Rapid Hydrological Appraisal in the Context of Environmental Service Rewards

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RHA Guidelines in the Context of Environmental Service Rewards

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EXECUTIVE SUMMARY

Agriculture usually implies impacts on the broad complex of 'watershed functions', if we take a natural forest without any human presence as point of reference. Forest protection as part of watershed management is often (still) considered to provide downstream economic benefits that may well exceed the local benefits of agricultural use—but traditional land use rights of people in the upland mean that forms of rewards or compensation are needed to ensure that land use decisions in the uplands align with what may be optimal resource use at a larger scale of consideration. Especially where hydro-electricity schemes derive substantial economic benefits from the continued flow of water, the concept of payments for watershed protection services has become popular.

However, there is no shared opinion among scientists, farmers and policy makers about what these services really are, how they depend on the condition of the landscape (and the amount of forest that is part of it) and how payments or rewards can be made transparent (linking reward to delivery) and robust (surviving paradigm shifts). To judge how far apart the potential partners in a rewards mechanism are and what it would take to bridge the 'perception' and 'communication' gaps in the way the local 'forest and water' debate has developed, a form of 'rapid appraisal' is needed.

The experience of the 'Rewarding Upland Poor for the Environmental Services they provide' (RUPES) consortium has shown that the overall likelihood of achieving negotiated reward mechanisms depends on four aspects:

Value-shared perceptions of the way identifiable watershed functions are influenced by upland land use, and affect downstream interests;

Threat-the existence of trade-offs between the local utility of upland land use decisions and these identifiable watershed functions;

Opportunity-the presence of community scale institutions that effectively constrain individual land use decisions and that can secure compliance with agreements;

Trust-between local communities, governments and outside actors as a basic condition for negotiations and compliance by all partners to agreements.

The guidelines presented here allow for a 'rapid appraisal' (over a 6-month period) of the hydrological situation and the perceptions of key stakeholders (value, threat and opportunity) to enable an appraisal of the opportunities for negotiating land use agreements that include rewards for the protection or rehabilitation of watershed functions in the uplands.

The appraisal (with a focus on cost-effectiveness and a target budget below USD 10 000 when implemented in a country like Indonesia) is based on six components:

- Search of the literature and web-based resources on the area and initial 'scoping' meeting with key stakeholders;
- Spatial analysis of the landscape based on remotely-sensed imagery and available maps and digital data;
- Exploration of local ecological knowledge of the landscape, water movement and consequences of land-use options;
- Discussions with a wide range of stakeholders and policy makers on issues of land use and hydrological functions;
- Modelling of the water balance and water use in the landscape to explore scenarios of plausible land-cover change and their likely impacts on key performance indicators;
- Communication of results and appraisal of the opportunities for negotiated agreements.

Examples from a Rapid Hydrological Appraisal (RHA) in the Lake Singkarak area ,West Sumatra, Indonesia, illustrate the steps.

1. Background

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1. BACKGROUND

1.1. The end product of a Rapid Hydrological Appraisal

It may be best to start at the end (figure 1). At the end of a Rapid Hydrological Appraisal (RHA), an 'honest broker' or intermediary will have to advise the local and external stakeholders of a landscape with agricultural use as well as concerns over watershed functions, whether it is worth pursuing 'negotiations' on environmental-service rewards. If the answer is 'no', both sides can avoid disappointment by focussing on other activities or sites. If the answer is 'yes', further studies will be needed. If the broker isn't 'honest', all parties (including the 'broker') may lose by wasting time and effort.

Figure 1: The main conclusion of a Rapid Hydrological Appraisal is an advice to pursue more formal negotiations of environmental-service reward (ESR) mechanisms, or look for alternative arrangements as the chances of success are likely to be low.

1.2. Translating value into action

Rapid Rural Appraisal, Participatory Rural Appraisal, Diagnose and Design—there is a whole suite of methods to assess the relation between livelihood strategies of local communities and the landscape in which they live. Do we need a new name for a slightly different approach?

The relation between land use and the flows of water to downstream areas is important, because human demand on water for agricultural production, industries and domestic use are increasing globally, while supply is stable at best. Fears that the quality, quantity and regularity of flow of water from uplands is affected by 'deforestation' are at the base of much regulation of land use, restricting opportunities of upland people to make a living the way they want and see fit. Concerns over loss of tropical forest are based on the loss of 'intrinsic value' of forests, but also for the loss of environmental-service functions.

However, many countries cannot afford the luxury of having uplands without farmers, but neither can they afford lowlands without a clean and reliable water supply—so the trade-off between local livelihoods and external flows of water is an important one. Many upland communities live within the forest margin, or on previously forested landscapes. The land use mosaics they have created include forest areas, grassland areas, agriculture and agroforestry, and may still provide important environmental-service functions. Communities gain income or subsistence (direct benefits) from what they harvest, grow or extract from these upland landscapes. Yet, there is no income for maintaining the landscape in order to produce environmental-service functions for off-site and downstream beneficiaries. Maintaining or enhancing these functions thus remains an 'externality' to their decision making.

As purely regulatory approaches have not worked, there is a global interest in systems that combine regulation with positive incentives ('sticks and carrots'). In that context, however, we find that there are often substantial differences in perceptions among stakeholders as to what is at stake. On one hand downstream stakeholders may perceive that only 'full forest cover' can guarantee that their interests are secured and that any type of deforestation is a threat, on the other hand upland land users find that more open land cover types (agroforestry or even open-field agriculture or pasture lands) suit their livelihoods and can be made compatible with their local needs for watershed functions. To scope these perceptions and their degree of overlap and similarity, we started using the 'rapid hydrological appraisal' tool that we present here. It builds on the concepts and tools of participatory rural appraisal, but delves deeper into the perceptions of various stakeholders on:

- the severity of 'watershed problems' in relation to land use;
- the positive contributions made by specific land use practices that help reduce the problems;
- the potential basis for forms of 'environmental-service rewards' that provide incentives for supporting 'protective' activities as alternatives to more 'degrading' ones.

RHA takes the participatory appraisal process a step further via the use of computer-based landscape-hydrological simulation models:

- to compare the overlap between stakeholder perceptions of current and past patterns, processes and impacts of land and water use, and biophysical reality as assessed via independent analysis of the site landscape, hydrology and environmental characteristics;
- project forward the hydrologic and environmental implications of current trends or future changes in land- and water-use patterns by modelled 'scenarios'.

The overall 'objectives' are 'for all stakeholders' to better:

1. understand local land use patterns, the benefits they provide to actors in the landscape, the alternative land use options that exist and the current drivers of change;
2. understand the impacts of local land use change on environmental services, and thus on potential 'buyers' that are willing to provide incentives to maintain or enhance specific services;
3. evaluate whether or not it makes sense to invest further in a negotiation process that can lead to a reward mechanism that will deliver on stakeholder expectations.

1.3. Rewards for environmental services

Mechanisms that link lowland beneficiaries to upland land use decisions through appropriate reward mechanisms may provide a cost-effective way to enhance sustainable development. The RUPES ('Rewarding Upland Poor for the Environmental Services they provide') consortiumin which the World Agroforestry Centre (ICRAF), International Fund for Agricultural Development (IFAD), IUCN, Centre for International Forestry Research (CIFOR), International Institute for Environment and Development (IIED), Conservation International, the Ford Foundation, WWF and other international partners work together with national partners in (currently) Indonesia, the Philippines, Vietnam, China, Thailand, India and Nepal is supporting a network of 'action-research sites' and 'national policy review' activities to facilitate such mechanisms. Specific attention is given to 'pro-poor' forms of environmental-service reward (ESR) mechanisms. Benefits to poor people can come both through the way rewards are channelled and through the positive environmental impacts of the decisions they support.

The RUPES project has been developed in the expectation that mechanisms that link lowland beneficiaries to upland land use decisions, through appropriate reward mechanisms, may be a key 'action' required to address rural poverty in the uplands and provide a cost-effective way to enhance sustainable upland development, and to conserve the 'value' upland watersheds have for areas downstream (downstream usually refers to water flows, but is also used in the context of flows of greenhouse gasses influencing climate and flows of organisms affecting global biodiversity). The overall environmental value of upland areas for external stakeholders can be analysed in terms of biodiversity, landscape beauty, carbon stocks (and related greenhouse-gas emissions) or water flows. These four categories of services all derive from the make-up of the landscape (land-cover types and spatial organization) and they relate to broader human functions of provisioning of food and fibre, health, spiritual values and buffering against extreme events (figure 2). The main concept is to 'close the feedback loop' and ensure that the consequences for 'downstream' communities of the land use mosaics that evolve in the uplands are reflected in the rules and rewards that the upland communities receive and perceive. The scale at which these four types of environmental services are perceived varies (table 1).

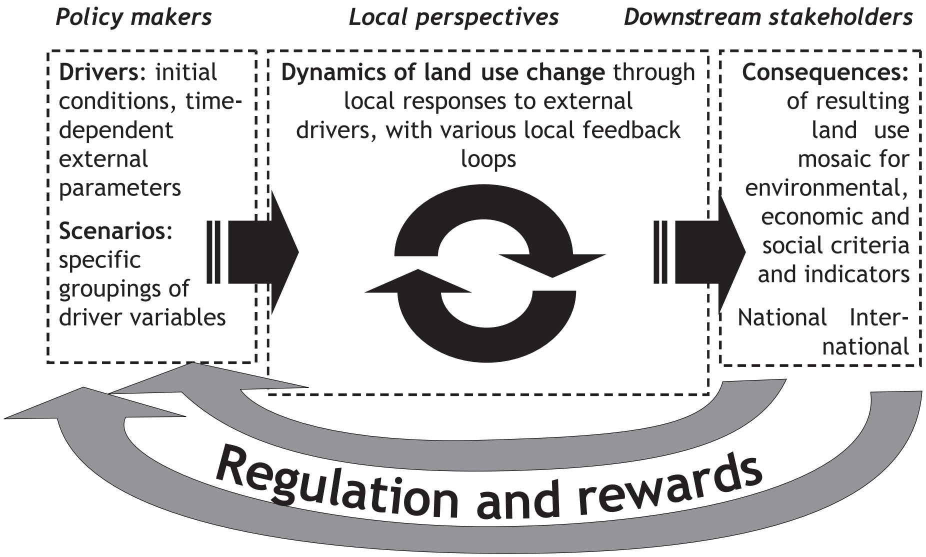


Figure 2: Drivers of land use change in the uplands, downstream consequences and the feedback loop via regulation and rewards that influence the real drivers of change.

Table 1: Generic rating of the scale of influence and concern among four categories of environmental services

Scale	Carbon stocks (global warming)	Biodiversity	Landscape beauty (ecotourism)	Water flows
Local rural community	0	++	++	+++
Provincial / district public & policy makers	+	+	++	+++
National public & policy makers	+	+	+	+++
Global public & policy makers	+++	+++	0	++

+++ very important; ++ important; + some significance; 0 not a direct concern.

Initial analysis suggests that carbon stocks and biodiversity are primarily global concerns, while concerns about water flows dominate at local to national scales.

The experience of RUPES (van Noordwijk et al. 2004b, van Noordwijk 2005) suggests that the overall likelihood of negotiated reward mechanisms depends on four aspects:

Value : shared perceptions of the way identifiable watershed functions are influenced by upland land use and affect downstream interests;
Threat : the existence of trade-offs between the local utility of upland land-use decisions and these identifiable watershed functions;
Opportunity : the presence of community scale institutions that effectively constrain individual land-use decisions and that can secure compliance with agreements;
Trust : between local communities, governments and outside actors as a basic condition for negotiations and compliance by all partners to agreements.

In the context of reward mechanisms for forest-derived environmental-service functions, 'watershed functions' in a broad sense are likely to be the most urgent, direct and marketable aspect of upland land use. Biodiversity protection may be eligible for higher rewards per person in specific areas and increasing terrestrial carbon stocks may have captured the imagination of many policy makers, but watershed functions are prominent in the public perception (van Noordwijk 2005). For any of these 'environmental services', the local, district and provincial levels are probably the most critical to project implementation success, as they are the level of operation where national and international plans and implementation concepts often tend to fall apart. It thus seems preferable to start with issues that are high on the agenda at this critical implementation level, and consider how other 'values' of land use can be 'bundled' in terms of overall rewards and incentives. The tentative conclusion is that watershed functions are the most urgent, direct and 'rewardable' aspect of upland land use that can form a basis for RUPES mechanisms. Poverty reduction mechanisms vary from reduction of blame to financial payments:

- Stop negative 'drivers' that enhance poverty and degrade environmental services (STOP 'PUPES')
- Enhance local environmental services and resources (e.g. regular supply of clean water, access to beneficial plant and animal resources)
- Enhanced security of tenure, reduced fear of eviction or 'take-over' by outsiders, allowing investment in land resources; increased asset value
- Enhanced trust with (local) government, increased 'say' in development decisions
- Increased access to public services (health, education, accessibility, security)
- Payment for labour at least equal to opportunity cost of labour
- Increased access to investment funds (micro credit or otherwise) for potentially profitable activities
- Entrepreneurism in 'selling' 'commoditized' environmental services.

In the public debate on watershed functions, all of these 'reward mechanisms' are likely to play a role.

1.4. Watershed services

The generic term 'watershed functions' means different things to different stakeholders and in different situations. General perceptions of these functions, although they may only have a weak relation with the biophysical reality, are the basis of policies and thus become the socioeconomic reality of the uplands, with conflict, evictions and resulting poverty as outcomes (figure 3).

After a century of attention to 'watershed management' there is still a remarkable lack of clear criteria and indicators of the hydrological functions that society expects to be met from water-catchment areas. Hydrological functions of watersheds, given the rainfall that the area receives and its underlying geology and land form, include the capacity to:

1. transmit water
2. buffer peak rain events
3. release water gradually
4. maintain water quality
5. reduce mass wasting (such as landslides).

The relation between full ('forest') and partial ('agroforestry') tree cover and hydrological functions in this sense involves changes at different time scales, and trade-offs between total water yield and the degree of buffering of peak river flows relative to peak rainfall events.

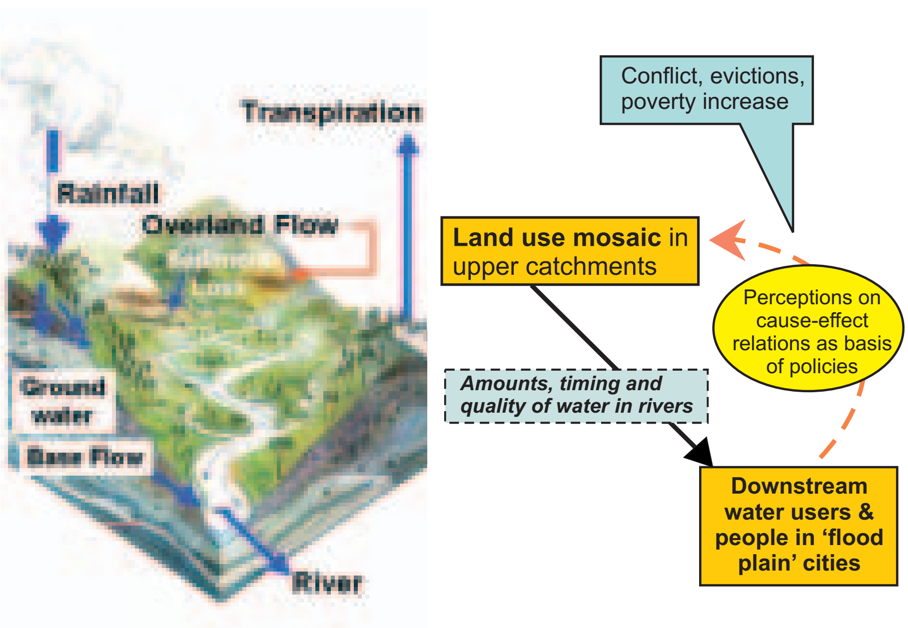
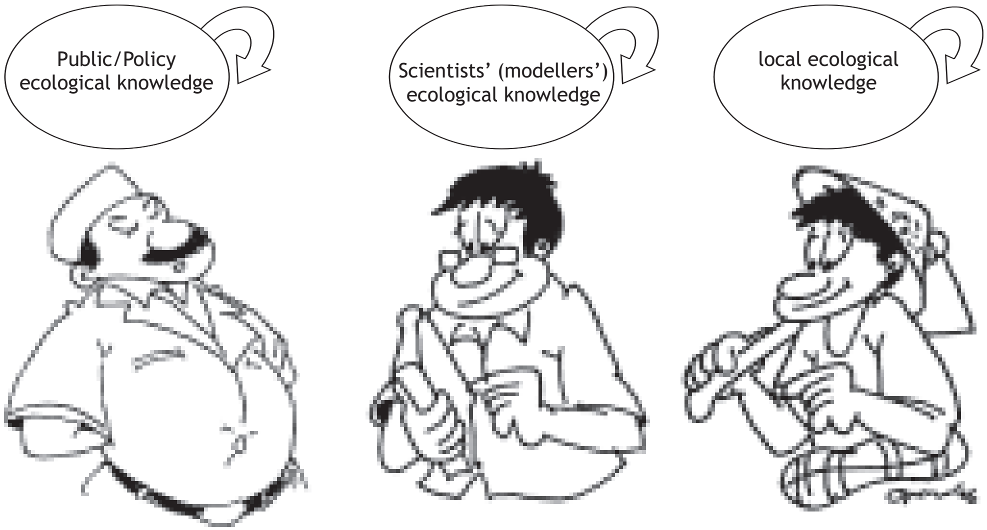


Figure 3:
Biophysical (ecological) perspectives on the flow of water through landscapes (left) are translated into human relations between downstream and upstream people — with perceptions that may have only a weak relation with the biophysical reality and policies based on these perceptions.

More realistic expectations of quantitative indicators for historical baseline, current situation and plausible future scenarios may help the negotiations (especially the differences between current situation and a range of plausible scenarios for change). The appreciation of the various quantitative indicators probably differs by stakeholder group and needs to be understood from the perspective of 'local-upland', 'local-lowland', 'public-policy' and 'ecology-hydrology' to facilitate the negotiation process.

The RHA approach has been further developed to address the hypothesis that communication may be constrained by gaps between three types of knowledge on watershed function (shown in figure 4). In discussions between upland and lowland land users, public policy, and science, the three types of 'knowledge' (local, public and scientific) are interacting, often expressed in languages that have little in common and using concepts that may be considered 'myths' by other stakeholder groups.



Where negotiations between multiple stakeholders are an essential part of any river-basin or catchment management programme or RUPES mechanism, clarity is needed on what environmental-service function is the focus, how it is provided, who can be (or claim to be) responsible for providing this service, how it is being impacted upon at present, and how rewards can be channelled effectively to enhance or at least maintain the function, address any negative impacts or enhance any positive impacts.

If scientists (hydrologists, modellers, environmental-impact assessors), local communities, the public and policy makers are to work together effectively to discuss water-resources issues, and jointly develop ESR schemes to address these issues, attempts must be made to close the gaps between the three groups' perceptions and achieve the situation shown in figure 5.

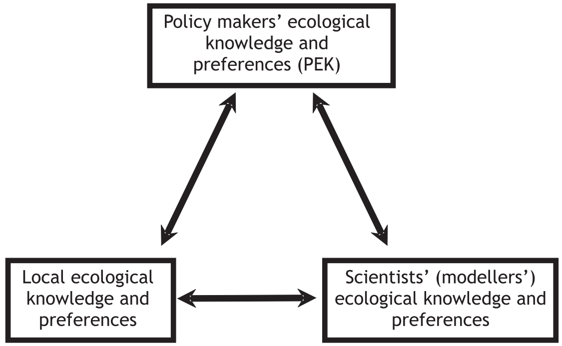


Figure 5: Desirable situation where the three knowledge domains are connected and interact.

Programmes or projects do not work without smooth communication, especially when multiple groups and layers of stakeholders are involved. Communication requires information so that all can work towards at least a common understanding of the alternative views, and (at best) consensus, regarding the issues for focus of follow-up work. The philosophy is that RHA should be the tool to supply the information that facilitates this smooth communication and the building of agreements to pave the way for follow-up ESR development.

1.5. RHA as an instrument for the 'scoping' stage of reward negotiations

From an initial idea that 'environmental-service rewards' (ESR) might be appropriate for a certain location to full implementation of an ESR mechanism, a number of steps are needed (figure 6). The RHA process has been developed for 'intermediaries' to facilitate communication between potential ESR buyers and sellers and assess whether further negotiations have a chance of success.

7 stages in development of RUPES reward mechanism

	Stage	Providers, sellers of ES	Intermediaries	Beneficiaries, buyers of ES
I	Scoping	←	R H A	→
II	Awareness	←	R H A	→
III	Identifying partners	←	R H A	→
IV	Negotiations		↔	
V	Action Plans			
VI	ES Reward support for action		↔	
VII	Monitoring			

Figure 6:
Seven steps in the development of an environmental-service reward (ESR) mechanism and the role of RHA in the initial stages.

1.6. Need for a new approach

Need for something quick and cheap

The traditional 'solid science' approach to studying catchment function and environmental services is costly in terms of time input, trained 'expert' input and subsequent expense. A typical 'paired catchment' experiment will take at least 2 years for a calibration phase and 3 (or better 10) years for the response to treatment effects to be recorded across relatively dry, relatively wet and average conditions. The results cannot be directly extrapolated to other locations, as details of soil, vegetation and rainfall patterns will differ. The scientific knowledge so derived is thus of little practical value for local stakeholders in a different set of circumstances (even if those differences are small).

There is thus a need to develop an approach which is both quicker and cheap enough so that local or provincial government bodies could implement it independent of outside aid (i.e. so they can set up their own ESR schemes). The RHA approach has been developed to meet this need:

- to assist at the initial 'scoping stage' of the development of an ESR programme;
- to reduce implementation time (target of less than 6 months) so as to keep implementation costs low and give rapid feedback to initiate other follow-up ESR development activities;
- to make it affordable (target of USD 5000 - 10000), to reduce labour and input costs, and to reduce the 'transaction cost' for any rewards agreement.*

Need to integrate across disciplines

Efforts are underway around the globe to conduct 'action research' to find a way to more effectively and smoothly integrate the different disciplines of participatory social survey, ecological modelling (hydrological-climatological-landscape modelling) and landscape spatial analysis (combined landscape ecology and land use change analysis).

RHA is part of this integrationist movement aiming to achieve this cross-disciplinary integration task, combine the inputs into the one 'negotiation support system (NSS)', and do so cheaply and quickly.

Need for clarity concerning criteria and indicators of hydrological function

Improved stakeholder understanding of quantitative indicators of watershed function and their use to determine the (historical) baselines may help the negotiations, especially if they allow the current situation to be compared with plausible future scenarios of the catchment condition. The appreciation of the various quantitative indicators probably differs by stakeholder group, and these differences in understanding need to be explored and understood within the RHA approach to facilitate the negotiation process.

Need to address the complexity of landscape and water-resource interactions

Efforts are also underway around the globe to conduct 'research' to determine precisely which factors are driving the changes in catchment function, and to what relative extent. The RHA approach aims to expand this body of knowledge in relation to tropical catchments, most especially within warm humid Asia:

*This cost target was chosen to be affordable where the potential value of environmental services to downstream beneficiaries is of the order of at least $50 000 per year if so, a one-off investment of $5000 is not unreasonable to get a proper foundation for an ESR.

- to clarify 'what' water-related service, to 'whom', is caused by 'which combination' of: 'natural capital' (rainfall, geology, landform and natural vegetation) and 'social or human capital' (jointly responsible for modifying land cover and land-use practices);

- to assist in the development of specific criteria and indicators for the (rapid) assessment of hydrological function of tropical catchment areas and land-use mosaics, that can be used to evaluate options for sustainable management of such areas.

In addition, there is a complex of cascading and cumulative environmental influences upon water quantity and quality, which needs to be addressed as the analytical focus of any ESR scheme scales up and moves down the river basin. It is hoped that the RHA approach will increase the effectiveness of water-related ESR schemes in addressing this complexity by adopting a 'spatial framework' for scoping river-basin-related environmental impacts (figure 7).

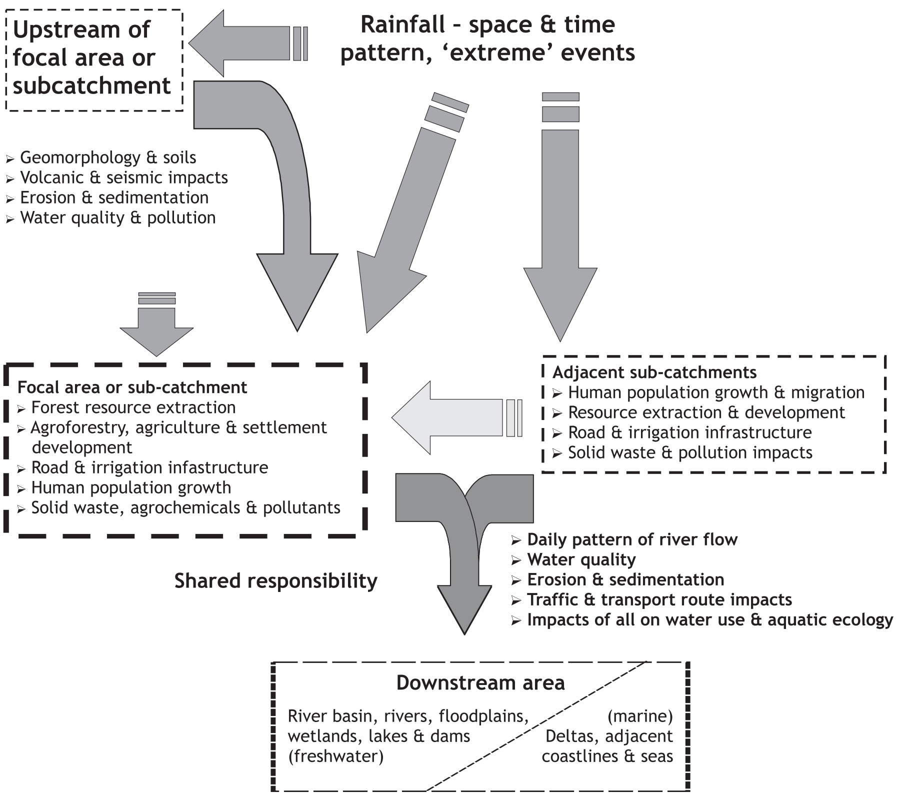


Figure 7:
The sub-catchments that are the focus of an RHA will generally be part of a wider river basin with areas upstream, adjacent sub-catchments and a shared responsibility of areas downstream usually with ultimate effects on coastal and marine systems.

The RHA analysis of environmental impacts, environmental values and ultimately ESR, when dealing with water resources, cannot realistically focus on the sub-catchment study site alone and in isolation. It must also consider upstream and adjacent area activities and influences upon the sub-catchment study site. It must also consider the cumulative influence of upstream, adjacent and study site landscape and water-resource related activities on the downstream environment.

Similarly, regarding communication on water-resource and environmental issues, the complexity of cascading and cumulative interaction often leads to stakeholders having differing perceptions regarding problem issues and causes, depending on their location within the river basin, or their ability to perceive and understand the cascading interactions within the basin. The RHA 'scoping environmental spatial framework' hopes to assist communication, by providing a framework to separate the different hydrology or water-quality impacts, and different causes of impacts, in relation to spatial location within the basin.

The current RHA approach was derived from a more comprehensive 10-step 'catchment analysis and management framework' (figure 8) developed by ICRAF-SEA as a 'negotiation support system' (NSS) (van Noordwijk et al. 2001, 2004a). 'The highlighted 'Domains' only in column 3, figure 8, are currently covered by RHA process.'

Step	Main questions	Domains
1	'Characterization' (rainfall, population density, migration status, main agricultural enterprises, etc.); and 'diagnosis' of main issues and problems related to watershed functions and livelihoods (including sources of drinking water)	L, S
2	'Landscape appraisal', slopes, land use and vegetation zones, toposequences of soil from ridge to river (lake)	L, W
3	Understanding the 'flows of water' and consequences for lateral flows of soil, nutrients, pollutants. 'Entrainment' of soil particles into the overland flow of water, potentially followed by filtering effects that separate water from soil particles	W, L
4	Characteristics of 'land-use systems' (cash and labour input requirements, yield, profitability) and impacts on water flows (evapotranspiration, impacts on soil compaction, surface cover)	A, W, S
5	Characterization of landscape mosaic on 'segregate-integrate' spectrum, and consequences for the way productive and environmental functions are being met	A, L, S

Step	Main questions	Domains
6	Understand 'trade-offs' between relative agronomic function (RAF) and relative environmental function (REF)— builds on step 4	A, W
7	The 'landscape mosaic' (building on step 5) in the context of lateral flows and 'externalities' for on-farm decision making; 'existing regulation and incentives' ('carrots and sticks') at community and government level; is the existing landscape mosaic a stable configuration meeting all needs?	S, L
8	Analysing the existing patterns and land use practices from a multistakeholder (including 'gender and equity') perspective	S, N
9	Understanding the existing problems and conflicts at the level of 'local, policy and scientific knowledge': is there a shared perspective (but possibly different appreciation of the various outcomes) or is there a need for 'levelling off' as first step in 'negotiations'	N, S
10	Follow up to 'negotiated agreements', monitoring compliance and impact on environmental services and people's livelihoods	N, S, W, A, L

Domains: L Landscape, S Socioeconomic relations (household level), W Watershed functions, A Improved land use / agroforestry technology, N Negotiation support systems.

Figure 8: Ten steps in a Negotiation Support System (NSS) process to assist stakeholders to improve land use mosaics from the perspective of critical watershed functions and healthy (profitable, sustainable) land use practices.

Need to test the limits of reliable science

Lastly, behind the development of the RHA approach is the experimental desire to run new action research on the ground to see if the 'cheap and rapid' concept actually works. The 10-step approach to an NSS (figure 8) was the inspiration for the 'simplified' RHA. Does this simplification still maintain the rigour required for a responsible, cost-effective appraisal process? Three key questions are:

- Does RHA deliver an answer with adequate precision for the purpose at hand?
- Can RHA be scaled-up to realistically deal with the river-basin scale of management?
- How far can we 'push' it (i.e. reduce the cost, reduce the time input and reduce the labour input) before it 'falls apart' (i.e. becomes no longer reliable or useful)?

1.7. Spatial scale and context in river-basin management

The first step in the RHA approach is to define the working area; primarily in terms of river-basin and sub-catchment boundaries, but also in terms of the government administrative boundaries that overlay these physical features. The primary determinant for the 'scale' of the assessment of an RHA is the administrative entity that may form the basis for 'environmental service rewards'. However, this may require adjustment of the boundaries of the appraisal to hydrological realities.

While a hydrologically correct 'sub-catchment' should include all the 'headwaters', the administrative entities that are the basis for a RHA might not. In figure 7 we assume that there may be 'headwaters' upstream of the area that is the focus for an RHA. Usually, the unit of assessment is only part of a larger 'basin' and shares the 'downstream' area with other sub-catchments (figure 7).

An RHA may become part of a broader 'environmental management strategy' for the water resources of the total river basin (figure 9), as it may help define the 'environmental baseline' and 'environmental assessment' which are also the first steps of a standard river-basin 'environmental management plan' (EMP). The RHA also overlaps directly with the 'institutional strengthening' and 'monitoring' sub-components of the standard river-basin EMP approach (figure 9).

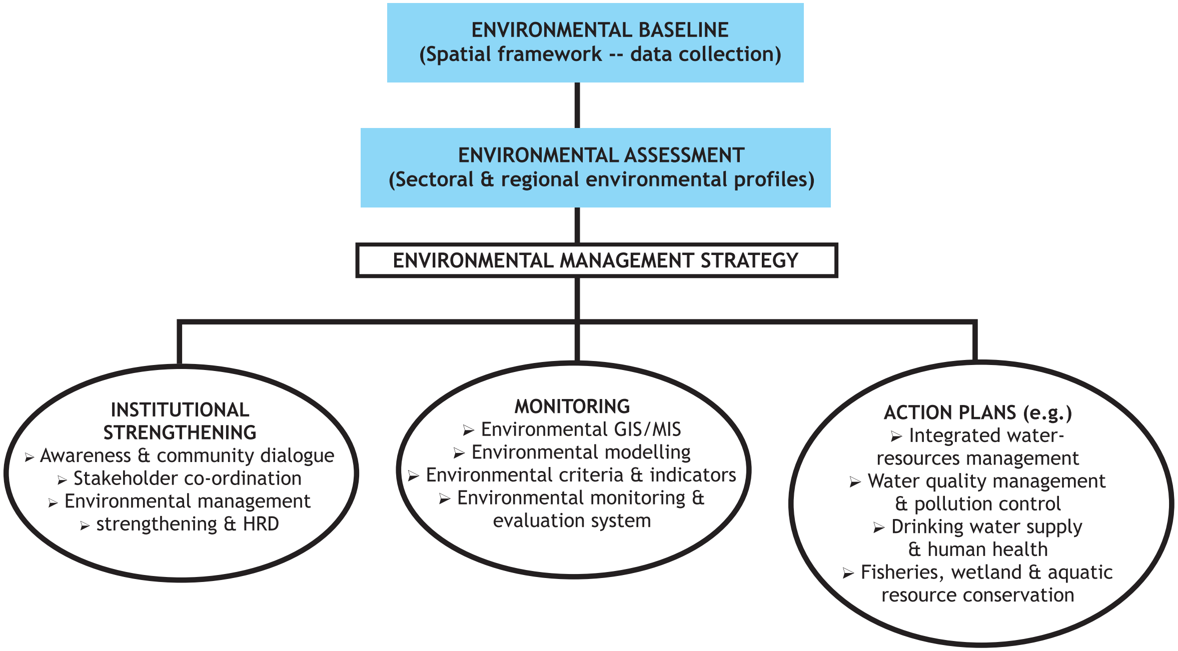


Figure 9: RHA within the context of a river-basin environmental management framework.