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Putting Research Knowledge into Action

Land and Water Resources Management for Upland Farms in Southeast Asia: Some Lessons Learned

Current policies on upland agriculture need reviewing in light of recent research that shows that slash-and-burn farming systems are not only more sustainable than other systems but could also play a better role in sustaining downstream hydropower and river delta rice-bowls.

Key findings

- Partnerships between upland farmers and hydropower developers could help protect future hydropower generation from high erosion rates and reservoir siltation.
- Adaptation to climate change will require a strong focus on stabilizing slopes prone to landslides and more effective management of riparian zones.
- Large-scale commercial biofuel production systems have higher rates of erosion than traditional cropping systems and require strong soil conservation measures.

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The Nam Ngum hydropower facility in Lao PDR that provides energy for domestic and international markets. Accelerated siltation of hydropower dams has significant economic, environmental and social implications.

Upland agriculture

Deforestation and inappropriate agricultural practices have damaged 2 billion hectares of the world's arable land. In spite of global improvements in the management of land resources, unsustainable land use practices result in net losses of cropland productivity estimated to average 0.2%/year. Given the extent of the damage already done, it is imperative that we increase the productivity of arable land in a manner that can sustain both food security and ecosystem services.

In Southeast Asia, an estimated 50 million upland farmers practice slash-and-burn or 'swidden' agriculture. This traditional farming practice of shifting cultivation involves clearing and burning forest plots for cultivation of subsistence crops such as upland rice. These plots are cultivated for one to three seasons and left fallow for between 6 to 15 times the cropping period.

When uplands are cleared of forests and farmed using unsustainable methods, the soil loses nutrients and the soil structure can be permanently damaged. As the land becomes less productive, crop yields fall and lead to increased competition for dwindling resources. Without appropriate interventions, the soil washes away when it rains and the land becomes unusable. The continued rapid clearance of upland vegetation for agriculture is likely to reduce rainwater infiltration, resulting in the higher occurrence of floods and droughts and, eventually, crop failures. Climate change may well amplify the problem.

Long-term studies were undertaken by the French Institute of Research for Development (IRD), International Water Management Institute (IWMI) and their national partners in several small watersheds in Lao PDR, Thailand, Vietnam, Philippines and Indonesia, to quantify how land use change related to a range of farming systems affects soil erosion and the hydrological response of watersheds. In total, 27 upland catchments were analyzed.

What the research tells us

Annual rates of sediment generation under normal rainfall and traditional slash-and-burn systems are, on average, less than one tonne per hectare a year, which is well within natural rates of soil regeneration.

Converting land from traditional slash-and-burn production systems to commercial cash crops such as maize, cassava or tree plantations, particularly non-native species such as rubber, can result in substantial increases in sediment yields (>6-13 t ha^{-1} yr^{-1}) that exceeds the tolerable rate of soil loss of about 2.5 t ha^{-1} yr^{-1}.

Extreme rainfall events, such as typhoons, have a significant impact on soil erosion which can exceed the impact of changes in cropping systems. A single event in Vietnam in July 2003 accounted for 42% of the total sediment yield that year.

Water yields in the dry season are highly responsive to changes in land use. As watersheds are returned to the fallow phase in a slash-and-burn farming cycle, the baseflow in streams in the dry season is significantly reduced, resulting in lower water yields to downstream users. In other words, more forest in the watershed translates into less water and not more.

Changes in land allocation, settlement policies and property rights can significantly, and not always positively, affect soil degradation.

Soil washed away from degraded uplands silts up rivers and water bodies downstream. Implementing sustainable land-use practices can reduce such negative impacts.

The cultivation of slopes using traditional implements results in a significant movement of soil down the slope contributing to the entire erosion process.

Implications for policymakers

Slash-and-burn farming systems can be sustainable. Rates of sediment generation under slash-and-burn systems are well within the bounds of natural replacement. As long as the fallow phase on the rotation is long enough (8-15 years), and the cropping phase is short (1-3 seasons), these systems can rejuvenate and remain highly productive. A key to sustaining slash-and-burn systems is the relative low population density of most upland areas. Depopulation of uplands associated with urbanization and out-migration for off-farm opportunities will help traditional slash-and-burn systems to remain sustainable. For these reasons, a review of current policies encouraging the eradication of slash-and-burn farming systems is warranted.

Promotion of commercial cash cropping systems for maize, jatropha, cassava and perennial tree-based plantations such as teak and rubber should be tied to appropriate conservation methods that minimize sediment generation. Many simple, inexpensive methods are readily available. However, conservation policies using these technologies and approaches need to be formulated and enforced. These may include incentive-based mechanisms such as payments for environmental services (PES) or a National Soil Conservation Act enforceable through a legal framework and institutions (e.g., conservation and extension services). This becomes even more critical in the context of climate change, when severe extreme events are predicted.

Watersheds respond rapidly to changes in land use. Revegetation of catchments either naturally or through plantations will result in declining dry season water yields. This has significant implications for people in communities and industries who depend on these flows. Ideally, provisions will be made to ensure the supply of water in light of land uses in upper catchments. Such provision might include small water storage and supply infrastructures as well as land uses that are diversified to match upland landscapes. As land-use changes are often initiated by changes in property rights or market incentives, such instruments will require an ex-ante impact assessment before being implemented.

Concluding observations

Results from this long-term study have significant implications in view of the different regional and global stress factors and drivers affecting agricultural production. For example, the current regional emphasis on hydropower generation could be undermined by high erosion rates and reservoir siltation. Hydropower developers could protect their investments through partnerships with upland communities that offer economic incentives for the use of conservation agricultural practices in upland watersheds.

The increasing probability of extreme rainfall events - predicted to come with climate change - would drastically increase erosion rates. Preventative, 'no regrets' approaches include a strong focus on stabilizing slopes prone to landslides and more effective management of riparian zones.

Changes in traditional land-use, in particular the shift to large-scale commercial biofuel production will require increased soil conservation measures as these systems showed much higher rates of erosion than traditional cropping systems.

Erosion should be seen as a natural process which requires balancing management interventions with both the positive and negative impacts associated with sediment generation. For instance, in view of the world food crisis and the role that Asian deltas play in global rice supply, sediment-rich floodwater constitutes a natural fertilizing system and must be maintained. This implies a basin approach for any social cost-benefit analysis to consider the impacts of upstream interventions on all types of downstream communities and water uses.

In order to achieve sustainable development and management of land resources that deliver the desired outcomes of enhance productivity, improved livelihoods and the provision of ecosystem services, an integrated approach to land-use management and planning is required. The development of a management plan that considers the social and economic needs of communities living in both the upper watersheds and the lower river basins is a prerequisite.

Source

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The content is, in particular, based on the following externally peer-reviewed publications:

Valentin, C.; Agus, F.; Alamban, R.; Boosaner, A.; Bricquet, J. P.; Chaplot, V.; de Guzman, T.; de Rouw, A.; Janeau, J. L.; Orange, D.; Phachomphonh, K.; Do Duy Phai; Podwojewski, P.; Ribolzi, O.; Silvera, N.; Subagyono, K.; Thiébaux, J. P.; Tran Duc Toan; Vadari, T. 2008. Runoff and sediment losses from 27 upland catchments in Southeast Asia: Impact of rapid land use changes and conservation practices. *Agriculture, Ecosystems and Environment* 128: 225–238.

Clement, F.; Orange, D.; Williams, M.; Mulley, C.; Epprecht, M. 2009. Drivers of afforestation in Northern Vietnam: Assessing local variations using geographically weighted regression. *Applied Geography* 29(4): 561-576.

Other Related IWMI Publications

Open access (electronic version freely accessible via the internet)

Clement, F. 2006. *Understanding farmers' strategies and land use change in the northern uplands of Vietnam.* Water Figures Asia: news of IWMI's work in Asia, 1:4-5.

Clément, F.; Amezaga, J.; Orange, D.; Toan, Tran Duc. 2007. *The impact of government policies on land use in Northern Vietnam: an institutional approach for understanding farmer decisions.* Colombo, Sri Lanka: International Water Management Institute (IWMI). 21p. (IWMI Research Report 112). doi: 10.3910/2009.112

Kurian, M. 2004. *Institutions for integrated water resources management in upland watersheds of Southeast Asia: A comparative analysis of Thailand and Lao PDR.* Colombo, Sri Lanka: International Water Management Institute (IWMI). 25p. (IWMI Working Paper 081). doi: 10.3910/2009.253

Orange, D.; Podwojewski, P.; Toan, Tran Duc; Van Rinh, Pham; Phai, Do Duy; Phuong, Nguten Duy. 2007. *Impact of land-use on bed load transported by rivers in the Dong Cao Watershed, North Vietnam.* Water Figures Asia: news of IWMI's work in Asia, 1: 4-5.

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