
Forest and Water Policies. The need to reconcile public and science perceptions

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ABSTRACT

This paper compares and contrasts some of the science and public perceptions of the role of forests in relation to the water environment. It is suggested that the disparity between the two perceptions needs to be addressed before we are in a position to devise and develop land and water policies (whether market or non-market based) which are aimed at either improving the water environment, and by doing so improving the livelihoods of poor people by greater access to water, or conserving and protecting forests. Examples are given of three research projects in South Africa, India and Costa Rica where, through the involvement of stakeholder groups, often with representatives comprising both the science and public perceptions, interactive research programmes were designed not only to derive new research findings with regard to the biophysical processes but also to achieve better “ownership” and acceptance of research findings by the stakeholders. It is concluded that to move towards a reconciliation of the different perceptions and to put in place better policies and management systems, where policy is better connected with science, will require further efforts: a) To understand how the “belief” systems underlying the science and public perceptions have evolved, and how these are affecting land and water policy processes; b) to develop management support tools, ranging from simple dissemination tools, which can demonstrate the impacts of land use decisions on the water environment to institutions and local people, to detailed robust and defensible hydrological models which are needed to help implement the new land and water policies, such as those now being implemented in RSA; and c) to understand better how land and water related policies impact on the poorest in society. It is argued that many present policies may not be significantly benefiting the poor and may even, in some situations, be resulting in perverse outcomes.

KEYWORDS | Forestation. Water policies. Water resources. South Africa. India. Costa Rica.

INTRODUCTION

When we draw up the “balance sheet” for forest valuation, conventional wisdom would generally have us believe that there are high positive values attached to their “hydrological services”.

On the basis of this conventional wisdom, in many countries of the world forest and afforestation programmes are still being promoted within watershed development programmes on the basis of these “hydrological services” and “headwater conservation functions”. In turn, the expectation is often that the increased “hydrological services” will benefit the livelihoods of poor people through increased access to water supplies.

Financing mechanisms designed to help conserve and protect indigenous forests and to partly support the costs of reforestation programmes have traditionally referred to, and are also often based on, this conventional wisdom. In Costa Rica, both the government led Payment for Environmental Services (PES) programme and all private agreements with the hydroelectric sector were initially based on this ‘universally accepted’ knowledge, although currently it is defended as a ‘precautionary principle’ in the absence of better – or more accepted – scientific knowledge.

But this conventional wisdom, 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 these issues have been debated since the nineteenth century (Saberwal, 1998), to appreciate 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 (in press).

It is suggested that organisations which are developing land and water policies should be aware that there is a disparity between the traditional public perception and the science perception of the role of forests in relation to water. We argue that there is an urgent need to move towards a reconciliation of these different views if we wish to develop sustainable and defensible land and water policies which avoid the possibility of perverse outcomes.

CONTRASTING THE SCIENCE AND PUBLIC PERCEPTION

This section is largely based on earlier published material (Calder, 1998, 1999, 2000, 2002). Here just two of the “myths” or “conventional wisdoms” relating to forestry and water are reviewed as a means of highlighting the disparity between the “science” and “public” perception and to identify the remaining gaps in our knowledge. The “conventional wisdoms” considered are: 1) forest increase runoff and 2) forest regulate flows.

Forests increase runoff?

Modern scientific understanding has evolved from over 25 years of research of evaporation from forests in dry and wet conditions based on process studies. These studies, and the vast majority of the world’s catchment experiments, indicate decreased runoff from areas under forests as compared with areas under shorter crops.

These studies indicate that in wet conditions interception losses will be higher from forests than shorter crops primarily because of increased atmospheric transport of water vapour from their aerodynamically rough surfaces.

In dry seasons and drought conditions the studies show that transpiration from forests is likely to be greater because of the generally increased rooting depth of trees as compared with shorter crops and their consequent greater access to soil water.

The current scientific understanding indicates that in both very wet and very dry climates, evaporation from forests is likely to be higher than that from shorter crops. Consequently runoff will be decreased from forested areas, contrary to the widely accepted folklore.

The few exceptions, (lending some support to the folklore), are: 1) Cloud forests where cloud-water deposition may exceed interception losses; and 2) very old forests. Langford (1976) showed that following a bushfire in very old (200 years) mountain ash, *Eucalyptus regnans*, forest covering 48% of the Maroondah catchment, one of the water supply catchments for Melbourne in Australia, runoff was reduced by 24%. The reason for this reduction in flow has been attributed to the increased evaporation from the vigorous re-growth forest that had a much higher leaf area index than the former very old ash forest.

Conclusion, notwithstanding the exceptions outlined above, catchment experiments generally indicate reduced runoff from forested areas as compared with those under shorter vegetation (Bosch and Hewlett, 1982).

Finally, it has to be considered that information on the evaporative characteristics of different tree species/soil type combinations are still required if evaporation estimates with an uncertainty of less than 30% are required. In both temperate and tropical climates evaporative differences between species and soil types are expected to vary by about this amount.

Forests regulate flows - increase dry season flows?

Although it is possible, with only a few exceptions, to draw general conclusions with respect to the impacts of forests on annual flow, the same cannot be claimed for the impacts of forests on the seasonal flow regime. Different, site specific, often competing processes may be operating and the direction, let alone the magnitude of the impact, may be difficult to predict for a particular site.

From theoretical considerations it would be expected that: 1) Increased transpiration and increased dry period transpiration from forests will increase soil moisture deficits and reduce dry season flows; 2) increased infiltration under (natural) forest will lead to higher soil water recharge and increased dry season flows; and 3) for cloud forests increased cloud-water deposition may augment dry season flows.

There are also observations (Robinson et al., 1997) which indicate that for the uplands of the UK drainage activities associated with plantation forestry increase dry season flows both through the initial dewatering and in the longer term through alterations to the hydraulics of the drainage system.

Observations from South Africa and India indicate that increased dry period transpiration reduces low flows. Bosch (1979) has demonstrated, from catchment studies at Cathedral Peak in Natal, that pine afforestation of former grassland not only reduces annual streamflow by 440 mm but also reduces the dry season flow by 15mm. Van Lill et al. (1980), reporting studies at Mokobulaan in the Transvaal, showed that afforestation of grassland with *Eucalyptus grandis* reduced annual flows by 300-380 mm, with 200-260 mm of the reduction occurring during the wet summer season. More recently Scott and Smith (1997), analysing results from five of the South African catchment studies, concluded that percentage reductions in low (dry season) flow as a result of afforestation were actually greater than the reduction in annual flow. Scott and Lesch (1997) also report that on the Mokobulaan research catchments under *Eucalyptus grandis* the streamflow completely dried up by the ninth year after planting. The eucalypts were clearfelled at age 16 years but perennial streamflow did not return for another five years. They attribute this large time lag as being due to very deep soil moisture deficits generated by the euca-

lypts which require many years of rainfall before field capacity conditions can be established and recharge of the groundwater aquifer and perennial flows can take place. In India, Sikka et al. (2003), focusing on the Nilgiri Catchment in southern India, identified significant reductions in low flows in the driest months of the year when comparing streamflow from a grassland catchment with that from a catchment afforested with *Eucalyptus globulus*.

Bruijnzeel (1990) discusses the impacts of tropical forests on dry season flows and concludes that the infiltration properties of the forest are critical in how the available water is partitioned between runoff and recharge (leading to increased dry season flows).

As conclusions, competing processes may result in either increased or reduced dry season flows. Effects on dry season flows are likely to be very site specific. It cannot be assumed that it is generally true that afforestation will increase dry season flows.

It has to be taken into account that the complexity of the competing processes affecting dry season flows indicates that detailed, site specific models will be required to predict impacts. In general the role of vegetation in determining the infiltration properties of soils, as it affects the hydrological functioning of catchments through surface runoff generation, recharge and high and low flows and catchment degradation remains poorly understood. Modelling approaches which are able to take into account vegetation and soil physical properties including the conductivity/ water content properties of the soil, and possibly the spatial distribution of these properties, will be required to predict these site specific impacts.

EXAMPLES OF ONGOING RESEARCH ON THE ROLE OF FORESTS AND WATER

Three examples are given of ongoing "interactive" research in South Africa, India and Costa Rica which are addressing questions of policy related to land use change involving forestry and the water environment. Interactive, in this context, implies that the eventual users, or stakeholders, of the research interact closely with the researchers in both the design stage, by helping to define the objectives of the research and by ensuring that the necessary resources are mobilised, and also in the implementation phase by monitoring and steering the research programme. Experience of using this model for the management of applied environmental and hydrological research programmes has shown that it has a number of benefits:

- The users, through close involvement with all

phases of the research, assume “ownership” of the programme and are more likely to both “believe in” and “take up” eventual research findings.

- Best use is made of existing knowledge and data resources by building on the collective resources of all the stakeholders.
- The interaction between “users” and “researchers” through stakeholder group meetings not only facilitates linkages and information flows between the users and researchers but also facilitates linkages and information flows between the users themselves. This in itself has often been seen as an important output of the interactive research programme. Increasingly it is being recognised that successful Integrated Land Use and Water Resources Management requires not only a sound science base but also the understanding, commitment and collaboration between the different organisations responsible for and impacted by Integrated Management.
- The formation of a representative stakeholder group with a diversity of interests and perspectives is more likely to achieve the ultimate goal of integrated land use and water resources management by ensuring that all aspects of development affecting water resources, basin economics, ecology/-conservation, socio-economics and the sustainable livelihoods of basin inhabitants are considered and represented.

It is also believed that if stakeholder groups can be formed with representatives comprising both the science and public perceptions this may, through a process of “action learning”, provide a means of reconciling disparate views.

The policy issues that the research programmes are addressing in South Africa, India and Costa Rica, are both similar in each of the countries and also similar to those in the UK and Panama reported previously (Calder, 2002). They relate to how we can best manage both existing and potential forest lands to meet competing demands, particularly in connection with demands for production (e.g. timber and water), Conservation, Amenity and Recreation (CARE) products and for supporting people’s livelihoods. Underlying these policy issues is the value we attach to forests and water products and their impacts on society. Commercial forestry has often been promoted by development organisations because of its perceived environmental benefits. Yet, as identified in Section 2, science based research has shown that many of the expected environmental benefits (which may in some cases be provided by natural forests) cannot be achieved

through commercial plantations. Increasingly we are now becoming aware of the environmental dangers, rather than benefits, that have been caused by these plantations. Not only is there usually a high cost in terms of lost water associated with fast growing commercial plantations but, as has been recognised by the government of South Africa, there may also be dangers associated with “escaping” plantation trees where these are “alien” to the landscape in which they now survive.

The three examples considered below demonstrate the continuing need to improve our understanding of the biophysical linkages between forests and the water environment, particularly in relation to the impacts on seasonal flows.

These three examples also illustrate the different degrees of “connectivity” between science and policy in the different countries.

Catchment Management and Poverty Alleviation (CAMP)

In 1998, South Africa’s new National Water Act (RSA, 1998) declared commercial forestry as a “Stream Flow Reduction Activity” (SFRA), and as such requires that it is managed through the issuing of water use licences and is subject to water resources management charges. Furthermore, in the February 2000 budget, US \$ 100,000,000 (over five years) was awarded to the so-called Working for Water Programme -WFW- (DWA, 1996) for the purposes of controlling and eradicating alien invading tree species. The expectation is that without this programme the invaders would eliminate indigenous plant species and seriously reduce water resources. The programme also has a major poverty alleviation component, through specifically targeting the poorest in society for employment. The success of these two policy instruments has important implications for the management of forestry in the landscape, both in South Africa and worldwide.

The purpose of the CAMP project is to integrate hydrological, economic and livelihoods’ analyses of these policies at the watershed scale. The research site is the Luvuvhu catchment in Limpopo province, South Africa, which drains into the Limpopo River at the border with Zimbabwe and Mozambique. It covers 5940 km² with a temporally and spatially variable rainfall regime (mean 740 mm/year) that determines land use practices (Fig. 1). The Luvuvhu catchment illustrates the acute problems posed for water and land use management related to forestry activities: there is potential for a considerable increase in the area of commercial forestry, it is presently affected by alien invader tree species, it is water short and it has high levels of poverty.

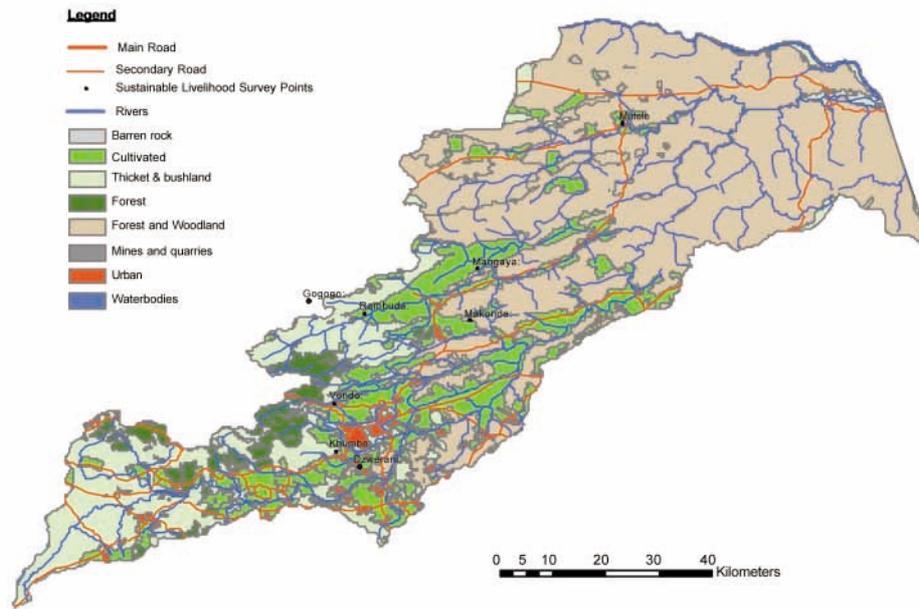


FIGURE 1 | Land use, and settlements where Sustainable Livelihoods assessment was carried out, on the Luvuvhu catchment, Limpopo Province, South Africa.

The project attempts to provide an assessment of the above mentioned water and land use policies, and to show whether the livelihoods of the poor are improved by them. A methodology has been developed to assess the trade-offs between the livelihood strategies of the rural poor and catchment-level economic productivity, which result from the hydrological impacts of changes in land use.

Two land use sensitive hydrological models, HYLUC (Calder, 2003) and the ACRU Agrohydrological modelling system (Schulze, 1995), both used extensively in forestry related studies (Calder, 2002; Jewitt and Schulze, 1999) have been configured for use in the Luvuvhu. Output from these models, in the form of simulated streamflow and estimates of forest biomass production per water unit transpired, is provided as input to economic and livelihood analysis models. In these models, the nomenclature adopted by Falkenmark (1995, 2003) is used to highlight the role of land use on hydrological functioning and these outputs are referred to as Blue Water and Green Water respectively. Economic assessments and livelihood scenario outcomes provide a basis for comparison of the potential benefits and shortcomings of potential land use change scenarios which may arise from the application of the SFRA and WFW policy tools in the catchment. Through the use of this integrated framework (Fig. 2), which includes hydrological simulation models, economic assessments and livelihood scenario outcomes, the CAMP project is

attempting to model the impact of these two policy instruments as they affect not only water resources and catchment scale economics but also the livelihoods of the poorest in society.

As part of the assessment of land and water-related policies and their impact on the poor, the role of improved water provision from the government of South Africa's drive to meet the international Millennium Development Goal of halving the 1.2 billion people without adequate water supply by 2015, has also been investigated. Livelihoods' analysis in the Luvuvhu catchment indicates that the relationship between poverty (in income terms) and greater water provision (reticulated, rainfall) is not statistically significant. Evidence suggests that whilst there may be food security gains from water resource interventions (e.g. more improved water for irrigation of kitchen gardens) the distributional impacts are regressive due to the appropriation of these resources by wealthy and more influential elites (Hope et al., in press). The efficiency and sustainability of standardised or "norm based" criteria of universal improved water provision as a poverty reduction intervention, within the demands of national economic growth and development, is challenged. Issues of water scarcity, water allocation trade-offs among competing users (industry, agriculture, human needs, environment, etc), and demand management of an often limited water resource are contested domains that must be adequately addressed by policy makers in developing countries to avoid 'perverse outcomes'.

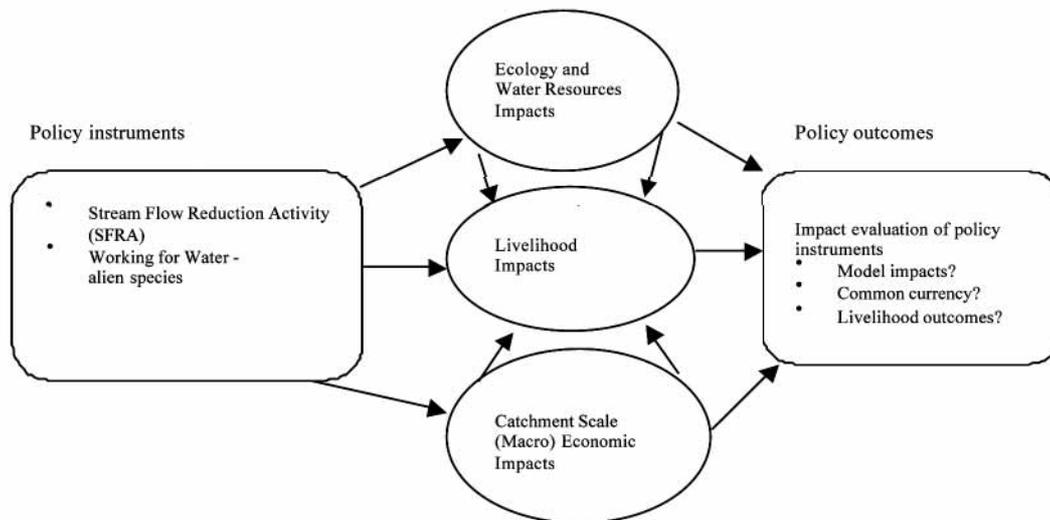


FIGURE 2 | The CAMP project will investigate how two forest and water related policy instruments, the Working for Water Programme and the charging of landowners for Stream Flow Reduction Activities (SFRAs), will affect water resources, catchment scale economics and livelihoods.

Emerging evidence suggests that ‘water benefit thresholds’ for the poor that are disaggregated by income or social cohorts may provide a productive and insightful approach for poverty reduction policy. Understanding the marginal benefit or utility of water above a certain basic human need threshold (defined as 25 lcd –litres per capita per day- in South Africa) for different social cohorts offers the potential for government to make better informed decisions about trade-offs in water allocations at the catchment, regional and national scale. Mechanisms that tax higher water land uses (e.g. forestry, irrigated agriculture) in upper catchment areas to compensate poorer rural communities in the lower catchment may offer a more integrated approach to achieving the three tenets of sustainability: social justice, economic efficiency and ecological integrity.

Thus, the project highlights a number of issues relating to forest and water management, issues that are probably not specific to South Africa. These include how to devise and implement forest and water policy instruments which will meet the requirements of Integrated Water Resources Management (water resource, basin economics and conservation) whilst also meeting the demands of major international and donor organisations as World Bank and DFID (UK’s Department for International Development) that policies should have an equity dimension and support and enhance (particularly the poorest) people’s livelihoods.

India. Forest impacts on dry season flows, forest and water policies

In dry zone regions of India, water availability is

recognised as a major constraint on development. People’s livelihoods are under threat as water supplies for agriculture, livestock, manufacturing and water services diminish (KAWAD, 2001). This is one of the drivers that has led the Government of India to recognise water as one of the most limiting resources in the country and in 1987 led the Government to adopt a National Water Policy, which has been recently renewed and updated. A key element of this policy is “watershed management through extensive soil conservation, catchment-area treatment, preservation of forest and *increasing the forest cover* and the construction of check-dams..... efforts shall be to conserve the water in the catchment ” (Art. 3.4; Government of India, 2002).

In India “watershed management” is largely based on local level micro-watershed management for improved soil and water management. It is promoted by government as part of its rural development strategy, with an estimated spend of approximately US \$ 500 million per year since the mid-1990s (Turton and Farrington, 1998). Watershed development is frequently supported by foreign development aid. The focus on water is generally towards increasing local resource availability. There is usually no effort to deal with local level allocation or other demand management issues, nor to consider these issues within a larger level catchment management framework (Moriarty et al., 2001).

Typically, supply side measures include engineering interventions together with forestry programmes which are expected to regulate or even increase flows. Planting trees to increase local rainfall and runoff are some of the misconceptions about water and land use that permeate watershed development (KAWAD, 2001). In drought-

prone areas, where the objective is the “minimisation of evaporation losses”, forestry is promoted nationally as a less water demanding mode of development (Art. 19.1; Government of India, 2002). Saberwal (1997) has reviewed the policy discourse in India and traces the policy makers acceptance of the positive link between water and forest to a ‘desiccationist’ discourse promoted by Indian foresters since the middle of the 20th century.

It is believed that watershed management policies, which promote increased irrigation from groundwater supplies and increased afforestation as a means of improving the livelihoods of the poor, may also be based on misconceptions and may be resulting in perverse outcomes (Calder and Gosain, 2003). In many Indian states implementation of these policies has contributed to the lowering of groundwater tables to the extent that local people are now unable to access groundwater supplies through hand pumps and are having to purchase water from tanker deliveries. It would be expected that in these situations where, in contrast with South Africa, there is no free right to water of any quantity, increased access to water by the poor could have major livelihood benefits.

This project aims to improve both the biophysical understanding of the impact of forests on the water regime, and particularly on dry season flows, in dry zone regions and the understanding of the constraints within which forest and water policies can be developed in India. The biophysical research will calibrate and test the hydrological models developed in other partner projects (funded under the DFID Forestry Research Programme’s (FRP), Forestry and low Flows (FRP FLOWS cluster) for use in dry and monsoonal climates. For this purpose, case study catchments have been identified in Himachal Pradesh and Madhya Pradesh. This research is carried out in collaboration with The Indian Institute of Technology, Delhi and with the Department of Science and Technology of the Government of India’s programme for developing information technology tools for local level planning of land and water resources (Natural Resource Data Management Systems programme).

The policy analysis component of the project will research the institutional and policy constraints to the development of forest and water policies, paying particular attention to the identification of key narrative issues on the land use/water interactions and the establishment of frameworks for the evaluation of land use impacts on water resources. The interaction of water, land use and forestry policies at the district level and at the state level will be discussed within stakeholder groups involving state/district administrators, policy makers and donors.

Costa Rica. Cloud forests impacts on dry season flows, forest and water policies

In Costa Rica, the perceived environmental benefits of good forest cover have led to the proclamation of several innovative laws during the middle 1990’s, the Environmental Law, Forestry Law and Biodiversity Law. A new water law is currently being debated in the National Congress and around the country to regulate and organise water use and conservation. The introduction of the 1996 Forestry Law recognised the benefits of forest environmental services, provided the institutional and legal framework for rewarding forestry services as a valuable commodity (Miranda et al., 2002), and stipulated the economic mechanism by which forest owners would receive such compensations: the Payment for Environmental Services (PES) programme. A continuous “learn-through-experience” process ensures that the programme is constantly being evaluated and adjusted by interventions of the government, civil society and the scientific community. According to Calvo (2000), Rojas and Aylward (2002) and Pagiola (2002), the magnitude of the compensation payments reflects a balance between the willingness-to-pay and the perceived importance of a particular forest area rather than on any scientific understanding of the actual hydrological role of the forest.

The potential importance of cloud forests in augmenting flows was recognised by Zadroga (1981), a consultant with the Instituto Costarricense de Electricidad (ICE) but his plea for in-depth investigations was never followed-up. Although various bodies within Costa Rica have commissioned consultant reports over the years to ascertain the influence of forest on stream flow (CT Energía, 2000; IUCN-ORMA, 2001), limitations in the available data (notably high year-to-year variability in rainfall) and the black-box approach adopted in such studies (simple rainfall-runoff comparisons for individual catchments without taking underlying processes or sub regional differences in rainfall regimes into account) have rendered such attempts inconclusive or even misleading (Aylward et al., 1998).

Although Costa Rica is beginning to put the institutional capacity, comprising the organisational, cultural, political, legal and economic tools in place for payments for environmental services, the underlying hydrological knowledge base is still weak. Clearly, a more complete, process-based approach is needed to identify the separate effects of land cover and climatic variability on stream flow.

The key biophysical question addressed by this research project is: What is the relationship between the area and distribution of forest and cattle pasture in the landscape with river flow, particularly during the dry sea-

son? A consortium of local and international institutions coordinated by the Vrije Universiteit, Amsterdam, is developing mathematical simulation models, calibrated from measurements of cloud water deposition and forest and pasture water use, to determine and predict the impacts of forest removal/conservation on the water regime. The models will be tested using the good historical records of both the hydrology and the land use of the 90 km² Rio Chiquito catchments in the Tilarán area, northern Costa Rica.

It could be argued that the Costa Rican concerns about deforestation activities affecting the hydrological regime have now become largely academic as deforestation in Costa Rica has virtually come to a halt in recent years (from 16400 ha/year in 1986-1997 to 3300 ha/year in 1997/2000, see Sánchez-Azofeifa and Calvo, 2002). However, the question of changes to streamflows following forest removal remains relevant elsewhere in Central America (Kaimowitz, 2004) where upland forest protection is much less secure (IUCN-ORMA, 2001). The continued pressure to undertake revegetation activities, particularly reforestation, and the environmental services payments that promote such efforts remains a strong driver in Costa Rica, as elsewhere in the world. Recently Reyes et al. (2001) carried out a research project, sponsored by FONAFIFO (Costa Rican Forestry Fund, its main objective is to develop forestry activities together with the protection of natural landscape) with the objective of defining parameters to allow the evaluation of hydrological services provided by natural forest and forest plantations. However, this project did not directly address the question of the forest-hydrological relationships and the need remains, as demonstrated by Kaimowitz (2004), to better understand not only the hydrology but also the economics of reforestation programmes and watershed services payments. We would also recognise that within generally "top down" watershed management social issues have often been given only tertiary importance and that there is a very real need to invert the process and work first to understand the source and nature of social beliefs surrounding water and land issues, particularly given that conventional wisdom in Costa Rica often seems to be at odds with scientific knowledge in this regard.

The socio-economic component of this project will investigate the livelihood impacts of changes in stream flow resulting from the historical conversion of cloud forest to pasture, and the potential for reforestation or silvipastoral management and ecotourism management in the Arenal region of Costa Rica. It will also provide recommendations for land management options and the development of watershed service markets that positively impact on the livelihoods of low-income groups. To

understand the source and nature of social beliefs surrounding water and land issues, a study will investigate different stakeholder groups' perceptions into knowledge, attitudes and beliefs on land/water relationships, particularly the effects of forest (or deforestation) on water quality, quantity, and the effect on low flows.

The preliminary findings from this study, involving 11 focus groups and several personal interviews held in January 2003 confirm that the public perception of the role of forests in relation to the water environment is very positive; interviewees were generally adamant in their beliefs that "without forests water would not exist", and the reason for diminished flows downstream was deforestation around the water springs, a process that started during the first half of the last century when forest gave way to ranching and coffee growing. The public perception of Monteverde residents is that the apparent decrease in water resources is related to reduced forest cover. However, other explanations may be possible for the apparent decrease in water resources. During recent times, a large scale switch from ranching activities to ecotourism has led to significant increases in water demand upstream which is now affecting not only the amount of downstream flows, but also the quality of water due to the lack of controls on waste waters.

CONCLUSIONS

The research conducted in the Luvuvhu catchment in RSA indicates that, where in RSA there is a right to free water for each inhabitant (25 lcd), increasing this entitlement, at a large cost to the government, may not significantly increase the livelihood benefits to the poorest people. It is believed that richer people would be most able to benefit from increased supplies. In India, where water policies are such that there is no free entitlement, it is suggested that implementation of present forestry and irrigation policies, which are again very expensive to donors and government, may also mainly be benefiting richer communities. In India it is argued that policies which promote increased irrigation from groundwater supplies and increased afforestation, as a means of improving livelihoods of the poor, may result in perverse outcomes. In many Indian states implementation of these policies has contributed to the lowering of groundwater tables to the extent that local people are now unable to access groundwater supplies through hand pumps and are having to purchase water from tanker deliveries. It would be expected that in these situations where, by contrast with South Africa, there is no free right to water of any quantity, increased access to water by the poor could have major livelihood benefits.

In Costa Rica, policies that support the payment for watershed services have been legislated, but questions

regarding their scientific validity remain. Furthermore, social issues have largely been ignored in the legislative process. Water in Costa Rica is administered as a public good (albeit it is not a free good). While water in the upper parts of Monteverde is abundant, public perceptions are that these resources have decreased through time during not only the dry seasons but also rainy seasons. The public perception is that the decreased water resources are related to decreasing forest cover. However, other explanations are possible for the apparent decrease in water resources. During recent times, a large scale switch from ranching activities to ecotourism has led to significant increases in water demand upstream which is now affecting not only the amount of downstream flows, but also the quality of water due to the lack of controls on waste waters.

It is concluded that organisations which are developing forest valuation and financing mechanisms should be aware that there is a disparity between the traditional public perception and the science perception of the role of forests in relation to water. There is a need to move towards a reconciliation of these different views which will require further efforts directed not only towards the scientific research but also to ensuring that these research findings are better disseminated and “connected” to policy and decision making relating to land use planning and forests.

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