

## INTISARI

### PEMODELAN SPASIAL EKOLOGIS UNTUK OPTIMALISASI PENGGUNAAN LAHAN DAERAH ALIRAN SUNGAI (KASUS DI DAS SOLO HULU)

Oleh : S e n a w i

Musibah banjir, longsor lahan, kekeringan, dan meluasnya lahan kritis sekarang menjadi ancaman besar bangsa Indonesia. Banyak pihak yakin bahwa masalah lingkungan tersebut timbul karena adanya kesalahan bentuk penggunaan lahan daerah aliran sungai (DAS). Penelitian ini bertujuan mengungkap karakteristik dan potensi biogeofisik DAS; kesesuaian spasial ekologis dan dampak penggunaan lahan aktual terhadap tata air, erosi tanah dan degradasi lahan; nilai faktor konversi bentuk penggunaan lahan; dan luas lahan hutan optimal DAS.

Penelitian dilakukan dengan metode survei pada 21 Sub-DAS dari DAS Solo Hulu. Karakteristik biogeofisik DAS disederhanakan melalui pemodelan spasial ekologis bentanglahan menggunakan pendekatan genesis geomorfologi bentuklahan dengan kerangka kerja satuan lahan. Pemetaan satuan lahan dilakukan dengan teknik *overlay* komponen bentuklahan, kemiringan lahan, jenis tanah, dan penggunaan lahan. Perolehan data biogeofisik lahan dilakukan melalui interpretasi citra Landsat ETM, peta-peta tematik, survei lapangan dan diolah dengan sistem informasi geografis. Kesesuaian spasial ekologis penggunaan lahan aktual dianalisis secara matching terhadap arahan fungsi kawasan dan kelas kemampuan lahan. Besarnya erosi tanah diperhitungkan dengan metode USLE. Neraca air dianalisis menurut fungsi meteorologis dengan metode Thornthwaite dan Mather. Optimalisasi penggunaan lahan DAS dilakukan melalui pemodelan kuantitatif dengan *linear programming* menggunakan program QSB+.

Hasil penelitian menunjukkan bahwa satuan lahan dengan keseragaman bentuklahan, kemiringan lahan, jenis tanah, dan bentuk penggunaan lahan secara fisik dapat sebagai model spasial ekologis bentanglahan dan layak digunakan untuk dasar evaluasi dan optimalisasi penggunaan lahan DAS. Penggunaan lahan aktual terbukti banyak yang tidak sesuai karakteristik dan potensi biogeofisik DAS, sehingga menghasilkan erosi tanah yang mengakibatkan terjadinya degradasi lahan, kekeringan di musim kemarau, dan banjir di musim hujan. Lahan hutan terbukti memiliki kemampuan pengendalian tata air dan erosi tanah paling baik dibanding penggunaan lahan yang lain. Keberadaan hutan pada suatu DAS lebih diperlukan untuk fungsi pengaturan tata air daripada fungsi pengendalian erosi tanah. Kebutuhan luas hutan optimal setiap DAS tidak sama, tergantung genesis geomorfologi bentuklahan, kepekaan tanah, kemiringan lahan, dan komposisi penggunaan lahan yang lain. Luas hutan optimal Sub-DAS denudasi berkisar 25,71 – 70,56 % (rerata 42,89 %), Sub-DAS vulkanis berkisar 0,00 – 74,33 % (rerata 34,92 %), Sub-DAS solusional (karst) berkisar 12,62 – 27,22 % (rerata 21,85 %) dengan rerata secara umum 35,71 % luas Sub-DAS.

Kata kunci : karakteristik satuan lahan, tata air, erosi tanah, luas hutan optimal DAS

## ABSTRACT

### SPATIAL ECOLOGY MODELLING FOR WATERSHED LAND-USE OPTIMIZATION (CASE AT UPPER SOLO WATERSHED)

S e n a w i

Floods, landslides, droughts and enlargement of critical land currently become serious threat to Indonesia. Some people believe that those environment problems occurred were caused by forest resource degradation and/ or failures in land-use allocation of a watershed. The study aimed to comprehensively reveal: condition of landscape and biogeophysic characters of a watershed; spatial-ecology suitability of actual land-use and its impacts on water balance and soil erosion; advantages of forestland compared to other land-uses in controlling water balance and soil erosion; and coverage of forestland area based on optimization of a watershed land-use allocation.

The study was done in 21 sub-watersheds of Upper Solo watershed. Biogeophysic characters of watershed that were varied and complex were simplified through spatial ecology modeling with landscape approach and framework of watershed landform partition into land units. Land units mapping was done by overlaying components of landform, land slope, soil type, and actual land-use. Land biogeophysic data was collected from interpretation of Landsat ETM image, thematic maps, field surveys, and analyzed using Geographical Information System. Spatial-ecology suitability of actual land-use in the watershed was analyzed by comparing recommended function allocation of land units to actual function of land-use. Soil erosion rate was calculated based on USLE method. Water balance was analyzed based on meteorology function using Thornthwaite and Mather method. Optimization of watershed land-use was done by quantitative modeling through linear programming using QSB+.

The results showed that land unit with identical landform, slope, soil type, and land-use, was physically appropriate as a land spatial-ecology model that could be used to evaluate land-use system in a watershed. Actual land-use showed that it was foremost negatively unsuited to spatial-ecology condition of the landscape and biogeophysic characters of watershed that resulted in excessive soil erosion that induced land degradation, drought in dry seasons, and flood threat during rainy seasons. Forestland had shown the best ability in controlling water balance and soil erosion compared to other land-uses. The presence of forest land was more as water balance control rather than soil erosion control. Based on optimization of watershed land-use, it was revealed that optimal coverage of forestland in each watershed was varied, depended on geomorphology genesis, land slope, other land uses composition in the watershed. Optimal forest land on denudation sub-watershed ranged 25,71 – 70,56% (average 42,89%), Sub-watershed volcan rangen 0,00 – 74,33% (average 34,92%), Sub-watershed karst ranged 12,62 – 27,22% (average 21,85%) with general average was 35,71% of total area of sub-watershed.

Keywords: land unit characters, water balance, soil erosion, watershed optimal forestland

