Water Policy Briefing

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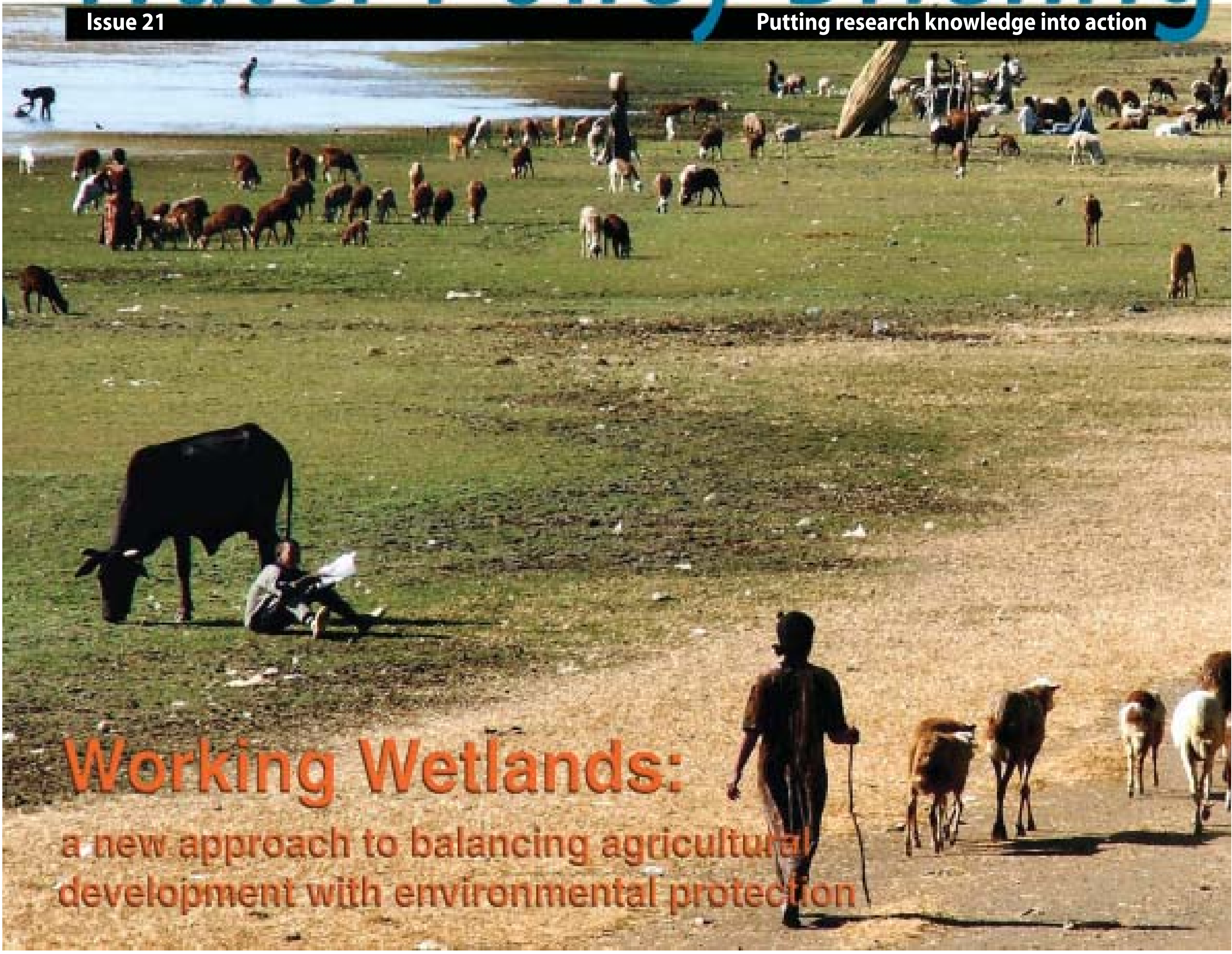
Putting research knowledge into action



Working Wetlands:

a new approach to balancing agricultural development with environmental protection

Dry season livestock grazing on the shores of Lake Tana, Ethiopia.

Photo Credit: Matthew McCartney

Wetlands provide valuable ecosystem services to society. Yet, in many parts of the world, wetlands have been degraded or lost, and demand for development—particularly from agriculture—is putting pressure on many of those that remain.

Policymakers and planners have to consider a bewildering set of biophysical, economic and social factors when deciding whether or not wetlands should be developed for a specific agricultural use. A simple new tool is now available to help them systematically consider multiple criteria and rapidly assess the opportunities for, and possible consequences of, developing agriculture in a wetland.

International Water Management Institute

Working Wetlands:

a new approach to balancing agricultural development with environmental protection

The trade-off between environmental protection and development is most acute in dynamic and complex ecosystems such as wetlands. Wetlands 'work' for society. They maintain environmental quality, sustain livelihoods and support biodiversity. However, socio-economic pressures mean that we are now pushing wetlands to work even harder, for example, by producing more crops or grazing more cattle. History shows that 'over-working' wetlands can cause them to change significantly—often with negative effects on the communities or even civilizations that depend on them.

Safeguarding the benefits of wetland services for society must be weighed against the potential benefits of development. But making such decisions is difficult. Besides physical, economic and social factors, the impact of any changes on stakeholders at all levels—local, regional and global—must be considered for 'wise use' of wetlands.

Policymakers and planners need to ensure that they take the most comprehensive range of factors possible into account in any trade-off between wetland services and development choices. Fortunately, a simple six-step approach to determine Working Wetland Potential is now available to help assess the opportunities and risks of changing a wetland's workload (Fig. 1). This method, one of the first of its kind, combines both the social and biophysical aspects of wetlands into one index relevant to agricultural use.

IWMI has applied the approach to proposed agricultural activities in wetlands in southern Africa—a region where development is essential and pressure on wetlands is increasing. The approach ensures that many crucial questions about using wetlands for agriculture are made explicit and, at least, considered in the planning process. It is a step forward in securing and improving people's quality of life while, at the same time, safeguarding the ecological benefits derived from wetland ecosystems.

Wetland ecosystem services improve human well-being

Wetland ecosystems, such as rivers, lakes, marshes, rice fields and coastal estuaries, provide many benefits that contribute to human well-being. These include fish and fiber, water supply, water purification, climate regulation, flood regulation, coastal protection, recreational opportunities and, increasingly, tourism (Box 1).

The livelihoods of people living in, or on the borders of, wetlands often depend partially or entirely on wetland ecosystem services. Loss or degradation harms them directly. In Cambodia, for example, fish from the freshwater Tonle Sap wetland ecosystem provides 60-80% of the country's animal protein. In Malawi, local people use the fruits, seeds, tubers, roots and leaves of around 200 plants from the wetlands surrounding Lake Chilwa. In Malaysia, rural households earn up to US$80 a month selling medicinal plants gathered from wetlands.

Worldwide, most freshwater for human use comes from inland wetlands—lakes, rivers and swamps. The Everglade wetlands in Florida, USA, supply five million people with water. Laguna El Jocotal, a shallow floodplain lake in El Salvador, provides 10,000 people with water in the dry season.

Wetlands also play a critical role in maintaining the quality of the environment by absorbing and processing waste products. Wetlands biologically cycle carbon dioxide, methane and hydrogen sulfide. They sequester (trap) and release carbon, regulating climate change. Globally, wetland peat deposits take up just 3% of the land area but store 14-16% of the soil carbon pool.

Wetlands support a rich diversity of plants and animals. These species and their genetic diversity help to maintain wetland processes such as water storage, sediment trapping and nutrient cycling. Wetlands are especially important for many migratory birds.

This Water Policy Briefing is based on *Working Wetlands: Classifying Wetland Potential for Agriculture* by Matthew P. McCartney, Mutsa Masiyandima and Helen A. Houghton-Carr (IWMI Research Report 90); *Wetlands: Functions and Values* by Matthew P. McCartney; and *Challenges for Wetlands: Water Management and Agriculture* by Max Finlayson, Mutsa Masiyandima, David Molden and Rebecca Tharme.

Box 1. Ecosystem services provided by or derived from wetlands

Wetlands services	Benefits to human well-being
Provisioning	
Food	Production of fish, wild game, fruits and grains
Fresh water*	Storage and retention of water for domestic, industrial and agricultural use
Fiber and fuel	Production of logs, fuelwood, peat, fodder
Biochemical	Extraction of medicines and other materials from biota
Genetic materials	Genes for resistance to plant pathogens; ornamental species, etc.
Regulating	
Climate regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water regulation (Hydrological flows)	Groundwater recharge/discharge
Water purification and waste treatment	Retention, recovery, and removal of excess nutrients and other pollutants
Erosion regulation	Retention of soils and sediments
Natural hazard regulation	Flood control, storm protection
Pollination	Habitat for pollinators
Cultural	
Spiritual and inspirational	Source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	Opportunities for recreational activities
Aesthetic	Many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	Opportunities for formal and informal education and training
Supporting	
Soil formation	Sediment retention and accumulation of organic matter
Nutrient cycling	Storage, recycling, processing, and acquisition of nutrients

* Within the ecosystem services concept of the Millennium Ecosystem Assessment the supply of freshwater is classified as a provisioning service whereas hydrologists are more likely to classify it as a regulating service.

Source: Millennium Ecosystem Assessment, 2005. Ecosystems and Human-Well-being: Wetlands and Water Synthesis. World Resources Institute, Washington, DC.

The intangible benefits of wetlands contribute to people's spiritual and emotional well-being. The ceremonies associated with movements to and from the floodplain as water levels rise and fall enhance the social cohesiveness of the Lozi people in western Zambia, for example. And, increasingly, tourists are seeking out—and paying to see—the beauty and pristine wildernesses of wetlands such as the Okavango Delta in Botswana and the Caroni Swamp in Trinidad.

Policymakers and planners may be unaware of the many tangible and intangible benefits wetlands bring to huge numbers of people. Often the beneficiaries are far removed from wetlands. As a result, the connections between wetland services and human well-being may be unrecognized and/or under-valued, and therefore not taken into account when decisions about wetland use are being made.

Wise use of wetlands

Over the coming decades, policymakers and planners will have to make major policy decisions to determine how wetlands will be used in the present and in the future. Some of the most important will be those on agriculture in wetlands and how it will affect water quality and biodiversity.

Strategies to increase food production often entail converting wetlands to agricultural production. This reduces their area and may reduce the services wetlands provide. Plus, using more agrochemicals may degrade water quality. What is more, although food production may increase, some groups—and society in general—may be worse off.

The concept of 'wise use' of wetlands, laid out in the intergovernmental Ramsar Convention on Wetlands signed by 153 parties[1], recognizes the need to integrate conservation and development. It is acknowledged that, rather than simply protecting wetlands from all change, human development often necessitates alterations to wetland ecosystems. But, the 'wise use' concept advocates that, before any such changes are made, the processes that sustain the ecosystems need to be closely examined. Especially important is the need to identify and consider the value placed on wetland services by the people who use them directly.

Valuing wetland services

Communities value wetlands differently from place to place and over time. Some developed societies place very high values on wetland aesthetics and biodiversity, to the extent that they pay farmers to rehabilitate rather than

[1]http://www.ramsar.org

cultivate wetlands on their land. In developing countries though, the social and economic pressures to use wetlands to produce more food are often immense.

In some cases, changing wetland ecosystems can raise the value of the benefits they bring. The draining of England's East Anglian fens, for example, created highly productive farmland and, in recent years, a thriving tourist sector. Interestingly, some areas are now being reflooded, in order to re-create small wetlands (partly because the costs of pumping are now considered too high). Rice cultivation across Asia illustrates that highly modified wetland systems can be both productive and sustainable. These examples can be described as 'working wetlands'. That is, wetlands that have been extensively modified to increase their agricultural productivity.

Modifications to the ecosystem, however, significantly affect wetland ecology and functions—often decreasing other potential benefits. Installing irrigation, for instance, may lower the quantity of water or amount of fish that the wetland provides. Simply put, working wetlands represent an informed compromise between conserving wetland services and development.

Clearly 'wise use', maximizing the workload of wetlands whilst maintaining the benefits of wetland services, requires trade-offs. The traditional approach to deciding trade-offs was to put a value on wetland services and conduct cost-benefit analyses. But calculating the value of wetland services purely in economic terms is extremely difficult. IWMI therefore developed the Working Wetland Potential approach to meet the demand for environmental valuation techniques that assess the non-monetary impacts of proposed changes.

Working Wetland Potential: weighing up the pros and cons

The Working Wetland Potential approach explicitly weighs up both social and biophysical factors relating to changing, or continuing, a particular type of agriculture in a wetland. The approach has six steps that systematically consider the biophysical and socioeconomic aspects of the proposed change to a wetland (Fig. 1). The result is a index, between 1 and 25, that represents the potential of the proposed change. A low number indicates low potential, a high number, high potential (Table 1).

Drawing a diagram of the suitability and hazards allows policymakers and planners to see, at a glance, the overall potential and the dimensions of the opportunities and risks (Fig. 2).

IWMI researchers have applied the approach to various wetlands under pressure from agriculture in Southern Africa. The case of the Bumbwisudi Wetland, Zanzibar

Figure 1. A six-step procedure is a first screening step when changes to a wetland are proposed. The simple procedure systematically considers key criteria to assess the opportunities and implications of whether or not to develop (or continue to use) a wetland for specific activities.

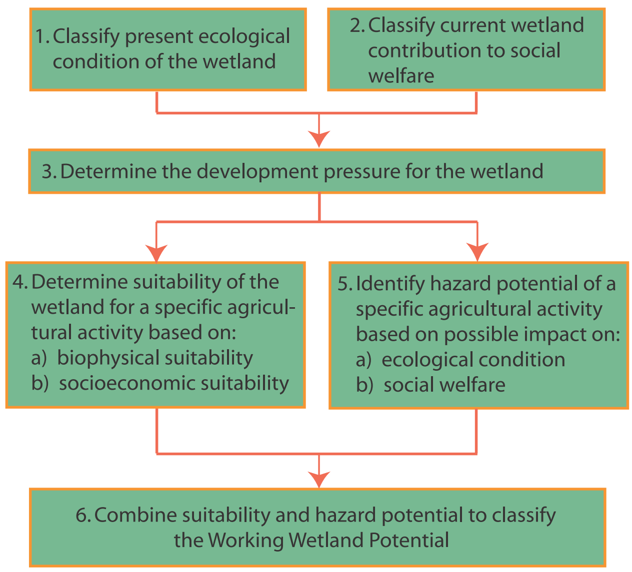
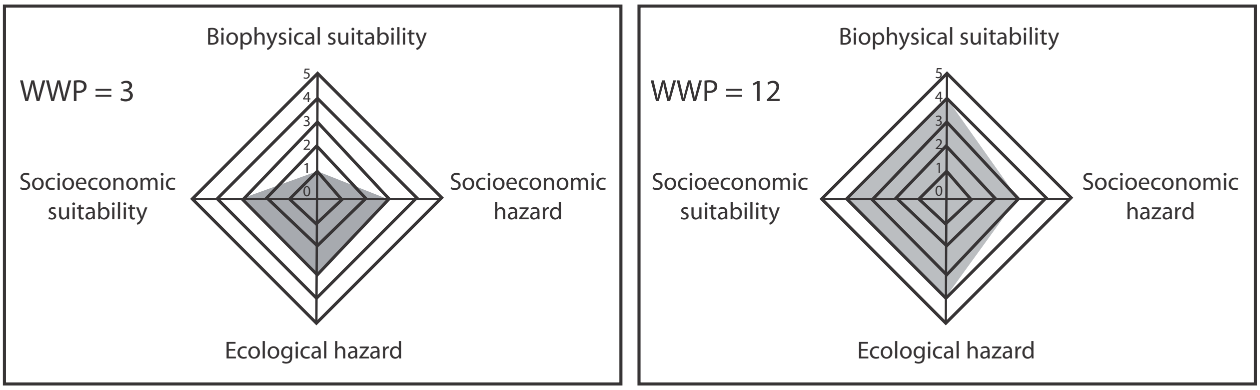


Table 1. Working Wetland Potential (WWP) classes: >21 High, 16-20 Moderate, 11-15 Marginal, 6-10 Low, <5 None. The Working Wetland Potential procedure results in a number that indicates the working potential of the proposed change to a wetland. The higher the number, the higher the potential (benefits) and the lower the hazards associated with the proposed change.

Suitability	Hazard				
	1 (high hazard)	2 (moderate hazard)	3 (low hazard)	4 (very low hazard)	5 (no hazard)
1 (not suitable)	1	2	3	4	5
2 (currently not suitable)	2	4	6	8	10
3 (marginally suitable)	3	6	9	12	15
4 (moderately suitable)	4	8	12	16	20
5 (highly suitable)	5	10	15	20	25

Figure 2. Plot of the suitability and hazard variables used to calculate the working wetland potential (WWP). The greater the shaded area the higher the potential. The value on each of the axes represents the extent to which this factor limits the potential; the lower the value, the more limited the potential.



WWP=3
Very low WWP, highly constrained by biophysical suitability

WWP=12
Higher WWP, but somewhat constrained by socioeconomic hazard

(Tanzania) is a good example, and is used in this briefing to illustrate the Working Wetland Potential approach in action.

In this area, most people rely on the wetland for some part of their livelihoods. But human pressure is increasing (the population in the area rose sharply from 7,232 in 1988 to 11,973 in 2002). Added to this is the fact that the 1993 Zanzibar National Irrigation Master Plan promotes the use of wetlands for irrigated agriculture to improve food security and alleviate poverty—through rice production for example. Using the WWP approach, it is possible to assess just how much potential the area has in this regard by using the steps described below.

Assessing the ecological condition of a wetland

As wetlands, like all ecosystems, change over time, there is no specific baseline state against which to measure the condition of a particular wetland. For the purposes of the Working Wetland Potential approach, the ecological condition of wetlands is broadly defined relative to a reference 'undisturbed' state. The present condition is classified on a qualitative scale ranging from 'natural' to 'extensively modified'. The classification is based on expert knowledge, comparison with similar least disturbed wetlands in the region, and the historical knowledge of wetland users and local communities.

It is important to understand that this classification is not a value-based one. This means that a wetland classed as 'extensively modified'—for example, a wetland rice system—is not necessarily in an unacceptable condition. In this case, stakeholders value the many benefits provided by the rice system in its current state and want this to continue. For these stakeholders, 'natural' would be an undesirable condition for this wetland.

The Bumbwisudi Wetland was classified as 'extensively modified'. It covers about 560 hectares, of which about 390 hectares are devoted to rice cultivation. Groundwater pumped from wetland boreholes irrigates 30 hectares of this rice. Between 1977 and 1989, sparse vegetation and rice cultivation increased at the expense of mixed cropping and natural vegetation. Villagers and Department of Environment staff report that populations of frogs, butterflies, grasshoppers, lizards and birds are shrinking.

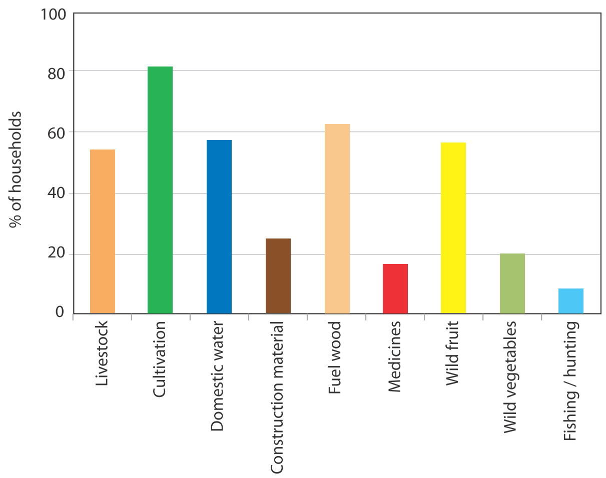
Assessing a wetland's contribution to social welfare

Checking a wetland's contribution to social welfare involves looking at five main concerns: reliance on wetland resources; livelihoods dependent on current wetland agricultural activities; differences in the benefits to different genders and socioeconomic groups; benefits beyond the wetland, for example downstream; and benefits on the global scale. Ideally, much of the information would be gathered through participatory assessments.

On the basis of this information, the wetland's contribution to social welfare is classified on a qualitative scale ranging from 'major contribution' to 'negligible contribution'.

The Bumbwisudi Wetland was found to make a 'major contribution' to social welfare, because it provides many agricultural and non-agricultural benefits to the surrounding communities (Fig. 3). Besides rice, cultivated crops—sweet potatoes, cassava and vegetables—provide income and food security. Households eat 40-60% of what they grow and sell the rest. Crops grown in the wetlands make up 6-20% of total household income from cultivation.

Figure 3. The Bumbwisudi Wetland benefits surrounding communities and makes a 'major contribution' to social welfare. (Derived from data in Shaaban *et al*. 2004.)



The wetland also provides other important benefits. Irrigation boreholes and hand-dug wells in the wetland supply water for 58% of households. About 20% of households, mostly the better-off, graze cattle in the wetland. And women, particularly from poorer families, gather wild plants for food and medicines while the men collect wood for construction and fuel.

Identifying the pressure for wetland development

Different and opposing objectives often emerge at this stage. What is it that stakeholders wish to gain or achieve from the wetland? What will be the state of the wetland when their objectives are met? What kinds of agriculture will take place in the wetland? Who will benefit and in what way?

As far as possible, priorities need to be set so that efforts will focus on the most important objectives. Depending on the uniqueness and roles of the wetland, the wider implications—at the local, regional, national or global scale—might be important too.

Clearly, the inhabitants of the Bumbwisudi Wetland want a 'hard-working' wetland that remains significantly altered. Over 65% of people surveyed are in favor of more irrigated cultivation in the wetland. They support proposed plans to construct 12 km of new, lined irrigation canals, and to rehabilitate 10 disused boreholes and 2.4 km of existing canals.

Assessing the suitability of a wetland for agriculture

The suitability of a wetland for any proposed agricultural activity depends on a combination of biophysical and socioeconomic factors. For example, grazing cattle requires quite different conditions to those needed for rice or maize. Also, socioeconomic conditions such as markets for produce, roads, extension services, as well as likely benefits to both women and men and poorer groups, must be favorable.

Each set of factors—biophysical and socioeconomic—is rated separately. Then, using the lowest rating, a wetland's suitability for agriculture is classified in the range from 'highly suitable' to 'not suitable'.

The Bumbwisudi Wetland study found that it is only 'marginally suitable' for the proposed intensification of irrigated cultivation. Investigations showed that, while physical limitations could be relatively easily overcome, on the socioeconomic side, the constraints are more severe.

Groundwater recharge is more than adequate to sustain additional boreholes to draw water for irrigation. And applying fertilizers will deal with low levels of nitrogen and phosphorus in the soil.

But, when it comes to marketing the extra produce, there may be competition. Farmers report that, in the dry season, prices for produce are undercut by cheap imports from mainland Tanzania and Kenya. Any increase in production will have to compete with cheaper food produced by large commercial firms with economies of scale and well-established marketing networks.

As for operating and maintaining the upgraded irrigation system, this would be the responsibility of the water user group. But the water user group in the Bumbwisudi Wetland is largely defunct. Resurrecting it would need considerable effort.

So, taking the 'moderately suitable' rating for biophysical factors and 'marginally suitable' rating for socioeconomic factors together, the assessment classed the wetland as only 'marginally suitable' overall for the proposed scheme.

Assessing the hazards

The links between causes and effects are often uncertain. The more that is known about how a wetland functions and the ways in which it supports livelihoods, the greater the confidence in assessing potential hazards. Such hazards include loss of species, inequities, dangers to health, loss of livelihoods, adverse effects on downstream communities and so on. As far as possible, the hazard rating, from 'none' to 'high' takes into account risks to existing livelihoods and the ecological condition of the wetland. When in doubt, the 'precautionary principle' is applied.

So many households depend on the Bumbwisudi Wetland for water that maintaining water quality is particularly important. Applying fertilizers would pose a real threat to water quality. But, because water quality and hydrological flows have not been monitored, it is impossible to assess the potential effects on surface water and groundwater quality and human health. There is also a danger that the already-high prevalence of malaria, bilharzia and liver flukes might increase. In addition, it was only possible to speculate on the potential impact on downstream communities and irrigation systems.

Increasing the irrigated area means less fallow land for grazing in the dry season. So, the proposed scheme might also escalate existing tensions between livestock farmers and crop-growers.

The hazard to the ecological condition of the wetland is 'very low' because the scheme is unlikely to change the wetland significantly. Clearly though, implementation could pollute water supplies and increase exposure to disease vectors—significant threats to human health. So, because of the risks of pollution and disease, the hazard potential on social well-being is classed as 'moderate', resulting in an overall hazard classification of 'moderate'.

Evaluating the Working Wetland Potential

The suitability assessment coupled with the hazard rating determines the Working Wetland Potential (WWP). The WWP rates the potential of using a particular wetland for specific agricultural activities in one of five classes, from 'high potential' to 'no potential'.

This differentiates the 'high potential' activities that offer substantial benefits and pose low risks, from lower potential schemes that offer fewer benefits or pose risks to the environment or social welfare. Importantly, the rating also points to cases where detailed environmental or social impact assessments need to be carried out.

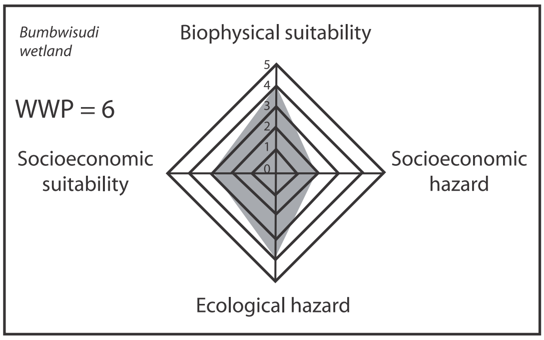
In the Bumbwisudi Wetland, combining the suitability ('marginally suitable') and hazard ('moderate') assessments for expanding irrigation resulted in a WWP of 6 (Fig. 4). This means that, before proceeding with additional agriculture, it would be prudent to thoroughly investigate the potential impact downstream and on human health.

Towards wise use of working wetlands: where next?

Developing countries in particular lack information on the biodiversity and ecological attributes of individual wetlands. This makes evaluation of ecological hazards highly subjective. The emphasis placed on human–wetland interactions on the local scale gives less weight to broader environmental issues such as carbon sequestration and global loss of biodiversity. Different stakeholders will almost certainly attribute different values to the four components that comprise the Working Wetland Potential index.

Figure 4. The Working Wetland Potential (WWP) for rehabilitation of rice irrigation infrastructure in the Bumbwisudi Wetland, Zanzibar. The potential suitability takes into account biophysical and socioeconomic factors and is 'marginal'. Hazard potential looks at the ecological condition of the wetland and its contribution to social welfare and is 'moderate'. Multiplying the potential suitability score by the hazard potential gives a 'low' Working Wetland Potential of 6. This means that it would be wise to assess the environmental and health impacts before going any further.

Summary of WWP Classification for the Bumbwisudi Wetland.						
Wetland name	Bumbwisudi					
Location	6° 03′ S, 39° 17′ E					
Current ecological condition	'Extensively modified'					
Contribution to social welfare	'Major contribution'					
Development pressure	Rehabilitation of rice irrigation infrastructure to enable double cropping					
Potential suitability Biophysical	4	Socio-economic	3	Overall	3	
Hazard potential Ecological condition	4	Social welfare	2	Overall	2	
Working Wetland Potential	6					



These issues will need to be addressed on three fronts. Firstly, we need to develop quick, objective methods that can be used to assess the value of wetland services at all scales, from local to global.

Secondly, we need to develop ways of reconciling the perceptions of different stakeholders. This means defining objective quantitative measures for each component of the index, and maybe weighting factors for each component.

Thirdly, we have to broaden the approach so that it goes beyond agriculture, and can be used to assess the potential of other development options. In the case of the WWP so far, the questions asked have been concerned with issues of agricultural development in wetlands. However, the same approach could be used to explore other uses, such as carbon sequestration, water storage, development of tourism or fish farming.

Dry season irrigation of vegetables on the Limpopo floodplain, Mozambique

Photo Credit: Max Finlayson

Water Policy Briefing Series

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IWMI is a non-profit scientific organization funded by the Consultative Group on International Agricultural Research (CGIAR). IWMI's research agenda is organized around four priority themes covering key issues relating to land, water, livelihoods, health and environment:

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Theme 2: Land, Water and Livelihoods: *improving livelihoods for the rural poor*

Theme 3: Agriculture, Water and Cities: *making an asset out of wastewater*

Theme 4: Water Management and Environment: *balancing water for food and nature*

The Institute concentrates on water and related land management challenges faced by poor rural communities in Africa and Asia. The challenges are those that affect their nutrition, income and health, as well as the integrity of environmental services on which food and livelihood security depends. IWMI works through collaborative research with partners in the North and South, to develop tools and practices to help developing countries eradicate poverty and better manage their water and land resources. The immediate target groups of IWMI's research include the scientific community, policy makers, project implementers and individual farmers.

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