Management strategies for enhanced fisheries production in Sri Lankan and Australian lakes and reservoirs—extension project (FIS/2001/030)

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Project number	FIS/2001/030
Project name	Management strategies for enhanced fisheries production in Sri Lankan and Australian lakes and reservoirs—extension project
Collaborating institutions	Australia: Deakin University Sri Lanka: Kelaniya University; National Aquaculture Development Authority (NAqDA); National Aquatic Resources Research and Development Agency (NARA); University of Peradeniya
Project leaders	Australia: Sena S. De Silva, Deakin University Sri Lanka: Upali S. Amarasinghe, Kelaniya University
Duration	1 January 2001 – 30 June 2005
Budget	Total A$390,183 (ACIAR contribution: A$295,183) (FIS/1994/040 was extended and given a new number, FIS/2001/030. The budget for FIS/1994/040 was $420,880.)
Countries	Australia, Sri Lanka
Commodity	Fish
Related projects	FIS/2001/013, FIS/2005/078

Motivation for the project and what it aimed to achieve

The project 'Management strategies for enhanced fisheries production in Sri Lankan and Australian lakes and reservoirs—extension project' (FIS/2001/030) was a logical extension of a previous project (FIS/1994/040) with the same primary name that had begun in 1997. An independent review in 2000 strongly recommended continuation of certain facets of the initial work, and the new 'extension' project (FIS/2001/030) was completed in 2005. Related projects designed to enhance reservoir fishery production were also undertaken subsequently in Vietnam (FIS/2001/013: Culture-based and capture fisheries development and management in reservoirs in Vietnam) and Laos (FIS/2005/078: Culture-based fisheries development in Lao PDR), primarily driven by the success of the work in Sri Lanka and acceptance by other governments in the region that culture-based fisheries (CBF) are an appropriate strategy to improve fish yields in rural areas, benefiting these communities.

In particular, the management strategies for enhanced fisheries production in Sri Lankan and Australian lakes and reservoirs project entailed two major components in Sri Lanka:

1. development of improved management measures for the existing reservoir capture fisheries
2. development of CBF using hatchery-bred juveniles stocked in non-perennial/seasonal reservoirs (locally referred to as village tanks), including related work on improvements to cage rearing of hatchery-bred juveniles in perennial reservoirs.

A partial harvest from a culture-based fisheries reservoir 4 months after stocking. Depending on the size of the water body, such partial harvests will be carried out as water levels begin to recede. (Photo: S. De Silva)

Component 1 set out to validate a geographical information system (GIS)–based model developed for yield prediction for capture fisheries in perennial reservoirs. In the validation, data collated by the NARA, the research arm of the Ministry of Fisheries and Aquatic Resources Development, were used to add rigour to the fishery yield-prediction models developed. The validated models were to be used for introducing improved, science-based management measures for sustained use of the reservoir fishery resources.

The overall aim of component 2, on CBF, was to develop a best-practice model for popularising CBF in seasonal tanks/non-perennial, small water bodies (estimated to total around 30,000 ha) in the dry zone of Sri Lanka, aligning it with one of the major inland fisheries development strategies adopted by the Government of Sri Lanka and other regional governments (e.g. Vietnam and Lao PDR), and associated development agencies active in Sri Lanka (e.g. the Rural Development Project of the North Central Province and the Asian Development Bank). That is, the aim was to promote the optimal and sustained use of seasonal reservoirs for fish production by local communities, using a stock and recapture (CBF) strategy.

Outputs—what the project produced

Development of predictive yield models (component 1)

(a) Using GIS, predictive yield models were developed in which the fish yields were found to be closely related to catchment characteristics, such as forest cover, grasslands etc. Statistical robustness of the developed models was enhanced by applying the datasets independently collected by NARA. The robustness and acceptance of the models were tested through publication of the findings in peer-reviewed major international fisheries journals.[1]

(b) The findings of the models on potential yield and the optimal number of craft that should be permitted to operate in each of the large perennial reservoirs (>750 ha) were provided to NAqDA for perusal, consideration and implementation.

Culture-based fisheries development (component 2)

GIS-based modelling expertise was used to develop guidelines for selection of non-perennial reservoirs for CBF developments, and a set of science-based criteria was developed for determining optimal stocking densities, species combinations etc.

1 Nissanka C., Amarasinghe U.S. and De Silva S.S. 2000. Yield predictive models for the Sri Lankan reservoir fisheries. Fisheries Management and Ecology 7, 425–436.

De Silva S.S., Amarasinghe U.S., Nissanka C., Wijesooriya W.A.D.D. and Fernando M.J.J. 2001. Use of geographical information systems as a tool for fish yield prediction in tropical reservoirs: case study on Sri Lankan reservoirs. Fisheries Management and Ecology 8, 47–60.

Amarasinghe U.S., De Silva S.S. and Nissanka C. 2002. Evaluation of the robustness of predictive yield models based on catchment characteristics using GIS for reservoir fisheries in Sri Lanka. Fisheries Management and Ecology 9, 293–302.

Based on the above, farmer-based trials were successfully completed (two cycles). Subsequently, all the information was collated and disseminated in printed and electronic (DVD) form. Most of the findings were published in peer-reviewed international journals,[2] thereby supporting their scientific robustness. One of the most significant achievements of the project was bringing about a policy change through the amendment of the Agrarian Act No. 240 of 2000 that legalised fishery-related activities in minor, non-perennial reservoirs. This, in turn, enabled the communities to access insurance schemes, and to make suitable modifications to the water bodies to facilitate fishery-related activities, such as placing netting around sluices to prevent fish losses.

Adoption—how the project outputs are being used

Predictive yield models (component 1)

According to NAqDA sources, the managerial measures are now practised in most of the 130,000 ha of perennial reservoirs in which there are fisheries. As the reservoirs are densely distributed, requests to fishers to move from one reservoir in which the numbers operating were more than desired to another where the fishing pressure could be stepped-up were generally met.

The adoption of the project findings has been a component of a suite of measures that has been introduced by NAqDA, including the strict implementation of the fishing gear regulations and so forth. Overall, there has been a significant increase in inland fish production as result of all these measures (Table 1). A recent detailed study on two reservoirs has shown the measures that lead to the increased fish production,[3] a trend that is likely to continue. In addition, the project permitted the retesting of the establishment of a fishery for 'minor cyprinids'—indigenous, self-recruiting, small fishes. As a consequence, NAqDA is in the process of permitting the establishment of a fishery (on a trial basis) and the required amendments to the gear regulations have been put forward. These developments will likely lead to a further increase in fish production.

2 Jayasinghe U.A.D, Amarasinghe U.S. and De Silva S.S. 2005. Limnology and culture-based fisheries in non-perennial reservoirs of Sri Lanka. Lakes and Reservoirs: Research and Development 10, 157–166.

Jayasinghe U.A.D, Amarasinghe U.S. and De Silva S.S. 2005. Trophic classification of non-perennial reservoirs utilized for the development of culture-based fisheries, Sri Lanka. International Reviews of Hydrobiology 90, 209–222.

Wijenayake W.M.H.K., Jayasinghe U.A.D., Amarasinghe U.S., Athula J.A., Pushpalatha K.B.C. and De Silva S.S. 2005. Culture-based fisheries in non-perennial reservoirs in Sri Lanka: production and relative performance of stocked species. Fisheries Management and Ecology 12, 249–258.

Jayasinghe U.A.D., Amarasinghe U.S. and De Silva, S.S. 2006. Culture-based fisheries in non-perennial reservoirs of Sri Lanka: influence of reservoir morphometry and stocking density on yield. Fisheries Management and Ecology 13, 157–164.

3 Kulatilake M., Liyanage H.S.W.A., Fernando W.M.J.R., Chandrasoma J. and Van der Knaap M. 2010. Development of co-management in the inland fisheries in Sri Lanka: case studies of Senenayake Samudra and Mahavilachchiya reservoirs. Aquatic Ecosystem Health and Management 13, 281–287.

Table 1. Trends in inland fish production in Sri Lanka

Year	Production (tonnes)	Year	Production (tonnes)
1999	31,450	2005	32,830
2000	36,700	2006	35,290
2001	29,870	2007	38,380
2002	28,130	2008	44,490
2003	30,280	2009	46,560
2004	33,180	2010	52,410

Source: based on data from <http://www.naqda.gov.lk/inland_Aquaculture.php>

A silver carp at harvest, weighing approximately 1.5 kg, which it attained in 6 months from the time of stocking (at 10–20 g). Silver carps are one of the main species used in culture-based fisheries in Sri Lanka and elsewhere in the region. (Photo: S. De Silva)

Culture-based fisheries development (component 2)

The informational material developed for the project and used widely for promoting CBF among rural communities also stimulated the production by NAqDA of educational videos on CBF that were broadcast nationally at prime times. All these videos are also used by NAqDA for transmission of information at village-level meetings on extension of CBF practices.

The methods based on GIS for selection of non-perennial reservoirs are being used by NAqDA, which is pursuing development of CBF through the dry zone of Sri Lanka as a major development strategy for food-fish production in rural areas. The number of farmer communities undertaking CBF development in the water bodies allocated to them for management has increased significantly over the years, with a consequent increase in food-fish supplies and income generation for the communities. The encouragement initiated by the project to make savings from the first year harvest toward procurement of fingerlings for the next cycle and so on, is a principle that was also encouraged by NAqDA when it started on CBF development and extension. Much progress has been made in this regard, bringing self-sufficiency to communities to meet seed-stock needs.

Impact—the difference the project has made or is expected to make

The adoption of the managerial measures, apart from increasing reservoir fish production and its sustainability, also has had an indirect impact on the strengthening and functioning of the reservoir fishery societies and, indeed, have stimulated the formation of societies where these were lacking. Currently, 46 reservoir fishery societies are established and functional, covering 40 reservoirs with a total area of 74,463 ha (NAqDA, pers. comm.). These societies function as 'watchdogs' for each of the reservoirs, ensuring proper management.

NAqDA has proceeded to make a policy change, and new inland fishing gear regulations (Fisheries and Aquatic Resources Act No. 2 of 1996) are to be enacted soon, permitting a well-managed fishery for minor cyprinids to be established in medium and large perennial reservoirs in Sri Lanka. This will result in a substantial increase in reservoir fish production, provide rural populations with an alternative, nutritious, low-cost food-fish source and additional livelihood opportunities, and contribute to food security.

Component 1 of project has had spillover impacts, such as stimulating other donors to recognise the importance of reservoir fisheries as a provider of livelihoods, rural income generation and improvement of nutrition in rural populations in Sri Lanka and elsewhere in the region. In this context, the Icelandic International Development Agency (ICEIDA) funded 'Strategies for development of Asian reservoir and lake fisheries', a regional project coordinated by the Network of Aquaculture Centres in Asia–Pacific, 2007–2010 (details at: <http://www.enaca.org/modules/inlandprojects/index.php?content_id=4>).

All this has raised the profile of Asian reservoir and lake fisheries, which, overall, are a very significant contributor to global inland fish production of 10 million tonnes/year. This will encourage and facilitate research and development (R&D) in this sector, thereby in the long term resulting in increased fish yields and sustainability of the sector.

The major impact of component 2, CBF, has been through more communities embracing the activities, resulting in significant income gains to them and increased food production (Figure 1). Bearing in mind

that the introduction of CBF to farming communities is a relatively slow process, the trend is encouraging and significant. If, as is expected, this trend continues, with NAqDA emphasising and recognising CBF as a major strategy for increasing inland fish production, particularly in rural areas, inland fish production is likely to exceed marine production by 2015, as planned by the Government of Sri Lanka (Dr Damitha de Zoysa, Secretary, Ministry of Fisheries and Aquatic Resources Development, pers. comm., December 2010). These developments also have triggered individual and/or corporate (e.g. fishery societies) entrepreneurship to embark on fry-to-fingerling rearing as a means of livelihood support, thereby aiding the removal of the bottleneck affecting fingerling availability for CBF.

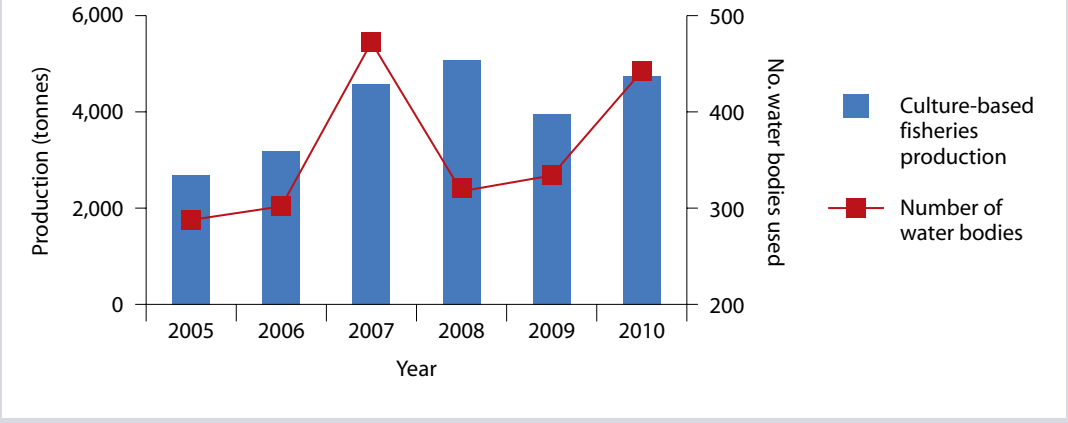

Figure 1. Trends in culture-based fisheries (CBF) production and water-body use for CBF in Sri Lanka.

Realisation of the importance of CBF as a strategy for increasing food-fish production and contributing to income generation and improvements of livelihoods has spread far and wide in the region. This new activity led to a request to ACIAR from Vietnam and Lao PDR for support for R&D on CBF in those countries, resulting in ACIAR-funded studies that have had similar outcomes to those reported for Sri Lanka. Cambodia and Indonesia also have sought such support. All in all, there is a marked recognition in Asia that CBF are a most appropriate strategy for food-fish production that will contribute to improving the livelihoods and nutrition of rural populations.

This component also had spillover effects: the Norwegian Agency for Development (Norad), recognising the importance of CBF as an important rural activity, has funded a study to evaluate the climate change impacts on CBF; this is an important and a useful study, particularly so as the whole CBF cycle of activities is dependent on climate—primarily the rainfall patterns. It is expected that as a result of this study a re-evaluation will be made on the methods/criteria used for determining the suitability of perennial water bodies for CBF.

The importance of CBF to Sri Lankan fisheries production is further evidenced by the fact that NAqDA is planning to provide statistics on CBF production as a separate entity, an initiative that has been welcomed by the Food and Agriculture Organization of the United Nations (FAO) Statistical Collection unit (NAqDA Chairman, pers. comm.). This is perhaps the first step in the recognition of CBF as a significant contributor to global food-fish production.

In some countries, such as Lao PDR, the whole village community participates in harvesting culture-based fisheries. Households often purchase nominally priced 'tickets' to participate. The household is free to sell or use the catch, and the ticket sale proceedings are used for communal activities, including improvements to dykes, sluices and other water-body utilities. (Photo: S. De Silva)

An unquantifiable but very significant impact of the project was capacity building among researchers, extension officers and fisheries inspectors of NAqDA on CBF and fisheries management per se and, even more importantly, among the many hundreds of farmers who were rice cultivators formerly, who were literally co-opted into CBF activities through the respective cultivation committees of each of the non-perennial reservoirs. Former project research staff continue to collaborate with NAqDA on continuation of CBF activities in the country, albeit to varying degrees. Importantly, CBF has become a component of the curriculum at under- and postgraduate level in a number of universities, training the scientists who can occupy the job opportunities that will arise as CBF and inland fisheries as a whole become increasingly important to the economy of the country.

Perhaps the only deficiency in the project and the adoption of its results is a lack of understanding of gender engagement in the activities, and the benefits to females. This is a lapse in inland fisheries research in general although it is estimated that the nearly 60 million people who are involved in it globally are mostly women and rural poor.[4] It is suggested that, now that both minor cyprinid fisheries are to be legalised and CBF is on a firm footing, a small study dedicated to gender issues in these activities would be useful.

4 Beard T.D., Arlinghaus R., Cooke S.J., McIntyre P., De Silva S., Bartley D. and Cowx I.G. 2011. Ecosystem approach to inland fisheries: research needs and implementation strategies. Biology Letters, at <http://dx.doi.org/10.1098/rsbl.2011.0046>.