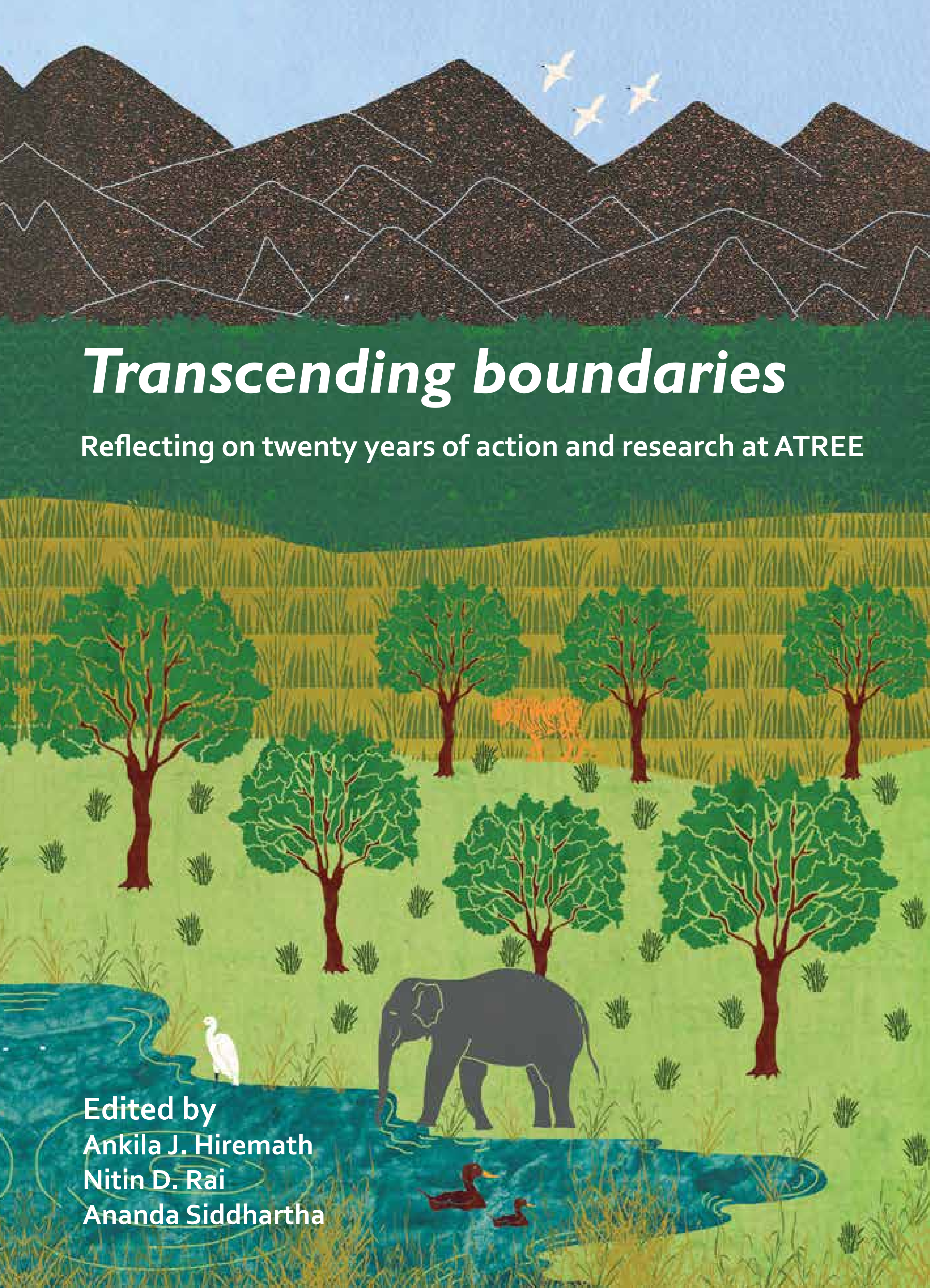


Transcending boundaries

Reflecting on twenty years of action and research at ATREE

Edited by
Ankila J. Hiremath
Nitin D. Rai
Ananda Siddhartha

First published in 2017 by
Ashoka Trust for Research in Ecology and the Environment (ATREE),
Royal Enclave, Srirampura, Jakkur PO.
Bangalore - 560064, Karnataka, India.
Website: www.atree.org
Tel: 91-80-23635555 | Fax: 91-80- 23530070

ATREE regional offices
Eastern Himalaya Office
C/o Theyzong Heem, Near Brahmakumari's
Development Area, Gangtok 737101, India
Tel: 91-3592-206403

New Delhi (Liaison and Development)
C-86, 2nd floor, B.K. Dutt Colony
New Delhi 110003, India.
Tel: 011-24603134

W.Q. Judge Press,
97 Residency Road,
Bangalore - 560 025.
Phone.: 91-80-2221 1168, 2224 0561

creative commons

All chapters, unless otherwise noted, are licensed under a Creative Commons Attribution 3 License. You are free to copy, distribute and transmit the work, and to remix or adapt the work under the following conditions:

- You must attribute the work in the manner specified by the author or licensor (but not in any way that suggests that they endorse you or your use of the work).
- For any reuse or distribution, you must make clear to others the license terms of this work.
- Any of the above conditions can be waived if you get permission from the copyright holder.
- Nothing in this license impairs or restricts the author's moral rights.

The full text of this license is available at: http://creativecommons.org/licenses/by/3.0/

Recommended citation:

Hiremath, AJ., Rai, ND., Siddhartha, A. (Eds.) 2017. Transcending boundaries: Reflecting on twenty years of action and research at ATREE. Bangalore: Ashoka Trust for Research in Ecology and the Environment.

Design and Layout: Suneha Mohanty

ATREE Ashoka Trust for Research in Ecology and the Environment

Norwegian Embassy

Contents

The Painted Word vii

Foreword viii

Acknowledgements xi

Introduction 1

1 Society and conservation

Non-timber forest products, livelihoods and sustainability: What have we learnt? 10
Siddappa Setty, Sharachchandra Lele and Safia Aggarwal

Shrinking harvest: Genetic consequences and challenges for sustainable harvesting of non-timber forest products 20
Ravikanth G. and Siddappa Setty

Tryst with *Lantana camara* 28
R. Uma Shaanker and Gladwin Joseph

Beyond trekker platitudes: How forests and farmers fare in an Eastern Himalayan forest edge 36
Siddhartha Krishnan, Soubadra Devy M., Sarala Khaling and Jagdish Krishnaswamy

Engaging in Eastern Himalaya-Northeast India: Twenty years and beyond 44
Sarala Khaling and Sunita Pradhan

Conservation in the wide blue yonder of Agasthyamalai: Can knowledge be linked with action? 52
Soubadra Devy M., T. Ganesh and R. Ganesan

One size needn't fit all: Conservation lessons from long-term research in the Biligiri Rangaswamy Temple Tiger Reserve, South India. 60
Ankila J. Hiremath, Nitin D. Rai and C. Made Gowda

2 Ecosystems in transition

Rainforest dynamics in a changing world: Monitoring plants, animals and climate at Kalakad Mundanthurai Tiger Reserve, Tamil Nadu 72
T. Ganesh, Soubadra Devy M. and R. Ganesan

Navigating murky waters: Challenges and approaches for conservation planning of freshwater ecosystems of India 80
Aravind NA., Madhushree Munsi and Roshmi Rekha Sarma

Filling in the (forest) blanks: The past, present, and future of India's savanna grasslands 88
Abi T. Vanak, Ankila J. Hiremath, Siddhartha Krishnan, T. Ganesh and Nitin D. Rai

Moving from requiem to revival: India's rivers and riverine ecosystems 94
Jagdish Krishnaswamy, Manish Kumar, Nachiket Kelkar, Tarun Nair and Vidyadhar Atkore

Addressing pollution in urban rivers: Lessons from the Vrishabhavathy river in Bengaluru 104
Priyanka Jamwal and Sharachchandra Lele

Going with the flow: Urban wastewater and livelihood change in peri-urban Bengaluru 114
Bejoy K. Thomas, N. Deepthi and Priyanka Jamwal

Whose river? The changing waterscape of the upper Arkavathy under urbanisation 122
Veena Srinivasan, Sharachchandra Lele, Bejoy K. Thomas and Priyanka Jamwal

3 Perspectives on conservation and development

A cultural crisis amidst the ecological crisis: Critiquing the conservationist understanding of culture 132
Siddhartha Krishnan

Domesticating water: The challenges in Indian cities 140
Durba Biswas and Veena Srinivasan

Contested waterscapes: Land use change, decentralised interventions and complex impacts 148
Shrinivas Badiger and Sharachchandra Lele

Conserving the less charismatic: Making conservation inclusive for insect diversity 156
Dharma Rajan Priyadarsanan, Anu Radhakrishnan and Seena Narayanan Karimbumkara

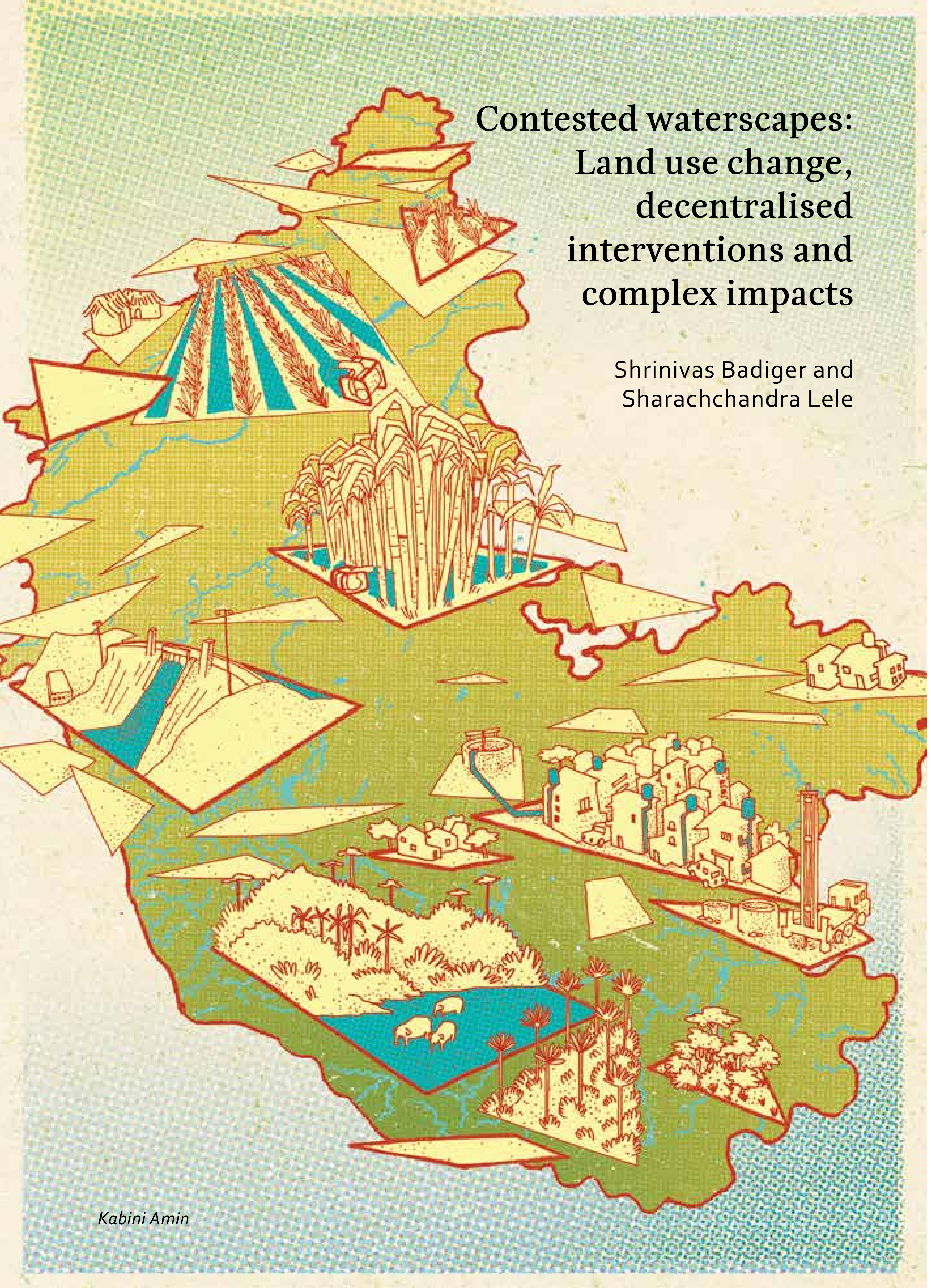
The nitty gritty of a name: Systematic biology and conservation 162
R. Ganesan, Aravind NA., Dharma Rajan Priyadarsanan and G. Ravikanth

Why do we care? Unpacking the 'environmental' in our environmental science 172
Sharachchandra Lele

A dialogue of disciplines: ATREE's PhD programme in conservation science and sustainability studies 178
Nitin D. Rai and Gladwin Joseph

Contested waterscapes: Land use change, decentralised interventions and complex impacts

Shrinivas Badiger and Sharachchandra Lele



Kabini Amin

THE CHANGING WATERSCAPE OF KARNATAKA

Traversing the state of Karnataka in peninsular India, from the coconut-shaded coastline, through the spectacular Sahyadri mountain range, towards the vast Deccan Plateau, one encounters a fascinating range of hydrological conditions. The Sahyadris, or Western Ghats, running close to the western coast, not only forms a natural hydro-climatic divide, but is also a complex vegetated landscape of rich forests intermingled with diverse agro-ecosystems in its valleys and slopes. Heavy monsoon rains in this densely vegetated Sahyadri ridge is the primary 'source' of water for all the major rivers—both east- and west-flowing—and a lifeline to more than a quarter of a billion people in peninsular India. The west-flowing rivers are short but gushing, creating a water-rich coastal area before joining the Arabian Sea. On the other hand, the east-flowing rivers are long and slow, meandering across the much drier Deccan Plateau of Karnataka, and then Telangana, Andhra Pradesh, or Tamil Nadu before reaching the Bay of Bengal.

These landscapes and waterscapes have been significantly transformed by civilisations over centuries, initially through modest alterations to make the water work for an agrarian way of life. Thus, the water and forest-rich environments of The Sahyadris have seen the emergence of agricultural adaptations: arecanut and paddy cultivation in the valleys, and coffee cultivation on the slopes, with highly localised water diversions. The relatively drier eastern plains see more visible hydrological interventions, with thousands of cascading irrigation 'tanks' dotting the landscape, built over centuries and enabling agricultural intensification. More recently, large-scale interventions such as large dams for irrigation and hydropower, big pipelines for urban water supply, and millions of deep borewells to expand irrigation have dramatically transformed the waterscape across the state.

Environmentally speaking, one distinct feature of water is that it always flows: in streams and rivers but also from the surface into the ground through 'infiltration' and then from groundwater back in to streams as 'baseflow'. This flow links upstream and downstream users, as also surface and groundwater users, in complex ways. As we reach greater intensities of water use far beyond those prevailing for much of the Anthropocene, tensions and conflicts between upstream and downstream water users have increased dramatically, especially in water-scarce countries like India.

While the impacts of direct interventions in hydrology, such as the construction of large dams, is fairly obvious, the cumulative impact of indirect or subtle interventions such as modifying forest vegetation or soil, changing agricultural practices, constructing tiny water conservation structures, or pumping of groundwater from thousands of wells, are much less visible or understood. We present here some of the understanding of these cumulative impacts we have gained through research spanning a decade and a half and ranging from the forest catchments in Uttara Kannada and Mysuru, to the eastern slopes in Belagavi, and the water-scarce semi-arid regions of Bidar, Haveri and Chitradurga.

INFLUENCE OF HUMAN USE OF FORESTS ON WATER

It is conventional wisdom in environmentalist circles that forests provide numerous benefits to humans, including flow of streams and rivers. Even conservation scientists claim that 'hydrological regulation' is one of the key benefits of tropical forests. Deforestation or forest degradation is therefore considered to affect downstream communities through hydrological change, in addition to all the other impacts these processes might bring. Yet, the hydrological changes actually caused by changes in tropical forest condition and their social implications are the most poorly understood and contentious of all the environmental benefits of forests. Human use changes forests in diverse ways—e.g., in the Western Ghats of Karnataka, this has created tree savannahs, pure grasslands, sometimes barren lands and in other places dense fast-growing plantations out of dense 'natural' forests. Some forest hydrologists have argued that denser forests (or fast growing forest plantations) may consume more water as compared to tree savannas or grasslands. Others point out that forest use, especially grazing of livestock, not only changes vegetation dynamics but also often compacts the soil, which may decrease infiltration and increase surface runoff. What the net hydrological effect is, and more importantly, how exactly this affects downstream communities, has been debated but hardly studied in the tropics, especially in India[1,2].

Between 2002 and 2006, we carried out a multi-disciplinary effort to understand some aspects of this issue using sites in two regions in the Western Ghats of Karnataka. What seems to emerge is that not all types of 'forests' have equal or even unidirectional influence on hydrology, and neither do these changes in hydrology have the same socio-economic impact everywhere.

One set of catchments was in a high rainfall (2000-3000 mm) region in Uttara Kannada district, where farmers had modified some forests into tree savannas (known as *soppina bettas*, locally) to meet their firewood, fodder and mulch needs, while the Forest Department had pursued a plantation programme with fast-growing earleaf acacia (*Acacia auriculiformis*) in other patches. Farmers cultivated paddy during the monsoon, but also used the seepage flows from headwater catchments to irrigate more valuable arecanut and spices in the valleys, and downstream of it, if possible, some cultivated a second crop of paddy. Another set of catchments was in a low rainfall (700-800 mm) semi-arid region in Nanjangud *taluka* of Mysuru district near Bandipur National park, where villagers also used forests for firewood and grazing. However, farmers also captured monsoon runoff from these heavily used forest catchments in irrigation tanks, and, if adequate, used that for cultivating paddy (surprising, since this is a low rainfall region).

The impact of intensive human use of forests for firewood collection and grazing on the surface hydrologic processes was similar in both regions: reduced infiltration and increased overland flows. But in the high rainfall region, where soils had inherently higher permeability, groundwater recharge was still significant even under human-impacted catchments, and the

[1] For details, see Krishnaswamy, J, S. Lele and R. Jayakumar (eds.). 2006, *Hydrology and watershed services in the Western Ghats of India.* New Delhi: Tata McGraw-Hill.

[2] Lele, S. 2009. Watershed services of tropical forests: from hydrology to economic valuation to integrated analysis. *Current Opinions in Environmental Sustainability* 1(2): 148–155.

lower density vegetation in these catchments may have partly compensated with lower evapotranspiration loss. Planting up originally grazed patches with acacia improved infiltration, although it also increased evapotranspiration to some extent. Thus, these land use transformations affected the post-monsoon baseflows in streams only somewhat, as long as the larger catchment contained a mosaic of intact and modified forest[3].

Further, a comparison of productivity and profitability of arecanut cultivation in valleys with different duration of post-monsoon flows showed that the valleys with longer post-monsoon flows had, on an average, greater arecanut productivity. On the other hand, farmers with greater access to forest products, particularly leaf manure and mulch, also had higher arecanut productivity. This suggests that arecanut farmers have to strike a balance between the hydrological benefits of intact forests, and the direct benefits of forest product harvest for agriculture, livestock, and the domestic sector, and up to a certain threshold, they might get enough of both. Human use of forests causes limited hydrological impact, and the impacts are compensated by the direct benefits of forest use.

In the drier region also, intensive use of forests reduced infiltration, and therefore groundwater recharge. But the increased and earlier runoff that resulted, actually benefited downstream farmers, because their irrigation tanks were more likely to fill under these conditions. If, on the other hand, the forest cover in the tank catchment is somehow improved, that would then decrease surface runoff, increase evapotranspiration from the trees and probably increase groundwater recharge marginally. Eventually, this ground-

Farmers can take up paddy when the irrigation tank fills. (Photo: Shrinivas Badiger)

water could emerge as baseflow in the stream somewhere much downstream of the tank. But in a tank-based irrigation system, which is designed to support a water-intensive paddy crop, partially-full or slowly filling tanks are not useful. Our simulations indicated that improved forest cover would significantly reduce the probability of tanks filling, and the frequency with which farmers could cultivate irrigated paddy crops. Thus, paradoxically, reforestation may have negative economic consequences for farmers in the command area of such tanks[4].

In short, forest use or reforestation will change the hydrology of forested catchments. But whether the socio-economic consequences of these changes are positive or negative is highly contextual. The type of technology society has used to create socially useful flows, such as irrigation tanks, seepage-based agriculture, or wells influences these outcomes. Thus, hydrological 'services' of forests depend not only on the type of forest transformation but also on the type of socio-technical conditions downstream of the forest.

[3] Krishnaswamy, J., M. Bonell, B. Venkatesh, BK. Purandara, S. Lele, MC. Kiran, V. Reddy, et al. 2012. The rain-runoff response of tropical humid forest ecosystems to use and reforestation in the Western Ghats of India. *Journal of Hydrology*, 472–¬473: 216–237.

[4] Lele, S., I. Patil, S. Badiger, A. Menon, and R. Kumar. 2011. Forests, hydrological services, and agricultural income: a case study from Mysore district of the Western Ghats of India. In: *Environmental valuation in South Asia.* (eds. Haque, AKE., MN. Murty, and P. Shyamsundar) Pp.141–169. Cambridge, UK: Cambridge University Press.

Diversion of river water for water-intensive crops such as sugarcane has led to increasing conflict between upstream farmers and downstream domestic water users. (Photo: Shrinivas Badiger)

UPSTREAM AGRICULTURE AND DOWNSTREAM IMPACTS

How significant are these forest-cover-driven hydrological changes in the larger picture of changing hydrological patterns in Karnataka? We analysed several decades of streamflow data from government records of 20 catchments in the Western Ghats, and also estimated forest cover changes in these catchments using satellite images. It turned out, neither was forest cover decline significant in most of the catchments, nor could the hydrological change—where visible—be explained by just declines in forest cover or changes in rainfall pattern. Several catchments showed declining trends in flows, which could only be explained by increased agricultural water use through direct pumping from the streams[5].

This led us to pay greater attention to agricultural land use changes. The catchment of a major irrigation dam on the Malaprabha—an east-flowing river in Belagavi district, Karnataka—provided an interesting case. The upper 10% of the 2200 km² catchment is under forest cover, which has not changed much over several decades. The remaining area is largely under agriculture. The rainfall varies from 2000 mm in the upper catchment to 500 mm at the dam, and even lower in its command area. The dam is witnessing a steady decline in inflows. Initial visits suggested it might be the towns immediately upstream of the dam that were extracting water for domestic use, but these quantities turned out to be rather small. We then analysed the changes in agricultural land use in the catchment using multi-season IRS-P6 satellite data[6]. We found that the net area under irrigated crops in the catchment had increased from 10f to almost 40% of the total cultivable land, and this area consisted primarily of sugarcane, paddy and some area under oilseeds. Sugarcane, the most water-intensive of these crops, and one that is perennially irrigated, occupied almost half the irrigated area. The crops were being irrigated either by pumping from borewells or by (mostly clandestine) lifting of water directly from the Malaprabha river and transporting it several kilometres. It is this increase in consumptive use of water for irrigation that is responsible for reduced inflows into the dam.

Interestingly, the reduced inflows into Malaprabha did not trigger a conflict between command area farmers and upstream farmers, probably because there are similar inequities within the command area itself[7]. But it did trigger action from Bailhongal and Soudatti towns, which depend significantly on the Malaprabha reservoir, in the form of sending patrols to stop illegal lifting of water from the river-bed upstream. But the larger role of groundwater pumping in the catchment as a whole was not foregrounded. An exploration of what is driving sugarcane expansion in the Malaprabha catchment took us into the political economy of sugar production and policies supporting the setting up of sugar factories at the expense of other forms of agricultural development. But that is a story for another day[8].

WATERSHED DEVELOPMENT: NOT A SILVER BULLET

As environmental concerns around large dams became prominent in the mid-1980s, one solution to the problem of water scarcity and low agricultural productivity in semi-arid areas that became quite popular in both civil society and policy circles was the idea of 'participatory watershed development'. The idea was to carry out soil and water conservation activities in common lands, streams, and individual farms, so as to capture as much of the rain falling in micro-catchments and to make it available as soil moisture, and to recharge the groundwater, which can later be pumped for farming. The activities included land levelling, farm bunding, contour trenching, re-vegetation of common lands, check-dams and other recharge structures on streams, all of which were to be planned and implemented in a participatory manner. This idea was piloted in places such as Ralegaon Siddi in Maharashtra, and Sukhomajri in Haryana, and then mainstreamed into rural development policy for semi-arid areas. Starting in the late 1990s, a series of large state and donor-funded projects and programmes were implemented

Rainwater harvesting structures constructed in many watershed development programmes become dysfunctional even before they start reaping benefits due to lack of social engineering. (Photo: Shrinivas Badiger)

across the country, including the drier parts of Karnataka, for enhancing and stabilising rural livelihoods. It seemed that a silver bullet for integrated natural resource-based rural development had been found[9].

As a part of a collaborative three-state study spanning Karnataka, Maharashtra and Madhya Pradesh, we sought to firstly assess whether these programmes had resulted in any lasting impacts on the rural landscape and the water resource, and then to understand the hydro-agro-socio-economic nature of these impacts (where visible) and factors shaping them. A rapid assessment across a large number of locations indicated that, on an average, 40% of recharge structures, such as check dams and nala bunds, were already damaged within the first year of project completion, and more than half of the structures were no longer in good condition 3 years after project completion. And while micro-credit groups set up in these projects—but de-linked from natural resource management—continued to function, watershed committees set up to maintain

[5] Lele, S., J. Vaidyanathan, S. Hegde, V. Basappa, and J. Krishnaswamy. 2007. *Influence of forest cover change on watershed functions in the Western Ghats: a coarse-scale analysis.* Project report. Bengaluru: Centre for Interdisciplinary Studies in Environment and Development.

[6] Heller, E., JM. Rhemtulla, S. Lele, M. Kalacska, S. Badiger, R. Sengupta and N. Ramankutty. 2012. Mapping crop types, irrigated areas, and cropping intensities in heterogeneous landscapes of southern India using multi-temporal medium-resolution imagery: implications for assessing water use in agriculture. *Photogrammetric Engineering & Remote Sensing* 78(8): 815–827.

[7] Farmers at the head-reach of the Malaprabha canals appropriate most of the irrigation water, and so hardly anything reaches the tail-end. In this situation, the effect of reduced inflows and releases from the dam are hardly felt by the head-reach farmers.

[8] Badiger, S., S. Gopalakrishnan, and I. Patil. 2013. Contextualizing rural-urban water conflicts: bio-physical and socio-institutional issues of domestic water scarcity. In: *Water in a globalizing world: state, markets and civil society in South Asia.* (eds. Narain, V., C. Gurung Goodrich, J. Chourey, and A. Prakash) New Delhi: Routledge Publishers.

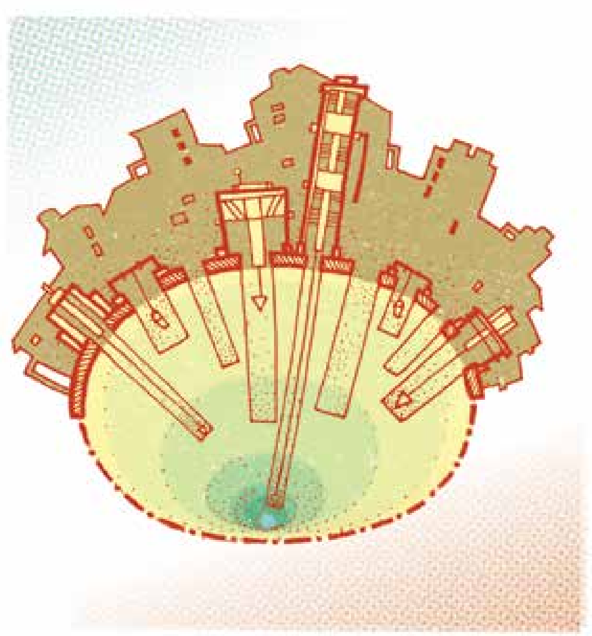
[9] Joy, KJ., A. Shah, S. Paranjape, S. Badiger and S. Lele. 2009. Re-visioning the watershed development programme in India. In: *Agricultural development, rural institutions, and economic policy: essays for A.Vaidyanathan* (eds. Kadekodi, GK, and B. Viswanathan). Pp.152-175. New Delhi: Oxford University Press.

recharge structures or regulate common land management were largely dysfunctional.

A detailed assessment of the more successful watershed development programmes—spread over Bidar, Haveri and Chitradurga districts—indicated a more complicated dynamic that illustrates how such interventions lead to mixed outcomes. First, structures such as check dams increased groundwater recharge, but this only benefitted those farmers who already owned or dug new borewells or open wells close to these structures. Thus, the benefits were highly unevenly distributed within the watershed. Second, even if the structures were maintained over time, the benefits were becoming unsustainable because groundwater pumping was encouraged and unregulated, resulting in gradual but irreversible groundwater decline.

This is not to say that the watershed development has not worked. We had ourselves documented the success of this approach in Hivre Bazar in Maharashtra. In such cases, people had not built very different structures, but they had managed to put in place strict regulations on water-intensive crops and drilling of borewells. Mechanisms for water sharing were collectively agreed upon even before the structures were built and much before the benefits of these structures started showing up. Distributional issues were sought to be addressed through sharing of wells. Where access to commons was closed off to enable regeneration, compensatory fodder supply and changes in livestock management were promoted. Unfortunately, government-supported or implemented watershed programmes lacked both the patience and the political will to mandate fair water allocation or regulation of water use in their agenda.

A third dimension of our findings further underlined how such well-meaning micro-level interventions, made in the absence of a full appreciation of larger socio-hydrological processes, can have unintended consequences. The micro-watersheds we studied in Bidar district were part of the catchment of a medium irrigation tank on the Upper Mullamari stream, most of which had been similarly 'treated' with watershed development interventions. The tank was providing irrigation water to about 1,000 ha. We asked whether scaling up watershed development in the catchment—including not just increased recharge but also, as mentioned above, increased utilisation—had any implications for the tank. Our analysis of the tank inflows and outflows indicated that, during the 18 years prior to the watershed interventions, the monsoon runoff into the reservoir was 16% of the net seasonal rainfall. During this period, the reservoir filled 10 times, of which it overflowed to downstream tanks 7 times. During the post-intervention periods, the runoff was 14% of the rainfall over a period of 4 years and the reservoir filled twice but without any overflows to downstream tanks. Anecdotal information gathered from discussions with farmers further confirmed the implication that large-scale watershed development upstream had reduced downstream flows. This is not to say that watershed development has adverse impacts per se, but that it reapportions surface water flows in favour of micro-watershed-level users, like the "robbing Peter to pay Paul" analogy. It triggers rapid expansion in groundwater over-extraction that can eventually undermine these gains, which anyway accrue only to those who already have or can afford to dig new wells. And local gains—when scaled up—can have wide spread consequences if prior use of surface water existed downstream.



SUBTLE ACTIONS, LINKED HYDROLOGIES AND COMPLEX OUTCOMES

Conducted in different contexts with different methods, collaborators, and even overall goals, these studies nevertheless have shown us that understanding of linkages, contexts, and scales can upset conventional 'wisdoms'. First, our hydrological work has showed the importance of understanding linkages—between forest cover and infiltration, between upstream water use and downstream availability, and between surface and ground water. Second, the socio-technical context determines whether the hydrological changes are positive or negative and for whom: the same biophysical impact produced by trees or rainwater harvesting in the upper catchments has different implications depending upon whether downstream users harness surface water or groundwater, what crops they grow, and how they distribute water. Third, scaling up of apparent silver bullets—whether all-out afforestation with fast-growing species, or indiscriminate construction of check dams—may lead to both hydrologically inequitable and socially unsustainable outcomes.

While the era of large dam construction seems to be drawing to a close, at least in peninsular India, the last few decades have seen a shift towards millions of micro-scale interventions in watersheds, with different motivations—greening, soil conservation, groundwater recharge, agricultural development or drought-proofing. But focusing on techno-fixes with a cursory nod to participation will not work in the long run, and participation will have to be coupled with self-regulation. For this to work we need a better understanding of how water moves in complex ways, how human modifications in the landscape influences this movement at multiple scales, and how traditional and modern socio-technical adaptations or interventions shape and re-shape when, and how, and to whom, benefits accrue.

Acknowledgements

The insights presented here emerged from collaborations and conversations over many years with several colleagues, including Ajit Menon, Jagdish Krishnaswamy, Iswaragouda Patil, K J Joy, Suhas Paranjape, Amita Shah and other collaborators from UNESCO, National Institute of Hydrology, SOPPECOM, and Gujarat Institute of Development Research.

Further reading

Bruijnzeel, LA. 2004. Hydrological functions of tropical forests: not seeing the soil for the trees? *Agriculture, Ecosystems and Environment* 104(1): 185–228.

Joy, KJ., S. Paranjape, AK. Kiran Kumar, R. Lele and R. Adagale. 2004. *Watershed development review: issues and prospects.* Bengaluru: Centre for Interdisciplinary Studies in Environment and Development.

Lele, S. 2009. Watershed services of tropical forests: from hydrology to economic valuation to integrated analysis. *Current Opinions in Environmental Sustainability* 1(2): 148–155.

Narasimhan, TN. 2006. Water and science in India. *Current Science* 90(10): 1321–1322.