

# Increasing the Water to Food Conversion Rate in Tropical Floodplains



**T**he world's tropical floodplains are important resources that could be tapped for fish production to provide a rich protein source for communities. However, many of the strategies to increase food output from the world's tropical floodplains have been limited to agricultural crop cultivation and have not fully taken advantage of integrating fish culture and other aquatic resources, that will also increase the rate of water-food conversion.

The CGIAR Challenge Program on Water and Food (CPWF), through the community-based fish

culture project and teams of national researchers worked together to implement a project on enhancing community-based fish production in the floodplains of Bangladesh, Cambodia, China, Mali and Vietnam.

The project aimed to scale out a successful model of floodplain aquaculture, developed through three decades of research on community-based fisheries management and floodplain aquaculture in Bangladesh. It disseminated the model to other areas in Bangladesh and to four other countries that also have extensive floodplain resources. It also

developed appropriate technical and institutional options for the integration of community-based fish production into existing floodplain and irrigation systems. The project identified the most appropriate models of collective action for aquaculture under different socioecological contexts and assessed the value of these approaches to the sustainable development of floodplain resources and irrigation systems.

The project has led to a range of outcomes and variable successes in each of the project countries, delivering different levels of benefits both within and between countries. Negotiating access and managing institutions and benefit—sharing arrangements within a system where rights are dynamic, have created particular challenges to the implementation of the project. As a result, only sites in Bangladesh and China generated data over the many fish culture cycles. Substantial improvements in resource governance were, however, seen in Mali, where the intervention showed strong potential for uptake and dissemination.



## Comparison of floodplain fishery development in five countries

The dissemination of the community-based fish culture (CBFC) model developed in Bangladesh to other countries in Asia and Africa is an important contribution to a suite of aquaculture technologies currently available to rural households across the world. Testing the CBFC model in a range of environmental, social and economic contexts has provided important insights into the conditions that support CBFC and where such an intervention is both appropriate and likely to generate benefits for rural communities (see Table 1)

The Water to Food conversion rate could increase if the world's tropical floodplains are tapped by integrating community-based fish culture with agricultural crop production.

**Comparison of Floodplain Fisheries in Bangladesh, Vietnam, Cambodia, China and Mali.**

Country/ Description	Methods and Approaches	Technical Design	Ownership of Floodplains and Beneficiaries	Fish Production and Benefit Sharing
<p><b>BANGLADESH</b> CBFC was developed in Bangladesh. Although significantly helping floodplain communities, CBFC is said to exclude large numbers of poor people who are marginalized when benefits are captured by the local elite.</p>	<p>Floodplain management committees (FMC) were established to represent stakeholder groups and make decisions on fish culture activities. Project implementation committees (PIC) were tasked with advising the FMCs and coordinating project activities in CBFC.</p>	<p>Culture sites were delineated by flood control dikes. Bamboo fencing was installed at water inlets and outlets to permit entry of wild fish fry and prevent the escape of stocked fish. Concrete ring culverts were introduced in Kalmina Beel and water regulation using sluice gates in Beel Mail increased water retention following flood recession.</p>	<p>Floodplains were completely under private ownership and had the landless, fishers and landowners as beneficiaries. For publicly owned floodplains under lease agreement, fishers' groups were mostly the beneficiaries. Others were fisher-lessees and landowner-investors.</p>	<p>Fish production and benefit sharing varied among sites, depending on land tenure arrangements associated with the water body. Where public land was leased by a fishers' society, fishers received a larger share of the net benefits than those on privately owned sites. Benefits also depended on investments made in the lease. At all sites, the share included a revolving fund with one site achieving financial autonomy. In some sites, the landless either received 5% of the total benefit or were only allowed to catch self-recruited species.</p>
<p><b>VIETNAM</b> Floodplain aquaculture in Vietnam has not shown significant development as the government is focused on intensifying rice culture. It has only recently begun to experiment with different types of aquaculture in flooded rice fields.</p>	<p>In all three sites, land ownership within the culture site was a pre-requisite for participation. At two sites, non-landowners were permitted to join, but only a few did. A leader, vice leader, secretary and accountant were elected to form the management committee.</p>	<p>Culture sites were delineated by dikes. Fencing to define the culture area was introduced at some sites. Fencing was installed at the top of dikes to prevent fish from escaping during high floods.</p>	<p>CBFC in Vietnam limited membership to households who owned land within the perimeter of the project site, although this was not intended at project inception.</p>	<p>When the water level became low enough to make the boundaries of individual rice fields visible, wild fish caught within the boundaries belonged to the rice field owner and were not recorded as part of the CBFC harvest.</p>
<p><b>CAMBODIA</b> Cambodia's fresh water capture fisheries ranked 4th most productive behind China, India and Bangladesh.</p>	<p>Participation was open to all community members. Those interested in participating in fish culture registered during</p>	<p>Culture sites were located in rectangular enclosed areas made of nylon nets and supported by wooden poles within open access reservoirs or on</p>	<p>Selection of participants was on a voluntary basis, including landowners. At all sites, benefit sharing was done according to</p>	<p>Floodplain aquaculture in Cambodia did not achieve levels of production sufficient to generate benefits for project participants. Environmental factors, including flooding, late arrival of floodwaters and</p>

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	a village-level meeting.	private rice fields delineated by net fencing. Fish pathways and ditches were introduced into rice fields in some sites in the second year to facilitate fish migration.	membership and included a share of 10% for poor households of two villages in Cambodia.	reduction of the grow-out period undermined fish production. Vandalism of fish culture enclosures also led to high losses.
<p><b>CHINA</b></p> <p>The CBFC model was adapted to create a system based on pooling resources (land and/or labor) by community participants.</p>	<p>Fish culture was managed by a caretaker household/contractor that has had experience in fish culture. All households in each of the communities received a previously agreed share of the benefit from fish culture. The local fisheries bureau supervised the project in the village.</p>	<p>In Jiangsu province, fish were stocked in irrigation canals. Culture sites were delineated by fencing. In Yunnan, fish were stocked in flooded rice nurseries. There was no enclosure used or modification of infrastructure.</p>	<p>CBFC in China did not bring about significant change in income or livelihoods. However, it did generate social benefits, such as creating additional funds for social welfare and rural development programs and decreasing the amount each household needs to contribute yearly. It has improved relationships between villagers and has increased the production of lotus in Yunnan province.</p>	<p>In terms of output, households in Taiping chose to eat their share of production—fish being a luxury protein source. In Jiangsu province, farmers shared the fish they got from the project with family and friends. Generally, Yunnan communities wished to continue fish culture to obtain an eco-friendly protein source at a low price.</p>
<p><b>MALI</b></p> <p>CBFC provided local communities, NGOs and the national agricultural research and extension system (NARES) with a model for increasing the productivity of <i>mare</i> (flood plain depression), which represent the primary source of income for most households during the dry season.</p>	<p>Fish culture was managed by a committee, composed of the village chief and representatives of main ethnic groups and resource users.</p>	<p>Net pens were set up in one large enclosure located within <i>mare</i>.</p>	<p>Access to <i>mares</i> is regulated by the main families, who were descendants of the original farming-fishing settlers.</p>	<p>Due to persistently high water levels in the <i>mare</i> this year, the enclosures could not be harvested before the end of the project. We find that overall catch would increase over 100% but more significantly, we find that the catch per individual participating in the collective fishing event would increase roughly 500%</p>

# Impact and change

Fish culture in communities in Bangladesh, China and Mali showed potential impact in terms of food security and increased income. In Vietnam and Cambodia, research increased understanding of the conditions required for collective action, specifically for developing CBFC systems.

This research will contribute directly to the development of locally appropriate and technically feasible fish culture systems in both countries. In Cambodia, the project responded to government commitments to establish community-based fish refuge ponds (FRPs) in every village in the country by providing best-practice guidelines for FRPs.

In Bangladesh, increase in fish production brought significant changes to the community, who related the story of their village in the community-produced film, 'The Island of Dreams and Success'. Moreover, prior to the intervention, households fished individually in open access waters and competed with one another for the fish catch. Since the introduction of fish culture on a community basis, households have learned to work together to manage fish culture activities and to protect the fish stock.

Beneficiaries in Bangladesh say that the overall impact has been the generation of income so that they can afford to educate their children or to purchase assets such as mobile phones and

televisions—technologies that are important in providing rural households with access to information.

Although relatively modest levels of fish production were achieved in China, fish production still provided significant benefits to participating communities. In Taiping village, in particular,



beneficiary households preferred to receive their share of production in the form of fish rather than in cash. Fish production from CBFC led to a significant increase in fish consumption in Taiping. The additional fish that the project provided for home consumption was a sufficient incentive for the community to continue fish culture.



In Mali, the impacts of constructing the aquaculture enclosures in Mama Pondu *mare* go well beyond that of fish production within the enclosures. The project focused on development and management of the *mare* resources and has increased community awareness of its reliance on this common resource and its commitment to improve *mare* resource governance overall. Consequently, livestock herders have taken greater care in tending their flocks, fishers have limited their poaching during the closed season and farmers have reduced the amount of vegetation that they extract as fodder for small livestock.

At the institutional level, national agricultural research and extension system (NARES) partners also reported important changes in their working practice and research, knowledge and skills. The application of participatory rural appraisal (PRA) methods has expanded the scope of their research beyond a simple analysis of fish productivity. Consultation with farmers at the local level in order to understand their needs and preferences has also increased.

The opportunity to build international partnerships was cited as an important outcome of the project, particularly among NARES partner participants in China. The increased visibility of local departments, through connections established by the project, has led to further funding for national-level projects in areas that previously receive little attention from national agencies.



# Conclusion

Floodplain aquaculture could increase water to food conversion significantly and provide much needed protein. Organizing a community to join forces in implementing floodplain aquaculture can provide multiple benefits, including food production, increased income, community empowerment and improved cooperation. It also brings about increased awareness of the importance of the environment and hygiene and of the fact that the floodplain is a common resource from which everyone should be able to benefit.

## Contact Persons

Nastaja Sheriff (nastaja.sheriff@gmail.com), Olivier Joffre, Meen Chee Hong, Benoy Kumar Barman, A.B.M. Haque, Fazlur Rahman, J. Zhu, Hao van Nguyen, Aaron Russell, Martin van Brakel, Rowena Valmonte-Santos, Christine Werthmann, Amaga Kodio

## Partner Organizations

Africa Rice Center  
Bangladesh Agricultural Research Center  
Cambodia Fisheries Administration  
Freshwater Fisheries Research Center, China  
International Food Policy Research Institute  
Institute D'Economie Rurale, Mali  
Research Institute of Agriculture 2, Vietnam

## Key Reference

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