Water Requirements of Floodplain Rivers and Fisheries: Improving Decision-support Tools

WorldFish CENTER

COMPREHENSIVE Assessment of water management in agriculture

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The Challenge

As demand for freshwater rises worldwide so increasing investment is required to develop ways to improve water productivity at the basin scale. To do this decision-makers at local, national and basin levels require accurate information on the role of river flow in sustaining a wide range of environmental benefits including river and floodplain fisheries. Not only do inland fisheries yield an estimated 8 million tons of fish per year, providing employment, income and an essential supply of animal protein for hundreds of millions of people, but they also support some of the most diverse vertebrate faunas in the world. As the use of water from river systems for agriculture, hydropower generation, and domestic and industrial supply has increased, aquatic ecosystem structure and function has been degraded, leading to a decline in fish catches and the disappearance of individual species.

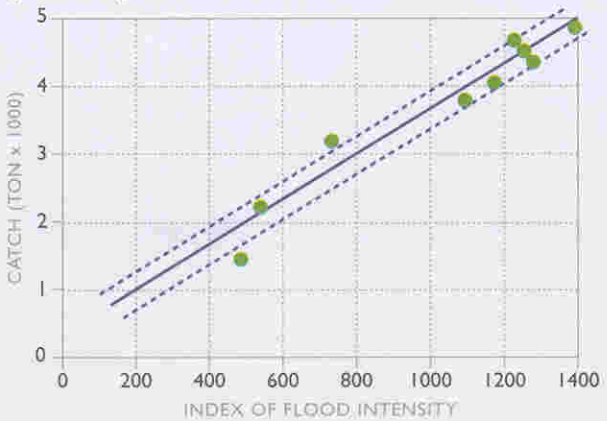
There is now widespread international recognition that future water allocation and flow management in river basins for food production must incorporate the needs of river ecosystems, fish and fisheries, and the human communities that depend upon them. For example, the World Water Vision, the World Commission on Dams (WCD) and the Global Dialogue on Water for Food and Environment have all called for a new approach to the allocation of water for fisheries as an integral part of efforts to improve the sustainable benefits that people obtain from river systems. Yet while this growing international recognition of the importance of river resources provides the incentive for more effective policy frameworks, efforts to improve water management in individual rivers have been less successful because of the lack of specific information on the value of the fisheries, the impact of changes in water flow on them, and the effects on the people who depend upon them. As a result river fisheries in the tropics continue to decline.

The Approach

In response to the growing need for informed management of the world's rivers in the face of growing demand for freshwater, there has been growing research devoted to environmental flow assessments. This research aims at establishing how much of the original flow regime of a river is required, and with what timing, to maintain specific river and floodplain ecosystems and the productivity that they sustain [Fig 1]. Hundreds of different models that have been used to assess the impacts of changing flow regimes on fish and fisheries and a number of independent studies have examined their validity and cost-effectiveness. To further review the suitability of these approaches for effective decision-making on the allocation of water to sustain river fish populations and fisheries an international research project led by the WorldFish Center was undertaken through the Comprehensive Assessment of Water in Agriculture. This study examined the various tools that are currently available to assess the impact of changes in hydrological regime on river ecosystems and their fisheries, evaluated their suitability for application in large floodplain rivers, and identified steps required for the further development and testing of improved tools in selected river basins. It is argued that these methodologies and models can provide a complementary suite of tools to guide

planners and policy makers on the consequences for fisheries of various possible changes in hydrological regime resulting from water abstractions and other types of alteration to natural river flow regimes.

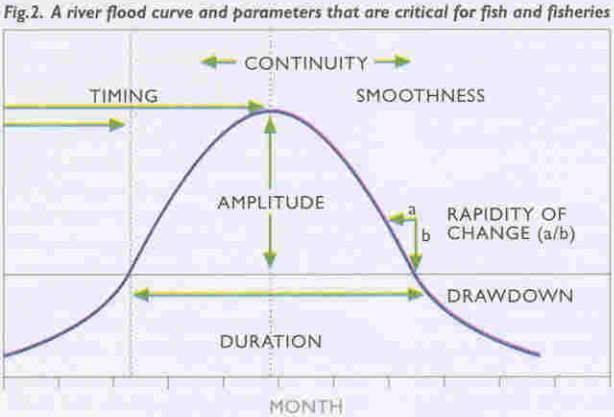
Fig.1. Relationship between flooding and fish catch from the Central Delta of the river Niger.



The Conclusions

Much of the earlier work on environmental flows aimed at establishing minimum flow requirements for the survival of the fish stock and a multitude of methods have been developed independently in different parts of the world. However these have been applied almost exclusively to in-stream flows in small temperate systems. Such models are rarely helpful in the tropics where water volumes are greater, seasonality more marked, and large floodplains form an important component of most systems. They also usually require large amounts of data, considerable expertise and are costly, all factors that are of little assistance in tropical systems. In addition, as understanding of river ecology has developed, so has recognition of the limited value of the concept of minimum flow requirements [Fig 2]. Rather a continuum of response to changing hydrology is needed by planners to set flows at levels that are optimal among all users. The environmental flow methodologies and fisheries models assessed in this study are, therefore, oriented more towards a series of scenario-based predictions rather than the production of a single figure such as a minimum flow.

Fig.2. A river flood curve and parameters that are critical for fish and fisheries



Three main approaches to environmental flow assessments were agreed to provide the best information:

i. Holistic methods that integrate information from a number of sources into a series of scenario based solutions;

ii. Bayesian networks that use probability theory for a similar purpose;

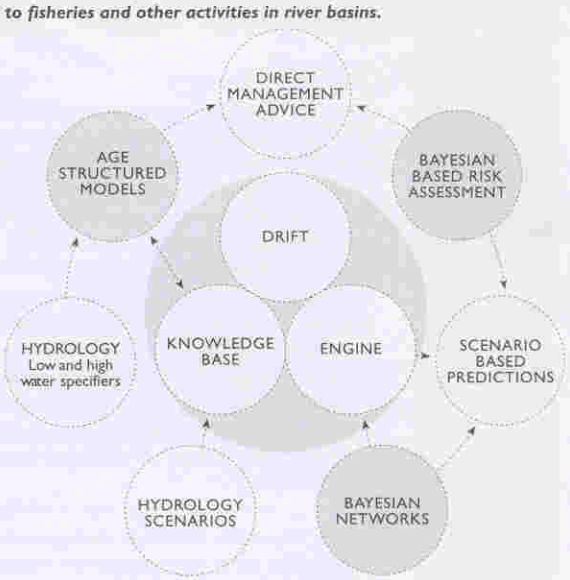
iii. Age-based modelling that specifically describes the reaction of the fish stock and fishery to changes in hydrology.

Consideration of the strengths and weaknesses of holistic methodologies has suggested that the DRIFT methodology, developed in South Africa and applied to several rivers in Africa and Australia, is the most amenable to further modification. By combining DRIFT with Bayesian networks and age structured modelling the three methods can be combined to form a complementary suite of activities that together are capable of providing balanced advice to decision makers [Fig 3].

The Future

As demand for freshwater, and the consequent pressures upon the world's freshwater resources increases, the need for assessments of the specific fisheries impacts of alterations in flow regimes in tropical rivers is growing. A suite of methods consisting of DRIFT, some aspects of Bayesian networks and age based modelling need to be developed and applied to tropical river systems so that they can be used by a wide range of stakeholders in reaching more scientifically based decisions on the use of river water resources.

Fig 3. Methods for assessing the impact of changes in hydrological regimes to fisheries and other activities in river basins.



The full report by Arthington et al, Water Requirements of Floodplain Rivers and Fisheries: Improving Decision-Support Tools will be published by the WorldFish Center and Comprehensive Assessment of Water in Agriculture and will be available in early 2004.

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