

Forests and Integrated Water Resources Management,

DFID Forestry Research on Forest and Water Interactions

Ian R Calder

Centre for Land Use and Water Resources Research
University of Newcastle upon Tyne, UK

INTRODUCTION

The public perception that forests are, in all circumstances, necessarily good for the water environment, that they increase rainfall, increase runoff, regulate flows, reduce erosion, reduce floods, “sterilize” water supplies and improve water quality, has long been questioned by the scientific community. Although this simplistic public perception has been debated since the nineteenth century (Saberwal, 1997) and a large literature is available on the debate, the evolving “modern” science perception (the reader is referred to reviews by Bosch and Hewlett (1982), Hamilton and King (1983), Hamilton (1987), Bruijnzeel (1990), Calder (1992), particularly as regards tropical forests, and the more recent reviews, in the light of new studies, by Calder (1999, 2000) and Bruijnzeel (2001, 2002)) suggests a more complex and generally less advantageous functioning of forests in relation to the water environment.

In a world where increasing demands are being made on water resources for food production, for domestic consumption, for industrial use and for ecological purposes, there is a greater awareness that the costs of the generally higher water use of forests as compared with other vegetation types needs to be evaluated in relation to their benefits for timber and conservation, amenity recreation and environment (CARE) products and for supporting livelihoods.

Financing mechanisms which are directed at conserving environmental services and protecting indigenous forests, and which may also serve to provide compensation payments to inhabitants of upper water catchments, are being promoted in many regions of the world. But for these mechanisms to be sustainable and defensible requires that the disparity between the public and science perceptions of the role of forest needs to be addressed and also that the bio-physical and socio-economic impacts of changing land use and forest cover are understood.

IDENTIFIED RESEARCH NEEDS

Research on the management of upper water catchments is supported by the DFID Forestry Research Programme (FRP). The research derives from an expressed need by stakeholders during FRP surveys of the priority problems of the forest-dependent poor. The identified need is for better incentives for land and forest management practices which maintain or enhance environmental services. The identified services include quality and quantity of water supplies, carbon sequestration, conservation of biodiversity, and the maintenance of landscape beauty. Current markets for environmental services in developing countries involve payments which are usually small in monetary terms and are often, it seems, based on erroneous or poor theoretical understanding of the biophysical interactions. It is commonly assumed that more trees equals more water from the catchment.

As markets for environmental services become more sophisticated, it is unlikely that such crude assumptions will remain unchallenged. If the objective is to seek more realistic compensation payments for maintained or enhanced environmental services, it will be necessary to demonstrate that particular management systems do indeed lead causally to particular beneficial outcomes. These outcomes might include perennial supplies of cleaner water, less erosion and sedimentation, more carbon sequestered,

more attractive landscapes conserved, as well as improved livelihoods for the catchment land and forest managers and users.

CURRENT RESEARCH

DFID is currently funding research to improve our understanding of both the biophysical and socio-economic interactions of forests and water in South Africa, Grenada, Tanzania, Costa Rica and India. A series of surveys relating to markets for forest watershed protection services have also been coordinated under the Environmental Economics programme of the International Institute for Environment and Development (IIED) in countries including Brazil, Costa Rica, Ecuador, Grenada, Indonesia, Jamaica, Philippines, Trinidad, and Vietnam, with other surveys intended in India and South Africa.

Catchment management and Poverty (CAMP) – South Africa, Grenada and Tanzania.

In water-stressed environments the livelihoods of poor people are directly affected by their access to water resources, but land and water management policies are not generally evaluated against this impact. Particular concern exists over the inadequate consideration given to the impact of forestry operations, and in some cases the escape of alien species, on water availability. The study (FRP project no. R7937) is comparing and contrasting the application of resource focussed (integrated water resources management, IWRM) and people focussed, Sustainable Livelihoods (SL) approaches to land and water management within catchments in the Limpopo Province in South Africa as a means towards identifying policy instruments which both improve the livelihoods of poor people and protect the resource base. The project employs macro-scale hydrological/economic modelling combined with household-level SL assessment to examine the effects of alternative policy instruments relating to forestry and water allocation. The application of the modelling methodologies will be tested in Grenada. Stakeholder consultations in Tanzania will provide additional insight into transferability of project outputs and methods.

Cloud forest Research – Costa Rica

The development of process methods for hydrological research provides an alternative to black boxes. FRP is supporting a study (R7991) in the Tilarán catchments of Costa Rica. The tropical montane cloud forest (TMCF) in those catchments affords an opportunity to develop a quantitative relationship between the area and spatial distribution of forest vegetation and dry season base flow. The TMCF is broken up with cattle pasture. The research aims to quantify the relationship between the area and distribution of forest and pasture, and dry/drier season base flows. The good historical records of hydrology and land use in the Monteverde area should provide checks backwards on the model(s) to be developed between now and 2005.

The environmental law in Costa Rica allows land owners to negotiate compensation deals with users and consumers of environmental services. Socio-economic studies in the same Tilarán area of Costa Rica will survey the different ways in which stakeholders value the forest and its environmental services, and suggest how compensation mechanisms and quantities of compensation might be rationalised. One end product would be a decision support system for use in other areas.

Impact of forests on water resources in the semi-arid zone, India

The project in India, (R8171), will focus on :

- (a) improving, through modelling and field calibration (in the dry zone), the scientific understanding of forest interaction with flows, particularly dry season flows;
- (b) improving dissemination of the “science perception” to stakeholder organizations and local communities.

The improved dissemination will be achieved through research into how the institutional and public “belief systems” regarding forest and water arose and how they can be improved, together with the development of web based GIS “dissemination” tools which can assist this process. These tools will help to “connect” village level approaches to development, and village level decision making, with integrated water resource management approaches, through demonstrating the water resource impacts of forestry programmes and engineering interventions. Research within this project will validate the hydrological model(s) developed in other projects in the FRP cluster for use in dry and monsoonal climates. It is believed that the large spending of development funds in India on tree planting as a means of improving groundwater recharge may be based on a serious misconception. Equally, if not more serious, is the concern that the focus on forestry programmes for improving water resources may be diverting attention from the urgent need for demand management measures to limit groundwater abstractions for the irrigation of off-season crops, which is leading to the excessive lowering of ground water tables in many southern Indian states.

Developing markets for forest watershed protection services

A series of surveys, co-ordinated by the Environmental Economics programme of the International Institute for Environment and Development (IIED), have been carried out in a number of countries to identify developing markets for forest watershed protection services. Surveys range in spatial scale from whole-country studies with key informants to single catchment studies with local communities. A common view amongst informants was that access to water was a human right and that the access should be free of charge, hence explaining, perhaps, the nominal amounts which have often been charged in developing countries for catchment management.

There is more recognition that clean water needs active management and that this costs money. The IIED diagnostic surveys indicated that there may be better possibilities for changing human behaviour and improving livelihoods by attention to water quality in addition to water quantity. FRP suggests that the following elements or issues need to be considered in order to understand their effects on the livelihoods of inhabitants of upper and lower water catchments:

- a. **Water quality.** How important in the livelihoods of upstream catchment land and forest managers is water quality or changes in water quality? How does the "enabling environment" of legislation, regulation, taxation, subsidy encourage or discourage land use and forest management practices which maintain or improve water quality? What are the current incentives for preventive and remedial actions?
- b. **Control of erosion and sedimentation.** How serious is erosion and sedimentation in various social/geophysical/land use situations ? - volume, frequency, actual expenditure on prevention and remedial measures, desirable expenditure on prevention and remedial action;
- c. **Control of water pollution caused by forest management/harvesting, agrochemicals and animal manure, industrial processes, and inadequate human sanitation.** How serious - volume, toxicity, persistence, frequency, actual expenditure on prevention and remedial measures, desirable expenditure on prevention and remedial action;
- d. **Practicability of prevention and remedial actions by upstream catchment land and forest managers;**
- e. **Practicability of remedial actions by downstream distributors, users and consumers of water.**

RESEARCH OUTPUTS

The anticipated outputs from the socio-economic and biophysical studies within the DFID FRP cluster of projects on water catchment management will include the following:

- a) A guide to which economic and financial tools and instruments are most appropriate under specific circumstances, taking the FAO Forestry Paper number 127 ("Valuing forests: context, issues and guidelines", by Hans Gregersen, Mike Arnold, Allen Lundgren and Arnaldo Contreras Hermosilla, 1995) as a starting point. The development of this guide will include comparative studies of the different methods at one or more data-rich sites.
- b) Through participatory consultation, the development of either a "common currency" for evaluation or methods involving multi-criteria analysis, to facilitate rational debate between stakeholders. It is expected that the "common currency" or the results from multi-criteria analysis will help in reaching a consensus for decisions about forest and land use management which will produce the greatest net social benefit.
- c) decision support systems, using the result of (b) above as one element, to help participatory processes and institutions work through arguments about changes in forest and land use. The decision support systems should use minimum data sets. The data requirements for some methods described in FAO Forestry Paper 127 are too large for most upland communities, so research on parsimony will be one element of the comparisons between methods. The new research should build on the FAO André Mayer Fellowship study by Sebastiao Kengen (1997) "Forest valuation for decision-making: lessons of experience and proposals for improvement".
- d) compensation mechanisms which have potential to transfer value captured by downstream users and consumers of goods and services, to benefit those forest managers who adopt good (conservative or service-enhancing) land and forest management practices upstream.
- e) equitable mechanisms for the capture and distribution of benefit (values) resulting from good forest management. More than a decade of trial implementation of trading in carbon emission reduction certificates has resulted in a relatively narrow range of prices for sequestered carbon. (There is much less experience in developing countries in markets for watershed protection services. In the IIED surveys referred to above, compensation values appear to be quite arbitrary and mostly of nominal value.)
- f) the decision support systems may be applied to markets for water quantity and quality, sequestered carbon, conserved biodiversity, and landscape beauty. It seems likely that trading in bundles of environmental services may be more beneficial for upland communities but more difficult for downstream users and consumers. Maximisation of outputs of some services may have adverse effects on others.
- g) a more rational approach to valuation of forest goods and services should enable greater consensus to be obtained on taxation regimes for forests and lands in marginal areas."
- h) Improved understanding of the role of forests in relation to water (ranging from high altitude Cloud Forest in Costa Rica to semi arid zone forests in India), particularly as they affect dry season flows in rivers.
- i) Better convergence of the public and science perceptions of the role of forest and water amongst development institutions and local communities.

COLLABORATION WITH OTHER PROGRAMMES

Collaboration is being sought with the Centre for International Forestry Research (CIFOR), which has expressed interest in studying the relation between local beliefs about the interaction of vegetation, rainfall and streamflows, and the science-based knowledge which is developing from the hydrological studies.

Similarly there may be possibilities for collaboration with the regional RUPES project in South East Asia on "Rewarding the upland poor in Asia for environmental services they provide". RUPES is

concentrating initially on 10 diverse catchments. The project is part-funded by IFAD and will be managed through a consortium led by the ICRAF South East Asia programme with CIFOR, Conservation International, FAO, IUCN, NARS and national universities, and WRI among the partners.

UN INTERNATIONAL YEAR OF THE MOUNTAINS

Interim outputs from this project cluster are expected during calendar year 2002 and will count towards DFID's contribution to the UN International Year of the Mountains.

CLUSTER MANAGEMENT AND COORDINATION

DFID's Forestry Research Programme (FRP) is managed by Natural Resources International Ltd. Contacts: Mr John Palmer, j.palmer@nrint.co.uk, Programme Manager; Dr. Hannah Jaenicke, h.jaenicke@nrint.co.uk, Deputy Programme Manager; Natural Resources International Ltd, Park House, Bradbourne Lane, Ditton, Aylesford, Kent, ME20 6SN, UK. The intellectual input, leadership and guidance of the Programme Manager and the Deputy Programme Manager in the furtherance of the research programme and in the production of the information note on which much of this paper is based, is gratefully acknowledged.

The co-ordination of the FRP cluster of socio-economic and technical projects dealing with forests and water (FRP project management no. ZF0176) is being carried out by the Centre for Land Use and Water Resources Research (CLUWRR) at the University of Newcastle, U.K. Contacts: Professor Ian R. Calder, Director of CLUWRR; i.r.calder@newcastle.ac.uk for technical details and Ms. Kate Gallop for administrative information k.m.gallop@newcastle.ac.uk. Details of the hydrological work can be viewed on the website www.cluwrr.ncl.ac.uk/projects/flows.

REFERENCES

Bosch, J.M. and Hewlett, J.D. 1982 A review of catchment experiments to determine the effects of vegetation changes on water yield and evapotranspiration. *J. Hydrol.* 55: 3-23.

Bruijnzeel, L.A. 1990 Hydrology of moist tropical forests and effects of conversion: a state of knowledge review. UNESCO International Hydrological Programme, A publication of the Humid Tropics Programme, UNESCO, Paris.

Bruijnzeel, L.A., 2001. Hydrology of tropical montane cloud forests: A Reassessment. Land Use and Water Resources Research (LUWRR) <http://www.luwrr.com/>

Bruijnzeel, L.A., 2002. Tropical forests and environmental services: not seeing the soil for the trees? *Agric. Ecosystems and Environment*. In press

Calder, I.R. 1992. The Hydrological impact of land-use change (with special reference to afforestation and deforestation) Proceedings of the Conference on priorities for water resources allocation and management, Natural Resources and Engineering advisers conference, Southampton, July 1992. Overseas Development Administration.

Calder, I.R. 1999 *The Blue Revolution, Land Use and Integrated Water Resources Management*. Earthscan, London, ISBN 1 85383 634 6.

Calder, I.R. 2000. Land use impacts on water resources. Background paper 1. FAO Electronic Workshop on Land-Water Linkages in Rural Watersheds. 18 September – 27 October 2000. <http://www.fao.org/ag/agl/watershed/>

Gregersen, H.M., Arnold, J.E.M. , Lundgren, A.L. and A. Contreras-Hermosilla. Valuing Forests: Context, Issues and Guidelines, Food and Agriculture Organisation of the United Nations (FAO) Forestry Paper 127, 1995.

Hamilton, L.S., 1987 Tropical watershed forestry – aiming for greater accuracy. *Ambio* 16, 372-373.

Hamilton, L.S., King, P.N., 1983. Tropical Forested Watersheds. Hydrologic and Soils Response to Major Uses or Conversions. Westview Press, Boulder, Colorado.

Kengen, S. (1997) "Forest valuation for decision-making: lessons of experience and proposals for improvement". Food and Agriculture Organisation of the United Nations (FAO)

Saberwal, V.K. 1997 Science and the Desiccationist Discourse of the 20th Century. *Environment and History* 3 (1997): 309-43.