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Putting research knowledge into action

Integrating fisheries into irrigation planning and management

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Fisheries, the harvesting of wild fish and other aquatic animals, often play a valuable role in livelihood strategies that is not readily replaced by the development of irrigated agriculture. Despite this, the impacts of irrigation development and management on fisheries are seldom considered.

Viewing fisheries and irrigation within an integrated and participatory management framework ensures that livelihoods and food security are enhanced rather than hurt by irrigation development. And it provides an opportunity to increase the overall productivity of irrigation systems—at little additional cost.

Protecting and enhancing fisheries in irrigated areas

Policymakers and planners have tended to overlook artisanal fisheries—despite the fact that in rural areas, fisheries often contribute significantly to incomes and diets. An estimated 50 million people in developing countries derive income and food from inland fisheries. In locations as diverse as the Mekong, Amazon and Lake Chad basins, researchers found that rural households typically obtain 10 to 30 percent of their total income from inland fishing. And, particularly for poor households, fish is often the primary source of protein.

Irrigation development and management can have direct and indirect impacts on fisheries. It can change flow patterns, size and connectivity of aquatic habitats, and water quality—affecting the productivity and diversity of fisheries. It can also change physical accessibility or rights of access to water bodies—affecting who is able to benefit from the resource.

But, contrary to popular belief, fisheries can happily co-exist with irrigation systems—contributing to the overall productivity of systems and to livelihoods and food security of the surrounding communities. Recent research from Laos and Sri Lanka has shown that irrigation development can actually enhance fisheries production, with appropriate water management and policy support.

Benefits of an integrated and participatory management of irrigation and fisheries

The prevailing sectoral approach to natural resources management tends to prevent optimal use of water for irrigation and fisheries. Irrigation generally falls under one department and fisheries another, with very few, if any, institutional linkages between the two responsible agencies—even though the productivity of fisheries in irrigated areas is closely linked to irrigation management. With an integrated and participatory management approach, fisheries can often help "top up" the benefits provided by irrigation, and may match the needs of poor and vulnerable groups otherwise neglected or adversely affected by irrigation development.

Identifying the main interactions between biophysical and economic/social systems provides a new and broader perspective for the management of both irrigation and fisheries. These, in turn, need to be considered in the context of the multiple and competing water uses within a river basin, as addressed in an Integrated Water Resource Management (IWRM) framework. In "Water Management and Ecosystems: Living with Change," Malin Falkenmark describes the first-order of business for responsible water management as identifying essential ecosystem goods and services and taking steps to protect those resources. It is important to keep in mind that "ecosystem" applies to modified as well as "natural" environments. Ecological protection has tended to focus on rivers and lakes, but man-made habitats are often equally if not more important from a livelihood perspective.

The drive to secure human welfare means that few landscapes are untouched. The challenge is to find ways to "live with change"—"secure capacity to absorb continuous change without loss of the dynamic capacity of ecosystems to uphold the supply of ecological goods and services."[1]

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River restoration, while a good investment from the standpoint of conserving biodiversity, can be irrelevant from the standpoint of contributing to livelihoods dependent on fisheries production.

Misconceptions

Since irrigation development modifies aquatic habitats and hydrology, it usually has negative effects on at least some components of local aquatic biodiversity. But this does not mean that impacts on fisheries are necessarily negative as well: some species may actually benefit—for example, if reservoir construction increases the extent of their habitat. Depending on local conditions and infrastructure design and operation, irrigation may enhance overall fisheries production levels. In the two case studies reported here, irrigation development created new aquatic habitats without substantially affecting the extent or production capacity of the existing habitats supporting fisheries production: rain-fed rice-fields in Laos and ancient tanks (small reservoirs) in Sri Lanka.

Another popular belief that has misdirected policy in the past is that fishing is an activity of last resort and that it can easily be "replaced" by irrigated agriculture. In Laos, researchers found that the majority of rural households fished as part of a traditional livelihood strategy—one that also involved farming, collection of forest products and occasional wage labor. Policy responses need to be adapted to local conditions and to recognize that fisheries can perform a range of functions, from an activity of last resort, through part of diversified livelihoods, to a specialized and remunerative occupation.

It is true that irrigation development may draw some labor away from fishing because in comparison to rain-fed farming, the demand for labor in irrigated agriculture will usually be higher, less variable, and for a greater proportion of the year. On the other hand, poor households without access to the benefits of irrigation, and perhaps economically and socially marginalized by its development, may be driven to rely more heavily on fishing as one element of a usually diversified livelihood strategy. For responsible planning and management, decision-makers need accurate information on the role fisheries play in a community and potential impacts on stakeholders. If the importance of fisheries is not recognized, irrigation development may actually increase poverty and food insecurity among certain stakeholder groups.

Lessons for Irrigation Planning and Management

- Fisheries can co-exist with irrigation—in many cases, adding to the overall productivity of irrigation systems.
- Irrigation management and farming practices can have a greater impact on fisheries than infrastructure development.
- Fisheries production and livelihood considerations are not necessarily identical with biodiversity issues; different tools are required to assess the impact of irrigation development and often different measures are required to mitigate negative effects.
- Fisheries can play diverse roles in livelihood strategies within a community.
- To adequately capture livelihoods issues, irrigation impact assessments need to be disaggregated spatially and by socioeconomic group.
- Sectoral approaches—where irrigation and fisheries are managed by different agencies with weak institutional linkages—can prevent communities from deriving the maximum benefit from aquatic resources and may lead to conflicts between fishers and farmers. An integrated water resources management approach is needed to optimize the productivity and livelihood approaches of fisheries and irrigation systems.

[1]Falkenmark, Malin 2003, "Water Management and Ecosystems: Living with Change", TEC Background Paper 9, p. 27.

Case Study: Sri Lanka

Impact on Fisheries of Established Irrigation Scheme

In Sri Lanka, researchers assessed the impact that the Kirindi Oya Irrigation and Settlement Project (KOISP) has had on fisheries. The results, which highlight several opportunities for enhancing fisheries productivity by reforming irrigation management and farming practices, demonstrates the value of conducting such assessments even after an irrigation scheme has been in operation for some time.

The assessment showed that 7 percent of the total households in the community engaged in fishing as a regular activity—producing an estimated 2,550 tons of fish per year. The estimated gross income from fishing was US$1.4 million per year—13 percent of the total income in the area. Catchment-scale fisheries production has increased by about 75 percent since implementation of the KOISP. But the value of production has increased by only 10 to 25 percent, because of the decline of the high-value shrimp fishery in the lagoons.

Stakeholders identified the following fisheries concerns in relation to the KOISP:

- Reduction in river flow and flooding,
- Declining dry season water retention in tanks and reservoirs,
- Inflow of drainage water into the lagoons—negatively impacting shrimp fishery by changing salinity (to deal with this problem, fishers regularly create openings from the lagoon to the sea).
- Conflicts between fishers and farmers, and
- Weak linkages between fisheries institutions and irrigation institutions.

Overall results suggest that while the KOISP contributed to increased fisheries production through the creation of a large new reservoir, the scheme's operation and water management has had a negative impact on production in pre-existing reservoirs and the lagoons. Improving irrigation efficiency and reuse of drainage water would help to address these negative impacts by retaining more water in the tanks and reservoirs and reducing irrigation drainage flow into the lagoons. Developing minimum water retention targets for tanks (reducing the incidences of "extreme drawdown") is another key recommendation from the assessment.

An appropriate policy mix needs to be developed which can maintain the role of fisheries as a "safety net" (at least in the short term) along with promotion of small-scale commercial fisheries in the larger reservoirs and regulation for environmental criteria of a rehabilitated fishery in the lagoons.

Incorporating fisheries into planning and impact assessment

Considering biodiversity is not enough

Environmental impact assessments, while useful for addressing biodiversity and ecological integrity issues, do not generally capture productivity and livelihood issues. And while biodiversity may be linked to livelihoods and productivity in some cases, in others it is not. The loss of certain habitat types or habitat connectivity may cause a loss in biodiversity without affecting overall fish production levels, while loss of the extent of the habitat may cause a decline in fish production, without greatly affecting biodiversity.

Different tools are needed to assess biodiversity and livelihood impacts, and often different measures are required to mitigate any negative consequences of irrigation development. In Sri Lanka and Laos, because both systems were modified at the outset, before modern irrigation development, the river, which had been the dominant aquatic habitat prior to human interference, now accounted for only a small percentage of fisheries production. In these cases, if the objective is to preserve or enhance livelihoods, maintaining the fisheries in the man-made habitats should be the priority. If the objective is to preserve biodiversity, restoring the river's natural flow patterns and lateral connectivity may be the best option.

Farmers in Laos harvest more than just rice from their fields. Simple traps made from woven palm leaves and twigs placed at drainage points also yield enough fish for family consumption. Additional fish are sold, traded, or dried and stored.

Capturing livelihood issues

Impacts on livelihoods depend on the objectives of households that fish, the functions fishing performs in their livelihood strategies and their access to fisheries. To adequately judge the function of fisheries in livelihood strategies, assessments need to be disaggregated by socioeconomic group and gender. It is commonly believed that fishers will be a specialized and easily recognizable group. But fishing may play diverse but equally critical roles for different segments of the community. It may be a supplemental activity for the majority of the community, but a critical component in the livelihood strategies of one group. Or it may be an integral part of the livelihood strategies of the whole community.

As fisheries perform a range of livelihood functions even within socioeconomic groups, assessments also need to look beyond just incomes. For example, benefits provided by fishing as part of a diversified livelihood strategy may include: helping to buffer against shocks, manage income risk, and smooth labor use and consumption. Fish can be a primary source of protein and a readily accessible source of income. The act of fishing may serve as a means for reciprocal exchange and participation in social networks and also as a form of recreation.

Physical, temporal and institutional determinants of accessibility for different groups must also be considered. Access to fisheries resources at critical times of the year or close to a dwelling may be more important than overall levels of production—especially for women fishers, who because of the demands of child-care or security concerns may need to stay close to home.

The importance of stakeholder involvement

Involving stakeholders in the assessment process can help focus, (or broaden, depending on the 'a-priori' technical and scientific perspective), the assessment by rapidly identifying key issues and priorities for mitigation or enhancement. Being able to quickly home in on key issues and priorities is particularly useful if there is not enough funds or time for a more complete assessment. Stakeholder involvement can also help address community concerns and potential conflicts, establish ownership and commitment to any measures ultimately agreed on and create a foundation for on-going dialogue and negotiation.

As highlighted in the GWP TEC paper "Integrated Water Resources Management," meaningfully involving stakeholders means raising awareness and providing information as well as gathering it. For

Case Study: Laos

Impact on Fisheries of New Irrigation Scheme

In Laos, the assessment was to determine possible impacts from new irrigation development in an area with rich fishery resources, and where fishing plays an important role in the livelihoods of well over 85 percent of rural households.

According to the assessment, the proposed irrigation project should have a slight positive impact on fisheries production. This is, perhaps, a counter-intuitive result because:

- Natural fish production is to a large extent derived from rain-fed rice fields and can be sustained within the irrigated system, provided that the rain-fed wet season rice crop is maintained.
- The reservoir fishery that will be created should be sufficient to at least compensate for production losses arising downstream in the river and associated flood-plain.

The overall impact on the livelihoods of people living in the project area is also expected to be positive. In addition to the benefits from irrigated farming and the stimulus this provides to the local economy, they will be able to benefit from the habitat provided by the new reservoir.

But these overall positive results hide some potentially negative impacts on certain segments of the society. Those most likely to be negatively affected are landless or land deficient households, more heavily dependent on fishing but more remote from the reservoir. In this case, monitoring impacts differentiated by location in the catchment, socio-economic status, and gender is necessary to ensure that the interests of vulnerable groups are safeguarded.

Although irrigation development may provide new livelihood opportunities, the semi-subsistence and backward nature of the rural economy will persist for some time, making it essential that the livelihood contributions of fishing are sustained. Fishing can continue to be a part of the livelihoods of most rural households, while also playing the role of a "safety net" for the poorest sections of the population. In addition, some management efforts could be directed to supporting the emergence of more commercialized, though still small-scale, fishing activity.

Table 1. Fisheries productivity for different habitats - empirical estimates

Habitat	Area measure	Productivity (kg/ha)	
		Mean	Range
River without floodplains	Catchment area	0.3	0.06 - 0.57
River floodplain	Maximum flooded area	80	7 - 186
Rain-fed rice fields (Laos)	Rice field area	60	4 - 230
Estuaries and lagoons	Average water area	100	4 - 2200
Reservoirs (Sri Lanka)	Average water area	220	40 - 500
Small reservoirs (Laos)	Average water area		
Non-managed		100	36 - 176
Enhanced and managed		250	50 - 550

women and other marginalized groups, building confidence is an additional component. "Creating participatory opportunities will do nothing for currently disadvantaged groups unless their capacity to participate is enhanced."[2]

Representation from different stakeholder groups, including relevant civil society and government agencies, is necessary, not just from the standpoint of ownership and equity issues, but also because knowledge and perception of impacts differ between groups.

That stakeholders will introduce a bias or misinformation into the assessment is, of course, a risk. But combining technical expertise with local knowledge from multiple stakeholder groups can help minimize this risk and ensure adequate and objective coverage of issues.

Incorporating Fisheries into Irrigation Management

Planners and managers of irrigation schemes should be open to the possibility of protecting and sustaining fisheries, or developing fisheries in new or modified habitats. Even in systems already under operation, there may be opportunities to enhance fisheries benefits or mitigate negative impacts. Impact assessments of the type described above are useful in identifying and addressing these opportunities. Whether the impact on fisheries is positive or negative depends on the irrigation scheme's mode of operation, as well as the design of the scheme itself.

In fact, irrigation management and farming practices can have a greater impact on fish production than infrastructure development. In the Lao case, sustaining the fisheries depends on maintaining a rain-fed, wet-season rice crop. Any modification in the cropping cycle that reduces water retention on the rice fields is likely to cause a drastic reduction in fisheries production. In Sri Lanka, extreme drawdown of the tanks dramatically reduces fisheries production.

Lessons for Preparation of National IWRM and Water Efficiency Strategies

- Fisheries can help get more food per drop from irrigation systems, thus increasing water efficiency.
- Integrating fisheries and irrigation management is better at yielding significant benefits with relatively little investment.
- Analysis of access to water for the rural poor needs to go beyond drinking water and irrigation.
- Impact assessments for irrigation development and other interventions likely to affect the hydrology of a given area should consider man-made as well as natural aquatic habitats.
- Environmental impact assessments focusing on biodiversity are not enough to capture fisheries-related livelihood issues.
- The value of fisheries, in terms of livelihood strategies and nutrition for the rural poor as well as straightforward economics, needs to be considered when making water allocation decisions.

[2] *Global Water Partnership Technical Committee 2000. Integrated Water Resources Management. Stockholm, Sweden. p. 17.*

How Integrated Water Resources Management Contributes to Millenium Development Goals

One of the outcomes of the World Summit on Sustainable Development (WSSD) in 2002 was a specific recommendation for all countries to develop IWRM and Water Efficiency Strategies by 2005. The recommendation states that all countries should have a strategy—regardless of their level of financial or water resources—and that developing countries must be supported in the process of preparing their strategies. The content of these strategies is to be wide-ranging, covering institutional, financial and technological change.

Once the minimum conditions required to sustain productive and diverse aquatic resources and the livelihood opportunities they provide have been assessed, these can then be evaluated in the light of the trade-offs and compromises they may impose on water management for irrigation and other activities. Under favorable conditions, fisheries can add value to the use of water in agriculture, and this should be given due weight in decision-making on water allocation—particularly in situations of water scarcity.

Both in Laos and Sri Lanka, the irrigation projects assessed offered the opportunities to further increase fisheries production with very little additional investment or impact on crop production. But to make the most of such opportunities, the irrigation, fisheries and agriculture sectors need to work together—in both the design and management stages of irrigation development. Fisheries-friendly considerations in irrigation planning and design include ensuring habitat connectivity through "fishways" and physical access to fishing grounds. Irrigation managers need to consider flow patterns and water quality. In addition, agricultural interventions to control pesticide use can reduce negative impacts on fisheries.

Fisheries in irrigation systems may also benefit from specific fisheries management measures, such as creation or restoration of spawning habitats, restrictions on fishing in fishways or at culverts where harvesting is very efficient and can reduce overall catches through overfishing or the stocking of fish species that are well adapted to the habitats created by irrigation infrastructure.

Additional Resources

GWP publications (available at www.gwpforum.org)

TEC Background Papers:

- Water Management and Ecosystems: Living with Change (no. 9)
- Integrated Water Resources Management (no. 4)
- Poverty Reduction and IWRM (no. 8)

IWRM ToolBox Case Studies:

- Philippines – Laguna de Bay resource use and allocation (no. 115)
- Bangladesh: Compartmentalization as an approach to Flood Management (no. 188)
- Australia – Independent inquiry into the Clarence River System, NSW (no. 155)
- Mexico and Indonesia: Participatory strategies for integrated bay and watershed planning and management (no. 85)

IWRM ToolBox References:

- B1.09 Civil society institutions and community-based organizations
- C2.1 National Integrated Water Resources Management Plans
- C2.4 Coastal zone management plans
- C2.2 Basin management plans
- C2.6 Environmental assessment (EA)

IWMI publications (IWMI Research Reports and Working Papers are available at www.iwmi.org/pubs)

- Renwick, Mary 2000. Valuing Water in Irrigated Agriculture and Reservoir Fisheries: A Multiple-Use Irrigation System in Sri Lanka (IWMI Research Report 51)
- Bakker M., Barker R., Meinzen-Dick R., Konradsen F. 1999. Multiple Uses of Water in Irrigated Areas: A Case Study from Sri Lanka (SWIM Paper 8)
- Nguyen-Khoa S., Smith L. and Lorenzen K. 2005. Adaptive, Participatory and Integrated Assessment (APIA) of Irrigation Impacts on Fisheries – Evaluation of the Approach in Sri Lanka (IWMI Working Paper 89)

Comprehensive Assessment of Water Management in Agriculture Publications

- Penning de Vries F., Acquay H., Molden D., Scherr S.J., Valentin C. and Cofie O. 2003. Integrated Land and Water Management for Food and Environmental Security (CAWMA Research Report 1)
- Nguyen-Khoa S., Smith L. and Lorenzen K. 2005. Appraising Irrigation Impacts on Fisheries – Case studies in Laos and Sri Lanka (CAWMA Research Report 7)

Useful websites

- Dialogue on Water, Food and Environment – www.iwmi.org/dialogue
- GWP IWRM ToolBox – www.gwpforum.org
- Tutorials and training material on IWRM – www.cap-net.org
- DFID KaR - www.dfid-kar-energy.org.uk
- Comprehensive Assessment - www.iwmi.org/assessment

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The Global Water Partnership

The Global Water Partnership (GWP) is a world-wide network created in 1996 to promote Integrated Water Resources Management (IWRM) through knowledge exchange and partnership building. The GWP operates through regional, country and area water partnerships—bringing stakeholders and leading water professionals together to discuss shared problems and devise appropriate IWRM solutions.

For policymakers and water management professionals, the GWP provides the tools and knowledge needed to move away from fragmented, sectoral policies and practices and towards integrated, cross-sectoral approaches. Since the World Summit on Sustainable Development held in Johannesburg in 2002, a key aspect of this work has been to support countries in developing national Integrated Water Resource Management (IWRM) and Water Efficiency Strategies, in accordance with the WSSD's Plan of Implementation.

More information on the GWP and IWRM tools and publications are available at **www.gwpforum.org**

The GWP Advisory Center at IWMI

The GWP Advisory Center at IWMI provides research and knowledge to support countries and regions in developing and implementing Integrated Water Resources Management (IWRM) and Water Efficiency Strategies. The core work of the Advisory Center is to facilitate the formation of partnerships at multiple levels, promote knowledge of IWRM tools and practices, provide support for dialogue on IWRM issues and policy, and identify knowledge gaps and support research to fill them.

The Center provides support to the GWP's extensive network of partners in Asia and Africa —drawing on IWMI's expertise in water and land-resource management. The services provided are demand-driven—determined by the needs expressed by countries and regions. Partners include government agencies, public institutions, private companies, development agencies and others committed to sustainable water management.

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