Challenges and constraints for developing CBF in Cambodia and a possible strategy for success

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Abstract: Fish is the most important source of animal protein in Cambodia. On average it makes up more than 75 % of animal protein and in some areas of the country aquatic resources make up 80 % of the available animal protein. Overall, fish consumption is estimated to be around 63 kg/caput/year (FiA, 2013) (whole fish equivalent) and is many times greater than the global average, reflecting the importance of the fisheries sector to the diet and culture of Cambodian people.

The application of culture-based fisheries in Cambodian waters commenced with the initiation of a project under the auspices of the Australian Centre for International Agricultural Research (ACIAR Project FIS/2011/013), coordinated by NACA. For the initial trial, 16 small reservoirs located in four provinces were selected. These reservoirs differed from each other in surface area, mean depth and the catchment land use features, the latter evaluated using GIS software. In choosing the reservoirs, initial consultations with the village communities responsible for the water regime management were held and their agreement obtained for monitoring and cooperating through the trial period. One common feature in all the reservoirs selected, and for that matter in all water bodies in Cambodia, is the provision of a "conservation zone", generally in the deeper areas of the water body, where fishing is prohibited.

Culture-based fisheries are a form of aquaculture that utilise small water bodies, both perennial and non-perennial, which cannot support a fishery through natural recruitment processes, for food fish production through a stock-recapture strategy. Culture-based fisheries are environmentally friendly as the only external input is seed stock. It also engages a co-management approach utilising the downstream farming communities in most instances already organised into functional entities for dry land agriculture as the principal beneficiaries (De Silva 2003). Culture-based fisheries are an attractive development strategy as it mobilises dry land farming communities (e.g. rice farmers) to use existing water bodies for the secondary purpose of food fish production. The strategies to optimise benefits from culture-based fisheries, however, vary in detail from country to country and across climatic regimes.

Culture-based fisheries activities were conducted over two growth cycles and in all instances the fish production increased above the levels that were obtained prior to the implementation of culture-based fisheries. In this presentation the stocking strategies and the yields obtained are presented. It is believed, however, the yields could be further enhanced by utilisation of the conservation as nursery areas which will be dealt with in a separate presentation.

Key words: *Fish consumption, small water bodies, culture-based fisheries, free access, conservation zone, co-management.*

Introduction

Cambodia (13 00°N, 105 00°E) with a total area of 181,035 km² and with relatively short coast line (443 km) and a current population of nearly 15.5 million is blessed with extensive water resources, estimated at 4,520 km². Cambodia with its vast freshwater resources, principally the Mekong river with its two main tributaries (Tonle Sap and Bassac) flowing through it, together with the Tonle Sap Lake or the Great Lake, have been the major source of food fish. Not surprisingly Cambodian people have one of the highest fish consumption levels in the world, estimated at 63 kg/caput/year; considerably higher than the average in Asia (27-29 kg/caput/year) and the world (17-19 kg/caput/year). In some regions of the country, for example in the Tonle Sap region and the associated plains, it could be as high as 67 – 80 kg/caput/year. This high fish consumption, primarily freshwater fish eaten fresh and or in variety of processed forms, translates into nearly 80 % of the animal protein requirements of Cambodian people (FAO, 2011), which is considerably higher than that in other developing countries (28 - 32 %).

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Fish yields from the Lower Mekong Basin, the primary source of fish for Cambodia (MRC 2010) were estimated to range from low, median and high estimates of 197,572, 395,144 and 790,288 t/yr, respectively, and considerably higher than for other riparian countries (Hortle 2007). The main inland fisheries in Cambodia, until very recently, were the fishing lots in the Great Lake (Tonle Sap) (see for example, Chadwick et al. 2008) and the dai fishery in the mainstream of the Mekong River. The latter is a very seasonal and an intense fishery in which very large quantities of fish, primarily carp species such as *Henicorhynchus* spp., are captured during their migratory phase (Adamson et al. 2009). The latter fisheries provide the raw material for the preparation of the various types of fish sauces and pastes that form a crucial component of the Cambodian cuisine. In the recent past changes in the fishery regulations resulted in the prohibition of the establishment of fishing lots in the Great Lake, and thereby opening vast areas of the lake for fishing by individuals on an open access basis (FiA 2013).

Overall, the fish yield from inland waters in Cambodian waters is at best plateauing (Figure 1). On the other hand, the population of Cambodia is increasing and the most conservative estimate predicts that it would reach 20-22 million by year 2020 (http://www.indexmundi.com/g/g.aspx?v=21&c=cb&l=en). Even if the current level of fish consumption is maintained the food fish requirement of Cambodia by year 2020 would be around 1.153 million t/yr, more than double the current supply level..

It is in the above context that the Royal Government of Cambodia has recognised the need to utilise small, inland water bodies for culture-based fisheries development (CBF) as a plausible strategy for increasing food fish availability in rural communities and to augment their income (Government of Cambodia 2010). As CBF is new to Cambodia and the rural communities thereof, and involves practices that need to be geared to specific locations/regions to obtain optimal returns (De Silva et al. 2006), a R&D program under the auspices of the Australian Centre for International Agricultural Research (ACIAR) (FIS/2011/013) was initiated. During the course of this program it became evident that optimal results (i.e. optimal yields) from CBF cannot be achieved under the existing fishery regulations in Cambodia.

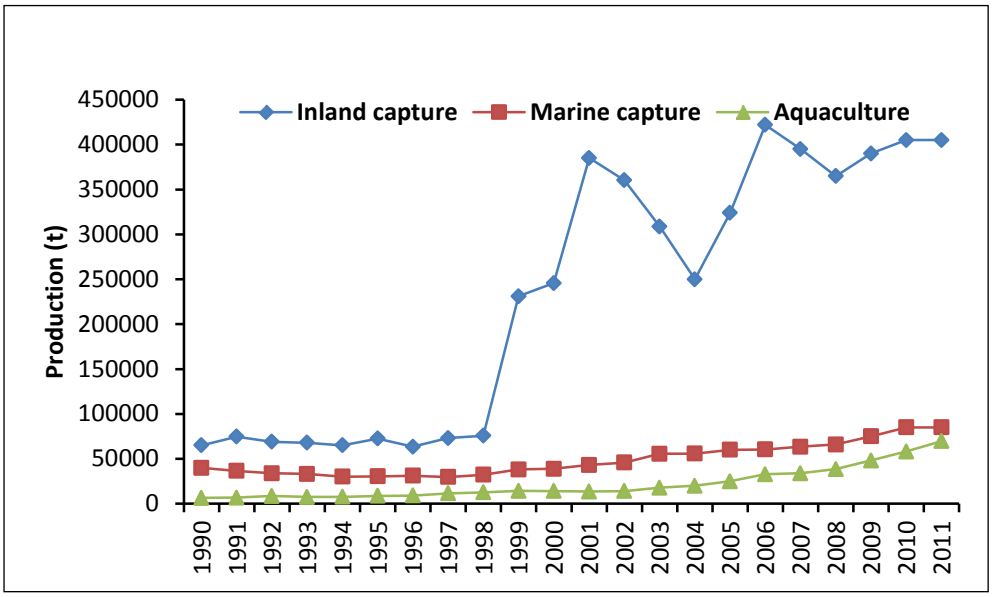
Accordingly, this paper, which is an extension of an earlier treatment of the subject (Limsong et al. 2013) discusses the plausible strategies that could be adopted and the R&D needs to make the returns from CBF practices in Cambodia optimal.

Basics of CBF

CBF is essentially a stock enhancement practice applied to water bodies that are incapable of supporting even a subsistence fishery though natural recruitment, and where the stocked seed is cared for through a community management process, by virtue of this direct and or indirect ownership of the stock it becomes an aquaculture practice, and extensive one at that. Apart from the external input of seed stock there is generally minimal other inputs thereby making it an environmentally friendly process.

In an ideal operation of a CBF practice, once the water body is stocked, the seed is permitted to grow, utilising the naturally produced food resources, for a period of six

Figure 1. Trends in inland, marine and aquaculture production in Cambodia, 1990-2011 (based on FAO, 2014).



to eight months after which, under tropical conditions, the stocked fish will be ready for harvest (see De Silva et al. 2006). Generally, fast growing fish species that are known to have local consumer preferences are chosen. The extent of care rendered to the stock as well as the nature of harvesting and the distribution of profits could vary among the communities/countries.

Cambodian context

Free access

The Cambodian fishery regulations permit free access to any type of water body. Equally, and unlike in most other countries in the region, the communities living besides water bodies suitable for practicing CBF are not organised for water management for downstream cultivation for example. The key here being that when CBF is practised in most countries, the already operational community organisations and or their representatives, are also engaged in CBF management (see Wijenayake et al. 2005; Nguyen et al. 2006; Kularatne et al. 2009; Saphakdy et al. 2009).

Consequently, even though communities living in the vicinity of a water body in Cambodia could be organised into a suitable CBF management unit, as in other countries, under the existing fishery laws this unit does not have the power to stop free access and fishing even immediately after stocking. The situation is further exacerbated by the fact that fishing in relatively easily accessible water bodies to meet the daily food fish needs is a traditional and cultural practice in rural Cambodia. As such a very high proportion of the stocked seed do not reach table/marketable size and the overall yield is considerably reduced.

Conservation zones

The demarcation of a conservation zone in every water body, irrespective of its scientific merits, was introduced in 2010. The conservation zone is indicated very conspicuously with appropriate signage, and overall the community abides by this regulation by refraining from fishing in this zone. The area of the conservation zone in a water body could vary from 10 to 30 % of the area at full supply level, and is often wooded and/or with rooted vegetation such as water lilies, lotus (*Nymphea* spp.), which are also not harvested. There is a community belief that the conservation zones provide spawning grounds for some native species. However, explicit scientific evidence in this regard is yet to forth come.

Potential/feasible strategy

The objective of any strategy that would enhance CBF production in small water bodies in Cambodia should comply with the existing fishery regulations. Equally, the most direct and logical way of increasing production from CBF practices will be to provide time for the stocked seed to grow to a larger size i.e. reduce the probability of recently stocked fry/advanced fry and or fingerling being captured relatively early in the growth cycle.

Considering all of the above extensive consultations were made with stakeholder communities from four provinces (Kampong Thom, Oddor Meanchey, Preah Vihear and Siem Reap) that are engaged in the ongoing CBF project (FIS/2011/013) with regard to the possibilities of utilising conservation zones as possible nursing areas for an extended periods. The communities were agreeable to such an innovation.

Accordingly, it is proposed that seed stock, whatever stage at the time of purchase (generally advanced fry or early fingerling) be released into the conservation zone which will be appropriately cordoned off either using netting or fencing. Furthermore, brush parks will be introduced into this zone prior to stocking. The netting/fencing will be gradually removed in stages, based on observations on the rate of growth of stocked species. Needless to say there are a host of unknowns that have to be researched in order to adopt this strategy to optimise fish yield from CBF in small water bodies.

Immediate research needs

The immediate research needs are many fold. As the extent of conservation zone in a water body has been based on random observation it will be necessary to determine the optimal ratio of the conservation zone to the water body at full supply level for purposes of nursing the stocked seed. As replication is not possible it will have to be investigated on a random basis where the size of the conservation zone relative to the water body area is increased in a step wise manner (5 % increments) from about 15 to 45 %, taking care that at least three water bodies are included for each increment. It would be desirable to maintain a unified proportion of brush parks in each conservation zone.

The results from the above trial would provide an indication of the range in the extent of the conservation zone that will likely provide the best production. In a subsequent trial, using the same water bodies, a second growth trial should be conducted to ascertain the best length of time the conservation zone be utilised as a nursing area for the stocked seed.

Women folk of village communities play an active role in CBF in Cambodia (left); a selection of fish from CBF in small water bodies (right); monks are often involved during stocking (bottom).

Once armed with the above information, i.e. the ratio of the area of the conservation zone to the total area of the water body and the optimal length of time the former should be utilised for nursing the seed stock, a third trial could be conducted to fine tune these parameters. In all trials, as had been done in other countries, limnological parameters as well as the performance of individual stocked species (the percent recovered, size at harvesting, etc.) should be obtained, and all these data employed to develop a case for better management practices of CBF in Cambodia that could be disseminated to the public/communities for adoption.

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