



# **Land-Water Linkages in Rural Watersheds Electronic Workshop**

**18 September – 27 October 2000**

**Conclusions  
and  
Recommendations**

## **Summary of conclusions and recommendations**

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS  
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## Summary of conclusions and recommendations

This report synthesizes the proceedings of the electronic workshop “Land Water Linkages in Rural Watersheds” hosted by the FAO Land and Water Development Division from 18 September to 27 October 2000. The workshop examined relationships between land use and water resources in rural watersheds. It identified mechanisms and instruments for sharing benefits and costs resulting from land use impacts on water resources between upstream and downstream stakeholders in a watershed context, as well as priorities for further work.

### **CLASSIFICATION AND IDENTIFICATION OF LAND USE IMPACTS ON WATER RESOURCES**

Classifications of biophysical impacts have tended to reflect the concerns of better studied areas, which are disproportionately in northern temperate zones, and have much higher average rates of runoff than arid and semi-arid countries. Much less is known about processes that are important in the arid and semi-arid countries, where water stored in soil may be more important than surface water, and erosion and sedimentation rates are naturally much higher.

The most significant impacts of land use are often associated with infrequent and extreme events. For example, the greatest transport of eroded sediment and pollutants will occur during large rainstorms, during extreme storm events such as hurricanes or when heavy rains follow a period of drought. Impacts also vary depending on the affected peoples' location, and to the extent that the people depend on affected resources for their livelihoods, or have other options. Ranges of variability of natural processes are the most important parameter for identifying actual and potential impacts of land use practices. Land use impacts are compounded by the complexity of hillslope processes and, potentially, by climate change. The knowledge of natural processes relative to the impact of anthropogenic land use change is critical for development of effective and appropriate response strategies.

Given that impacts of land use on water resources are the result of complex interactions between diverse site-specific factors and offsite conditions, standardized types of responses will rarely be adequate. These relationships can be better understood through the use of process models, which must be combined with site-specific assessment.

Watershed management is understood to include livelihood concerns, including both socio-economic as well as biophysical components. Workshop discussions provided suggestions to revise the classification to better reflect concerns more specific to developing countries in general, where poverty alleviation is a more dominant consideration.

### **Recommendations:**

1. A typology of biophysical impacts of land use on hydrological processes should be revised to include recharge of soil moisture, which is more significant in arid semi-arid lands.

2. Ranges of variability in natural watershed processes need to be established as a basis for identifying the range of actual and potential human-made land use impacts, including the influence of climate change.
3. With regard to hydrological and sediment-related impacts, river dynamics and lowland processes should be distinguished from hillslope processes to identify which process is dominant, and to find adequate management responses.

#### **CHANGE IN THE RELATIVE IMPORTANCE OF LAND–WATER INTERACTIONS WITH THE SIZE OF THE WATERSHED: CONSIDERATIONS OF SCALE**

As a general rule, impacts of land use activities on hydrological and sediment-related processes can only be verified at smaller scales (up to some tens of square kilometres) where they can be distinguished from natural processes and other sources of degradation. This suggests that the use of economic instruments and mechanisms will also be most effective at this scale. Assumptions that relationships observed at smaller scales hold at the largest scales, and that processes observed in one particular region can be applied to another, have often led to inappropriate and ineffective responses, because different processes are dominant at different scales. Certain impacts of land use on water quality, such as salinity, have an impact at larger scales as well. At the largest scales, impacts are difficult or impossible to verify because of a long time lag between cause and effect, and many overlapping factors. This makes it difficult to arrive at agreements between users about rights and responsibilities needed to implement mechanisms for sharing costs and benefits at large river-basin scales.

#### **Recommendations:**

1. Impacts and responses to them need to be considered at the appropriate scale – efforts to change land use practices and to implement mechanisms for sharing of benefits and costs will be most successful in response to measurable problems in small basins.
2. At larger scales, long-term monitoring is needed because of the long time lag between cause and effect. Mechanisms of sharing costs and benefits at these scales will most likely deal with water quality concerns.

#### **ADEQUACY OF EXISTING KNOWLEDGE AND UNDERSTANDING OF BIOPHYSICAL IMPACTS OF LAND USE CHANGE**

Although much is known about watershed processes, such knowledge is often used to make generalizations that are not always appropriate. Site-specific information is often inadequate to determine which management actions will be most effective, which makes stakeholder negotiations difficult. Community involvement is needed to identify and agree on causes of and responsibilities for land use changes, and to develop institutions and functions to reduce risk and manage disasters associated with land use practices. There is a need to build greater capacity for site-specific research, which could be supported through the development of long-term hydrological monitoring and forecasting systems. In all regions, a better understanding of large scale and cumulative effects is needed.

**Recommendations:**

1. More emphasis should be placed on participatory research, as well as long-term monitoring and assessments, which should clarify uncertainty for stakeholders.
2. Biophysical processes singled out as research priorities are: soil water retention capacity, groundwater processes, and variability of land use impacts across spatial and temporal scales.

**TOOLS AND METHODS FOR ASSESSMENT OF THE RELATION BETWEEN LAND AND WATER RESOURCES**

Tools and methods of assessment range from particular methods applied to the understanding of individual processes, to more integrated and participatory approaches. Though slow and expensive to initiate, participatory approaches increase the potential for research to have impacts on policy. Other advantages include simplicity, cost-effectiveness and local relevance, that may outweigh potential bias and lack of precision, which can be calibrated through comparisons of results with researchers.

Among the parameters selected for ease of monitoring are: eroded soils and sediment contamination of streams, altered stream flows and soil export, bacterial contamination, demographics and land use, and community perceptions, memories and experience. It will be easier to find agreement among stakeholders on narrower, more technical indicators. However, conflicts among different interest groups may be inherent in deciding which impacts matter and in selecting appropriate indicators.

**Recommendations:**

1. Site-specific process models should be developed that allow local conditions to be considered in the design of interventions.
2. Project budgets and timelines should allow for stakeholder participation in research and in monitoring efforts.
3. Researchers should work with stakeholders to develop and apply acceptable measures of quality in participatory research and monitoring efforts.
4. Indicators need to be scientifically validated, of relevance to the affected community, be practical to measure, and relatively inexpensive.
5. The need for negotiation and conflict resolution should be anticipated in the selection of indicators.

**TECHNICAL AND FINANCIAL CONSTRAINTS TO ASSESSMENT OF LAND USE IMPACTS ON WATER RESOURCES**

By definition, a watershed approach implies addressing complex issues in large areas over long periods of time. This is difficult to achieve in a narrow technical framework and with budget limitations. Since financial and technical means are usually limited, uncertainty and the need for value judgements become inherent in decision-making. These constraints can be partly overcome by providing technical and financial support for community-based efforts, and by explicitly

considering issues of governance and institutional arrangements that determine which benefits and costs are considered in the assessment, and how these are distributed among stakeholders.

**Recommendations:**

1. Researchers and donor organizations should work in partnership with and provide technical and financial support for community-based efforts in the assessment process.
2. Assessment of land use impacts on water resources should include examination of governance and institutional arrangements that determine the distribution of benefits and costs among stakeholders, including those associated with uncertainty.

**VARIABILITY, UNCERTAINTY AND MYTHS ABOUT LAND–WATER LINKAGES**

In the absence of complete information, overgeneralizations or myths about links between land use activities and hydrological processes have emerged, such as “deforestation causes flooding” regardless of basin size, or “deforestation causes erosion” even where natural erosion rates are high. These generalizations, which cannot be verified, and in some cases have been disproved, by scientific analysis, are still frequently used as justifications for policy and programmes. Such myths may selectively single out particular causes from multiple ones in order to support institutional and political agendas, and may be a convenient basis for advice because their assumptions are unverifiable. This leads to misguided policies and remedial approaches that do not work, and often results in poor and minority populations in upland areas being made scapegoats, despite their contributions to a problem often being minor relative to other factors. Due to the complexity of landscape processes and the long time lag between cause and effect, uncertainty is inherent in any scientific findings and assumptions about land–water interactions. This uncertainty needs to be made very explicit to avoid the emergence of new myths.

**Recommendations:**

1. General statements about land–water interactions need to be continuously questioned to determine whether they represent the best available information and whose interests they support in decision-making processes.
2. The uncertainty inherent in findings about land–water interactions needs to be made explicit to avoid the emergence of new myths.

**VALUATION OF LAND USE IMPACTS ON DOWNSTREAM WATER RESOURCES**

Impacts of land use practices can be distinguished in impacts on use values and non-use values. Use values can be further distinguished into consumptive, for example irrigation and domestic use, and non-consumptive values, for example transportation. Water bodies and riparian areas may also have significant non-use values, for example as reservoirs of biodiversity. It is equally important to consider the distribution of costs and benefits between upstream and downstream users, as well as within communities. The analysis of affected values is an important basis for selecting the most appropriate benefit-sharing mechanism.

Uncertainty regarding links between upstream land use activities and impacts on downstream resource users also creates uncertainty regarding economic values. However, even partial values may be sufficient to justify investments in watershed protection. When differences with and without a project do not show significant benefits within the time frame of the analysis, less tangible and less certain costs and benefits can be considered. The decision will then primarily be based on consideration of societal benefits or equity concerns, in addition to the immediate monetary benefits.

**Recommendations:**

1. To value costs and benefits of changes in specific land use practices, the ideal is to be able to identify how those changes will affect the availability of specific resources of concern, and their value to users. This can be made more manageable by dividing the watershed into hydrological sub-units based on uniform agro-climatic conditions.
2. The results of valuation should be communicated to stakeholders and used to identify existing land use incentives. Since complete information will rarely be obtainable, it is important to clarify limitations of the valuation, which factors have been included, and the degree of uncertainty.
3. When the more tangible and monetary costs and benefits are not sufficient to justify investments in watershed management, the decision should be presented as a matter of policy, including societal and long-term benefits.

**BENEFIT-SHARING MECHANISMS FOR LINKING UPSTREAM AND DOWNSTREAM USERS**

Mechanisms and instruments consist of a broad range of approaches ranging from regulatory and market instruments, education and awareness building activities, to development of new institutional arrangements and participatory approaches. These mechanisms are not mutually exclusive. Rather, they seem to work best when different instruments are used in combination, and applied simultaneously at different scales.

In the process of scaling up resource management from site level to watershed level, it is important to ensure that all stakeholder groups people are represented in watershed associations that transcend individual villages and in negotiations over large-scale problems. Appropriate mechanisms need to take into account the distribution of benefits and costs within the communities themselves, both upstream and downstream, and incentives of different stakeholders, based on economic valuation and existing property rights.

Stakeholder cooperation is more likely if benefits are demonstrable, the distribution of benefits as well as costs is considered fair and acceptable, and agreements are enforceable. It may also be motivated by the threat of regulation.

Successful initiatives have evolved over time, from management of a water body to management of its whole catchment, or from narrow and ad hoc to broad intersectoral initiatives, often with the assistance of Non-governmental organizations (NGOs). At the largest scales, given the difficulties of linking cause and effect, river basin negotiations tend to emphasize water allocation issues and provide a basis for sharing benefits and reducing costs through more general economic cooperation.

**Recommendations:**

1. Economic instruments are likely to be more effective if they are combined with education and awareness building activities, and participation by affected people, for example through watershed organizations. Successful mechanisms have evolved from a narrow to a broad focus or from management of a water body to the whole catchment area.
2. The development of stakeholder associations with decision-making autonomy should be promoted starting at the smallest scales, to ensure that local interests are represented in negotiations over larger-scale problems, and to reduce transaction costs. NGOs can play an important role in this institution-building process.

**CONSTRAINTS TO THE IMPLEMENTATION OF BENEFIT-SHARING MECHANISMS**

Implementation of mechanisms and instruments may be constrained by conflicts between the objectives of sustaining livelihoods and natural resources, and between different stakeholder groups. Other constraints may be posed by equity considerations and the acceptability of the instruments' distribution function. For example, transfer payments for watershed protection may not be seen as fair as they may violate the "polluter pays" principle and create perverse incentives. Such payments, when these are necessary and appropriate, may be complemented by taxes on pollutants. On the other hand, such payments may be equitable considering the income situation of the rural poor in marginal upper watershed areas. Lack of property rights and capacity for collective action may constrain the adoption of management practices if expected benefits are long-term. Finally, if significantly affected stakeholders are excluded from the process, they may have an incentive to sabotage any initiatives taken.

**Recommendations:**

1. Stakeholders should be involved in the initial phase of management interventions, and be provided with information about the distribution of costs and benefits and equity implications.
2. Establishment or recognition of property rights should not overlook customary tenure arrangements that may otherwise be put at a disadvantage in formal land titling programmes.
3. One should be realistic as to what participatory approaches can achieve in terms of priority concerns: for example, small-scale erosion control measures typically implemented through such approaches may not have a big impact on downstream sedimentation when structural measures are needed to prevent landslides or streambank erosion.

**CRITERIA FOR SUCCESS FOR THE IMPLEMENTATION OF BENEFIT-SHARING MECHANISMS**

For benefit-sharing arrangements to be successful, stakeholders must at least have a common understanding and agreement about the nature of expected impacts, the approximate magnitude of costs and benefits, and also about areas of uncertainty. This is best achieved at smaller scales, where anthropogenic impacts can be verified and distinguished from natural processes. At such scales, people will be more likely to be willing to make the necessary commitments for resolving interest conflicts and reaching agreements.

When there are numerous stakeholders, establishment of watershed organizations is an important way to make negotiations manageable and reduce transaction costs, provided that the organizations are representative of all of the relevant interest groups, that they have a transparent and autonomous decision-making process, and are appropriate to the scale of the watershed. Perhaps the most important incentive for stakeholders to participate and invest resources in benefit sharing arrangements is the assurance that they will in fact have access to the benefits, which often take time to materialize. Security of tenure is an important factor in the adoption of watershed management practices, as well as recognition of traditional resource use rights.

Regardless of whether the above criteria have been met, initiatives to establish mechanisms for sharing benefits and reducing costs are still unlikely to succeed unless stakeholders accept them as fair. The process of assessment and valuation of land–water interactions can provide an important input to such deliberations because it clarifies costs and benefits, and also how they are distributed among different stakeholders. It provides an opportunity for mutual learning among stakeholders, whose local knowledge can provide insight into the context of the situation and feasible options. Finally, the assessment process can improve feedback between science, local knowledge and policy.

The criteria for successful implementation of benefit-sharing instruments in a watershed context, as modified by recommendations made throughout the discussions, are as follows:

1. There is some common understanding and agreement among stakeholders regarding the impacts of upstream land use on downstream water use, as well as awareness of uncertainty.
2. The groups of upstream and downstream stakeholders are generally few and well organized.
3. The economic impact of land use on downstream stakeholders can be approximately quantified.
4. There is a political commitment to establish upstream-downstream linkages whether it is through contractual agreements or through policy frameworks, and some underlying technical basis for it.
5. There is a strong institutional and legal framework, including land tenure structure, which allows for the implementation of benefit-sharing instruments.
6. There should be decision-making autonomy for those who pay and who benefit, and a transparent mechanism for deciding how the money is spent.
7. Management interventions and also watershed associations should be appropriate to the scale of the river basin.
8. Basin treaties should be acceptable to all riparians, for equitable use, protection and management of water resources in basins.
9. Information about impacts, and their potential costs and benefits, needs to be communicated using common methods of expression.