

## Hubungan antara banjir dengan kerusakan ekosistem: studi kasus daerah aliran Bengawan Solo Hilir

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### Abstrak

#### **ABSTRAK**

Fluktuasi debit sungai di daerah aliran Bengawan Solo Hilir sangat tinggi, hal ini mengakibatkan terjadinya banjir pada musim penghujan dan kekeringan pada musim kemarau. Debit sungai yang tinggi akan menyulitkan dalam pemanfaatan sumber daya air baik secara kuantitas maupun kualitas. Debit sungai di daerah aliran Bengawan Solo Hilir berbanding lurus dengan intensitas curah hujan artinya curah hujan yang tinggi akan mempengaruhi secara langsung terhadap besarnya debit sungai di daerah aliran Bengawan Solo Hilir. Dihak lain kapasitas peresapan (infiltrasi) di daerah aliran Bengawan Solo Hilir sangat kecil.

Penggunaan lahan yang berbeda pada setiap daerah aliran sungai akan mengakibatkan perbedaan jumlah air hujan yang sampai dipermukaan tanah; hal ini akan mempengaruhi besar-kecilnya aliran air limpasan (water run off).

Adanya tanaman penutup lahan (cover crops) akan memperkecil volume dan kecepatan aliran permukaan dan dapat meningkatkan kapasitas peresapan suatu daerah aliran sungai. Penelitian ini dilaksanakan untuk mengkaji hubungan antara banjir dengan kerusakan ekosistem di daerah aliran Bengawan Solo Hilir.

Indikator kerusakan ekosistem yang diukur adalah : debit banjir pada sungai utama (Bengawan Solo) dan cabang-cabang sungai, kapasitas sungai, curah hujan, kapasitas peresapan, sedimen terangkut dan luas tata guna lahan di daerah aliran Bengawan Solo Hilir. Data yang terkumpul dianalisis untuk mencari hubungan antara kerusakan komponen ekosistem dengan bencana banjir yang terjadi di daerah aliran Bengawan Solo Hilir.

Dari hasil analisis tersebut diperoleh suatu bentuk hubungan komponen ekosistem dengan bencana banjir sebagai berikut :

1) semakin tinggi curah hujan akan semakin besar debit banjir,

2) semakin sempit luas vegetasi penutup lahan (cover crops) semakin kecil tingkat peresapan air ke dalam tanah,

3) semakin meningkat debit banjir semakin meningkat pula erosivitas lahan dan semakin tinggi tingkat sedimentasi serta semakin menurun kapasitas sungai.

Dalam upaya menurunkan debit banjir agar sesuai dengan kapasitas sungai (full bank flow) maka perlu dilakukan upaya peningkatan kapasitas peresapan, penurunan kecepatan dan volume aliran permukaan (run

of]) dengan mempertebal profit tanah di daerah aliran Bengawan Solo Hilir, memperluas lahan bervegetasi (cover crops) dengan pepohonan yang mempunyai fungsi konservasi.

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Dari hasil perhitungan debit sungai pada setiap sub daerah aliran sungai (Y), pengukuran luas sub daerah aliran sungai (X1), curah hujan (X2), pengukuran luas vegetasi penutup lahan (cover crops) (X3), pengukuran peresapan (X4) serta mengevaluasi kegiatan manusia di setiap sub daerah aliran sungai (C), maka banjir di daerah Bengawan Solo Hilir merupakan fungsi dari (X1,X2,X3,X4 dan C) dari hasil hubungan tersebut didapat bentuk hubungan sebagai berikut :

<br><br>

$$(1) \text{ S.Wulung : } Y = 0,1156X_1 + 0,0016X_2 - 0,0011X_3 - 0,0405X_4 + 0,9244C$$

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$$(2) \text{ S.Grabagan : } Y = 0,0320X_1 + 0,0040X_2 - 0,0219X_3 - 0,02323X_4 + 0,970C$$

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$$(3) \text{ S.Tinggang : } Y = 0,0212X_1 + 0,0040X_2 - 0,0086X_3 - 0,0140X_4 + 0,953C$$

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$$(4) \text{ S.Batokan : } Y = 0,0509X_1 + 0,0024X_2 - 0,0051X_3 - 0,0358X_4 + 0,9031C$$

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$$(5) \text{ S.Gandong : } Y = 0,0630X_1 + 0,0019X_2 - 0,0066X_3 - 0,0440X_4 + 0,8830C$$

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$$(6) \text{ S.Tidu : } Y = 0,02673X_1 + 0,0020X_2 - 0,0056X_3 - 0,0018X_4 + 0,944C$$

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$$(7) \text{ S.Kening : } Y = 4,1870X_1 + 4,0013X_2 - 0,0057X_3 - 0,0113X_4 + 0,6865C$$

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$$(8) \text{ S.Pacal : } Y = 0,0967X_1 + 0,0018X_2 - 0,0083X_3 - 0,0727X_4 + 0,8205C$$

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$$(9) \text{ S.Besuki : } Y = 0,0276X_1 + 0,0024X_2 - 0,0092X_3 - 0,0285X_4 + 0,9414C$$

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$$(10) \text{ S.Merkuris : } Y = 0,2183X_1 + 0,0026X_2 - 0,0099X_3 - 0,01653X_4 +$$

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$$(13) \text{ S.Serning : } Y = 0,0594X_1 + 0,0014X_2 - 0,0029X_3 - 0,0415X_4 + 0,8889C$$

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$$(14) \text{ S.Brangkal : } Y = 0,0685X_1 + 0,0013X_2 - 0,0037X_3 - 0,0414X_4 + 0,8857C$$

$$(15) \text{ S.Semarmendem: } Y = 0,0614X_1 + 0,0013X_2 - 0,0030X_3 - 0,043X_4 + 0,8882C$$

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Dari persamaan tersebut di atas dapat disimpulkan bahwa banjir di daerah Bengawan Solo Hilir sebagian besar disebabkan oleh kegiatan manusia yang berada di sub daerah aliran sungai. Untuk menurunkan debit banjir dan meningkatkan kapasitas resapan perlu dibuat sumur resapan sebanyak 272 (dua ratus tujuh puluh dua) unit sumur resapan.

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Pustaka : 41 literatur dan artikel terbitan 1968 - 1994

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<b>ABSTRACT</b><br>

The fluctuation of the water flow in Bengawan Solo Lower Stream catchments area is very high. This is the reason why flood is encountered during the wet season and dryness in the dry season. The flow of the river causes difficulties in utilizing the water resources, both in quality as well as in quantity. The river water flow in Bengawan Solo Lower Stream catchments area is directly proportional to the rainfall intensity, which means that the higher the rain fall intensity the higher river flow in Bengawan Solo Lower Stream catchments area. On the other hand the infiltration rate of the water in Bengawan Solo Lower Stream catchments area is too low. The difference of land use in the Bengawan Solo Lower Stream catchments area causes a difference in the rain water volume reaching the land surface, affecting the rate of water run off. The existence of cover crops can reduce the volume and velocity of water run off and increase the infiltration rate of a catchments area. This study is conducted to assess the correlation between flood and ecosystem destruction in the Bengawan Solo Lower Stream catchments area. The indicators of the ecosystem destruction which will be measure are : the main stream (Bengawan Solo Lower Stream) and its tributaries discharge, river capacity, rain fall, infiltration capacity, sediment loads, and land use area at each sub catchments area. All the data collected will be analyzed to be use as parameters of the correlation between flood and the ecosystem destruction at bengawan Solo Lower Stream catchments area. The result of the data analysis at Bengawan Solo Lower Stream catchments area are as follows :

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1. The higher the rain fall intensity, the higher the flood discharge.

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2. The narrower the cover crops area, the lesser the infiltration capacity.

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3. The higher the discharge the higher the erosion and the higher sedimentation rate, resulting in the decrease of the river capacity.

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In order to reduce the peak river discharge so as to match the river capacity (full bank flow) the infiltration capacity needs to be enhanced, the velocity and volume of water run off needs to be reduced by thickening the soil profile at Bengawan Solo Lower Stream catchments area, widening the cover crops area and planting vegetation which have conservation function. Based on the calculation of river discharge (Y) at each sub catchments area, area measurement of the sub catchments area (X1), measurement of the rain fall intensity (X2), measurement of the cover crops area (X3), measurement of the infiltration capacity (X4) and by evaluating the human resources activity (C) the result of calculation as follows:

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(1) S.Wulung :  $Y = 0,1156X1 + 0,0016X2 - 0,0011X3 - 0,0405X4 + 0,9244C$

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From the above equations it can be concluded that floods at Bengawan Solo Lower Stream catchments area is more due to human resources activities in the sub catchments area. Bengawan Solo Lower Stream catchments area is characterized by many meanders, high sedimentation, and the horizontal erosion which more intensive than the vertical erosion. Most of rain water (90%) falling in Bengawan Solo Lower Stream becomes run off water while (10%) will infiltrate into the ground. The land use in the Bengawan Solo Lower Stream catchments area may be divided into 6 (six) groups i.e. forest, bushes, dry land, rice fields and swamps. Floods normally occur in December up to March.

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In order to limit floods discharge and increase infiltration capacity reforestation is required in each sub catchments area of rivers which is estimated as follows :

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$$(1) \text{ Wulung R : } 311 \text{ km}^2 (72,66 \%),$$

$$(2) \text{ Grabagan R: } 79 \text{ km}^2 (72,48 \%),$$

$$(3) \text{ Tinggang R: } 80 \text{ km}^2 (66,12 \%),$$

$$(4) \text{ Batokan R: } 147 \text{ km}^2 (70,33 \%),$$

$$(5) \text{ Gandong R: } 176 \text{ km}^2 (69,74 \%),$$

$$(6) \text{ Tidu R: } 91 \text{ km}^2 (69,74 \%),$$

$$(7) \text{ Kening R: } 512 \text{ km}^2 (62,21 \%),$$

- (8) Pacal R: 269 km<sup>2</sup> (75,14 %),
- (9) Besuki R: 98 km<sup>2</sup> (75,38 %),
- (10) Merkuris R: 81 km<sup>2</sup> (75,70 %),
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- (15) Semarmendem R: 230 km<sup>2</sup> (65,71 %).

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Floods can be reduced so as to match the river capacity (full bank flow) if 55,95 % to 75,70 % of the Bengawan Solo Lower Stream catchments area which is in the form of forest with conservation function, while in the settlement areas 272 infiltration wells are required.

<br><br>

References : 41 Textbooks and articles, published during period 1986 - 1994;<b>ABSTRAK</b><br>

Fluctuation of river discharge in the Bengawan Solo Lower Stream area is very high, this causes the occurrence of floods during the rainy season and drought during the dry season. High discharge will affect the utilization of water resources both in quantity and quality. Discharge in the Bengawan Solo Lower Stream area is directly proportional to the intensity of rainfall, meaning that high rainfall will directly affect the magnitude of discharge in the Bengawan Solo Lower Stream. On the other hand, infiltration capacity in the Bengawan Solo Lower Stream area is very small.

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Use of land in each river area will cause differences in the amount of water that reaches the ground surface; this will affect the magnitude of surface runoff (water run off).

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The presence of cover crops (cover crops) will reduce the volume and speed of surface runoff and can increase the infiltration capacity of a river area. This research was conducted to study the relationship between floods and ecosystem damage in the Bengawan Solo Lower Stream area.

Indicators of ecosystem damage that are measured are: flood discharge in the main river (Bengawan Solo) and branch rivers, river capacity, rainfall, infiltration capacity, sediment transport and land use in the Bengawan Solo Lower Stream area. Data that are collected are analyzed to find the relationship between ecosystem components and flood disasters that occur in the Bengawan Solo Lower Stream area.

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From the analysis results, a form of relationship between ecosystem components and flood disasters is obtained as follows:

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1) The higher the rainfall, the greater the flood discharge,

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2) The narrower the cover crop area (cover crops), the smaller the infiltration of water into the ground,

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3) semakin meningkat debit banjir semakin meningkat pula erosivitas lahan dan semakin tinggi tingkat sedimentasi serta semakin menurun kapasitas sungai.

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Dalam upaya menurunkan debit banjir agar sesuai dengan kapasitas sungai (full bank flow) maka perlu dilakukan upaya peningkatan kapasitas peresapan, penurunan kecepatan dan volume aliran permukaan (run of)] dengan mempertebal profit tanah di daerah aliran Bengawan Solo Hilir, memperluas lahan bervegetasi (cover crops) dengan pepohonan yang mempunyai fungsi konservasi.

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Floods can be reduced so as to match the river capacity (full bank flow) if 55,95 % to 75,70 % of the Bengawan Solo Lower Stream catchments area which is in the form of forest with conservation function, while in the settlement areas 272 infiltration wells are required.

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References : 41 Textbooks and articles, published during period 1986 - 1994