SOURCE: BERNARD WAHIHIA / UNEP

ROOTING POLICY IN SCIENCE

The effects of trees on watershed function are complex and confounded, requiring a science of watershed management that is nuanced and adaptable to a variety of specific conditions. Compounded by the many different interests at play in policy choices, poor understanding of watershed processes frequently results in policies and programmes that trade-off human and environmental interests. ***More than a decade of research has shown that watershed policies that balance human and environmental interests can be developed and implemented on the basis of sound scientific evidence relevant to the local context.*** Scientists at the World Agroforestry Centre (ICRAF) and their partners have developed several tools for evaluating the impacts of tree cover and land use on the various watershed functions.

Key Findings

1. Be specific!

Policies and programmes based on specific understanding of the impacts of trees and forests on important watershed functions are most likely to balance hydrologic, environmental and human well-being objectives.

2. Watershed management policies can be evidence-based and locally-relevant

There is positive experience from Africa and Asia of integrating scientific understanding into multi-stakeholder negotiations at the watershed and national levels. In some regions, agroforestry systems, founded on traditional land management practices, provide an important bridge between the interests of communities and policy makers looking for integrated natural resource management solutions.

3. A powerful combination: agroforestry systems, forests and upland cropping

Integrated landscape mosaics, including agroforestry systems, can protect soil, maintain water quality and quantity, and generate livelihood options for larger populations than could be supported by natural forests. ICRAF scientists and collaborators have developed a number of useful tools for targeting and adapting agroforestry systems to different watershed contexts.

Implications for the watershed science – policy nexus:

A paradigm shift in the watershed science – policy nexus is needed across Africa and Asia. Scientific studies need to generate and disseminate data and evidence on watershed management issues that are most important in the local context. Robust policy processes will involve all stakeholders, recognize different interests, and account for variation and uncertainty in key relationships.

- Identify scientific findings most appropriate for the realities on the ground, where decisions are being implemented. Understand the importance of different watershed functions. Don't over-generalize the science!
- Engage in multi-stakeholder policy processes
- Consider the interplay with existing social systems, including indigenous knowledge of the environment and traditional land tenure systems
- Think beyond the forests – mixed agroforestry systems can provide tested and true approaches to managing watersheds

Section 1. Be specific!

Avoiding the over-generalization of knowledge leads to better policies and progammes

Many policies affecting land use in Asia and Africa are based on over-generalizations about the effects of forests on watershed functions. In Asia and Africa, a number of countries have implemented large and costly tree planting initiatives on the assumption that greater tree cover will enhance water quality and reduce flood risk. China's Sloping Land Conversion Programme, 'Green for Grain,' perhaps the largest example, was launched as a rapid and direct response to the devastating floods of the Yangtze and Song rivers in 1998. While apparently achieving some of its afforestation objectives, there has been limited participation by farmers and local governments, and little measured improvement in specific watershed functions. Collaborative research by Chinese institutions and ICRAF has shown the need to make the programme more attractive to farmers and to measure success in terms that are truly connected to flood risk (1, 2).

In many cases, tree planting can actually be part of the problem of watershed management. This is especially true in arid and semi-arid regions, where tree planting can exacerbate water shortages. As research by the World Agroforestry Centre (ICRAF) and other research groups has shown, fast-growing evergreen species can reduce dry-season flows of rivers and streams (3). Combining tree water use measurements with WaNuLCAS, a model developed at ICRAF, will allow scientists to illustrate the impact of tree water use at the landscape-level (3). This combination of techniques can produce context specific scientific findings that are critical to understanding the challenges inherit in watershed management, a necessary step in identifying real solutions.

> "While apparently achieving some of its afforestation objectives, there has been limited participation by farmers and local governments and little measured improvement in specific watershed functions

Green for Grain, China

SOURCE: J.BENNET / ANU CRAWFORD

Section 2. Watershed management policies can be evidence-based and locally-relevant

Southeast Asia is rich in examples of systems in which farmers combine trees for production, remnants of natural forests, and annual food crops. In Indonesia, indigenous agroforestry systems, known as 'Kebun Lindung' or protective gardens, are an excellent opportunity to reconcile development and environment targets (4, 5). Yet, obstacles in the recognition of this useful system remain: they may not meet the legal definitions of 'forest' or be in conflict with the existing land use regulation systems and policies.

Indonesia is one of many Asian countries that maintain policies of state ownership of upland areas, policies inherited from the colonial period and based on 19th century European law (6). Over half of Indonesia's land mass is classified as 'watershed protection forest' and managed by the Forestry Department. The millions of farmers living in those areas thus have insecure land and tree tenure, and disincentives to invest in tree systems. In Indonesia, contemporary debate and conflict over the control of lands designated as 'watershed protection forest' continues to revolve around the watershed functions of forests compared to other land uses. ICRAF scientists and partners in Indonesia have developed an approach they call 'Negotiation Support Systems' to better link science and policy in Indonesian watersheds (7, 8).

The promotion of integrated water resource management has contributed to the institutionalization of multi-stakeholder dialog as a means to resolve water resource conflicts (9). Despite their obvious advantages, these processes can be subject to elite capture and inappropriate intervention (10). The 'Negotiation Support Systems' approach has been implemented by ICRAF and its partners in the Sumberjaya watershed in Sumatra, where there has been severe conflict over land use, in order to address key gaps and differences in knowledge that are communicated through multi-stakeholder fora. The result has been a shift from eviction to negotiation at multiple levels (8).

Section 3. Powerful combinations

Agroforestry systems can be adapted to match a wide range of watershed contexts

Agroforestry systems vary in many respects, including water use and impacts on watershed function. As illustrated in Synthesis 1 in this series, tree species choice is a particularly important determinant of water use. Tree water use in turn affects stream flow. Synthesis 2 in this series focuses on the links between agroforestry, erosion and sedimentation — processes that in turn influence water quality and flood risk. The locations of trees within watersheds have major consequences on those processes.

Agroforestry options can also help resolve the apparent trade-off between maintenance of watershed functions and productive agriculture, by linking the field, farm and landscape levels. Integrated landscape mosaics can protect soil and maintain water quality and quantity, while simultaneously generating livelihood options for larger populations than could be supported by natural forests.

ICRAF and its partners have developed a suite of modeling tools to improve decisions about the adaptation of agroforestry to a range of watershed contexts, at spatial scales from plot to river basin (*www.worldagroforestry.org/sea/products/AFmodels*). These models can be used to address a number of policy-relevant questions: What are the impacts of different configurations of trees in a watershed on sedimentation? What is the potential for modifying upstream land use for achieving downstream benefits in terms of reduced sedimentation or flood risk? When combined with other information about agroforestry, such as farmer returns and market opportunities, the outputs from these models can support good decisions about agroforestry and the management of other tree resources within multi-use landscapes. A smart research approach — called Rapid Hydrological Appraisal (RHA) — has been developed for assessing the potential for providing rewards to upland residents for land uses consistent with desirable watershed functions (11).

Download the models at:

www.worldagroforestry.org/sea/products/AFmodels

SELECT MODELS

WaNuLCAS • Water, Nutrient and Light Capture in Agroforestry Systems

WaNuLCAS was developed to represent tree-soil-crop interactions in a wide range of agroforestry systems where trees and crops overlap in space and/or time. The model can be used for exploring positive and negative interactions for different combinations of trees, crops, soil, climate and management by the farmer.

GenRiver • Generic river flow model

GenRiver is a generic model of river flow in response to spatially explicit rainfall and a plot-level water balance that responds to changes in vegetation and soil.

SpatRain

The SpatRain model was constructed to generate time series of rainfall that are fully compatible with existing station-level records of daily rainfall, but can represent substantially different degrees of spatial correlation. The model can derive daily amounts of rainfall for a grid of observation points by considering the possibility of multiple storm events per day, but not exceeding the long-term maximum of observed station-level rainfall. Options exist for including elevational effects on rainfall amount.

SExI-FS • Spatially Explicit Individual-Based Forest Simulator

The SExI Forest Simulator focuses on tree-tree interactions in a mixed multi-species agroforest, using an object-oriented approach where each tree is represented by an instance of a generic class of tree. The simulated object trees, mimicking real trees, interact through modifying their neighbors' environment. These modifications are mediated through two major resources: space and light. A 3D representation of a one-hectare plot of forest serves as the grounds for the simulation of this competition.

FALLOW • Forest, Agroforest, Low-value Landscape Or Wasteland?

FALLOW is a landscape-dynamics model, that can be used for impact assessment and scenario studies, assisting the negotiation process between stakeholders in a changing landscape by visualizing possible/likely consequences of factors such as changes in commodity prices, population density and human migration, availability of new technology, spatial zoning of land use, pest and disease pressure or climate.

Future Implications

A paradigm shift in the watershed science – policy nexus is needed across Africa and Asia. Scientific studies need to generate and disseminate data and evidence on topics that are most important in the local context. Robust policy processes will involve all stakeholders, recognize different interests, and account for variation and uncertainty in key relationships.

Decentralization of natural resource governance can create a space for policy innovation. Researchers should identify opportunities to provide useful inputs into local policy processes, helping policy makers to go beyond simple generalizations. In any specific context, it will be important to identify the most important watershed functions, to understand the interests in those functions, and to mobilize data and evidence to clarify the links between trees, forests and those functions. Integrated land uses — including agroforestry systems that are profitable to their owners — will often have a greater role than is implied by received wisdom.

The models, tools and approaches developed by ICRAF and its partners can be further adapted for use across the tropics. The experience of ICRAF and its partners also shows the importance of 'boundary organizations.' The analysis of a wide variety of case studies has shown that the mobilization of science and technology for sustainable development is most effective when organizations manage boundaries between knowledge and practice in ways that simultaneously enhance the salience, credibility and legitimacy of the information they produce (12). Improved communication and mediation across the knowledge / practice boundary is equally important as the knowledge that is produced.

SOURCE: MEINE VAN NOORDWIJK / ICRAF

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http://www.worldagroforestry.org/WATER

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