Workshop on Fisheries Resource Management

Compendium of presentations

Organised by

Post Tsunami Sustainable Livelihoods Programme

Tamilnadu

2015

ICT based monitoring and dissemination system for aquaculture development

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Emerging technological changes in aquaculture can be enabled to perform better with improved use of allied science including Information and Communication Technology (ICT). It is the driving force of all the frontier sciences including agriculture and fisheries. Advanced information technology has been influencing the aquaculture environs by gradually producing the new technology for storage and transmission of recorded knowledge which are accessible electronically. ICT will be used as storage, monitoring and decision making system in the form of databases, expert system and decision support system etc. by the stakeholders to improve their farming system. In addition, the cost factor in face-to-face information dissemination at the right time, and the difficulties in reaching the target audiences, has also created the urgency to introduce modern tools in the form of Information and Communication Technology. This is particularly necessary to people in coastal / rural areas where they lack information and communication infrastructure. Several ICT driven modern tools such as community radio, television, mobile phones, internet, web based applications, e-learning module, knowledge center and advisory services will be useful for delivering the quick and coast effective messages.

e-Learning module

e-Learning techniques have drastically changed the way of dissemination of information, especially in the field of agriculture and aquaculture. Based on the overall assessment of the tribal farmers, Pathri, Gandevi taluk, Navsari, which is one of the tribal areas in Gujarat, CIBA has developed an e-Learning module on "Banana shrimp: A potential diversified species for culture in low temperature coastal areas". This module contains the information about distribution and bi[illegible]gy

of banana shrimp, seed production, culture practices and economics. Culture practices is subdivided into areas covering pond preparation, stocking of quality of seed, feeding strategy, pond management and harvest. Survey economics, total operational cost and net return/profit from the culture of banana shrimp per hectare for 110 days were discussed in the module. This module can be used as a ready reckoner for information about culture practices of banana shrimp by extension personnel, farmers, students and other stakeholders. In addition the institute has developed the e-Learning modules on Handbook of Fisheries Institutions, Mud Crab (*Scylla tranquebarica*) Fattening and Soil and Water Management in brackishwater shrimp aquaculture.

Mobile phones

The information requirement of farmers are related to weather, seed availability, season, harvesting, culture practices, disease outbreaks, input usage, availability of inputs, market rates, market demand, transportation, messages on new schemes, etc. Internet and mobile can do wonders to reach the farmers with the necessary information. Mobile communication has been expanding fast in rural/tribal areas than the internet. The Information Village Research Project of M.S. Swaminathan Research Foundation (MSSRF) has launched the icon-based mobile facility, a fishermen-friendly mobile facility which would provide vital information, like height of sea waves and weather report, etc. The information provided in English by the Hyderabad based Indian National Centre for Ocean Information Service to the Village Resources Center is translated into the regional language for onward communication to the fishermen. CIBA also took an initiative for sending aquaculture related information in the form of Voice Message Service and SMS to aqua farmers and stake officials.

Web based application

Web based application is an innovative way to promote effective information/ideas across the world to stakeholders. Central Institute of Brackishwater Aquaculture (CIBA) has developed a digital and online dissemination system in the form of website, www.ciba.res.in. It includes six

databases/ information retrieval systems on candidate species in brackishwater aquaculture; aquaculture production and export scenarios; major fish/shrimp diseases and preventive and curative measures; policy matters-licensing procedures, forms and contact persons, fisheries institutions and digital library related with aquaculture. In the website more than 800 publications including institute publications such as newsletter, bulletins, technology series, annual report, special publication and extension series; and abstracts of articles related with aquaculture have been uploaded. In addition, video films and e-learning modules developed in Tamil, English, Hindi and Telugu have been installed inside the system. As on date the users comprise of are students, researchers, extension personnel, progressive farmers and many stakeholders.

Interactive kiosk

An interactive kiosk is a touch screen device located in a public place to provide self-service access to products and services to the stakeholders of those institutions. CIBA has developed an interactive kiosk application for disseminating aquaculture related information along with the activities of CIBA for stakeholders. The kiosk application contains the details of brackishwater aquaculture statistics, potential aquaculture shellfish and finfish species, video films, technologies developed by the institute and services. Candidate species contains basic information such as scientific name, size, habitat and distribution etc. of crustacean and finishes species in brackishwater species. Video films on Institute profiles, mud crab fattening, value added products, farm made fish feeds, shrimp farming and animation movie for women self-help groups in difference languages such as Tamil, Telugu, Hindi and English have been uploaded. Details of other technologies such as CIBA Bhetkiahar, CIBA shrimp feed technology for commercialization, molecular kits, green water technology, NOVA RT- PCR kit for the diagnosis are highlights of the interactive kiosk application.

Advisory services

Need based advisory services for the farmers in a timely information on web or mobile or tablets. Agropedia (http:www.agropedia.in) is a state-of-the-art, one

stop shop for all knowledge and practice related to Indian agriculture. In Agropedia (Virtual Krishi Vigyan Kendra), one could create/send voice messages (30 seconds to 2 minutes) based on the queries, problems and other areas of interest. The system is generating knowledge bank and spreading it at large for wide usage, benefits and empowerment of the poor agriculture community. In CIBA website, the farmers' page will serve the purpose of advisory services. Stakeholders can ask any aquaculture related queries through this page. We are regularly receiving the queries related with soil and water, health, finfish and shrimp from different stakeholders. CIBA scientists are providing the scientific inputs/information for each queries through mail/website.

Knowledge center

In the past few years, the knowledge center act as the best information centers from where the operators provide various services to the community members. Knowledge centers are consisting of computers, telephones, network facilities, e-mail connectivity etc. The identified volunteers provide both on and off line information services to users. For example, Village Knowledge Centres of M. S. Swaminathan Research Foundation is not only a knowledge centre but also a value addition centre, which generates a number of databases to provide information on government schemes on agriculture, livestock, health, educational opportunities, employment news, market rate for farm products, audio clips related to agriculture, education, market prices, rural technologies, and other information that is useful for the rural communities. The institute is envisaging the establishment of e-knowledge centre will be useful for the development tribal/coastal areas in the country.

ADS: User-friendly aquaculture database system (Ver 1.0)

Owing to the availability of a vast amount of data in aquaculture and fisheries, the microcomputer user needs to store, retrieve selectively, and display items of possible interest. According to Consultative Group of International Agriculture Research, sustainable farming is the successful management of resources to satisfy the changing human needs, while maintaining or enhancing

the quality of environment and conserving natural resources. Farmers' satisfaction includes issues such as productivity, profitability, and social acceptability. Both sustainable farming and farmers satisfaction in a particular area indirectly depends upon the culture practices data about that area. Due to the importance of the culture practices information the research institutes are carried out the farm survey for collecting the required information in the form of questionnaires. Since hundreds of questionnaires have been collected by the research institutes, it has become a herculean task to view the detailed information on queries. With this objective in view, software called Aquaculture Database System (ADS) was developed for the management of information on brackishwater aquaculture practices collected by the research institute. The main screen of this software was designed into four modules namely, Entry, Search, User Manual and Exit. The retrieved information can be displayed on screen in the report format and also it can be export to MS Word or Ms Excel. In addition, the basic statistical analyses like frequency, percentage, mean and standard deviation was designed in the output screen based on their requirements. The user manual is self-explanatory which gives the step-by-step execution of the software. The exit module is used for closing the system. The system has been tested using the farm data collected from the brackishwater aquaculture area in West Bengal. The system is found working perfect. The proposed software can easily be adopted by other research institutions with similar farm data storage and retrieved requirements.

Indigenous Technical knowledge system in aquaculture

"Indigenous Technical knowledge system in aquaculture" was developed for documenting the traditional knowledge in aquaculture. In the system, search module is used to search and retrieve information based on users' keywords in the form of category-wise, location-wise, usage-wise and/or timeline-wise. Since the Institute had conducted a comprehensive survey in the coastal West Bengal comprising different farming systems in the brackishwater and north east of Tamil Nadu comprising environmental and climate changes and beliefs of tribes, sample of ITKs are utilized for testing the system. These ITKs are divided into categories

depending upon their approach for addressing the aspects of soil, water and productivity related, culture/ management related health related and environmental and climate changes. The database storing and retrieval systems are working with stable performance. Although illustrations are based on the brackishwater culture practices and environmental and climate changes, system is general and can act as a model to capture and display the ITKs for all other aquaculture and fisheries sectors.

Decision Making Tool in Aquaculture: DMTIOLA (Ver 1.0)

The success of aquacultural projects without adverse environmental effects largely depends upon the quality of the site selected for the project. In order to evaluate the multiple alternatives (or sites/farms), mathematical models are designed in the form of decision support systems/tools for assisting the decision making process. In view of this, model based software tool called DMTIOLA (Decision Making Tool for Identification of Optimal Location in Aqua farming development) was developed using visual basic programming language for identification of optimal location for aquaculture farming development. This tool has sufficient predictive power to help extension personnel, aquaculturist, land-use managers, aquafarmers, and other interested persons who may be unfamiliar with the specific requirements of aquaculture to identify the optimal location for aquaculture farming development.

Challenges in use of ICT tools

1. Availability of Power

Power availability in rural India is unreliable and the quality sub-standard to support the network. Power is usually available for few hours a day and on a sporadic schedule. Access of information in a timely manner is critical to success of the business model. To overcome this all projects required battery based uninterrupted power supply backup.

2. Bandwidth

Most of the modern tools are based on internet. At sites where the bandwidth often failed users were less willing to use internet facilities based tools. To overcome this we required minimum 100 kbps bandwidth to reduce any fatigue.

3. Hardware problems

Failing hardware also poses a problem for the usage of modern tools. We required the trained manpower and alternative resources for timely action and maintenance of the tools in the rural areas.

4. Language

Information in local language is vital for better comprehension of stakeholders to empower them. Modern tools like mobile phones, web site etc should basically concentrate on needs of rural areas in their language. As large mass of information is available in English, translation, facilities should be made available as an interface between local user and the global knowledge. The interface could be a coordinator or software for translating English into different Indian languages. To cope with this, there is need for trained person to support the stakeholders in the initial stages to cope with the technology and language barrier. This can be avoided by the multilingual websites.

5. Usage Skills

The stakeholders especially farmers needs to understand the basic technology, such as how to navigate the Internet or to maximize the use of the available tools, and marketing. This knowledge can be provided by excessive training in the area of modern tools related to aquaculture development. Training is an important component that influences and motivates in use of new approaches to development-it is applicable to technology as well as media usage.

6. Services for Sustainability

Access to information is essential for sustainability of the aquacultural and rural communication system. To make the usage of modern tools in sustainability mode, they need to have multiple services approach providing solutions to local problems as per the felt needs of the stakeholders covering livelihoods, quality of living, government programs, service and agriculture allied sectors information like weather, culture pattern, market prices, inputs, diseases information, breeding and

nutrition, eco-aquaculture and all other information related to socio-economic activates. Integration of several information and services would make it sustainable and commercially viable. Region specific information on species like package of practices, diseases and control measures are to be made available dynamically with access to experts as per the need.

Brackishwater Aquaculture based Alternative Livelihoods for Fisherfolk

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The natural disaster of tsunami provoked a rethink of brackishwater aquaculture for livelihood options to fisherfolks. Since it is necessary for livelihood experts to think of rehabilitating the displaced fisherfolk in avocations with which they could identify themselves. Many avocations and technologies have been developed for the aqua farmers in brackishwater aquaculture. The importance of coastal aquaculture technologies as a livelihood options increased after the Tsunami.

Brackishwater aquaculture offers best livelihood options for fisherfolks especially in coastal areas and offers plenty of scope for diversification of livelihood for those who live below poverty line. Aquaculture encompasses a wide range of different aquatic farming practices with regard to species (including seaweeds, molluscs, crustaceans, fish and other aquatic species groups), environments and systems utilized, with very distinct resource use patterns involved, offering a wide range of options for diversification of avenues, for enhanced food production and income generation in many rural and peri-urban areas.

Fisherfolks have contributed substantially to the social and economic growth of the economy. They play an indispensable role in fishery sector by taking part in various activities both in capture and culture fisheries, such as, fish farming, transportation and marketing of fish in domestic sector, shrimp-peelers in fish processing plants, workers in shrimp hatcheries, culture and fattening of mud-crabs, aqua feed production, preparation, processing and marketing of value added fish products and so on.

Central Institute of Brackishwater Aquaculture (CIBA), Chennai has developed a number of technologies which are tailored to suit the needs of the affected fisher folk and reorganize their lives and develop an alternate livelihood.

This article discusses on various brackishwater aquaculture technologies and avocations which were transferred and adopted by fisherfolks and coastal women as their alternate livelihoods.

CRAB FATTENING IN FRP CAGES

Fiber glass cages either with 6 or 9 compartments are used for crab fattening. Each compartment is stocked with 1 crab each weighing 500g - 700g. The four sides of the cages are well perforated for free circulation of water. Each compartment measures about 1m* 1m * 0.33m. The four sides of the cages were perforated for the free circulation of water. The culture period is 3-4 weeks. The feeds like trash fish or formulated feeds can be given. The fattening duration is about 20-25 days. The cages were checked from the 10^{th} day of stocking for the hard crabs. If hard crabs were found, they are harvested from 10^{th} day onwards and up to 25 days.

Periodical checking was done during the culture period. After use, the cages were dried and cleaned for next round of use. Trash fishes collected from the landing centres were fed @ of 10% of the biomass of the crab at two intervals (morning and evening) every day. In case of algal, and barnacle fouling on the crab carapace, they are removed by brushing. The harvesting of the fattened crabs is carried out by hand picking. Mud crabs are marketed in live condition. Hardened crabs are packed in bamboo baskets. Women Self Help Groups and Men Self Help Groups of Kancheepuram and Tiruvallur district were engaged in crab fattening of larger species *Scylla tranquebarica* in eight fiberglass cages.

FISHERFOLKS CRAB FARMERS (CRAB FATTENING IN PENS)

Crab fattening (in pens) was carried out in small pens with fence around ranging from 0.1 to 0.5 ha in size with water depth of 1.5 m. Fencing with height of between 0.5 - 1.0 m an the dyke is done with nylon materials. The tidal water flood through the creek causes sufficient water exchange in the pens. The soft shelled crab of 8 cm carapace width and above or crabs of more than 550 g are stocked density of 1 crab/1 to 3 m2. Crabs were fed with bivalve meat or trash fish daily at the rate of 5 to 10% of body weight. Duration of fattening was 20 days.

Crabs are harvested after shell becomes sufficiently hardened and before next moulting. Harvesting is done by using scoop nets and ring nets with baits. Harvesting was done in the early morning hours or evening to prevent mortality of crabs due to overheating of water at noon time. In a year 9 to 10 cycles of fattening can be done. The harvested crabs were sold by the WSHGs at the local markets and they had tie back arrangements with same crab retailers. Coastal Self Help Groups of Kancheepuram, Cuddalore and Tiruvallur district of TamilNadu, were actively involved in crab fattening in pens.

CRAB FATTENING IN CONCRETE TANKS

Crab fattening (in concrete tanks) were practised by fisherfolks near Cuddalore. Concrete tank of 10 ft x6 ft x5 ft is used for stocking the water crabs. Sixty six crabs weighing 300 – 400g (23 kg) were stocked at the rate of 6 nos/tank. Water crabs were collected from crab markets of Cuddalore and Chidambaram. The total height of the tank is 5 feet and the water depth is maintained at 2.5 feet. Water exchange is done daily. Trash feed is given @ 10% body weight of the crab. Feeding is done twice a day. The culture period is 45 days. The net profit was shared among the WSHGs group members in this village.

SEABASS NURSERY REARING IN HAPAS

Asian seabass *LATES CALCARIFER* is an ideal candidate species suitable for brackishwater aquaculture either in ponds or in cages. Seabass can tolerate wide range of salinity from 0-40 ppt and can be farmed in marine, brackish and freshwater conditions. Nursery rearing of seabass is an important component of farming practice, where the seabass fry is reared to fingerling size in net hapas, ponds and tanks. Hapa nursery rearing can be done either in open water bodies or in 1.5 m pond system having minimum of 1-1.5 m water depth. In hapas (2 m3) size. seabass fry of 1-1.5 cm size can be stocked @ 500 numbers /m2 and reared from 45-60 days. Asian seabass can grow above 1.0 kg in 8-10 month period and they can fetch Rs.250- 350 per kg depending upon the size.

After 60 days rearing, seabass fry can attain the fingerling size of 6-8 cm, when fed with either trash fish or pellet feed @ 10-15% body weight daily in two

rations. In hapa rearing, seabass seed have to be graded weekly twice in order to separate the shooters and to maintain uniform size. Regular grading would help in non occurrence of cannibalism, which results in improved survival rate. After nursery rearing, farmers can benefit with expected profit of Rs.6-10/piece and can earn monthly income Rs.10000-20000. Small scale farmers and tribal fisherfolks self-help groups can take up seabass nursery rearing as a livelihood option.

Ornamental fish trade is a multi-billion dollar global industry propelled by enormous consumer demands since the interest among the people for aquarium keeping is increasing every year. Development of breeding technology for these species would provide a source of income generation activity for rural poor.

CIBA has developed breeding and juvenile production technology for spotted scat *Scatophagus argus* under controlled conditions. Being omnivore, scat can consume benthic and filamentous algae, detritus matter, and zooplankton. After 1.5cm it can easily accept low protein formulated feed as dough. Since, scat can tolerate wide range of salinity from 0-35 ppt, it can be reared in marine, brackish and fresh water aquaria. Farmer can stock 1.0 cm size scat fry either in hapas/tank or in ponds for marketable size production. It can be stocked @ 500 numbers/m2. Scat fry can be fed with low protein artificial feed @ 8-10% body weight daily in two rations. The fry can attain 1-2 inch size in 45 days culture period with 70 -80% survival rate. Juvenile scat (1-2 inch) can fetch Rs.30-50/piece in retail market and fetch higher prices in the international market. Small scale aqua farmers and women self-help groups can take up scat rearing as backyard homestead activity as source of income generation and can earn Rs.8000 - 12000 per month.

POLYCULTURE OF CRAB & SEABASS IN COMMUNITY POND

In a community pond of 2.0 ha, with a water depth of 0.5 to 1.2 meter, temperature and salinity as 28-32°c and 30 - 45 ppt. a polyculture demonstration of mud crab (*Scylla serrata*) and Asian seabass (*Lates calcarifer)* was conducted. The entire pond was fenced by the nylon net to prevent escape of crabs from the pond. A total of 2000 nos. of seabass fingerlings at a cost of Rs. 15/- per fingerling with 6-9 cm total length and 4-6 g body weight and a total of 1048 nos. of crabs (249.2 kg) ranging from 100– 450 g of size at a cost of Rs.450/kg were procured

and stocked in this pond. Locally available low value fish (like *sardines, terapon* spp, *Tilapia, Eel* etc.,) procured from the local market were cut into small pieces and fed to crab and seabass. Feeding was adjusted based on the standing biomass and fed @ 8-10% of the boy weight of the stock.

Regular sampling of the seabass fishes and crabs were carried out once in 15 days to assess the growth and to check the health of the stock. A total of 217 seabass juvenile fishes and total weight of 159.5 kg of crab was harvested and total amount of Rs. 2,33,908/- was realized out of crab and seabass sales from this trial. A total of 147 irular tribal people both men (82 nos.) and fisherfolks (65 nos.) participated in this programme. Bank accounts were opened for the beneficiaries to manage the investment and profit. This intervention proves to be a good model of supplementary revenue generation portraying the community participation in adoption of common water bodies for fish farming in a community pond for fisherfolk.

FARM MADE FISH FEED PROCESSING

Aqua feed forms the essential component in all fisheries sector. Trash fish availability is expected to become a major constraint in many countries. The increasing scarcity of traditional fish foods such as trash fish and the high cost of available supplies make their continued use uneconomical. Artificial feeds, based mainly on feedstuffs of plant origin which are less expensive mixed with proper balance of nutrients, produce comparable results

CIBA aqua feed is produced using farm model fish feed unit and also largely using indigenous raw materials. Because of this the cost of the feed produced has an edge over the commercial imported feeds. A good hygienic, nutritious and quality feed can be produced using this farm model fish feed unit. Time and energy can be saved. Labour cost can be reduced. Fresh feeds can be prepared according to the requirements. The unit can be easily operated by the fisherfolks . It gives good nourishment and high survival rate to aqua fish, shrimp and crabs. Farm made aqua feeds are easily digestible by the animal. Feed possess good water stability. It can be stored for 2 months. Cost of one farm model aqua feed unit is Rs. 4 - 5 lakhs (INR). Capacity of this unit is 150 - 200 kg / day. Feed can

be stored for 2 months. Cost of the feed is Rs. 30 to 35/- Kg (INR). Aqua feed technology is a viable alternative livelihood option for the fisherfolks. They can take up this avocation and start their enterprise on a small scale level.

OTHER ALTERNATIVE LIVELIHOODS

JELLY FISH PROCESSING

Jelly fishes are free-swimming members of the phylum Cnidaria. Jelly fishes are found distributed in oceans from the surface to the deep sea. Jellyfish production is the major occupation carried out among coastal sectors especially among fisherfolks during jelly fish season. This avenue generates additional income for their families.

Fifteen coastal villages around Pulicat Lake, Tiruvallur district, TamilNadu, are involved in collection of 'Jelly Fish called as 'Soori' in Tamil during jelly fish season. These fishermen use small mechanized boats for this venture. Jelly fish is collected using (Scoop nets). Jelly fish processing provides employment for 75 fisherfolks and 100 men of Thonirevu village. Jelly fish (raw) is sold @ of Rs. 500/- per box. The price varies according to the agent. The middlemen processes the jelly fish and sends the processed jelly fish to the agent. Further, it is sent to the exporter for export. Jelly fish are sold at a profitable rate according to the quality. The production cost for 1 box (80 kg) of jelly fish is Rs 1000/- and the selling cost of 65 kg of edible jelly meat is Rs 2500/-.

Local fisher folk opine that, only after tsunami there have been large quantity of jelly fish occurrence in their area. They also opine that during the occurrence of jelly fish in the lake the availability of fish is more. This is because; the fish in the lake lays its eggs on the jelly fish. If proper technical knowledge on jelly fish processing and marketing is given to these fisherfolks of this village this will facilitate extensive marketing of jelly fish and thereby give more employment opportunities to the fisherfolks of this village. Jelly fish processing serves as an alternative livelihood to fisherfolks of Pulicat, Tiruvallur district.

NEERIS AND MOLLUSCAN COLLECTION

'Neeris' polycheate worm collection from dried ponds and non- stocked shrimp farms. Fisherfolks participate as families in *Neeris* worm collection and supplies the collected worms to shrimp hatchery as a feed for the shrimps. These worms are having a borrowing nature and it is 1-6 ft in size. Sardine fish is crushed in water and sprinkled in the areas were *Neeris* worm is collected. This smell attracts the Neeris worm to come out of the holes. This facilitates easy collection. Live *Neeris* worm is marketed @ Rs.1000/ kg and dead worm is marketed @ Rs. 600/kg. *Neeris* is marketed to AP and Kerala.

MUSHROOM FARMING INTEGRATED WITH ORNAMENTAL FISH FARMING

Mushroom farming integrated with ornamental fish farming is practiced by aqua farmers in Kancheepuram district, TN. Mushroom production enhances farm waste utilization. Waste materials (paddy straw) are decomposed and converted into rich edible food. Oyster mushrooms are produced out of paddy straw. Mushrooms are called vegetable mutton. Mushroom tastes like Non-vegetarian food. Rich in protein and amino acids. Cholesterol free food (zero percentage). Low cost investment, self-employment activity in Rural and peri-urban areas. Enhances easy digestion in human body because of rich in fiber. Portable food for irrespective of ages (6 – 60). Small scale farmers and tribal fisherfolks self-help groups can take up mushroom farming as backyard homestead activity as source of income generation and can earn Rs.350- 400/- day from a mushroom shed of 10x15 ft size shed. . As an alternative livelihood WSHGs of Kancheepuram district practise mushroom farming integrated with ornamental fish farming.

CONCLUSION

A large number of poor fisherfolks are engaged in traditional aquaculture activities and make an important contribution to the rural economy. Fisherfolks earn a significant supplementary income from these activities and increase the family income considerably. Fishferfolks need an alternate occupation apart from their normal fishing, fish sales and marketing, due to depletion of natural resources and

low fish catch in the sea. Brackishwater areas like lagoons, estuaries and creeks available in the coastal areas can be well utilized for brackishwater aquaculture technologies and other alternative avocations. Brackishwater aquaculture technologies and other alternative avocations transferred to coastal population, who were suffering in the post tsunami period, seemed to be a blessing for their living. If these technologies and avocations are adopted by fishferfolk it can very effectively become a viable enterprise for their livelihood improvement. The adoption of technology among the coastal fisherfolks implemented by CIBA will also help generate additional income and savings, which will increase the level of self confidence among the fisherfolks to become successful entrepreneurs in the future.