CGIAR RESEARCH PROGRAM ON Fish
Led by WorldFish

CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems

Integrated rice and fish systems

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Southeast Asia has undergone rapid social and economic development in recent decades, but agriculture still underpins many economies. Diets are also changing, though rice and fish still dominate in many countries, with supply, distribution and consumption continuing to provide crucial employment and shape cultural identity. Rice is the main staple in both Cambodia and Myanmar, the two focal countries for rice-fish systems research in the CGIAR Research Program on Fish Agri-Food Systems (FISH).[1] It provides 60 percent of daily calorie intake in Cambodia and 66 percent in Myanmar, rising to 80 percent in rural areas and making up over 20 percent of household expenditure among low-income households.[2,3,4] Fish complement rice, contributing micronutrients and essential fatty acids, and account for the largest contribution of animal-source food in local diets.[5] Harvesting fish and other aquatic foods from inland waters has been practiced for thousands of years in Asia,[6,7] and in Myanmar and Cambodia these inland fisheries are top five globally in terms of catch.[8,9]

Despite this apparent richness, poverty and malnutrition remain unacceptably high. The malnutrition rates among children under 5 years old in Cambodia and Myanmar are some of the highest in the region, with up to 40 percent of children in this age group being stunted and between 10 percent (Cambodia) and 25–33 percent (Myanmar) underweight. Social and geographic disparities in nutrient availability, especially of animal-source food, across communities increases the likelihood of these deficiencies in vulnerable groups, including women and children.[10,11,12]

Key messages

- Integrated rice-fish systems generate multiple benefits, including improved incomes, availability of diverse nutritious foods, livelihood options for women and youth, species and ecosystem biodiversity, resource efficiency, and climate change resilience.
- Realizing specific benefits of a shift to integrated rice-fish production requires an interdisciplinary approach linking technical, social and ecological priorities and outcomes.
- Spatial and analytical decision support tools can link decision-makers and other stakeholders across sectors, scales and disciplines with end users to better understand outcomes and determine priorities for targeting investments to scale rice-fish systems.
- Rice-fish systems occur within dynamic multifunctional landscapes. This complexity is shaped by different sector development priorities, their interactions, tradeoffs and impacts. Identifying, quantifying and integrating this data within broader land and water planning processes is crucial when considering suitability, adoption and scaling of integrated rice-fish systems.

Throughout Asia, integrated rice and fish systems[13] have been shown to increase productivity[14] and biodiversity,[15] contributing to food and nutrition security, water security and climate resilience. Rice-fish systems encompass a spectrum of practices, from the capture of indigenous fish that enter rice fields with inflows of water to fish farming in modified rice fields.[16] FISH

focused primarily on the Mekong and Irrawaddy regions, with the overall goal of securing the benefits of fish and aquatic foods for poor and marginalized households through rice-fish systems. Research aimed to achieve the following:

1. assess ecosystem-based water management for small-scale fisheries in rice-dominated landscapes
2. develop integrated production and governance models for small-scale fisheries and aquaculture in multi-use landscapes
3. create digital and analytical tools to support planners and decision-makers for better management and governance of rice-fish systems.

Community fish refuges in Cambodia

Community fish refuges are communal ponds within a village's rice growing area. Fish and other aquatic animals can take refuge and survive extended dry periods in these refuges before returning to adjacent rice fields via connecting channels when water levels rise. A community fish refuge thus acts as a seasonal refuge for fish and other aquatic animals to survive, grow and reproduce. FISH assisted with the development of a package of innovations for community fish refuges in Cambodia.

With financial support from the United States Agency for International Development under its Feed the Future initiative, robust monitoring of a 10 year rice-fish project showed that between 2012 and 2015, improvements in management of community fish refuges within rice-dominated landscapes involving 15,500 local people delivered increases in fish catch by 11 percent, fresh fish consumption by 14 percent, volumes of fish processed by 34 percent and household income by 22 percent. Currently in a new phase from 2016 to 2021, FISH researchers are scaling best management practices for these rice-fish systems at 140 sites across Cambodia. To date, results show similar gains, with increased fish consumption for 150,000 people, improved access to water for 120,000 people, and improved community capacity to manage fish habitat and assess and address climate change risks.

FISH innovations and policy recommendations for community management of fish refuges have now been accepted into Cambodia's 2020–2029 Strategic Plan for Fisheries Conservation and Management. Funding from the EU Capfish-Capture program has also allowed the Cambodian Fisheries Administration to further expand the approach to 50 new community fish refuge management committees, with plans to support 100 more.

Integrated rice-fish culture in Myanmar

The co-production of rice and fish in modified rice fields, or rice-fish culture, is a centuries old practice but a relatively new alternative to intensive monocropping, with positive outcomes for the environment, economy and rural livelihoods.[17] With support from the Australian Centre for International Agricultural Research, experimental trials and demonstration plots were established in the Ayeyarwady Delta. Rice-fish culture produced rice yields that were equivalent to or better than monocropped rice fields, and increased gross profit between 9 and 41 percent relative to rice monoculture. The increased fish production further provided local people with greater access to nutrient-rich animal-source food. Similar results have been documented across South and Southeast Asia in systems where no more than 10 percent of rice fields were converted for fish culture.[18,19]

To demonstrate the capacity for rice-fish culture to support food and nutrition security in Myanmar, FISH used performance data to present a "what if"scenario that examined potential benefits of rice-fish implementation across the Ayeyarwady Delta region. Early modeling results suggest that if 10 percent of the potential area for rice-fish culture was used, an additional 100,000 metric tons of fish and USD 100 million could be generated for participating households and the rural economy.

Significant changes have been made to the policy landscape after sharing FISH findings with local farmers and the signing of the Nay Pyi Taw Agreement, endorsed by the Ministry of Agriculture, Livestock and Irrigation. The two major shifts include (i) state and regional governments promoting integrated agriculture by allowing conversion of up to 15 percent of smallholder rice paddy areas for fish culture or refuge and (ii) recommendations by national parliamentarians to remove permission requirements for conversion of up to 30 percent of smallholder land holdings for fish culture under integrated agriculture


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systems. These evidence-based shifts have potentially huge implications for livelihoods, food and nutrition security and the environment in lowland areas of Myanmar.

Decision support tools to inform scaling of rice-fish systems

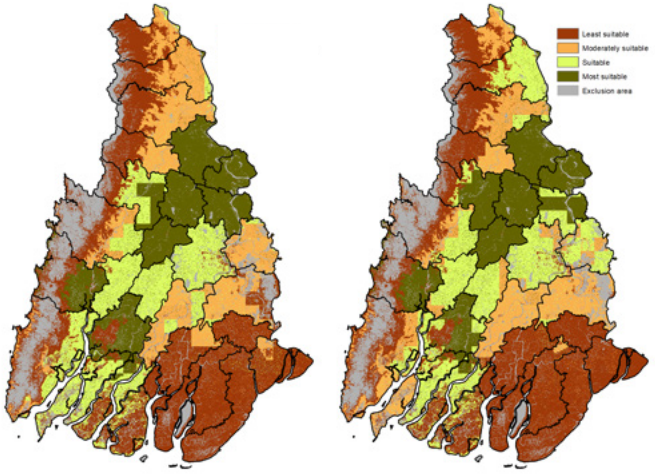
The FISH Decision Support System is a bundle of evidence-based digital and analytical tools to inform planning and management of rice-fish systems. The tools help ensure the needs and aspirations of stakeholders are reflected when tailoring investments for specific social, economic and environmental contexts.

The bundle is being developed in collaboration with partners[20] and stakeholders with sustainability in mind. It includes training modules and a comprehensive database of physical, social and climate variables that feed into a spatial rice-fish suitability model. The visual output can be easily used to assess trade-offs and identify priorities for scaling rice-fish production systems.

The inclusion of social variables is essential when assessing the feasibility of successful rice-fish system implementation, like the availability of skilled workers and the strength of local value chains. Additionally, the inclusion variables that reflect poverty or malnutrition levels enable the location and prioritization of areas where rice-fish systems can target local economic or nutritional needs.

The latest version of the suitability model also includes a predictive element to inform longer term planning by incorporating key climate-related hazard data to 2040. The bundle will be available as an open-source resource by the end of 2021 and will be adaptable by expert and non-expert users.

Overall suitability for rice-fish systems
Ayeyarwady Delta region, Myanmar



2020 hazard levels 2040 hazard levels

The future of rice-fish systems

Policy and investment

Rice is grown in more than half the countries in the world with a total harvested area of about 158 million ha, of which about 80 million ha is irrigated lowland rice. These landscapes are commonly managed only for rice, but FISH research indicates a much greater potential for integrated rice-fish systems as a contribution to global food system transformation, with outcomes of increased incomes, resilience, and availability of diverse, nutritious food where it is most needed.[21] Policy and investment recommendations for scaling FISH research include the following:

- national capacity building in integrated rice-fish production systems through university curricula and extension services development
- facilitation of the use and uptake of digital tools that link farmers with markets, extension services, and planning and decision-making processes
- ensuring integrated land and water planning processes include an assessment of alternate development trajectories and associated trade-offs, and are reflected in planning and decision-making over resource allocation and use
- integrating fisheries and aquaculture into national water and agriculture policies as well as management practices and standards at the landscape level.

Moving research forward

Further research can also help enhance the benefits from better governance and management of integrated rice-fish systems. Priorities include the following:

- monitoring and evaluation of integrated systems performance and factors that facilitate success in the Mekong region and beyond, including contributions to nutrition security and gender equality
- determining the effectiveness of decision support tools in ensuring stakeholder engagement in and enabling decision-making
- assessing the potential risks of integrated rice-fish systems, including impacts of rice management practices and climate change or extreme weather events
- assessing changes in land and water use efficiency, pesticide use and greenhouse gas emissions as a result of a shift to integrated rice-fish production.

FISH research has emphasized the need for shifting land and water management toward integrated rice-fish systems in suitable areas as approaches that can improve social, economic and ecosystem outcomes. Success requires (i) approaches suited to specific social, economic and environmental contexts, (ii) a strong evidence base, including decision support tools, to inform policy and planning, (iii) governance platforms for integrated, ecosystem-based, cross sector planning, (iv) effective multiscale stakeholder engagement, (v) targeted rice-fish system innovations coupled with governance and institutional capacities for their adoption, and (vi) strong state, civil society, and community networks and partnerships.

Notes

[1] The research presented in this strategic brief focuses on Myanmar and Cambodia, but also draws on research in the surrounding region, particularly Thailand, Vietnam and Bangladesh.

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[12] UNICEF. 2020. New York: UNICEF. https://data.unicef.org/

[13] Integrated rice and fish systems include "the wide range of aquatic species (including finfish, crustaceans, mollusks, reptiles, insects, amphibians and aquatic plants) used for consumption and/or sale and integrated farming systems (concurrent, rotational, side-by-side using the same water resources) being practiced in various intensities of input use from the harvesting of wild fish to the introduction of cultured fish in rice areas." From FAO. 2014. A Regional Rice Strategy for Sustainable Food Security in Asia and the Pacific. Bangkok.

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[20] FISH research has been conducted in collaboration with partners from government, particularly the departments of agriculture, agricultural research and fisheries; the International Water Management Institute, building on their flood-based farming systems work; the International Rice Research Institute, as a partner in the Australian Centre for International Agricultural Research's Rice Fish project; and the FAO, through the FAO FIRST program and our work on climate risk assessments for fisheries and aquaculture.

[21] See the Sustainable Rice Program's Standards for more information.

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This brief is one in a series of synthesis products published in 2021 to share learnings, outcomes and impacts from the FISH program. It is intended to stimulate actions and investments into fish and aquatic foods to realize their role in the transformation of food, land and water systems in a climate crisis. We extend thanks to all the contributors of this research and the reviewers of this brief.

This is a contribution to the following:

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