to Karang Mumus river basin (width around 31.475 ha) that existed in Samarinda city region and some of Kutai Kartanegara district, East Kalimantan province.

Karang Mumus river basin, management activities that will be conducted bent on control or degrade sediment yield because of the disadvantage impacts generated by sedimentation process is greater than the benefit ones.

IV. CONCLUSION

Based on erosion data on 2000 and 2002, sediment yield that happened in Karang Mumus river basin had big improvement. On 2000, the obtained sediment yield is 1,010,976.3 tons/year becomes 2,819,698.4 tons/year on 2002. The improvement is 1,808,722.1 tons or around 178.9%. Sediment yield prediction by 2008 is 8,245,864.7 tons/year, with assumption that land utilization and cover in Karang Mumus river basin is not change

Flood is referred as besides resulted from precipitation intensity that go down hard relative, also at the same time sustained by back-flow (back water) water runoff from the Mahakam River that is being up to scratch high tide in part of downstream Samarinda city region

Contribution runoff surface that high relative and velocity of soil erosion as the sediment source at river that to Karang Mumus river basin

The disadvantage of impacts generated by sedimentation process is greater than the benefit ones.

V. REFERENCES

Asdak C. 2007. *Hidrologi dan Pengelolaan Daerah Aliran Sungai.* Yogyakarta: Gajah Mada University Press. (in bahasa)

[Balitbangda] *Badan Penelitian dan Pengembangan Daerah Provinsi Kaltim. 2002. Studi Penataan dan Konservasi Daerah Tangkapan Air (DTA) Karang Mumus dengan Budidaya Agroforestri Berbasis Masyarakat Setempat. Samarinda: Proyek Penelitian dan Pengembangan Pembangunan Regional Provinsi Kaltim*.(in bahasa)

[DPU] *Dinas Pekerjaan Umum Kota Samarinda. 2003. Studi Konservasi DAS Karang Mumus.* Samarinda. (in bahasa)

Guyot J.L., J.M. Jouanneau, L. Soares, G.R. Boaventura , N. Maillet, C. Lagane. 2007. Clay mineral composition of river sediments in the Amazon Basin. Catena, 71; 340–356

Hardjowitjitro, H. (1981): Soil erosion as a result of upland traditional cultivation in Java Island. In: T. Tinsangchali & H. Eggers (eds.), Proceedings of the Southeast Asian Regional Symposium on Problems of Soil Erosion and Sedimentation. AIT Bangkok, 173-179.

Jones, J.A.A., 1997. Global Hydrology: Processes, Resources and Environmental Management, Longman, Essex, UK, 399 pp.

Lootens, M., Lumbu, S., 1986. Suspended sediment production in a suburban tropical basin (Lubumbashi, Zaire). Hydrol. Sci. J. 31, 39– 49.

Park, J-K., 1992. Suspended sediment transport in a mountainous catchment. Sci. Rep., Inst. Geosci., Univ. Tsukuba, Sect. A 13, 137–197.

Sundborg, A. (1983): Sedimentation problems in river basins. Nature & Resources 14(2), 1021.

Timpakul. 2007. *Pengelolaan DAS Karang Mumus Kota Samarinda.http://timpakul.hijaubiru.org/karangmumus-2/* (10 Sep 2007). (in bahasa)

Walling, D.E. (1983): The sediment delivery problem. Journal of Hydrology 65, 209 237.