Economic Valuation of Land Use Changes in Besai Watershed – Tulangbawang, Lampung

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Abstract

Population pressure on land in watershed causes land-use changes. The study showed that conversion of forest to coffee plantation increased soil erosion and run-off, and inturn increased fluctuation of stream-flow in Besai. These changes resulted in higher erosion, higher stream discharge in wet seasons (35,9 cms) and lower in dry seasons (7.7 cms). This situation causes some losses in availability of water for irrigation, municipal used, and Besai hydropower plant. This loss has decreased the production of electricity in Besai Hydropower Plant, because the minimum stream discharge required to run the hydropower plant is 8.5 cms.
Simulation technique using Answeres model in this study showed that coffee plantation should be developed on coffee based agroforestry sistems with adequate soil and water conservation techniques to minimize adverse impact of the landuse changes.

Extended Summary

In a watershed, as a system of hydrology, interdependencies between upstream and downstream should always be considered in land use planning and management. Poor management in upstream area such as conversion of forest to unsustainable agriculture system can be detrimental to downstream area in the form of flood and/or drought.

In Besai watershed, Lampung, land-use changes occurring very rapidly especially from forest to coffee plantation. Forest area was decreased significantly, from 42 % of the watershed area in 1970's to 11 % in 1990's. On the other hand, coffee plantation was increased from quite small area (less than 10 %) in 1970's to about 45 % of the total area in 1990's.

Objective of this study were : (1) To study the Impacts of land-use changes on erosion, fluctuation of stream discharges and economic value of the land use changes in Besai Watershed and (2) To formulate alternative recommendations of land use that guarantee sustainable development.

This research was carried out in two steps. The first step was identification of land use changes and its impacts on erosion and hydrological characteristics of the watershed. The rate of erosion in coffee plantations was measured on erosion plot using multislot divisor method while on the

watershed scale was predicted using Answers model. The impact of land use changes on hydrology was evaluated using time series data from Besai watershed during 1975-1998 period. The second step was the evaluation of impact of land-used changes on economic value. The value of impact of land-use changes were estimated using: (i) changes in productivity approach, (ii) replacement cost approach and (iii) contingent valuation methods.

Results of this study showed that there was a significant change of land use in Besai watershed. The rapid increased of coffee plantation in 1994-1997 period was likely due to monetary crisis in Indonesia and the high prices of coffee . Farmers in Besai watershed tended to increase their family income by expanding their farming areas through conversion of forest area to coffee plantation. The expansion of coffee plantation occurs not only on secondary forest but also on protecting forest such as register 45 Bukit Rigis.

Forest area have been decreased from 42% of watershed area in 1975 to only 8.4% in 1997; at the same time coffee plantation was increased significantly from only 9.9% of total area in 1975 to 71.2% in 1997.

This changes have increased soil erosion from only 12 ton/ha/year when coffee plantation was only 9.9% to about 50 ton/ha/year when coffee area increased to 71% and forest area decreased to only 8.4%. This erosion rate was much higher than the general local tolerable soil loss which was only 22.4 ton/ha/year. The traditional managements of coffee plantation were considered as the major causes of soil erosion in this watershed. There are five types of coffee plantation systems which caused different rate of soil erosion. The system that using rorak and multistrata agroforestry systems were the best system of coffee plantation in the area.

Further results of this study showed that the land use changes have changed the hydrological characteristics of the watershed significantly. Run off coefficient of the watershed was increased from only 0.10 in 1975-1981 period to 0.25 in 1983 – 1998 period where forest cover was only 8.4% and coffee plantation area was 71.2% of the total watershed. Stream discharges in the period of 1975 – 1981 was not fluctuated very much; in the rainy season the stream discharge was 25.4 cubic meter per second (cms) and in dry season was 11.1 cms. However, after the land use changes the stream discharges in rainy season was increased up to 35.9 cms and in dry season was decreased down to 7.7 cms. The decreasing of stream discharges in dry seasons have decreased the production of electricity in Hydropower Plant about 9.6%. This is because the minimum stream discharge required to run the hydropower plant is 8.5 cms

Simulation technique using Answers model in this study showed that coffee plantation should be developed on coffee based agroforestry sistems with adequate soil and water conservation techniques to minimize adverse effect of the landuse changes. This practice will increase direct and indirect benefit such as farm productivity become 35% higher and soil erosion become 80% lower than the existing condition respectively. Even though this practice decreased net benefit to the farmer, the total economic valuation showed that using the techniques of soil and water conservation was still feasible in term of economic value. Furthermore, the soil and water conservation practices gave positive impact to the downstream community such as the increasing availability of water for irrigation, municipal use and to run hydropower plant in the dry seasons

and the reduction of the cost for sediment flushing in the hydropower plant. Total direct benefit become 24% higher and indirect benefit become 26% higher than that in existing condition.

Total benefit received by the community in downstream area due to better environmental management in upstream area, therefore, was much higher than that in upstream area. In contrast, the cost for practicing soil and water conservation techniques was totally born by the farmers in upstream area. To balance the benefit and cost for natural resources protection therefore, the community downstream that receive the benefit, should share the cost for practicing the soil and water conservation techniques. Government should promote rewards and/or compensation to the farmers in upstream area to restore and improve the environmental services to downstream area. These rewards can be given in the form of very low interest rate of conservation credit scheme, very soft loan , and/or cost sharing for practicing soil and water conservation techniques.

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