Research, policy and practice in water management

Activities within the Forestry Research Programme (FRP) revealed that many water management policies and practices are at odds with evidence from research. The question is: how to convert new research findings into new policies for improved management of water resources?

Key messages

- There is a need for simple-to-use and validated predictive models that can simulate the effects of changing land use on water supply, water demand and livelihoods.
- Greater understanding and a firmer scientific basis are needed to support the use of fees for environmental services.
- There is a need for cross-sectoral effort by institutions that have traditionally worked in isolation. This applies both to developing countries, and to the way in which water issues are managed by donor agencies.
- Research and policy processes should be more closely linked over the long term.
- Support is required for capacity development in developing country agencies responsible for administration of renewable natural resources.

Introduction

Some national agencies, which have international co-funding, are spending large sums of money on planting trees and erecting soil and water conservation structures in the belief that these will attract rainfall and/or facilitate recharge of groundwater. However, research from the RNRRS Forestry Research Programme (FRP) and beyond shows that many water catchment management policies and practices in developing countries are at best largely ineffectual and at worst counter-productive.

The FRP commissioned a cluster of projects on improved management of upper catchments in Costa Rica, Grenada, India, South Africa and Tanzania, with the aim of examining the validity of current water management policies and practices. Results from three of these studies are presented in this Brief, together with reflections about influencing policy and lessons learned.

Background

It has long been accepted that trees and forests are an essential part of a river catchment area, particularly the headwaters, where they increase water infiltration, prevent excessive runoff, minimise soil erosion and improve dry season flows. As a result, there have been extensive efforts to prevent deforestation and to plant trees, in the hope that this will reverse the declining soil fertility that is causing widespread hunger and poverty in many developing countries.

However, research has begun to question this thinking. For example, a project led by the UK's Institute of Hydrology (1985–1992) investigated

the water consumption of planted eucalypts in Karnataka, India. The results suggested that common belief in the power of trees to attract rainfall and improve dry season stream flows was misplaced (see Box 1).

Improved instrumentation and data logging, together with powerful computer modeling and geographic information systems, now enables assumptions about catchment management to be tested rigorously. It is possible to make more reliable predictions about the influence of proportions and spatial arrangements of vegetation on total and dry season stream flow. However, calibration of predictive models still requires substantial amounts of data.

Box 1. Dispelling the myth: water consumption of eucalypts

A study conducted by the Institute of Hydrology examined the effects of planted eucalypts on available water. The results showed that the trees were efficient consumers of water and grew faster than the indigenous trees. Moreover, the eucalypts were able to tap water from deep in the soil, in some situations to more than 9 metres, well below crop rooting depths. So, although it could be alleged that the trees were depriving crops of water, they tended to utilise water that was not available to the crops.

Since eucalypts are evergreen, they are likely to transpire considerably more water than low-growing food staple crops and grassland. Therefore, if dry season stream flows are all-important, it would be better to remove trees from the watersheds rather than plant more. However, trees have many other benefits, such as protecting soil from erosion and downstream sedimentation, conserving biodiversity, and provision of timber and non-timber products.

The conclusion is that the positive and negative benefits of trees need to be assessed in each local situation.

Testing current water management policy and practice

Findings from the following three areas of research demonstrate that current water catchment management policies and practices can be ineffective or even counter-productive. Since the investments in this area are so high, there should be an emphasis on engaging with policy analysts and practitioners to change policy and practice.

Market-based instruments for forest-derived environmental services

The aim of this research was to examine the use of market-based instruments to pay for forest-derived environmental services, including improved access to water for the poor. Such schemes assume that changes in land use affect the quality or quantity of forest-derived environmental services in a predictable way. If changes in vegetation (an expression of land-use change) do not produce such predictable effects, then there is no justification in paying the land owners/managers for conservation management to maintain or enhance these services.

Fiscal measures are more flexible in operation and easier to change than fixed land zones, but need to be thought through carefully to avoid benefits passing to unintended recipients. Government payments for environmental services in Costa Rica tend to benefit absentee and large-scale landlords who have enough land to set aside areas from production in strategic upland recharge areas. But there are several other reasons why the objectives of the scheme are being distorted. The environmental benefits from this scheme have not been demonstrated convincingly and poverty alleviation is not occurring.

The same line of research explored how rural land managers in Costa Rica made their choices from the options open to them. Lack of secure land tenure, rising administrative costs, lack of confidence in cash payment promises from the government, restriction to single owner applications, and short time scales were among ten significant factors that discouraged smallholders from participating in the programme. The work showed the complexity of trying to improve access to water for the poor and the difficulty of devising payments

for environmental services that benefit both the environment and the poor.

Agriculture, water and electricity in India

In many Indian States agriculture depends on groundwater for irrigation. Water demand has increased greatly since free or heavily subsidised electricity has been available. This has encouraged farmers to pump groundwater and grow irrigated crops in areas that would otherwise not support them. The high rates of evapotranspiration exceed the capacity of the monsoon rains to restore groundwater levels. Small-scale farmers and households who cannot afford to invest in pumps and bore holes could previously obtain water from hand-dug wells, but now the water table has fallen to such an extent that only deep bore holes can reach it. As a result, those who cannot afford a bore hole or a pump have no alternative but to buy water from private suppliers via water tankers. So the policy of providing free electricity, intended to put power into houses and villages, has actually further impoverished the poorest villagers.

Converting cloud forest to pasture

The focus of this research was to quantify the debated change in stream flow that occurs when tropical montane cloud forest (TMCF) is felled and replaced with pasture, under the climatic conditions prevailing in northern Costa Rica.

Hydrological research in TMCF at a range of plot and catchment sizes showed that, contrary to traditional belief, TMCF and cattle pasture differs in that the forest soil has greater absorptive capacity than the pasture, which becomes compacted by the hooves of the cattle grazing it. The greater moisture-stripping capacity of the forest in cloud, fog and wind-driven rain was less than expected, compared with pasture grass.

Communicating results to shape policy

Knowledge derived from the FRP research provides a firm basis for engagement with policy analysts associated with management of water supply and demand. However, several FRP-derived findings contradict accepted beliefs. This means that political sensitivity will be required during policy engagement, and a commitment to persistent lobbying for change in policies and practices.

A number of challenges face those aiming to influence water policy. Firstly, it is not easy to communicate scientific results, such as those of hydrological work, in forms that can be understood by policy shapers. It is particularly difficult to influence policy makers when new evidence counters accepted beliefs and practices.

Secondly, where giant development projects are at stake (e.g. in China and India), the livelihoods and reputations of large numbers of officials could be affected. At the same time, the rural poor could suffer in the short term (e.g. through loss of livelihoods derived from tree planting).

Thirdly, turning interest from stakeholders into new policies is a long-term challenge in countries that do not easily form and use cross-sectoral task forces or integrate scientists into policy forming teams. The cross-sectoral nature of most problems means that it is difficult to persuade institutions to participate in discussions and negotiations when they perceive that it is not their ultimate responsibility. Identifying the key players and securing their interest and commitment to participate is a major task for which traditional research teams may be ill-equipped.

FRP attempted to fill the knowledge gaps that were preventing acceptance of what appeared to be sound recommendations. Although the Programme found it difficult to influence any actual policy change, the effort was still worthwhile, since water management problems are becoming increasingly urgent and hydrological science is advancing rapidly.

Lessons for future research

Improving and testing predictive models

Great advances have been made in measuring techniques, data logging and modeling for water supplies. However, there is still a long way to go in identifying user-friendly predictive models that can simulate the effects of changing land use on water supply, water demand and livelihoods. Software specialists and psychologists could provide short-term input to aid development of easy-to-use simulators, as was carried out in the flood prediction model of the UK Environment Agency.

The applicability of predictive models for stream flows in relation to vegetation should be determined through sensitivity analysis. Hydrological work, such as the studies on TMCF, needs to be replicated along the aridity/vegetation gradient and in different kinds of landscape mosaics. There is a demand for continued high quality and well directed research, with good communication between research teams. More investment is required to determine the limits of the recommendation domains.

Valuing the resource

The concept of paying for piped water is generally well accepted. However, paying for land management as a means of ensuring a sustainable supply of clean water is a new, and far more complex idea. In addition, most current systems for payments for environmental services have little or no scientific basis.

Innovative approaches in natural resource economics, democratic development of scenarios and choice of options are showing progress but are not yet refined. It is perhaps too early for developing countries to fund such research themselves, despite the fact that water shortages are becoming more severe. The negotiation support system being developed through FRP to enable downstream consumers and users of water to negotiate equitably with upstream land managers (R7937, R8171) is a preliminary version. It will need further local adaptation if it is to help stakeholders reach defensible agreements.

Working across sectors

Attainment of the Millennium Development Goals for clean drinking water and effective sanitation relies on improving the joint management of water supply and demand. There is not enough fresh water to supply rising agricultural, industrial and domestic demand, while methods for capturing and using water are inefficient, ineffective and inequitable. The rising demand for a limited resource makes the poor especially vulnerable, and in many places they pay much more for water than those that are better off. There is a need for cross-sectoral effort from institutions that have traditionally worked in isolation. This applies both to developing countries, and to the way in which water issues are managed in donor agencies.

Linking research and policy processes

Phasing of research, so that findings from individual studies feed progressively into the framework of larger questions, requires stakeholders to agree on priorities and funding agencies to stay the course and engage on a sufficiently large scale. Such research and policy shaping should be carried out as part of a wider long-term strategy. The research framework itself needs to be flexible, to deal with inter-country institutional particularities and to extract and communicate global lessons effectively. For example, hydrologists need to interact more and exchange knowledge with policy shapers in agricultural planning and hydropower generation.

Developing capacity

The limitations of developing country agencies responsible for administration of renewable natural resources places major constraints on conducting research, communicating results and applying findings in policy and practice. These agencies are often highly politicised and technical decisions may be overridden by political considerations. They may have limited financial capacity and operational funds, and lack experience of cross-sectoral work and negotiations. In addition, a single ministry may have low status in central government, preventing it from engaging effectively in the development and operation of poverty reduction strategies. If regular programmes are not listed as required actions in poverty reduction strategy papers (PRSPs), these agencies are unlikely to have access to donor funds earmarked for such purposes. It is unclear how renewable natural resources agencies can obtain donor support for research and capacity building if they are not part of the PRSP. This must be a priority for any future renewable natural resources research strategy.

Additional resources

R7937 Catchment Management and Poverty Alleviation: The Role of Economic Instruments and Compensation Mechanisms in Water Resource and Forest Management

R7991 The Quantification of the Much Debated Change in Streamflow that is to be Expected after Converting Montane Cloud Forest to Pasture,

Initially under the Climatic Conditions Prevailing in Northern Costa Rica and at the Micro- to Meso-catchment Scale (< 100 km^2).
R8171 Management of Upper Water Catchments, Especially in Dry Forests in India with Low Base Flows; Forestry and Low Flows, Spatial Modelling and Open GIS Dissemination of the Science Perception
R8174 Socio-economic Impacts and Market Opportunities Associated with Land Use and Hydrological Change in Tropical montane Cloud Forest Areas in Arenal, Costa Rica
Forestry Research Programme http://www.frp.uk.com
For further information see http://www.research4development.info/projectsandprogrammes.asp

About this Brief

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About the Renewable Natural Resources Research Strategy (1995–2006)

The objective of DFID's Renewable Natural Resources Research Strategy (RNRRS) was to generate new knowledge and to promote its uptake and application such that the livelihoods of poor people are improved through better management of renewable natural resources. Through its ten research programmes it addressed the knowledge needs of poor people whose livelihoods are dependent on natural resources production systems in semi-arid areas, high potential areas, hillsides, tropical moist forests, and at the forest/agriculture interface, the land/water interface and the peri-urban interface. The breadth of the strategy programme reflected the wide variety of environments in which poor people live in poorer countries and the multiple routes by which research can reduce poverty.

For more information about the source papers and other RNRRS thematic summaries, visit http://www.research4development.info/thematicSummaries.asp

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