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Review: Addressing impacts of land use change with payments for watershed services

The role of payments for watershed services is to enable those downstream, who are affected by watershed degradation, to address upstream sources of impacts that are otherwise beyond their control. But those upstream also face “upstream” sources of impacts that are beyond their control. Land use changes are always local, but are often driven by national level changes including economic stagnation and the adoption of trade and agricultural policies aimed at economic liberalization, in response to the pressures of globalization (Barbier, 2000; Lambin, 2003). These factors have a powerful influence on determining the choices available to farmers and other land users and can undermine local strategies of payments for watershed services if they are not carefully thought through.

Policy influence on land use change is illustrated in a case study of Ban Lak Sip by the International Water Management Institute (Lestrelin, Giordano and Keohavong, 2005), located in the uplands of Laos, where national policies to promote investment in market based agriculture and to eradicate shifting cultivation, led to extensive resettlement of upland populations. Protection of the upland forested areas also reduced the amount of available agricultural land by one third. This resulted in agricultural intensification, which led to land degradation and erosion of soils. The cumulative downstream impacts were also felt across national boundaries, in the 3 other countries of the Lower Mekong river.

Cumulatively, land use changes have significant global consequences that extend beyond hydrology to climate processes also and undermine the capacity of the biosphere to provide the full range of ecosystem services. Many of the consequences are evident in satellite images, that can be seen in the recently released UNEP Atlas of Land Cover Change, and are reviewed in detail in the forthcoming reports of the Millennium Ecosystem Assessment. To put these changes in perspective, according to a review by Foley et al (2005), croplands and pastures cover approximately 40% of the global land surface. Associated with this change is an approximately 70% increase in irrigated areas – the major source of water consumption, a 700% increase in the use of fertilizers - which degrade freshwater and coastal ecosystems, and significant changes in the flow of freshwater. One study shows that clearing of land in the Tocantins river basin led to a 25% increase in river discharge between 1960 and 1995 without any significant changes in rainfall (Costa et al 2003). In addition to the clearing of forests for agriculture, other major types of land use change that have profound impacts on the hydrological cycle are urbanization, wetland drainage, water resources development, and surface mining (Eshleman 2004).

Land use change is an area of extensive research, that in spite of its global scale impacts, can only be addressed through a locally driven approach to understand how the full range of social, economic and biophysical factors interact in a particular location, and ultimately, how they affect human vulnerability. Just as it is generally beyond the reach of local initiatives to address regional and global scale issues, vulnerability is not something that science and international donors and NGOs have been very good at addressing - in spite of their objective to identify universal principles and develop pilot programs that can be applied more broadly, to similar conditions. Given that conditions are never quite the same anywhere, the development of strong local

institutions, including funding arrangements, is an indispensable building block for reaching that so far elusive goal of “scaling up” and harmonizing local and global initiatives (Binswanger, 2004).

An important step that can be taken locally, is to begin to consider the full range of land uses as part of water resource planning. One approach under development is to provide compensation in the form of Green Water Credits, not just for planting of trees and protection of forests, but for all management actions that protect and improve the infiltration and storage capacity of the soil. Green Water refers to the approximately 60% of fresh water that is stored in soil, which is either consumed by vegetation or added to streamflow (Blue Water), via groundwater. Green Water, therefore reduces the damage caused by overland runoff, which erodes topsoil, contributes to sedimentation of reservoirs and waterways, and carries pollutants. In addition to reducing these problems, Green Water Credits could provide a greater return on investment than irrigation and even reservoir development, as well as contributing to poverty alleviation due to the increased productivity of the vast majority of crops that rely on rainfall as well as the increased storage of water in the ground (David Dent, 2005).

Water infiltration and pollutant reduction can be increased through a variety of management practices for which some information sources are provided below. However, it is important to note that this will not be helpful in irrigated areas where groundwater is saline and increased drainage only brings saline water to the surface. This is an issue in New South Wales, where credits are provided for planting trees to prevent groundwater from rising to the surface.

Attempts to link land use with water resource planning may also help to identify policy contradictions and the reforms necessary to achieve recognition of these links. For example, even within local governments, decisions regarding water allocation and development projects that impact hydrology are made in a separate department to decisions on land use planning. These are also major sources of conflict, as well as key impediments to comprehensive planning, even within jurisdictional boundaries.

References and further information

Barbier, E. B. (2000). “Links between economic liberalization and rural resource degradation in the developing regions.” *Agricultural Economics* **23**: 299-310.

Binswanger, H. P. and T.-V. Nguyen (2004). [Scaling up community-development for dummies](#), World Bank (unpublished paper): 42.

DeFries, Ruth, Gregory P. Asner, and Richard Houghton. 2004. Trade-Offs in Land-Use Decisions: Towards a Framework for Assessing Multiple Ecosystem Responses to Land-Use Change. In *Ecosystems and Land Use Change*, edited by R. DeFries, G. P. Asner and R. Houghton. Washington, DC: American Geophysical Union.

DeFries, Ruth, Gregory P. Asner, and Richard Houghton, eds. 2004. *Ecosystems and Land Use Change*. Washington, DC: American Geophysical Union.

DeFries, Ruth, and Keith N. Eshleman. 2004. Land-use change and hydrologic processes: a major focus for the future. *Hydrological Processes* 18:2183-2186.

Dent, D. (2005) [Green Water Credits](#) (pdf). Presentation to the FAO/Netherlands Conference on Water for Food and Ecosystems: Make it happen! On behalf of the Green Water Team: ISRIC-World Soil Information and IFAD. 31 January 2005.

DFID, U. (2005). [From the mountain to the tap: how land use and water management can work for the rural poor](#) (pdf). UK Department for International Development, Forestry Research Programme: 54.

Eshleman, Keith N. 2004. Hydrological Consequences of Land Use Change: A Review of the State-of-Science. In *Ecosystems and Land Use Change*, edited by R. DeFries, G. P. Asner and R. Houghton. Washington, DC: American Geophysical Union.

Foley, Jonathan A., Ruth DeFries, Gregory P. Asner, Carol Barford, Gordon Bonan, Stephen R. Carpenter, F. Stuart Chapin, Michael T. Coe, Gretchen C. Daily, Holly K. Gibbs, Joseph H. Helkowski, Tracey Holloway, Erica A. Howard, Christopher J. Kucharik, Chad Monfreda, Jonathan A. Patz, I. Colin Prentice, Navin Ramankutty, and Peter K. Snyder. 2005. [Global Consequences of Land Use](#) (pdf). *Science* 309:570-574.

Geist HJ, Lambin EF. 2002. [Proximate causes and underlying driving forces of tropical deforestation](#) (pdf). *BioScience* 52(2): 143–50

Lambin, E. F., H. J. Geist, et al. (2003). "[Dynamics of Land-Use and Land-Cover Change in the Tropics](#)."(pdf) *Annual Reviews of Environmental Resources* **28**: 205-41.

Lambin, E.F., Turner, B.L. II, Geist, H.J., Agbola, S., Angelsen, A., Bruce, J.W., Coomes, O., Dirzo, R., Fischer, G., Folke, C., George, P.S., Homewood, K., Imbernon, J., Leemans, R., Li, X., Moran, E.F., Mortimore, M., Ramakrishnan, P.S., Richards, J.F., Skånes, H., Steffen, W., Stone, G.D., Svedin, U., Veldkamp, T., Vogel, C., Xu, J. (2001) [The causes of land-use and land-cover change - Moving beyond the myths](#) (pdf). *Global Environmental Change: Human and Policy Dimensions*. Vol. 11 (4): 261-269

Lestrelin, G., M. Giordano, et al. (2005). [When "conservation" leads to land degradation: Lessons from Ban Lak Sip](#) (pdf). Colombo, Sri Lanka, International Water Management Institute (IWMI): 25.

Millennium Ecosystem Assessment [Reports](#)

Other links:

Soil and water management practices database: [World Overview of Conservation Approaches and Technologies](#) (WOCAT)

Information about [salinity control](#) in New South Wales

List of [Land Use and Land Cover Change publications](#) (1998-2005), from the The Land Use and Land Cover Change (LUCC) Project is a Programme Element of the International Geosphere-Biosphere Programme ([IGBP](#)) and the International Human Dimensions Programme on Global Environmental Change ([IHDP](#)).

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Creating Pro-Poor Markets for Ecosystem Services. High-Level Brainstorming Workshop, 10 – 12 October 2005, London, United Kingdom. Organized by the Division of Environmental Conventions, UNEP in conjunction with the London School of Economics. [Background documents](#)

About the Flows Bulletin

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