Software to boost or restore natural fisheries

RIU

Validated RNRRS Output.

Newly-released EnhanceFish software helps fisheries staff calculate the costs and benefits—both social and economic—of boosting wild fisheries by stocking them with hatchery-reared fish. The software can be used to determine whether it's worthwhile to improve a fishery and, if so, with what, when and how. Although enhancing natural fisheries can improve incomes and have other social benefits, fisheries staff need to have a good understanding of the overall system and of the likely biological and socio-economic impacts. The package guides them through analyses and helps them advise and work with stakeholders in specific fisheries. EnhanceFish is already being used in Laos, Thailand and Cambodia. Strong interest from China and other governments indicate that this software has major potential to raise productivity and restore fisheries.

Project Ref: **FMSP10:**
Topic: **7. Spreading the Word: Knowledge Management & Dissemination**
Lead Organisation: **MRAG Ltd, UK**
Source: **Fish Management Science Programme**

Document Contents:

Description

Research into Use
NR International
Park House
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Geographical regions included:

Bangladesh, Cambodia, China, India, Lao PDR, Thailand, Vietnam,

Target Audiences for this content:

Fishers,

FMSP10

A. Description of the research output(s)

1. Working title of output or cluster of outputs.

Fisheries Enhancement Decision Support Tools: EnhanceFish

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

Fisheries Management Science Programme

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

R5023: Potential Yield of Small Reservoir Fisheries in South Asia (Lead: MRAG Ltd.; Partners: Thai Department of Fisheries, Zhejiang Institute of Freshwater Fisheries, Mangalore Fisheries College). Contact: Dr Kai Lorenzen.

R5958: Culture Fisheries Assessment Methodology (Lead: MRAG Ltd.; Partners: Thai Department of Fisheries, Zhejiang Institute of Freshwater Fisheries, Asian Institute of Technology). Contact: Dr Kai Lorenzen.

R6338CB:Reservoir Fisheries Management in Savannakhet Province, Lao PDR (Lead: MRAG Ltd.; Partners: Lao Department of Livestock and Fisheries). Contact: Dr Kai Lorenzen.

R7335: Adaptive learning approaches to fisheries management (Lead: MRAG Ltd.; Partners: Lao Department of Livestock and Fisheries). Contact: Dr Kai Lorenzen.

R7917: Self recruiting species in aquaculture – their role in rural livelihoods. (Lead: University of Stirling and Imperial College London; Partners: Asian Institute of Technology, Thai Department of Fisheries, Cambodian Department of Fisheries, Research Institute for Aquaculture 2 Vietnam, Gramin Vikhas Trust India, Intermediate Technology Development Group Bangladesh). Contact: Dr David Little and Dr Kai Lorenzen.

R8469: Decision support tool for enhancement fisheries (Lead: Imperial College London; Partners: Network of Aquaculture Centers in Asia-Pacific, FAO Fisheries Department). Contact: Dr Kai Lorenzen.

*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? **(max. 400 words)**. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

EnhanceFish is a comprehensive framework and decision support tool for analysing and developing aquaculture-

based fisheries enhancements (stocking of hatchery fish to improve fisheries). ***EnhanceFish*** was developed in 2005 to synthesize the outputs and lessons learned from six previous RNRRS projects (running from 1993 to 2004) and make them available worldwide.

Aquaculture-based fisheries enhancements aim to increase production, economic and social benefits from fisheries through the release of hatchery reared fish into natural ecosystems. Enhancements allow fishers to gain socio-economic benefits from the use of aquaculture technology in natural, usually common-pool aquatic resources. Demonstrated benefits of enhancements include higher resource production and productivity, recovery of overexploited natural aquatic resources, increased income, increased social capital through use of enhancement products in social exchange networks, development of new skills, and transformation of resource management institutions (with benefits extending far beyond the enhancement initiative).

Effective enhancement involves more than just stocking of hatchery fish: hatchery production, release and harvesting regimes must be adapted to local ecological and socio-economic conditions for benefits to be achieved. This requires a good understanding of the overall enhancement system, as well as quantitative analysis of the effects of management measures on biological and socio-economic outcomes of enhancement. ***EnhanceFish*** is designed to help fisheries professionals work effectively with stakeholders to develop and improve fisheries enhancements.

The ***EnhanceFish*** toolkit has three components:

(1) The ***EnhanceFish*** guide, which provides guidance on how to engage with stakeholders and conduct a broad-based, integrated analysis of enhancement systems and identify promising development options.
(2) The ***EnhanceFish*** tool, a software package that supports quantitative biological and economic analysis of enhancements.
(3) The ***EnhanceFish*** manual and tutorial, which explains the principles underlying the ***EnhanceFish*** tool and assessment methods, and provides guidance on the practical use of the tool, including worked examples.

The ***EnhanceFish*** toolkit has been found to be highly effective in guiding fisheries professionals to engage constructively with stakeholders and bring the best quantitative methods to bear on the development and improvement of enhancement systems. The ***EnhanceFish*** toolkit can also be used strategically at national or regional level to identify fisheries likely to benefit from enhancements.

The ***EnhanceFish*** toolkit complements and links with several other RNRRS outputs, in particular the adaptive learning approaches and stock assessment tools. ***EnhanceFish*** is the first tool for the analysis of fisheries enhancements and their role in fisheries management worldwide.

Keywords: Fisheries Enhancement, Culture-based Fisheries, Restocking, Stock Enhancement, Searanching, Hatchery, Stocking, Population Dynamics, Model, Decision Analysis, Fisheries Systems

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	Technology	Service	Process or Methodology	Policy	Other Please specify
	x		x		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

Freshwater and marine fish and shellfish. The complete set of outputs has been validated mostly in freshwater systems. The quantitative tools have also been applied to marine systems, and the other components of the toolkit are likely to be applicable though further validation would be desirable.

7. What production system(s) does/could the output(s) focus upon?
Please tick one or more of the following options.
Leave blank if not applicable

Semi-Arid	High potential	Hillsides	Forest-Agriculture	Peri-urban	Land water	Tropical moist forest	Cross-cutting
					x		

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	Irrigated	Wetland rice based	Smallholder rainfed highland	Smallholder rainfed dry/ cold	Dualistic	Coastal artisanal fishing
		X				X

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

The ***EnhanceFish*** toolkit integrates with, and complements several other RNRRS outputs, in particular the adaptive learning approaches and stock assessment tools. The ***EnhanceFish*** toolkit provides a framework for the integrated and quantitative analysis of enhancement systems. Adaptive learning can be an effective way of engaging stakeholders, fostering collective action and resolving uncertainties while applying the toolkit. Using the ***EnhanceFish*** toolkit also requires knowledge and skills similar to that required for FMSP stock assessment tools such as ParFish, CEDA and LFDA. There are thus potential synergies in promoting ***EnhanceFish*** together with other stock assessment tools. However, it must also be realized that the target audience is often different, with enhancement approaches typically associated with aquaculture rather than capture fisheries personnel of the target institutions. Hence care must be taken to ensure that the output is promoted to the appropriate target audience, and/or that target institutions create appropriate cross-disciplinary linkages.

Validation

B. Validation of the research output(s)

*10. **How** were the output(s) validated and **who** validated them?*

*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation **(max. 500 words)**.*

The outputs synthesized in ***EnhanceFish*** and the toolkit itself have been validated extensively over a 13 year period through peer review, policy formulation, direct application to the planning and management of enhancements, and evaluation of use and outcomes.

Scientific peer review. Most of the research results synthesized and made available through the ***EnhanceFish*** toolkit have been published in the peer-reviewed scientific literature. The papers have been cited over 100 times and one article that describes the scientific basis of ***EnhanceFish*** is widely seen as a landmark study in the field. ***EnhanceFish*** formed the basis of the opening keynote of the *3rd International Symposium on Stock Enhancement and Searanching* (Seattle, September 2006, www.searanching.org), demonstrating the output's standing in the scientific community.

Policy formulation. The principles, approaches and methods synthesized in the ***EnhanceFish*** toolkit have influenced policy at international and national level including the *FAO Bangkok Declaration and Strategy for Aquaculture Development*, the *FAO Technical Guidelines on Responsible Fish Stocking* currently being drafted, and national strategies as discussed further below. Influencing policy at this level demonstrates the value and wide relevance of the outputs.

Direct application to planning and management, and evaluation of use and outcomes. The outputs have been validated in a range of development, planning and management initiatives which are detailed below. This has involved validation in terms of applicability of the approaches and outcomes of their use, based on feedback from technical specialists as well as target beneficiaries.

*11. **Where and when** have the output(s) been validated?*

*Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above **(max 300 words)**.*

Bangladesh: Validation through analysis of Bangladesh floodplain lake (beel) enhancements by Professor Rezaul Hasan, Bangladesh Agricultural University, in 2001.

Cambodia: Validation through analysis of Cambodian reservoir enhancements at the ***EnhanceFish*** workshop in 2005.

China: Validation through a research project in collaboration with provincial fisheries officers 1994-1996. Strong interest from marine fisheries personnel with significant uptake expected in coming years.

India: Validation through a research project 1994-1996, and recent use by government officers within ICAR as well as university staff.

Laos: Extensive validation through long-term research and development projects in southern Laos (wetland rice-based farming system) from 1995 to 2004. This targeted whole communities dominated by diversified semi-subsistence livelihoods in which fishing played a significant part. Application of the approaches synthesized in EnhanceFish was found to be feasible by government officers and villagers, and resulted in substantially improved outcomes (see section 21).

Thailand: Validation through a collaborative research project 1994-96, and extensive use of ***EnhanceFish*** within the Government Department of Fisheries since release and training course in 2005.

Vietnam: Validation through analysis of Vietnamese reservoir enhancements at ***EnhanceFish*** workshop.

Current Situation

C. Current situation

12. ***How and by whom*** *are the outputs currently being used? Please give a brief description* ***(max. 250 words****).*

Outputs from the enhancement research synthesized in ***EnhanceFish*** are currently being used in several countries where research and development activities have been carried out in the past (Laos, Thailand, Cambodia). This use involves continued, participatory research by government officers and resource users aimed at understanding and improving enhancement systems.

The ***EnhanceFish*** tool itself (which became available only 6 months ago) now has 70 registered users, and the technical documents that form part of the wider toolkit (the Guide and Manual) have been downloaded over 200 times. The policy brief, the main document promoting adoption at higher levels of government has been downloaded over 400 times. Of the 70 registered users, 32 are government officers, 11 university scientists, and the remainder are from a range of backgrounds including NGOs and consulting. Requests for specific assistance and feedback from registered users shows that use of ***EnhanceFish*** occurs at different levels, from understanding the dynamics of enhancements by working through the tutorial, through to analysis of specific

fisheries with some stakeholder engagement.

The outputs are also widely used in the scientific community, having been cited over a 100 times in published literature.

*13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used **(max. 250 words).***

The ***EnhanceFish*** tool now has 70 registered users in 32 countries. The largest group (32 users) is based in Asia, reflecting both the comparatively great importance of enhancements in Asia and the result of promotion through the Network of Aquaculture Centers in Asia-Pacific (NACA). Various research outputs that have been synthesized in EnhanceFish are also being used globally and within the Asian region. More detailed information is provided on those countries in the PSA list.

Bangladesh: The approaches and models underlying ***EnhanceFish*** have been used in pilot analyses of floodplain lake enhancements. The extent of continued use is not known. There is one registered user of ***EnhanceFish***.

Cambodia: Cambodian reservoir enhancements have been analysed during the ***EnhanceFish*** workshop, and one such analysis forms part of the tutorial. There are two registered users of ***EnhanceFish***, and several others who use prototype tools as introduced in the workshop.

China: Some analysis tools were used by the Zhejiang Provincial Fisheries institute in the 1990s, but the extent of current use is not known. At the recent *3rd International Symposium on Stock Enhancement and Searanching,* strong interest in the tool was evident from government marine fisheries personnel, and significant uptake is expected in coming years.

India: Outputs have influenced government enhancement research and operational programmes since the mid-1990s, but there has been limited direct promotion. At present there are six registered users in government (ICAR) institutions and universities.

Laos: There is continued use of structures and processes established during long-term research leading up to ***EnhanceFish***. The tool itself has three registered users, but use appears constrained by capacity problems.

Thailand: There is significant use of the ***EnhanceFish*** tool within the Government Department of Fisheries, with 4 registered users who are known to actively apply the tool.

Vietnam: There has been some use of earlier analysis tools in the course of Mekong River Commission and ACIAR projects on reservoir fisheries enhancement. The current level of use in not known, and there is one registered user of ***EnhanceFish***.

*14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading **(max 250 words).***

The ***EnhanceFish*** toolbox became publicly available in April 2006. In the six months since release, 70 users have registered and downloaded the software. A far larger number of users (over 600) have visited the ***EnhanceFish*** pages on either the www.aquaticresources.org or NACA websites, and downloaded various items of documentation. Visits to the relevant pages and registrations continue steadily at a rate of about 100 visits and 10 registrations per month.

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? ***(max 350 words).***

The ***EnhanceFish*** toolbox and its underlying methods and approaches facilitate the outcome-oriented development and management of enhancements. They are thus most successful, and in greatest demand, in situations where basic technical (capacity to produce seed organisms in aquaculture) and institutional (provision for active management of resources by or with fishers) conditions are in place, and development initiatives or government policy demand that enhancement activities are outcome-oriented and accountable. Public sector reforms and the proliferation of co-management arrangements have created conducive conditions in many Asian target countries. The ***EnhanceFish*** toolbox enters into such situations at several levels, outlining the policy requirements for successful enhancement (policy brief) as well as providing practical tools for the broad-based and quantitative analysis of enhancement systems.

Support for uptake and successful implementation is often required in assisting existing institutions in making the cross-disciplinary and cross-sectoral linkages that are necessary to analyse and manage enhancement systems in an integrated manner. For example, enhancements are often dealt with by the aquaculture divisions of fisheries departments, which have little capacity to appreciate the harvest management or overall economic aspects of the system. It is then necessary to highlight the need for, and promote institutional linkages that can support integrated analysis and management. The second area where support is often required is in specific technical skills for key technical, social, and economic analyses. This is best done through initial training workshops followed by long-term but low-intensity support for applications to specific fisheries enhancements in the form of electronic communications, follow-up workshops, and exchange of case study information between users.

Current Promotion

D. Current promotion/uptake pathways

16. ***Where*** *is promotion currently taking place? Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion* ***(max 200 words).***

Promotion is currently being carried out at a regional level in Asia, through the Network of Aquaculture Centers in Asia-Pacific and the associated STREAM initiative, and globally by the Aquatic Resource Ecology Group at Imperial College www.aquaticresources.org (the developers of ***EnhanceFish***). Promotion is largely passive-responsive, i.e. the toolkit and related policy briefs are downloadable, and there are an online discussion group

and a dedicated email helpline to deal with user questions and problems. Active promotion is being carried out at meetings and through publications.

17. What are the current barriers preventing or slowing the adoption of the output(s)? Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. ***(max 200 words)****.*

In most Asian target countries there are substantial operational enhancement programmes as well as new initiatives that would benefit from the application of ***EnhanceFish***. Institutional conditions are broadly conducive and there has been substantial demand for support for the development and management of enhancement. The greatest barriers are lack of active promotion of the toolkit to target users, and in particular of continuous support for application. A survey of some of the current registered users of ***EnhanceFish*** has shown that many have attempted to apply the tool to 'their' enhancements but have run into minor problems due to lack of knowledge or specific data. All of the issues voiced could have been easily resolved had the users contacted the discussion list or email help. In practice, users often do not do this and therefore active long-term promotion with regular personal contact is important.

18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues ***(max 200 words).***

Active promotion and support of the use of ***EnhanceFish*** through workshops, low-intensity but long-term collaboration with key organisations, and various forms of networking and dissemination.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? ***(max 300 words).***

Most successful enhancement initiatives have involved a combination of collective action by fisher and technical and well as management support from governmental organisations. In promoting use of the outputs, its is therefore important to engage with both target end users (mostly government and NGO staff) and with target beneficiaries (fishers). In the absence of larger development projects or NGO activities engaging target beneficiaries directly, the target end users are the natural point of entry. Use of the ***EnhanceFish*** toolbox effectively forces and guides end users to engage with the beneficiaries constructively, and this is re-enforced through training and longer-term follow up with target users.

Impacts On Poverty

E. Impacts on poverty to date

20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

Laos: Impacts have been extensively evaluated through monitoring during the project, and documented in two PhD Theses and an evaluation report;

Arthur, R.I. 2004. Adaptive learning and the management of small waterbody fisheries: a case study in Lao PDR. PhD Thesis, University of London. 431 pp.

Garaway C.J. 1999 Small waterbody fisheries and the potential for community-led enhancement: case studies in Lao PDR. PhD Thesis, University of London. 414 pp.

Cambridge Resource Economics. 1998. Evaluative review of the DFID RNRRS Fisheries Sector Research Performance. Report to DFID.

Thailand: An economic cost-benefit analysis of enhancement research has been carried out as part of the original DFID project and published:

Lorenzen, K., Juntana, J., Bundit, J. & Tourongruang, D. 1998. Assessing culture fisheries practices in small water bodies: a study of village fisheries in Northeast Thailand. *Aquaculture Research*. **29**: 211-224.

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) ***(max. 500 words):***

- *What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;*
- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;*
- *Indicate the number of people who have realised a positive impact on their livelihood;*
- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded*

Laos: The most comprehensive assessment of poverty impacts has been conducted in Laos. This has revealed:
Economic impacts: Increase in communal cash income (average 200 US$/village/year), strong increase in fisheries productivity (catch per unit of effort) so that catches are obtained with lower effort. Impacts on approximately 40 villages within two years of project completion. (Project report, Garaway PhD, CRE Evaluation)
Impacts on capacity: Villagers' capacity to manage culture-based enhancements actively has increased, and income has been used for village projects. This has also increased the villagers' capacity to lever support for other activities from government and development organisations. (Project report, Garaway PhD, CRE Evaluation)
Impact on livelihoods assets:
Natural: moderate increase in yield, but strong increase in abundance of both wild and released hatchery fish.
Financial: dramatically increased village income, reduced contributions from households for village activities
Physical: infrastructure improvements as a result of community income (electricity, road, temple)
Human: Increased knowledge of fisheries management, some aquaculture knowledge, increased capacity to manage village funds and activities
Social: increased community cohesion as a result of joint management of aquatic resources for community benefit. (Project report, Garaway PhD, CRE Evaluation)

Thailand: Increases in production and income from enhanced village fisheries by 22-75 %, based on optimisation of stocking regimes alone. The costs of conducting the data collection and analysis activities to identify improved stocking regimes was estimated as 30% of the annual revenue from the enhanced fisheries, thus the benefits exceeded costs within one year.

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

Enhancements can have substantial environmental benefits, which are generated through the fish stocking activity as well as concomitant changes in fisheries exploitation and management. This was well illustrated in the Lao application described above where increases in resource productivity were combined with a dramatic recovery in wild fish stock abundance as a result of the enhancement.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

Poorly designed and managed fisheries enhancement systems can have negative environmental impacts due to ecological and genetic interactions of enhanced and wild fish stocks, and/or over-harvesting of wild fish stocks. The outputs are designed explicitly to minimize such impacts.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

Yes – the outputs allow poor people to maintain and increase the productivity of fisheries that have been degraded by a variety of factors, including climate change. Impact studies have also shown that fisher communities that engage in fisheries enhancement tend to improve their capacity to undertake other collective endeavours and lever support from external organisations, thus improving their resilience.
