Forest Cover and Global Water Governance

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Water availability will be increasingly precious for development

- 1.2 billion people live under physical water scarcity and another 1.6 billion people in economic water scarcity
- Millennium Development Goal: to halve, by 2015, the proportion of population without sustainable access to safe drinking water and basic sanitation
- The increased need for food and the need to adapt to climate change are expected to put a tremendous demand on water
Global trends enhance links between forests and water

- Changes in forest cover:
  - in some countries transition from deforestation to afforestation
  - increase in forest area mainly due to monoculture plantations
  - throughout the tropics the number of trees on farm are increasing
  - conversion of forests to other energy crops
- Climate change will impact on water availability and lead to changes in the nature, distribution and quality of forests
- Carbon mitigation measures (CDM, REDD) may increase and improve forest cover
- Development of previously poor societies often lead to increased water consumption
Land-use decision is often a water decision

- Different perceptions and generalisations about perceived benefits of forests on water management
- The hydrological consequences of forest cover are complicated by great spatial and temporal variability of land-use change as well as of hydrological systems
  - tree planting in one part of the landscape may not boost all water benefits in all other parts of the landscape
- There are trade-offs between soil carbon storage and water infiltrability of soils
  - due to tree planting and increased water use by the planted trees
Previous generalisations about forest and water relationship are often taken for granted

- The acclaimed benefits of reforestation for improved water availability, “the sponge theory”, contradicts the scientific evidence that trees use more water from soil and groundwater
  - lack of empirical studies
  - however, there is indication of decreasing groundwater resources upon reforestation in tropical semi-arid regions
- The total effect on change of groundwater storage is often negative for planted monocultures compared to old growth forests and grassland but is also highly dependent on site specific characteristics
- Landscape and watershed scale are the relevant scales for the management of forests and water
Evapotranspiration from rain trapped in tree crowns (Ei) and water taken up from soil (Et) is generally greater for forest than other vegetation, but the ratio between water infiltrated into soil in relation to quick surface runoff (Inf/Rsurf) is also greater under trees.
Trees and forests provide soil protection and improved water quality relative to other land uses

- Most soils need biological activity and soil organic material to maintain a soil structure with sufficiently large soil pores for water to enter the soil (infiltrate)
- A healthy vegetation is important for maintaining high soil infiltrability
- Trees assist groundwater recharge and help prevent fast surface runoff, but the change in vegetation type alone is not sufficient to influence major downstream flooding events
  - scientific evidence does not support massive forestation programs for preventing floods
Forest and water relationships may be difficult to prove as human activity has complex effects on water.

- Changes at the landscape and regional scales are the result of changing land uses that are occurring over time and superimposed on natural changes at a larger scale.
  - Effect of human interventions at the micro-scale is easily possible, yet flood peaks, sediment load and baseflow at higher scales cannot that easily be measured.

- Extreme weather events occur as a result of normal fluctuations of climate, although there is an increasing frequency that may not be within the normal range.
Time scales of land-use change-induced disturbances and their rehabilitation

With generalisations it is easy to avoid dealing with more complex factors in water management, including governance.
Global change disputes old generalisations

- Future forests will be very different from today, and old perceptions and knowledge of effects of land use on water management will not hold.
- Increasingly complex land-use due to increasing intensity and diversity of cultivation, and with different patterns of landowners’ rights. Water issues will become increasingly complex.
  → High demand for developing the technical and socio-economic knowledge base as well as for developing relevant policies, institutions and legislation for dealing with this new situation.
New challenges related to carbon storage

- In recent decades, soil rehabilitation and combined soil fertility-water management have been drivers for many re/afforestation programs.
- Soil management is related to carbon storage:
  - More research is needed on quantity and quality of increase of carbon in soils.
- To achieve significant improvements in soil properties such as infiltrability can take from 2 to 20 years.

→ It would be desirable to modify CDM (Clean Development Mechanism) guidelines and to design the REDD (Reducing Emissions from Deforestation and Forest Degradation) systems to optimise both carbon storage and water management.
New challenges related to increasing tree planting

- In reforestation the desired return to a previous “better situation” may not hold true, at least not in all aspects of water effects
  - soil conservation with improved infiltrability may be achieved, but often less efficiency in soil biological improvement with e.g. poorly decomposable leaves (pine, teak)
- Irrespective of plantation type, improving ground water recharge may not be achieved as plantation may use more water
  - this may be true also for naturally or spontaneously regenerating secondary forest, depending on the degree of ecosystem and soil degradation
  - the value of extra water used by trees has to be balanced against other societal values like soil stability, wood production and carbon sequestration
New challenges related to higher intensity land-use and ecological change

• Climate change related changes in e.g. temperature, rainfall or pests outbreaks may increase need for quick changes in land-use
• Increased demand on biomass production and climate variability may steer investments towards intensive cultivation systems with less risky short rotations
• Increasingly dynamic landscapes will make water budgets more complex and demand more coordinated management of forests and water with due consideration to technical, institutional and societal issues
Governance systems for water resources

- Functioning of ecosystems and the provision of specific human-welfare benefits to users of those ecosystem services are closely related.
- Sustainable provision of hydrological services is complex because of:
  - high uncertainty in the understanding of the hydrological cycle’s responses to climate change and land-use change
  - the need to deal with competing and changing demands for the resource
  - scarce resources to enforce actions
  - a largely weak institutional framework in regulation of land and water use
- Flexibility and learning mechanisms across sectors and scales needed as in adaptive governance (AG)
Payment for ecosystem services (PES)

- In addition to economic incentives, issues such as rights and trust in formal administrative institutions should be considered when developing PES strategies, especially in developing countries.
- Major challenges to effective conservation of hydrological ecosystem services are:
  - institutional weaknesses in the definition of rights
  - legitimacy of mechanisms for distribution of incentives
  - limitations in understanding and quantifying highly uncertain provision of ecosystem services, such as water, due to limited availability of data and asymmetric sharing of information.
Deficient knowledge base

- Information needed on how much and where in the landscape forests and other land-uses would be best located
- Integrated management of forest and water require a thorough knowledge of hydrological systems combined with appropriate tools such as biophysical and economical models to enable institutional, regulatory and other solutions such as PES
- There are
  - few good studies in the tropics, none involving tree planting on formerly deforested or degraded land
  - few long term experiments on watersheds with forests of various ages in the landscape
  - Oversimplifications, including no consideration of the soil quality factor in landscape
"Trialogue" for adaptive water governance

- Full potential benefits of integrated water resource management have yet to be realised, especially in developing countries
- Interaction - “trialogue” - is needed among government, the society and science for effective governance of hydrological ecosystem services
- Both governance and biophysical tools and their integration are needed
Increasing demands for water for social and economic development

Improving a complex social-ecological system such as provision and use of hydrological environmental services requires:

- Promoting common understanding of problems for short term solutions and future visions
- Modelling of scenarios to feed learning processes of the different stakeholders
- Empowering of key organisations in self-organised networks that often already exist in watersheds
- Building academic capacity in tropical countries both to support forest and water management and for empirical knowledge for modelling