Chapter 8

Integrated rice and fish culture/ capture in the lower Songkhram River basin, northeast Thailand

The lowland societies of Southeast Asia have been described as "rice–fish cultures", such is the importance and interconnection of these two basic food sources (Gregory and Guttmann, 2002). Raising fish in rice fields has been a tradition for more than 2 000 years in some parts of this region (Boxes 14 and 15). Rice–fish cultivation may be practised in rainfed and irrigated rice fields, and both upland terraced and lowland rice fields. While certain favourable areas of lowland mainland Southeast Asia have been under wet rice cultivation for many centuries, and have been more or less continually cultivated in that period, far greater areas are more marginal land that has only been converted to rice paddy in the last three decades.

A rice field ecosystem is a simplified version of the natural wetland ecosystem that preceded it. The main provisioning service is rice, with a variety of by-products (often undervalued and poorly understood by external agencies) such as fish and other aquatic organisms. Intensification and modernization of rice cultivation focusing on maximizing yield, exemplified by "green revolution" technologies, involving the transfer of natural wetlands to largely human-affected ones, has tended to further simplify and compromise the multibenefit functions and services of the modified wetland ecosystem (Figure 31). This has frequently resulted in significant state changes in the ecosystems

BOX 14

Wild capture fisheries in rice fields – the hidden harvest

In many instances in Southeast Asia generally, and in particular the lower Mekong basin, farmers harvest more than rice from rice fields, even where rice is the only officially recognized cultivated crop in the farming system. Although not considered rice–fish culture per se, as it is essentially an open system, farmers throughout the floodplain lowlands benefit from the entry of wild fish from outside the system. These usually migrate upstream into the rice field, and use the aquatic habitat as a temporary spawning, nursing or feeding refuge. Fields are often modified to accommodate the entry and harvest of these wild species, which are usually considered common resources. More than 20 species of fish have been found in rice field systems in the south of the Lao People's Democratic Republic, while 13 species are known to use rice fields for spawning in the lower Songkhram River basin. Apart from fish, other aquatic organisms commonly harvested from rice fields for sale and local consumption include: crabs, shrimp, bivalve molluscs, frogs and tadpoles, insects, water snakes, turtles and edible aquatic plants. Rice fields continue to yield valuable food items, important in local people's diets, long into the dry season after the rice harvest has been completed. Some aquatic species, such as crabs and insects, burrow into soil and are dug out by villagers in the dry season. This hidden harvest is often a crucial component of rural food security (Gregory and Guttman, 2002; FAO, 2003).

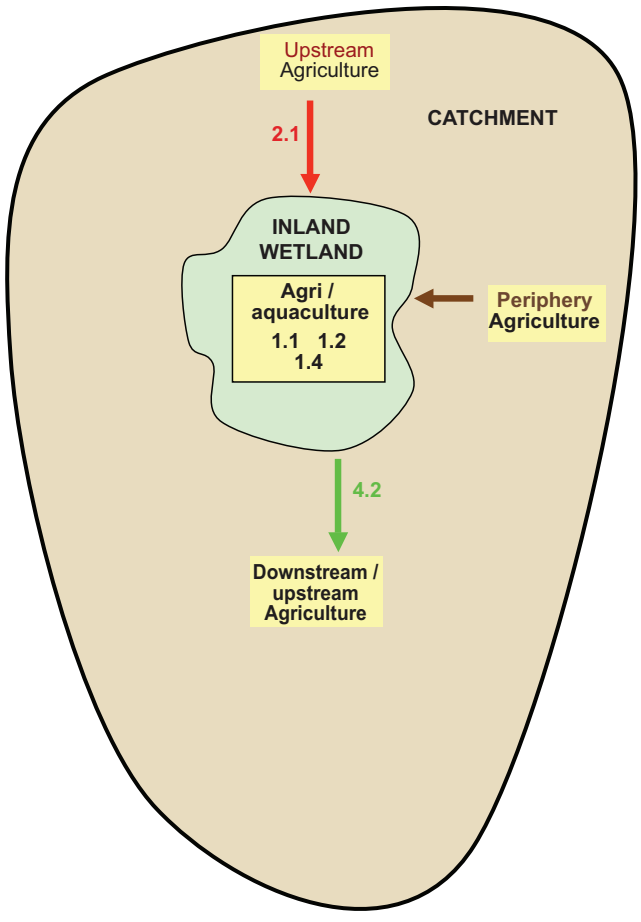
Lead author: ***David J.H. Blake (WA)***

BOX 15
Rice–fish cultures in other parts of South and Southeast Asia

In the rainfed and irrigated rice farming in the south of the Lao People's Democratic Republic three main types of small–medium-scale irrigation technology can be found (weir, dam and reservoir, and pumped irrigation). In this area, fish often play an important role. These water resources have been assessed in order to assess the impacts of irrigation and aquaculture on aquatic resources, important in the livelihoods of local people (Lorenzen, Khoa and Garaway, 2006). Fish are both cultured (usually stocked in small ponds and rice fields) and captured as a by-product of rice cultivation, along with a wide variety of other aquatic organisms that contribute to local diets (FAO, 2003).

In the extensive river floodplains and deltaic lowlands of Bangladesh, where floods last several months (rendering the land unsuitable for crop production), fish are linked with rice cultivation. The freshwater wetlands of Bangladesh consist of the ecologically distinct "haor" (backswamp between levees) and floodplain areas, each subject to a different management regime by local people (Ahmed, Haque and Khan, 2004). Integration of fish culture enables farmers to increase overall production in the flood-prone ecosystem. Both concurrent rice–fish culture in the shallower flooded areas and also alternating rice and fish culture in the deep-flooded areas of Bangladesh through a community-based management system have been trialled and extended to farmers (Dey and Prein, 2004).

FIGURE 31
AWIs in integrated rice and fish culture/capture systems in South and Southeast Asian tropical river basins



where the system is further skewed towards the exploitation of a single provisioning service. Conversely, attempts to integrate fish cultivation can serve to increase the diversity and complexity of the original ecosystem, by creating a number of new habitats that favour greater aquatic biodiversity and can restore some wetland functions and services.

Large parts of northeast Thailand are typified as "complex, diverse and risk-prone" (or CDR lands) and rely on rainfall rather than irrigation for water supply. Thus, the main rice crop is a single sowing in the early rainy season with harvesting at the start of the dry season (i.e. May–November/December), with relatively few farmers having access to reliable irrigation water for a dry-season crop. This is the case even in the relatively water-rich and high precipitation (1 200–2 100 mm) conditions of the Songkhram basin in northeast Thailand, where estimates show that only about 4 percent of the entire basin

is irrigated (Blake and Pitakthepsombut, 2006a). In most lowland areas, seasonal floods are as much a feature of the annual hydrological conditions as are prolonged periods of low flows and water scarcity.

Rainfed and irrigated rice farming in the lower Songkhram River basin (LSRB) in northeast Thailand forms part of an extensive wetland area largely converted to agricultural uses. However, significant areas of natural vegetation cover remain, such as seasonally flooded forest. These are recognized by local people and fishery scientists as providing valuable spawning, nursing and feeding habitat for a wide range of migratory fish, not easily adapted to monoculture rice fields. However, while large quantities of fish are harvested from rice fields, both in the dry and wet seasons, little deliberate stocking of cultured species occurs. Government policy has tended to recognize only the agricultural potential of the area, at the expense of the rich wetland resources and fisheries sector (Blake, 2006; Blake and Pitakthepsombut, 2006a).

DRIVERS

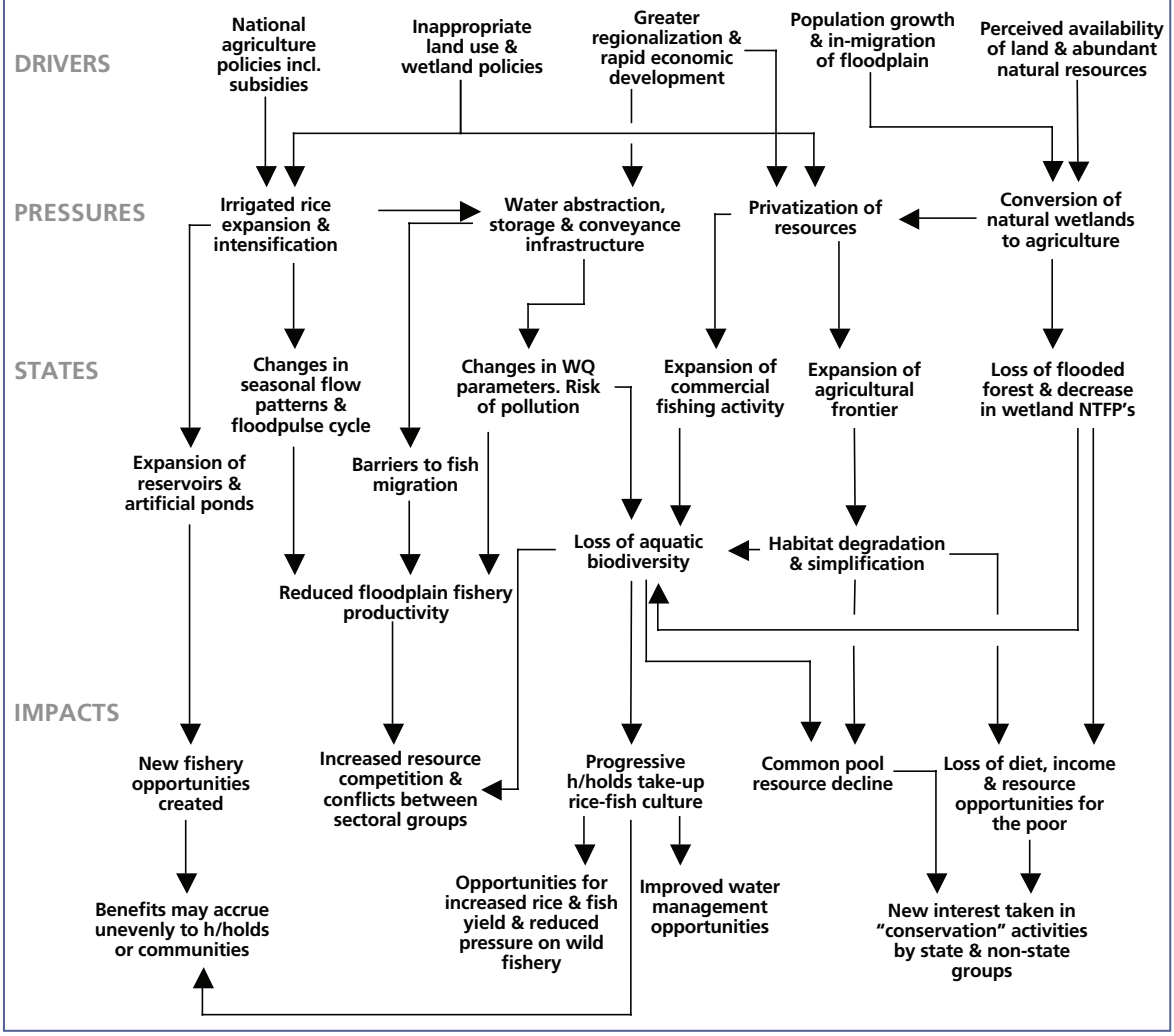
In the LSRB, the population has been growing steadily in the last four decades as a result of natural growth and in-migration from other provinces. However, the rate of increase has slowed considerably in recent years owing to a successful state-supported birth control programme. Thailand has also been closely integrated into the regional and global economies for decades. This regional integration and population growth have led to growing pressures on natural resources, especially forests (for timber, wildlife, agricultural land and pulpwood plantations) and water (for irrigation and hydropower). These general drivers (Figure 32) have been slightly moderated in the LSRB because of its remoteness and the resilience of the floodplain vegetation to disturbance. Government policies have stressed the importance of "modernization" of rice farming, leading to interventions in wetland ecosystems from irrigation system expansion and intensification of inputs. Fish rearing has also been promoted in Thailand by market forces, and there are opportunities for reaching a wide domestic and export market for capture and cultured fish. These market forces led to the wild capture fisheries of the Songkhram basin being opened up to large-scale commercial fishing in the 1970s. However, only recently has aquaculture started to gain a measure of popularity in this area, but with limited success.

Land-use and market policies have also been drivers of wetland change in the LSRB. State policies have encouraged the privatization of resources, land conversion and agricultural intensification, with a strong emphasis on irrigated rice through subsidies for agricultural expansion, irrigation infrastructure and agribusiness expansion. Fisheries and wetland management have been more or less ignored until recently. Limited funds have been made available for aquaculture promotion, but the focus has been more on intensive cage aquaculture rather than rice–fish culture or other semi-intensive technologies. The natural flood–drought cycle (flood pulse system) is both a facilitator and regulator of the agro-ecosystem, limiting to a large extent the choices and responses of local resource users, but driving system productivity.

PRESSURES

In the LSRB, the state tends to view the flood–drought cycle as an impediment to development. It seeks to alter the cycle through engineering interventions that will regulate the flow, theoretically supplying more water for rice in the dry season and ameliorating the impacts of floods in the wet season. Crop irrigation and intensification provides the main justification, not aquaculture or capture fisheries. The LSRB has seen three decades of sustained wetland conversion to agriculture, irrigation development and attempts to increase rice double-cropping (with relatively little success). Thus, the extent of failed irrigation infrastructure is obvious in northeast Thailand, where weirs, dams and pumping stations lie abandoned or are underutilized. Despite this,

FIGURE 32
DPSI linkages in integrated rice and fish culture/capture systems in South and Southeast Asian tropical river basins



there are new attempts to promote large-scale, transboundary water transfers from Lao rivers to northeast Thailand for basinwide irrigation coverage projects, including the Songkhram basin (Blake, 2006; Molle and Floch, 2007).

As farmers convert land for natural flood cultivation of rice, they will adapt or modify their fields to accommodate fish culture or permit entry and capture/harvest of wild fish from surrounding waterbodies. The modifications may take many forms, including trenches, pits or sumps, trap ponds and raised bunds. These features will tend to alter the flow of water across the landscape, increase the water storage capacity of the floodplain and, thus, the flood retention time. The construction of irrigation infrastructure also creates ecological and socio-economic pressures and alters the floodplain in various ways. These may unintentionally create new aquatic habitats favourable for fish, as where roads and canals alter drainage patterns and create ponds from borrow pits, or where the construction of dams, weirs and reservoirs create new perennial water resources that are often colonized rapidly by aquatic organisms and utilized by local people. At the same time, these infrastructures can create physical barriers to fish migration, alter water quality parameters, simplify aquatic habitats,

and radically alter the dominant wetland fauna and flora. Thus, some species tend to benefit, while others tend to be disadvantaged by habitat modification.

STATE CHANGES

The conversion of natural seasonal wetlands to multicropped rice fields has led to an expansion of surface water and aquatic habitats on the floodplain, both at the local level and the wider basin level, for storage and delivery of irrigation water. This areal and volumetric expansion of water sources is a major state change in the LSRB. As well as a quantitative change in water at different scalar and temporal levels, there is also likely to be a qualitative change with greater external inputs. This is especially the case where rice cultivation has intensified under "green revolution" principles with greater external inputs, as this has led to a concurrent decline in water quality and to occasional pollution incidents and fish kills. Moreover, there are anecdotal observations by local people of the gradual deterioration in water quality for human and animal consumption (Blake and Pitakthepsombut, 2006b).

It has been observed in Thailand that pressures to increase the area of irrigated rice lead directly to loss of the biodiversity and extent of native flooded forest vegetation, itself a vital habitat in which more than 50 Mekong fish species (some World Conservation Union [IUCN] Red List species) feed and complete their life cycles. This would appear to be causing a serious decline in native fish productivity, a factor in itself that would appear to both encourage further floodplain wetland conversion as livelihood options erode and stimulate interest in alternative farm-based livelihoods over capture fisheries.

Riverine and floodplain habitat diversity are changing in the LSRB as rivers are simplified by in-stream hydrological interventions and land-use changes. Dams, weirs, embankments and other infrastructure are tending to delay and reduce peak flows and attenuate seasonal flows at local and river basin levels. Riverine habitats are being replaced by lacustrine habitats, and downstream areas are becoming drier at some locations as water is abstracted for agricultural uses. This suggests that the aquatic environment is becoming more stressed and less resilient to external shocks.

Clearance and conversion of seasonally flooded forest habitat for irrigated agriculture in the LSRB has led to soil degradation, including declining soil fertility, salinization, and increased erosion. Groundwater levels have been raised and soil salts mobilized by reservoirs and irrigation schemes. Intensification of rice cultivation has encouraged greater use of chemical fertilizers, pesticides and non-native varieties of rice, causing localized pollution and further soil degradation in some instances.

IMPACTS

Rice–fish culture has been widely credited with improving the income status, household nutrition, public health and general social well-being of communities. However, figures from Thailand indicate that profitability in the rice–fish fields was only 80 percent that of rice monoculture (owing to the high initial investment costs in rice–fish culture). However, while the main benefit of rice–fish farming is often seen as providing an opportunity to increase income, the benefits through improvements in household nutrition and food security tend to be less well demonstrated or overlooked. An additional benefit of managed rice–fish culture systems is that the fish may help reduce populations of disease vectors such as mosquitoes and certain species of snail; while also encouraging farmers to adopt IPM practices (reducing the use of chemical pesticides in the process) with direct benefits to environmental and public health.

In the LSRB, it was found that villagers with more land and resources were better able than resource poor and landless households to take advantage of new opportunities presented in fisheries and aquaculture. Nevertheless, being largely an open-access resource, even landless villagers are able to exploit the fishery seasonally, which is often

a reason cited for not investing in major technology, as villagers are afraid others will harvest the benefits.

Conflicts between resource users are common occurrences in multi-use environment and livelihood situations, embodied by wetlands ecosystems. In the case of the LSRB, they are relatively well documented and may happen at the intracommunity, intercommunity, "state – resource user", and "resource user – private business" levels (Blake, 2006). Villagers using small non-commercial fishing gear are frequently in dispute with those using large, commercial or "destructive" gear, seen as harming the interests of the community as a whole. On the other hand, the auction of fishing rights that allow the exclusive use of such gear can provide income for the benefit of the community as whole. At the same time, there have been long and ongoing disputes between fishers using technically illegal, but locally accepted, fishing gear (e.g. stationary trawls) and the Department of Fisheries, which is charged with enforcing national fishery laws and regulations. Increases in cultured fish yields achieved by the minority would not appear to compensate for the resultant losses in wild aquatic resources borne by the majority. A new and growing threat in the Songkhram basin relates to disputes between powerful private pulpwood eucalyptus-growing interests (tied to transnational companies and national politicians) and communities over the loss of common resources, whether capture fisheries, wetlands foraging rights or livestock grazing.

Local communities are vital stakeholders for effective management of the wetland resources, but their participation in key management decisions has rarely been a prominent feature of past development programmes. These have either involved tokenism or have only rather recently been recognized by state institutions as being a worthwhile or valid form of governance. As a result, there tends to be a growing socio-economic differentiation between those resource users that are economically poor and disenfranchised (e.g. small-scale fishers and landless) and those that are relatively more wealthy and powerful in the community, as common-pool resources are usurped through a form of elite capture. Thus, for example, when large rice farmers turn to fish culture or intensify rice farming, they are in a way enclosing a former common-pool resource and privatizing it, where previously the aquatic resources benefits were shared between many users.

RESPONSES

Responses can be considered at several different levels depending on the actor involved and perceptions towards the wetland or farming system in question (Box 16). On the whole, the Government of Thailand tends to be relatively unresponsive to the needs of diverse livelihood wetland users and the unique characteristics and economic potential of wetlands ecosystems. Government bodies vary in their recognition of, and responses to, wetland issues, often with stark differences in policy and opinion between ministries and departments. This is highlighted in the Songkhram basin. Here, the Office of Natural Resources and Environmental Policy and Planning (ONREPP) wants to propose the LSRB as a potential future Ramsar site. However, the Department of Water Resources, under the same Ministry of Natural Resources and Environment, has been actively pushing for a massive transboundary water transfer scheme to bring water from the Lao People's Democratic Republic into the Songkhram River basin. These differences expose fault lines between the dominant, more-traditional, sectoral developmental paradigms and the more contextual and pluralistic approaches to development that are steadily gaining recognition in Thailand.

In the LSRB, numerous initiatives were undertaken through the LSRB Demonstration Site of the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) between 2003 and 2007 to: coordinate research; unite common interests between diverse state and non-state institutions; build capacity; and promote awareness

Box 16

Responses in rice–fish cultures in other parts of South and Southeast Asia

Along the floodplains in Bangladesh, farmers do not try to alter the environment radically to suit the crop. They tend to work within the natural flood–drought cycle by practising: (i) concurrent culture of deepwater rice with stocked fish followed by dry-season rice or non-rice crops in shallow flooded areas; or (ii) alternating culture of dry-season rice followed by stocked fish in the flood season in an enclosed area, such as a fish pen. Thus, the natural hydrological cycle is maintained.

It is unclear from available literature how the Bangladeshi government institutions involved are responding to the issues and opportunities presented by rice–fish culture integration and impacts. FAO and The WorldFish Center (2004) contend that "Bangladesh is one of the few countries actively promoting rice–fish farming and pursuing a vigorous research and development programme." Some NGOs would appear to be at the forefront of efforts to extend rice–fish culture, e.g. CARE-Bangladesh, which has promoted rice–fish farming in all its projects as an integral part of its IPM strategy. Apparently, thousands of farmers have experimented with rice–fish culture and have developed practices to suit their own farming systems.

In the south of the Lao People's Democratic Republic, the government had apparently recognized the results of an 18-month study of irrigation impacts and wanted to incorporate fisheries impact assessments into new water resources and irrigation legislation that was being drafted. The central government had demonstrated its commitment to integrating the approach to complex natural resource based livelihoods with a strong focus on fisheries and small-scale aquaculture by its permission to establish the Regional Development Committee (RDC) for livestock and fisheries in four southern provinces. This helped coordinate research and development efforts between provincial agencies, with a strong link to the Department of Livestock and Fisheries at national level. A follow-up research project funded by the Department for International Development (DFID) of the United Kingdom was planned, where guidelines for the integration of aquatic resource issues into irrigation planning and management would be disseminated through a variety of channels and institutions, active both in the Lao People's Democratic Republic and the wider region.

of wetlands ecosystem management and biodiversity value. The MWBP was able to coordinate effectively between local, provincial, national and regional bodies, leading to a much greater recognition of the LSRB wetlands in basin planning, including their biodiversity, livelihood and conservation importance. Other key activities included the community-led Tai Baan Research for understanding and addressing fisheries and natural resource management issues; an intermediate environmental flows assessment, and various youth and school conservation activities centred on wetlands.

VALUE OF THE DPSIR ANALYSIS

The DPSIR analysis shows that there has been no integrated response in the LSRB to the challenges posed by the intensifying development of the wetlands for rice production and other uses, and the impacts that this is having on the rice–fish system. Sectoral measures are being taken by different agencies, but there appears to be little or no communication between these agencies, and no attempt to develop a coordinated response. While this situation probably has much to do with interagency relations and professional training, it also stems from the fact that the "ecosystems services" concept, and the linkages between the different ecosystem services, are not well recognized. These are essential understandings that need to be applied in order to ensure the long-term sustainability of these key wetland resources and the multiple benefits. The analysis also suggests that there is a need for cross-agency institutions at national (e.g.

Thai National Mekong Committee) and regional (e.g. the Mekong River Commission) levels that can consider the different interests and take a multisectoral approach to building up such understandings.

The analysis also shows that there is a need to recognize how national policies, including agricultural subsidies and land-use policies, as well as population growth and market penetration, can be influenced as they can have negative impacts on wetland-use systems that are well adapted to the natural conditions and to the needs of the local communities.

CONCLUSIONS

Rice and fish are fundamental components of farming systems and diets in many South and Southeast Asian nations. The rice–fish system provides an example of the symbiotic relationships that can exist in wetlands between different provisioning services / livelihoods and be beneficial for other ecosystem services. This system creates a method of wetland use that is sustainable and can strike a balance in terms of provisioning and regulating services in many cases, provided care and sensitivity are exercised. Wetlands throughout the region have been converted from their natural state to rice fields, encompassing rainfed, deepwater and irrigated systems, which provide suitable environments for fish and other aquatic organisms. The real and potential impacts of the rice–fish system and the general utilization of living aquatic resources from a rice field, in terms of improved income and nutrition, are significant but generally underestimated and undervalued. Despite the potential, the uptake of more management-intensive forms of rice–fish cultivation has generally been low in most countries, and it has not been universally promoted across the region by state agencies.

Beyond the direct provisioning services of the food and income elements of rice and fish culture, rice fields are thought to play an important role in providing certain other ecosystem functions and services, including: groundwater recharge and discharge; flood control; water purification; and sediment/toxicant/nutrient retention. The extent to which these functions are enhanced or debilitated by the rice field environment compared with the natural, pre-agricultural wetland is uncertain. However, the key sociocultural role of both rice and fish cultivation and consumption in the lowland societies of the South and Southeast Asian regions should not be overlooked.

Typically, in the past, with single-sector agencies (usually irrigation-oriented) dominating state-led water management interventions in the developing countries of the region, there was little role for more multidisciplinary and holistic approaches to water management that would recognize the importance of living aquatic resources in the livelihoods of smallholder farmers. There is evidence that this situation is changing, with state agencies starting to take an interest in the role of living aquatic resources in the livelihoods of the poor and to create new implementing and research institutions (such as the RDC) that cross traditional governance barriers in order to be more farmer-focused. Rice fields are being recognized as being more than single-product environments. Multiproduct outputs of rice–fish systems, providing services and valuable ecosystem functions throughout the year even in non-irrigated rainfed paddies, are being recognized. This is enabling more flexible strategies to water management that can provide win–win situations to the resource users, product consumers, communities and the wider environment.