Correlation of streamflow and sediment concentration at upstream and downstream Padang Watershed

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Abstract. Sediment concentration affected b streamflow at river body. This research was conducted to study correlation between streamflow and sediment concentration at upstream and downstream Padang watershed on July until December 2013. The research was conducted by using survey method at two outlet of Padang watershed were Padang sub watershed and Padang Hilir sub watershed. Sampling of water at two (2) outlets were conducted at stream surface by using depth intergrating suspended sediment sampler technique at three (3) points of river body. Sampling waters conducted at two times that were after rain and no rain. Sediment concentration (Cs) calculated by Cs = (G2 – G1) / V equation. Streamflow (Q) calculated by multiplying velocity and wide of river by Q = A x V equation. The results showed that no correlation between streamflow and sediment concentration at upstream when no rain (Cs = 0,0007 + 0,0412 Q; R^2 = 0,43) and at downstream when no rain (Cs = 0,0002 Q + 0,07157; R^2 = 0,057). There were correlation between streamflow and sediment concentration at upstream after rain (Cs = 0,00041 Q + 0,0611; R^2 = 0,88) and at downstream after rain (Cs = 0,00015 Q + 0,03293; R^2 = 0,9).
Key words: sediment concentration, streamflow, watershed

Introduction

The high frequency of rainfall at Padang watershed from July to December sometimes make flood event at downstream zone. That was occurred because the riverbody has no able to catch water flow. The high intensity of rainfall detach and transport soil mass into the river. In another fact, the water flow bring sediment load from other riverside at the higher riverbank. Beside that deposit of sediment load could come from soil erossion alongside riverbank. Function change of land at upstream zone into plantation and rural land at around riverbank contributes soil erossion. Meanwhile the upstream zone of watershed has important role primarily in aspect of hidrology function protection therefore manytime of activity at upostream zone can make many impact at downstream zone as fluctuation of streamflow, sediment transport and material dissolved at that stream flow system. Upstream zone of Padang watershed located at Sipispis District (Padang sub-watershed) and dowanstream zone located et Tebingtinggi District (Padang Hilir sub-watershed). Land utility at upstream zone primarily for rubber and palm oil plantation and less for rural district, meanwhile the land utility at downstream zone comprises of plantation, rural district and industry.

Generally, sediment accumulated at hill foot, flooded land, river channel and water reservoir. Sediment concentration which come from erosion was created at catchment areas were measured at spesific time and locate. Deposition of sediment from overbank flow is a critical component of lateral connectivity between river channels and their floodplains that sustains riparian ecology and biodiversity (Ward and Trockner, 2001) and that may significantly reduce a river's total suspended sediment load (Walling *et al*., 1996). Sediment yield was obtained by measuring suspended sediment in the river or measuring directly at water reservoir. Sediment yields were depend on total erosion at watersehed /sub-watershed and soil particle transported by erosion out from cathment areas. Generally, sediment production to be bent on sediment velocity which flow pass away from one observation point at a watershed system. As soon as sediment go into the river body therefore sediment tranpor take place. Velocity of sediment transpor was functions of velocity of stream flow and size of sediment particle. Total of sediment size was transported by water flow was given by interaction of factors : size of sediment go into

river body/water channel, channel characteristic, debit and physical characteristics of sedimen particle. Total of sedimen go into the river and streamflow value were given by climate, topography, geology, vegetation and farming system at that catchment area where sedimen area come from. Sedimen transport was depend on interaction of many variables. There is no equation could be applicated at all conditions.

Material and Method

That research conducted at Padang watershed areal located at Sipispis District in Padang Sub-watershed (N : 03°18'3,19'', E : 099°08'0,05/slope) and Tebingtinggi District in Padang Hilir Sub-watershed (N : 03°12'9,96'', E : 099°03'6,68''/flat) from July to December 2012 (Figure 1).

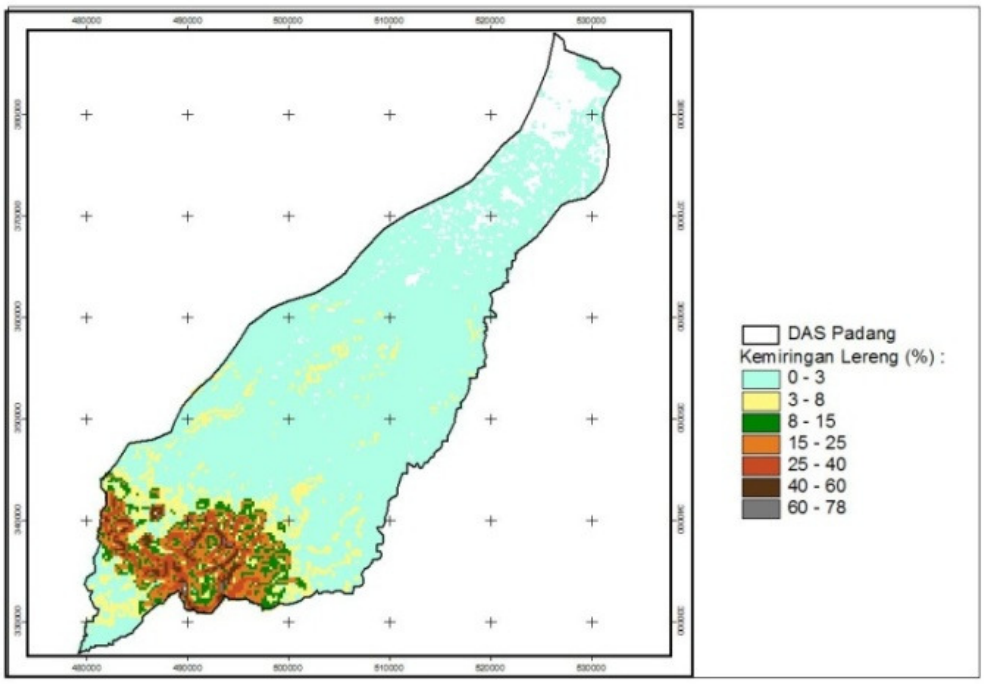

Figure 1 Padang Watershed Area

Material and utility of research using map of Padang watershed, water samples at two (2) outlets of Padang watershed, metre, filter paper, bottle, GPS and stop watch. Sampling of water at two outlet by using explorative survey method by using modification of sediment sampler (*U.S.D.H* 48) on depth intergrating suspended sediment sampler. Samples was taken at three (3) locates (left, centre and right) of surface river body. Stream flow of river determined on dictance of flow per second at each outlet where taken that water sample. The width of wet section obtained by multiply depth and wide of river. Debit of streamflow at each outlet determined by using DLAS equation (Chow, 1959 *dalam* Asdak, 2002) : Q = V A, where Q = streamflow (m/s), V = velocity of streamflow (m/s) dan A = width of wet section of streamflow (m^2).

Results and Discussion

The results of research showed that there were positive correlation between sediment concentration and streamflow (after rain) at upstream and downstream of Padang watershed (Figure 2 and 3). Sediment concentration increased refering to increasing streamflow significantly. As a matter of fact that land use of downstream zone extensively advantaged for plantation land primarily for palm oil and rubber crop. Mostly land surface at plantation has no cover crop and only covered by legumes crop that planted in strips narrow.

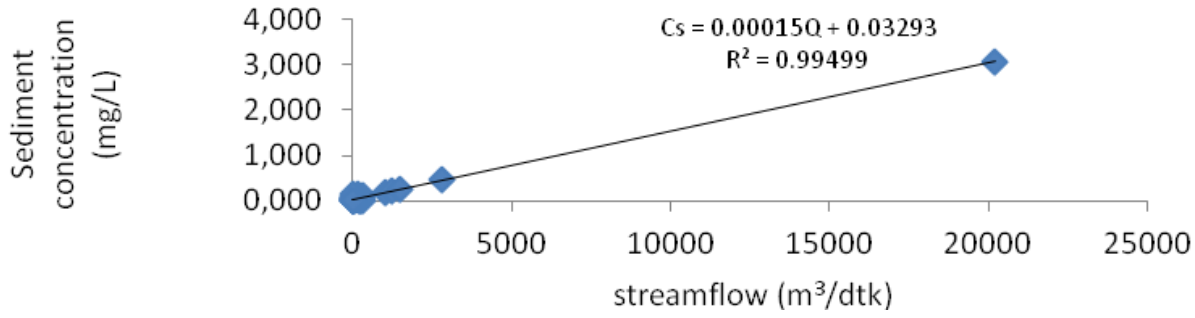

Figure 2. Streamflow and Sediment Concentration at Downstream of Padang Watershed After Rain (July - December 2012)

Intensity of daily rain at downstream of Padang watershed was maximum (27,7 mm) in August and minimum (7 mm) in December (based on Station of Meteorology, Climatology and Geography at Rambutan, Tebingtinggi). However amount of rainy day in October is the highest than another month.

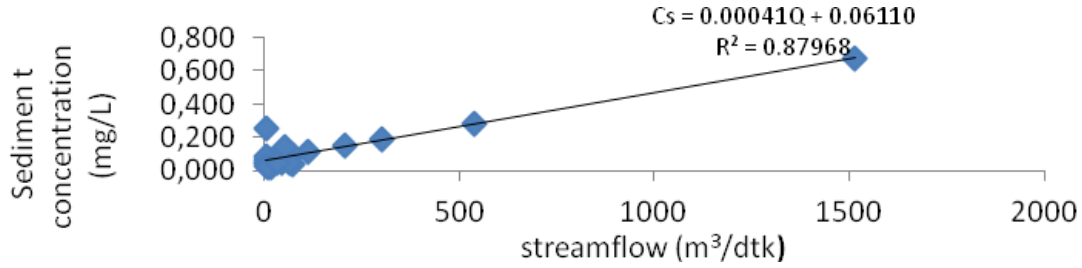

Figure 3. Streamflow and Sediment Concentration at Upstream of Padang Watershed After Rain (July - December 2012)

The results of research showed that there were no correlation between sediment concentration and stream flow (no rain) at upstream and downstream of Padang watershed (Figure 4 and 5). Stream flow at downstream at no rain tends as flat line caused by there were less tranpor of sediment load to another part especially at downstream. The riverbody at downstream larger than at upstream, therefore sediment load spread widely. `Intensity of daily rain at upstream of Padang watershed was maximum (16,1 mm) in November with sixteen rainy days and minimum in July with four rainy days (based on Station of Meteorology, Climatology and Geography at Berohol and Monaco, Sipispis).

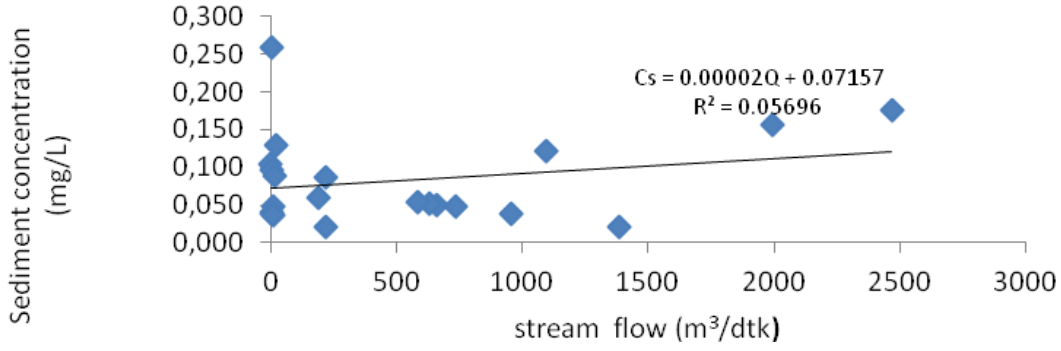

Figure 4. Stream flow and Sediment Concentration at Downstream of Padang Watershed at NoRain (July -December 2012)

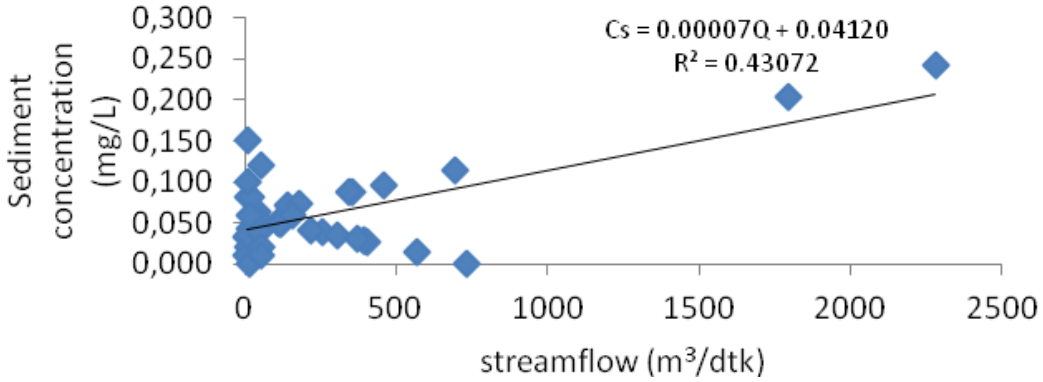

Figure 5. Streamflow and Sediment Concentration at Upstream of Padang Watershed at No Rain (July - December 2012)

Conclusions

There was correlation between streamflow and sediment concentration at upstream and down stream of Padang watershed after rain (July - December 2012). Sediment concentration increased as intensity of daily rain increased. Increasing of streamflow at rain season accumulated load of sediment concentration at two outlet of that watershed. Correlation at downstream of Padang waterdhe higher than downstream of Padang watershed a result of agricultural activities to being a result of a variety of human activities, increasingly associated with urban and suburban development. Sampling sediment sample must be added until one year to see effect of daily rain intensity and total sediment concentration in one year.

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