Indian J. Fish., 59(1) : 49-52, 2012

Adoption of sustainable capture based aquaculture practices by traditional fishermen of Karnataka

A. P. DINESH BABU, SUJITHA THOMAS, P. S. SWATHI LEKSHMI AND GEETHA SASIKUMAR

Mangalore Research Centre of Central Marine Fisheries Research Institute
Mangalore - 575 001, Karnataka, India
e-mail: swathi_lekshmi@yahoo.co.in

ABSTRACT

Capture Based Aquaculture (CBA) has emerged as the optimal solution to meet India's ever growing demand for protein food security, besides providing additional income to rural fishermen during the lean seasons. The following study documents the adoption of sustainable CBA in traditional farming systems with minimum inputs. The fish farmer being the end user in the technology adoption process, an empirical evaluation of the concept of sustainability is important in reducing the production costs, in harnessing environmental benefits and ensuring stable fish production. The reliability of Farmer Sustainability Index (FSI) to measure the adoption of sustainable practices in capture based aquaculture was measured using Cronbachs Coefficient of Alpha which worked out to 0.97, indicating a high index of reliability of the method used. The FSI constructed was administered to 40 traditional fishermen adopting CBA at Uppunda village of Kundapura taluk of coastal Karnataka. The overall mean FSI index for all the six practices from cage fabrication to harvest was 77.95, indicating a relatively high value of Farmer Sustainability Index for adoption of CBA practices.

Keywords: Adoption, Capture Based Aquaculture, Farmer Sustainability Index

Introduction

Fish has emerged as an important source of protein food in the developing countries of the world. Fish accounts for 20% of animal-derived protein in low income food deficit countries, compared to 13% in the industrialized countries (Delgado *et al.,* 2002). India has registered an impressive stride in fish production from a meager 0.75 million mt in 1950-51 to 7.85 mt in 2009-10. (Ayyappan, 2011) Fishing, aquaculture, and allied activities are reported to have provided livelihood to over 14 million persons in 2008-09, apart from being a major foreign exchange earner. The aggregate fish demand has been projected as 6.7-7.7 million t by 2015 (Kumar *et al.*, 2005). In this context, aquaculture seems to hold the key for meeting future challenges in demand for fish.

Aquaculture serves as an alternative to meet current and future demand for aquatic products. However, many aquaculture practices still need considerable refinement to make them more sustainable. Capture based aquaculture (CBA) addresses the overlap between capture fisheries and aquaculture (Ottolenghi *et al*., 2004). This activity is reported in FAO statistics as aquaculture rather than capture fisheries, even though it depends on seed from the wild rather than from hatcheries. CBA has developed due to the market demand for some high value species, for which life cycles cannot currently be closed on a commercial scale. In addition, the hatchery production of many cultured species is constrained by poor and unreliable survival of larvae in hatcheries.

If aquaculture is to play a major role in the food security of low income developing countries (LIDCs) as a much needed and affordable source of high quality animal protein, it is essential that the farmed species be produced *en masse* using low cost sustainable farming methods (Tacon, 1995). CBA provides significant profitable returns in areas with depressed and marginal economies, and an alternative livelihood for coastal communities. CBA is the practice of collecting "seed" from early life stages to adults from the wild, and its subsequent on-growing in captivity to marketable size, using aquaculture techniques. FAO (2006) states that responsible application of aquaculture, based on seed fisheries, requires that juveniles are caught before they experience severe mortality, recruitment must be sufficient to ensure that fisheries targeting adults are compensated, and capture methods must minimize bycatch of nontarget species and may not damage supporting habitats. Studies by the Central Marine Fisheries Research Institute, Kochi, India (Rao, 2009), have indicated that, dol nets of Gujarat and Maharashtra, shore seines of east coast and Thalluvalai of south-east coast of India which are operated at a depth of 5-10 m, land juveniles/seed of high value species. These realize a very low price and are dried/ converted into fish meal. If only a small fraction of this seed /juveniles are induced to be brought in live condition, they will form a very good source of seed for CBA, without affecting the ecosystem and livelihood of the fishermen (Rao, 2009). The Central Marine Fisheries Research Institute has initiated the capture based aquaculture systems in all the maritime states under its jurisdiction. Of these, the adoption of sustainable capture based aquaculture initiatives by the traditional fishermen groups, in the state of Karnataka is noteworthy. Estuarine and coastal waters of Karnataka is known for the abundance of finfish seeds of mullets, sandwhiting, pearlspot, milkfish, Indian terapon, butterfish and flatfishes. During June - September, juveniles of a number of cultivable species of finfishes like *Lutjanus* spp. *Gerres* spp. and *Etroplus* spp. are caught in the seines, castnets and gillnets operated along the coast. Usually these juveniles are discarded or are sold at a low price. An attempt was made to popularize the concept of CBA by judiciously utilizing these seed resources. The members of the traditional fishermen society *viz*., Samparadayaka Meenugara Sangha, Byndoor Valaya of Uppunda village, Kundapura taluk, Udupi district in Karnataka were the target fish farmers identified for the transfer of technology for CBA. The Low External Input Sustainable Aquaculture (LISA) concept has been made use of in this type of fish culture practice. There is a dearth of information on the adoption of sustainable fish farming practices with respect to CBA. Historically, the transfer of technology from a laboratory to a field has been a significant challenge for extension. The failure to recognize and address the psycho-social component of technology adoption as part of the educational process has served to illustrate that generating knowledge is not always synonymous with diffusing and adopting knowledge (Barao, 1992). The present paper attempts to apply the adoption diffusion model to the case of sustainable CBA by employing a measure of farmer's perceptions of sustainability of the adopted fish culture practices in their farms.

Materials and methods

The technology of CBA was demonstrated to a group of 42 traditional fishermen in Uppunda village in Byndoor, of Kundapura taluk, Udupi district. The traditional fishermen of this village were purposely selected as the target group, based on their interest in adopting CBA, since they viewed it as an alternative source of income generation during the lean season, when rough sea condition prevented them from venturing into sea. The technology was demonstrated in the Uppunda estuary. Various group extension methods, such as method demonstrations, group discussions and mass communication methods for educating the target group through slide shows and film shows on the viability and feasibility of the technology were employed by the scientists and technical staff of the institute.

The various steps involved in the transfer of technology on CBA are fabrication of netlon cages, seed collection, stocking, rearing, feeding and harvest. Swaminathan (2011) reported that, low external input sustainable aquaculture (LISA) measured adoption of sustainable aquaculture practices, as the extent to which biologically based practices that resulted in less reliance on purchased inputs were used in farming. Based on this line, for the present study, the adoption of sustainable aquaculture practices was operationalized, as the integrated use of improved and indigenous practices from seeding to harvest aimed at optimizing goals of production, natural resource conservation and reducing adverse impacts on human life. Therefore, to measure the adoption of sustainable agriculture practices by the fish farmers, a farmer sustainability index (FSI) was developed, based on the methodology suggested by Taylor *et al*. (1993).

Seeding to harvest practices were broadly classified in to those related to fabrication of netlon cages, seed collection, stocking, rearing, feeding and harvest. In developing the farmer sustainability index, attention was given to the implications of the practices to productivity, ecological stability and impact on natural resource base and human health, as ascertained through discussion with experts. Plus (positive) values were assigned to practices believed to contribute to sustainability and minus (negative) values to practices detracting from sustainability. Zero value was assigned to neutral position. The values were assigned based on the standard procedure developed by Mohamad *et al.* (1994).

The selected production practices were pretested with 20 farmers. In item selection for the final FSI, data on two of the 8 items were dropped and thus, 6 items related to production practices with scores ranging from - 4 to + 4 as described in the standard procedure was used. The content validity of the instrument was ensured through expert consultation and literature scan. Reliability, which ensured the consistency of the instrument, was ascertained using Cronbachs Coefficient Alpha. The Cronbachs Coefficient Alpha worked out to be 0.97, which is indicative of the high consistency of the instrument.

The data on FSI was collected through a well structured interview schedule. The cumulative score of all the items gave the unadjusted FSI score of a respondent. In order to facilitate interpretation of the FSI value for the different farmers in the study, the unadjusted FSI scores were adjusted so as to be in a range of 0 to 100 using the formula:

Adjusted FSI score = (unadjusted score - minimum score)/ (maximum score – minimum score) x 100.

Any score less than 50 was considered unsustainable and score values more than 50 as sustainable. Fifty was considered as the neutral score. This was adopted from the procedure standardized by Mohammed *et al*. (1994). SPSS (Statistical Package for Social Sciences) 16.0 was used for analyzing the reliability of the instrument. Simple statistical tools, such as mean, standard deviation and percentage analysis were used for the analysis of the data.

Results and discussion

Classification of farmers based on FSI

The practice-wise mean FSI scores of the CBA farmers is presented in Fig. 1. The fish farmers obtained a mean farmer sustainability index of 82.91 for the practice of adoption of netlon cages. The fingerlings of *Lutjanus argentimaculatus, Etroplus suratensis* and *Lates calcarifer* were stocked in floating cages of 2.5 m x 2.5 m x 2 m, made of Netlon (mesh of 30 mm) lined with nylon net. According to the fishermen, these cages could be easily fabricated with readily available materials and required only minimal maintenance. Besides, they were of the opinion that these cages also offer protection from predators, provide controlled feeding, and simplify monitoring and harvesting of stock, besides providing a convenient approach to raising fish for household and market consumption. Cage culture, however, solves the problem of pollution in a small space because there is a constant exchange of water between the screen-walled cage and the larger body of water in which it floats.

With respect to seed collection, it was observed that the fishermen scored a mean FSI of 65.83 which was the least of the FSI scores for all the practices adopted. The seeds or juveniles of *L. argentimaculatus,* and *E. suratensis* were collected from the wild. The fishermen were of the opinion that, in the capture fisheries scenario it is increasingly observed that, juveniles of high value fish are often caught in non-selective gears and shore seines, which are either discarded or sold at nominal prices. If suitable measures are followed, these juveniles could be used judiciously in CBA for sustainable use of high value resources for augmenting the food production from aquaculture. On the other hand, they were of the opinion that, collecting seeds from the wild was difficult and that it might have a significant impact on the wild stocks, in the long run.

The practice of stocking of seeds had a mean FSI of 73.21. The average stocking density of the cages was 35 fingerlings per m^3. The fishermen were of the opinion that the use of multispecies fishes of uniform size such as,

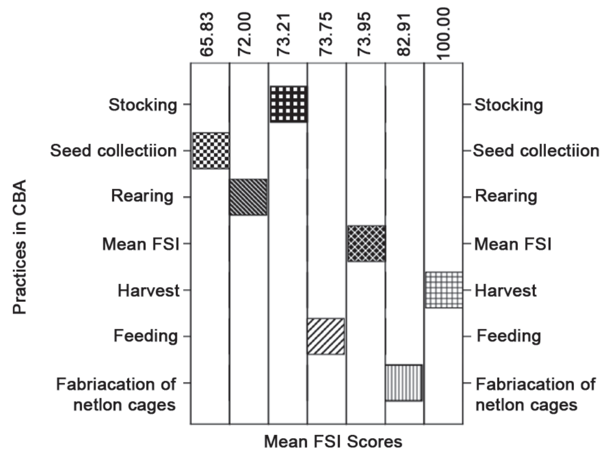

Fig. 1. Practice-wise mean FSI Scores of CBA farmers

L. argentimaculatus, E. suratensis and *L. calcarifer* was compatible, since outbreak of diseases and cannibalism were not observed. The FSI for the practice of rearing was observed to be 72. *L. argentimaculatus* and *E. suratensis* were continuously stocked by the fishermen and they were engaged in the cage setting, cage cleaning, feed sourcing, feed preparation and feeding. For the practice of feeding, the mean FSI was 73.75. Feeding was done with the locally available low value fish and fish waste procured from fish processing plants. A review of the cage culture practices in Asia, excluding China as reported by Halwart *et al.* (2007), has revealed that the major reasons for using low value fish in marine cage was that the stocks perform better on low value fish. The cost of low value fishes and ease of availability were perceived as reasons for adopting low value fish. The large range of FCR among grouper cage farming practices indicates that there is significant scope for improving efficacy of the use of low value fish, leading to greater cost effectiveness, less pollution and most importantly a significant reduction in quantity of low value fish used.

The FSI for harvest was observed to be the highest (100), among all the practices studied. The harvest method followed was partial harvest, wherein harvesting is initiated when a significant portion of the fishes reach the marketable size, besides meeting the domestic needs of the fishermen. Fishes which have attained the marketable size are first harvested, leaving the remaining fishes to grow, giving sufficient space for growth and feeding. This practice has been reported as most sustainable by the fishermen. The details of harvest are presented in Table 1.

A total of five cages were installed and three cages were partially harvested as and when the fishes were grown to marketable size to meet day to day needs of the fishermen. Two cages were kept for final harvest in order to demonstrate the total production possible from these

Table 1. Harvest details from two cages employed in CBA

Species	Numbers stocked*	Survival (%)	Harvest details (2 cages)				
			Mean size (mm)±SD and size range	Mean weight (g)±SD and weight range	Numbers	Harvest wt. (kg)	Amount (Rs.)
Red snapper	140	(80)	350 ± 70 (190-500)	755 ± 415 (105-1914)	105	150	27,000
Pearl spot	2000	(40-50)	158 ± 17 (115-205)	96 ± 35 (37-222)	988	150	22,500
Seabass	370	(70)	510 ± 50 (310-620)	1819 ± 540 (262-3049)	255	450	99,000
Total (2 cages)	2510				1348	750	1,48,500
Production per cage						375	74,250

*Culture period was continuous with partial harvests

cages. These cages were harvested during July, 2011, during mechanized fishing ban perod. *Lutjanus* spp. attained an average weight of 755 ± 415 g ranging from 105 to 1,914 g. The pearl spot ranged from 37 - 222 g (96 ± 35 g). About 255 numbers of seabass of average weight 1819 ± 540 g was harvested. The total production from the cages including seabass, red snapper and pearl spot, was around 370 kg per cage realizing a farm gate price of Rs. 74,250/- per cage.

The mean FSI for the CBA adoption by fishermen was observed to be 77.95. The relatively high value of mean FSI implies that, the CBA technology has made a major headway in the sustainable adoption of the fish farming practices. CBA has provided an alternative source of income generation for the traditional fishermen during the lean fishing seasons from June to August, particularly so during the period of mechanised ban. The encouraging results of the traditional fishermen of coastal Karnataka merits the attention and support of the research institutes, governmental agencies and extension systems whose concerted and persistent efforts can give a major fillip to the capture based aquaculture sector and can also ensure sustainable livelihoods for the fishermen community.

References

Tacon, G. J. A. 1995. Aquaculture feeds and feeding in the next millennium: major challenges and issues. First FAO electronic conference on tropical feeds and feeding systems. http://www.fao.org/ag/tacon.htm

Ayyappan, S. 2011. First convocation address of Director General, ICAR, at UAS, Raichur delivered on 16-04-2011. http://www.icar.org.in/files/convocation.

Barao, S. M. 1992. Behavioural aspects of technology adoption. *J. Ext.,* 30 (2): 13-15.

Delgado 2002. *Fish to 2020. Supply and demand in changing global markets, Demand for fish as food and feed through the 1990's,* 31 pp.

FAO 2006. Species choice in aquaculture: domestic processes, genetic improvement, and their role sustainable aquaculture. *Advisory Committee on fisheries research, Sixth Session,* Rome, Italy, 17-20 October, ACFR/VI/2006/3, Rome.

Ottolenghi, F., Silvestri, C., Giordano, P., Lovatelli, A. and New, M. B. 2004. *Capture based aquaculture: the fattening of eels, groupers, tunas and yellowtails.* Food and Agriculture Organization, Rome, 308 pp.

Matthias Halwart, Doris Soto and James Richard Arthur 2007. Cage aquaculture regional reviews and global reviews, *FAO Fish. Tech. Pap.,* 498: 43 pp.

Mohamed, Z. A., Mohayidin, M. G., Taylor, D. C., Shamsudin, M. N. and Chiew, E. F. C. 1994. Adoption of sustainable production practices: English cabbage farmers in Malaysia. *Sustain. Agric.,* 4 (4): 57-75.

Mous, P. J., Sadovy, Y., Halim, A. and Pet, J. S. 2006. Capture for culture: artificial shelters for grouper collection in SE Asia. *Fish and Fisheries,* 7: 58–72.

Praduman Kumar, Madan M. Dey and Ferdinand J. Perguas 2005. Demand for fish in India: three stage budgeting framework. *Agricult. Econom. Res. Rev.*, 18 : 167-186.

Rao, G. S. 2009. Capture based Aquaculture: Mariculture Initiatives by CMFRI. *Fishing Chimes*, 29 (1): 32-36.

Swaminathan, M. S. 2011. Fish for all - Research and Training centre. M. S. Swaminathan Research Foundation, www.mssrf.org

Taylor. D, Mohamed. Z., Shamsudin. M., Mohayidin. M. and Chiew. E. 1993. Creating a Farmer Sustainability Index: a Malaysian case study. *Am. J. Alternative Agr.*, 8: 175–184.

Date of Receipt : 23.09.2011
Date of Acceptance : 17.03.2012