Economic Valuation of Forest Catchment Conservation: Trade-Offs between Water and Timber Production*

Mohd Shahwahid H. O., Awang Noor A. G., Abdul Rahim N., Zulkifli Y., Razani U.

Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

E-mail of Corresponding Author: msho@econ.upm.edu.my

Key words: forest catchment, economic valuation, conservation, sustainability, land use trade-off.

Introduction

Forested catchments provide multiple goods and services, many of which are joint-production activities. Joint-production is characterised by inter-dependency whereby one use can impose externalities upon others. With growing demand for both water and timber, and the potential adverse impacts of logging on the hydrological attributes of forested catchments, forest managers are paying increasing attention to an integrated water and timber production objective. To assist forest managers, improved methods are needed to evaluate watershed protection benefits in specific sites and to assess the economic trade-offs between timber production and watershed protection objectives. Ultimately, new forest management systems that integrate timber production, watershed protection and other objectives will be required.

A fundamental question is how to assess the potential physical impacts of timber production on reservoir management and downstream activities. Further, there is a need to value and compare the intangible and non-priced benefits of forested catchment protection to the tangible economic benefits of timber production. This need must be addressed since policy makers in developing countries, like Malaysia, require estimates in monetary terms to help them make decisions on land use options. To ensure a comprehensive assessment of all the costs and benefits of different forest land use options and to achieve sustainable forest management, an integrated and multi-disciplinary research amongst the hydrologists, foresters and natural resource economists is necessary. The objectives of the study are (i) to identify the stakeholders or users of the forested catchments, (ii) to model sediment yield in forested catchments under total protection and alternative land use options and, (iii) to value the benefits and costs of managing forested catchments under protection and alternative land use options, and (iv) to determine the trade-offs between these different land use options

Materials and Methods

The theory of joint production between water and timber production in forested catchment adapted from Aylward *et al.* (forthcoming), Beattie et al. and Taylor (1985) and Maler *et al.* (1994) have been used that relate the production of timber and water related production with the environment as an input. The economic framework of formalising the potentiality for joint-production or multiple uses in forested catchment is a comparative assessment of the land use options. The most commonly used assessment method is Benefit-Cost Analysis (BCA) in which all costs and benefits of the options are specified in monetary terms and the net present values (NPV) of each land use option computed. The principles of accounting these costs and benefits have some similarities to that of Reyes et al. and Mendoza (1983), Cruz et al. (1988), and Aylward et al.(1995).

The valuation aspect of the study involves two levels; (i) enumerating the physical impacts of logging, and (ii) conducting a valuation of these physical impacts. The study site selected is the Hulu Langat Forest Reserve (HLFR), located in the State of Selangor, Malaysia. Quantitative estimates of the hydrological impacts can be obtained by transferring the existing data from nearby sites particularly from (Lai et al. 1992 and Low et al. 1971). The soil erosion and sedimentation from status quo no logging and two logging options (total protection (TP), conventional logging (CL) and reduced impact logging (RIL) were computed and their physical impacts upon downstream users particularly hydro-electric power generators and water treatment plants were determined. Information on impacts on timber harvests, and production of treated water and HEP have to be computed by relying on field surveys These physical impacts were monetised using economic valuation techniques, in particular the change in productivity approach.

Results and Discussion

Based on the benefit cost analysis framework described earlier, the NPVs of the two logging options are compared to the base case situation of total catchment protection. Overall, it is observed that logging resulted in higher net present values than the base case situation of catchment protection only under the RIL option. It can be suggested that the status quo use of the catchment as a protected reserve is a less efficient land use option than permitting timber harvesting. The RIL option is superior with 8.1% higher returns than the CP option. Apparently the combined net values of the joint production between timber and water uses can match the net values derived from the catchments when solely protected as raw water supplier for treated water and HEP production opportunities. But the added timber returns from increasing logging area under CL could not outweigh the net benefits from these water uses. There is little advantage in allowing conventional logging when downstream users have to bear losses arising from increased sedimentation. This observation is obtained when conducting an overall evaluation between the land use options of timber versus water without looking at individual contribution by each water use activity. What has happened was that the incremental net benefit gain in three of the compartments is high enough to outweigh the net benefit loss

in the fourth compartment for the RIL option while not for the CL option. This has provided the misleading conclusion that RIL option is an efficient land use in the forested catchments.

One is left to ponder on the appropriate trade-off decision. Whether it is a decision to allow only RIL in all the catchments or to permit logging, even under the conventional method, in HEP catchments only and not in the catchment functioning as a water impoundment for the water treatment plant. Water serves different purposes for the water treatment and HEP plants. The water treatment plant requires quantity and quality water since they produce treated water for consumptive purposes. The cost of treating raw water by the treatment plant is dependent on sediment concentration. Whereas the HEP plants need continuous water flow to turn the turbines with water quality, in terms of sediment concentration, not being critical as long as the sediments are trapped in the intake ponds prior to flowing into in-feed pipes.

The compartment level analysis has helped us identify that the central issue of joint productions in forested catchment. The issue is not the selection between logging methods to adopt but rather which water use can be combined or is compatible with timber production that can generate greater NPV than the status quo CP option. Under both logging methods, the returns from timber cannot meet that from the status quo production of treated water. It can be concluded that if joint production involving timber and the two water uses is to be permitted, it can only be done in HEP catchments. The efficient choice between the two logging methods is the RIL option owing to the higher returns and the lower externality imposed upon the status quo water users.

It should be noted too that the above finding is obtained without incorporating the tangible benefits from sustainable harvesting of non-wood commodities and the intangible benefits from bio-diversity conservation, carbon sequestration and aesthetic values, which are more likely to be greater in a CP option. Thus, as much as the finding indicates the superiority of logging in forested HEP catchment, it is not a blanket support. Not until impacts on these other attributes are incorporated in the study.

Conclusions

In this study, the trade-offs between three land use options in forested catchments are evaluated. Although forested catchments provide natural resource commodities, bio-diversity conservation, and environmental services, only two tangible goods are considered in this study: timber and water. Thus, the outcome of this study is conditionally qualified and due consideration be given on the net change in values of the other attributes of the catchment under the various land use options.

Analysis at the compartment level suggests that the central issue of joint production in forested catchment is not the selection between logging methods to adopt but rather which water use can be combined with timber production that can generate greater NPV than the status quo CP option. The returns from timber cannot meet that from the status quo production of treated water under both logging methods. But, complementing water uses with logging in forested catchments is efficient in HEP catchments. The efficient choice between the two logging methods is the RIL option owing to the higher returns and the lower externality imposed upon the status quo water users. Nevertheless, the RIL option still generates sediment load, which imposes substantial external costs on the downstream water users.

Benefits from the study

Research findings on economic trade-offs between alternative land uses of forested catchments.

Capacity building for interested researchers and government officers in the area of economic valuation applications. Serve as resource person in several training workshops on economic valuation sponsored by DANCED, WWF and UNEP/ MATREM.

The study also accounted for several publications of research findings, presentations at national and international conferences, articles in academic Journals, and in addition benefited two postgraduates.

Literature cited in the text

Aylward, B., Abdul Rahim N., Mohd Shahwahid, H.O., Awang Noor, A.G. and Zulkifli Y. (Forthcoming). Timber Production Versus Watershed Protection in the Humid Tropics: An Overview of the Issues in Malaysia. A paper submitted to the Environmental Economics Programme Discussion Paper Series.

Aylward, B., Echeverria, J. and Barbier, E.B. 1995. Economic Incentives for Watershed Protection: A Report on an Ongoing Study of Arenal, Costa Rica. CREED Working Paper Series No. 3.

Beattie, B.R. and Taylor, C.R. 1985. The economics of production. John Wiley & Sons, New York.

Cruz, W., Francisco, H.A. and Conway, Z.T. 1988. The on-site and downstream costs of soil erosion in the Magat and Pantanbagan Watersheds. Journal of Philippine Development 15(1) 85-111.

Lai, F.S. 1992. Sediment and solute yields from logged, steep upland catchment in Peninsular Malaysia. Unpublished Ph.D. Thesis. University of Manchester.

Low, K.S. 1971. Rainfall and runoff on the Sungai Lui Catchment, West Malaysia. Unpublished Ph.D. Thesis. University of Hull.

Maler, K.G., Gren, I.M. and Folke, C. 1994. Multiple use of environmental resources: a household production function approach to valuing natural capital. Beijer Reprint Series No. 23.

Reyes, M.R. and Mendoza, V.B. 1983. The Pantabangan watershed management and erosion control project. In Hamilton L.S. (1983) ed. 485-556. Forest and watershed development and conservation in Asia and the Pacific. Westview Press, Boulder, Colorado.

Project Publications in Refereed Journals

Mohd Shahwahid, H.O. and Awang Noor, A.G . 1998. Economic Rent from Hardwood Timber Extraction in the West Coast of Peninsular Malaysia. *Malaysian Journal of Agricultural Economics (MJAE).* 12: 1-15.

Mohd Shahwahid, H.O. and Awang Noor, A.G . 1999 'Estimating The Non-Timber Value of Forest: Beginning With Natural Stands of Rattan'. *Tropical Biodiversity.* 6(3):161-177.

Mohd Shahwahid, H.O., Awang Noor, A.G., Abdul Rahim, N., Zulkifli, Y. and Razani, U. 1999. Trade-offs on Competing Uses of a Peninsular Malaysian Forested Catchment. Environment and Development Economics 4(4): 281-314.

Project Publications in Conference Proceedings

None.

Graduate Research

AHM. Mustain Billah. 2000. Natural Resource Economics [PhD]. Universiti Putra Malaysia.

Chew Chang Guan. 1999. Resource Economics [MS.] Universiti Putra Malaysia.

* *An update of the abstract published in UPM Research Report 1998.*

I·R·P·A INTENSIFICATION OF RESEARCH IN PRIORITY AREAS

Research funded by the Intensification of Research in Priority areas (IRPA) - Supported by IRPA RM-7 (1996-2000), Cycle 1996, Grant 05-02-04-0008.