

on the flows is improved.

The policy response is likely to be governed by national law on Water Resource Management but local government will play a very important role as far as taxation and financial mechanisms are concerned. These issues which are related to the last two questions are scheduled for future research.

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Contact:

Daniel Murdiyarso and Ulrik Ilstedt
Center for International Forestry Research
(CIFOR)
Jl. CIFOR, Situgede, Sindang Barang, Bogor
Indonesia

Email: d.murdiyarso@cgiar.org

RAPID HYDROLOGICAL APPRAISAL (RHA) OF POTENTIAL FOR ENVIRONMENTAL SERVICE REWARDS: procedure and application in Lake Singkarak, West Sumatra, Indonesia

By Meine van Noordwijk

Forest protection as part of watershed management is often (still) considered to provide downstream benefits that may well exceed the local benefits. Especially where hydro-electricity schemes derive substantial economic benefits from the continued flow of water, the concept of payments for watershed protection services has become popular. However, as other articles in this newsletter highlight, there is no shared opinion between scientists, farmers and policy makers about what these services are, how they depend on the condition of the landscape (and the amount of forest that is part of it) and how payments or rewards can be made transparent (linking reward to delivery) and robust (surviving paradigm shifts)¹. To bridge the 'perception' and 'communication' gaps that are likely to exist in the way the local 'forest and water' debate has developed, a form of 'rapid appraisal' is needed to judge how far apart the potential partners in a rewards mechanism are, and to help develop a mechanism that is transparent and robust.

A recent report² presents results of such a 'rapid appraisal' during a 6-months period of the hydrological situation in the Singkarak Basin in West Sumatera (Indonesia) in the context of the development of payments for environmental services (ES) that are aimed

at rewarding the upland poor for protection and/or rehabilitation of watershed functions. Lake Singkarak is one of six 'action research' sites of the RUPES network³.

The local government unit (*Nagari*) of Paningahan, almost coinciding with the most forested of the lakeside subcatchments has become an action research site for the RUPES project. The main 'issue' is the relationship between the hydro-electricity project (HEPP, PLTA Singkarak), the fluctuations in the level of the lake, the water quality in the lake and the land cover of the catchment areas that contribute water to the lake. Current payments made by the PLTA to the local government can, in part, be seen as rewards for maintaining or improving environmental services.

The appraisal (with a focus on cost-effectiveness) was based on five components:

- Search of the literature and web-based resources on the area and initial 'scoping' meeting with key stakeholders,
- Spatial analysis of the landscape based on remotely sensed imagery and available maps and digital data,
- Exploration of local ecological knowledge of the landscape, water movement and consequences of land use options,
- Discussions with a wide range of stakeholders and policy makers on issues of land use and hydrological functions,
- Modeling of the water balance and water use in the landscape to explore scenarios of plausible land cover change and their likely impacts on key performance indicators with the GenRiver model.

The major land cover types in the Singkarak Basin are rice fields (17%), agricultural crops (15%) and forest (15%). Rice fields occur in the lowland area, below 1000 m asl and with slopes of < 30%.

The main conclusions of the consultations are that there is broad agreement on 'objectives' such as the need to maintain a clean lake, productive landscapes on hills and irrigated plains that meet the expectations of the high population density as well as produce electricity for the provinces of West Sumatera and Riau.

There is a widely held perception that the current landscape is *not* meeting all these expectations: the PLTA is not able to provide as much electricity as was expected, the fluctuations in the level of the lake are a concern to the people surrounding the lake, the water quality of the lake is a concern, the population of the endemic fish (*ikan bilih*) is declining and previous efforts to rehabilitate the Imperata grassland (*alang alang*) in the area have not been very successful.

Much of the debate is focused on *proposed solutions* and especially on the relative merits of 'reforestation' and the various alternative ways to achieve 'land rehabilitation'. While for many policy makers reforestation, either using the local *Pinus merkusii* or other fast growing tree species is the main approach, villagers in Paningahan are convinced that streams dry up in the dry season after reforestation with pine trees, while the natural forest is providing regular stream flows. The water balance model with the default parameter values for Pine tree confirmed a higher water use by canopy interception and transpiration compared to more open land-scapes, but

no substantial difference with natural forest. Impacts of land cover via soil properties may need to be further tested. Further hydrological distinctions between the limestone and granite parts of the landscape are needed as well

Overall the *water balance model* suggested that the possible performance of the PLTA is only mildly influenced by land cover within the range of scenarios tested. Compared to the current land use mosaic an increase of 5% or a decrease of 5% of the maximum electricity production can be expected, while the variation between 'wet' and 'dry' years of the 1991-2002 period is much larger. Details of PLTA lake management matter a lot. A change in mean annual rainfall under the influence of global climate change will have a strong effect on PLTA performance. Declining water quality in the lake leading to weed infestation will offset any gains in water supply that could result from 'land degradation'. Reforestation with fast growing evergreen trees will have a mildly negative effect on water usable by the PLTA.

A basic assumption for 'payments for environmental services' is that the supply of these services does depend on activities of those 'rewarded'. For the PLTA this assumption is not supported by much evidence... Payments made by the PLTA may have various types of rationale:

- Compensation for damage caused by the HEPP project, to the farmers along the Ombilin river whose waterwheel irrigation systems are disturbed and to farmers with rice fields surrounding the lake affected by increased flooding
- Shared responsibility for maintaining the water quality in the lake as the HEPP project modified outflow rates and increases debris accumulation
- Payments of tax to local government
- Goodwill enhancing payments to the local community
- Payments for environmental services conditional to the delivery of these services.

At this stage the evidence for the last component is relatively weak, and almost absent for the scale level of **avoided degradation** in a single nagari. Efforts of all lake-side nagari's will be needed to deal with the issues of lake water quality, while rehabilitating the other inflows to the lake need at least equal attention.

Further information:

Meine van Noordwijk,
World Agroforestry Centre (ICRAF) South East Asia.

E-mail: m.van-noordwijk@cgiar.org

Notes:

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² Farida, Kevin Jeanes, Dian Kurniasari, Atiek Widayati, Andree Ekadinata, Danan Prasetyo Hadi, Laxman Joshi, Desi Suyamto and Meine van Noordwijk, 2005. Rapid Hydrological Appraisal (RHA) of Singkarak Lake in the context of Rewarding Upland Poor for Environmental Services (RUPES). ICRAF Southeast Asia, Working paper 2005.

³ The RUPES ('Rewarding Upland Poor for the Environmental Services they provide') consortium in which ICRAF, IFAD, IUCN, CIFOR, CI, FF, WWF and other international partners work together

with national partners in (currently) Indonesia, Philippines, Vietnam, China, Thailand, India and Nepal is supporting a network of 'action research sites' and 'national policy review' activities to facilitate such mechanisms. Specific attention is given to 'pro-poor' forms of ES reward mechanisms. Benefits to poor people can come both through the way rewards are channeled and the positive environmental impacts of the decisions they support. <http://www.icraf.org/sea/networks/rupes>

FORESTS, FLOWERS OR FLAMINGOS: what drives the water balance of Lake Nakuru, Kenya?

By Brent Swallow

Lake Nakuru is a very shallow alkaline lake located in Kenya's rift valley, with a surface area of 44 km² and an average depth of 2.5 meters. The Lake is fed by one permanent river (Ngosur) and four seasonal rivers (Njoro, Nderit, Makalia and Lamudhiak), with a total catchment area of 1,800 km². The flamingos that give Lake Nakuru its distinctive pink shoreline are a major biodiversity and tourism resource for Kenya, with over 300,000 local and foreign holiday makers visiting the site each year. A completed fenced national park of 90 km² surrounds Lake Nakuru, providing a habitat to a number of threatened species, including the Black Rhino. Since 1990 the lake has been designated a Ramsar wetland of international importance. However, the lake is threatened by inflows from a number of pollutants and the level of the lake fluctuates: when it is low the flamingos move elsewhere, leading to less tourists. One possible cause of the degradation of the lake waters is the largescale conversion of

forest lands in the catchment, particularly in the eastern Mau forest that forms the headwaters of the Njoro River. The River Njoro flows over 60 kilometres from the eastern slopes of the eastern Mau forest to Lake Nakuru. Its catchment measures approximately 280 km² and has a population of over 300,000 people, including 30,000 who live in Njoro town and 240,000 who live in Nakuru town, including Egerton University and a growing horticultural industry. Given the general debate on 'forest and water', the recent forest conversion in the Mau forest is held responsible for, or expected to result in, a loss of flamingo-based income. Should the park pay for forest conservation?

Land use and forest cover have also changed dramatically in this catchment. It has been estimated that between 1969 and 2004, the percentage of cultivated land in the upper catchment area increased from 13% to 70%, while a corresponding fall in woodland and grassland cover of 87% to 30%. Major changes in hydrology have been noted: the Njoro River has become seasonal instead of permanent and major boreholes have dried up. Annual rainfall in the 1980's and 1990's has been about 10% below the preceding decades, with shifts in the monthly pattern. Water abstraction for flower production is increasing around Lake Nakuru, as the export industry has exploited all water and land resources accessible at the nearby Lake Naivasha.

Nakuru is an '*endorheic*' system, as there is no outflow from the lake and in the long run all rainfall is lost by evapotranspiration in the catchment area. The lake is only a temporary storage, bridging between relatively wet and relatively dry periods. Increased demand for water in the middle reaches of the streams and forest-