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AQUACULTURE ASIA

Community based integrated fish-duck farming, India

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Fish marketing, India

Pond beauty contest

Aquaculture Asia

is an autonomous publication that gives people in developing countries a voice. The views and opinions expressed herein are those of the contributors and do not represent the policies or position of NACA.

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NACA

An intergovernmental organisation that promotes rural development through sustainable aquaculture. NACA seeks to improve rural income, increase food production and foreign exchange earnings and to diversify farm production. The ultimate beneficiaries of NACA activities are farmers and rural communities.

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Aquaculture feed supply chain attracting scrutiny

Labour issues in the seafood industry continue to make news headlines for all the wrong reasons. Actually it is the whole illegal, unreported and unregulated (IUU) fishing issue of which labour abuses are just one component. However, IUU fishing and labour abuses tend to go hand-in-hand.

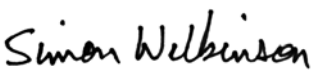
From the perspective of the aquaculture industry (and acknowledging that labour issues are not confined to the fishing industry) the main concern for aquaculture in relation to IUU fishing relates to feed ingredients. We have seen one recent case where a prominent manufacturer of aquaculture feed was found to have sourced fishmeal from fishing vessels associated with forced labour practices. Shrimp farmers that bought feed in good faith from what they thought was a reputable source suddenly found themselves and their produce being tarred with a very dark brush indeed.

To their credit the company looked into its supply chain, identified some cases of forced labour and terminated relationships with many of their suppliers and third parties to reduce risk and to improve traceability and transparency and hence public confidence in their supply chain. I hope that other leading feed manufacturers will follow suit.

Regular readers will know that I am something of a critic of aquaculture certification schemes. To my mind you can basically divide aquaculture certification issues into i) things that require regulatory oversight by government (eg. food safety, environmental impact) and ii) things that don't (eg. "organic" aquaculture). Labour abuses lie firmly in the regulatory camp as far as I'm concerned. It's an area where non-compliance requires a big stick and legal sanctions approach rather than denial of use of some logo.

By the far the best way to solve this problem would be to cut off supply of fishmeal from IUU sources altogether. Unfortunately dealing with IUU seems to have involved never-ending international wrangling, conventions, agreements, committee meetings and threats by trading partners. After more than twenty years of effort the problem doesn't seem to have been solved and frankly progress seems to be rather disappointing, given the amount of effort expended on it. Nor is it likely to get better, in my view, until states start cooperating on a programme of board-and-inspect at sea.

On another subject, this issue marks the last printed edition of Aquaculture Asia Magazine. I hope that you have enjoyed your paper copies, but from here on the magazine will be distributed in electronic form only by download from www.enaca.org.



AQUACULTURE ASIA

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Pond beauty contest, Ram Kumar and social development

Shailesh Gurung

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A land-locked country, the hills and mountains of Nepal occupy almost two thirds of the country's total area. Nepal has abundant inland water resources, including 6,000 rivers. As the majority of Nepalese farmers are presently smallholders unable to generate marketable surpluses and therefore remain at subsistence level, fish raising has been identified as a priority activity, generating high income at low cost over a short time span. Fisheries are considered one of the simplest and most practical solutions to the malnutrition problems of poor rural families. The development of fisheries in Nepal is expected to play a vital role in consumption, improving GDP, providing employment opportunities, income generation and favourably shifting the balance of payments. The inherent shortcomings of subsistence farming in Nepal have hindered the increase of efficiency in the agricultural sector and have deprived the farmers of cash income. Fisheries can be effective as a means of supplementing agricultural activities to generate cash income. Moreover the fisheries sector provides employment to the under-employed labour force of rural Nepal (Shrestha, 2003).

Nepal is deprived of any oceanic resources and overwhelmed by mountains, which comprise about 83% of the total land mass. Approximately, 5% of the total area of the country is occupied by different freshwater aquatic habitats. In general, the aquatic habitats and fish species can be viewed as prospects for fisheries and aquaculture development in the country. This also implies that aquatic resources located at different altitude and climatic zones can offer potential for different fisheries and aquaculture activities in Nepal. Fishing is traditional in Nepal but modern aquaculture techniques for fish production started since 1950s. It is speculated that this high fish diversity in the country is due to the diverse agro-ecosystem zones providing suitable habitats for different fish species (Gurung, 2003).

Total fish production of Nepal is estimated is 57,520 metric tonnes, with almost 60% of fish produced from aquaculture (Mishra, 2015). Many farmers in developing countries struggle to make a living from small-scale extensive farms and are vulnerable to food insecurity. The intensification of farm production often depends on the availability of external inputs such as mineral fertiliser, feed or pesticides. While this may improve productivity, it often has negative environmental effects and increases the risk for the farmer due to a higher capital investment under uncertain production conditions. Especially in densely populated Asian countries , there is no or very little scope to further expand farming area so

Sharing happiness after fish harvesting.

Regular monitoring of IFCAS.

Harvesting bottlegourds hanging on the trellis.

Awards at the Farmers Field Day.

feeding a growing population has to be accomplished by improving the productivity of currently farmed land. Integrated aquaculture–agriculture (IAA) offers an opportunity to increase farm-productivity for poor small-scale producers who are not well connected to input and output markets. It has been demonstrated that IAA technologies – which make use of on-farm synergies of crop and fish farming – can lead to improved efficiency, productivity and ultimately higher income of farmers (Dey et al., 2007; Karim, 2006; Nhan et al., 2007). Both the increased availability of fish as source of animal protein as well as the higher income subsequently result in higher food consumption and better nutrition of the household members.

Aquaculture and community development

Rupandehi District is located in south-western Nepal. The district is god-gifted with the number of natural water resources such as Tinaau, Rohini, Daanav, Kanchan and a multitude of riverines and rivulets linked with the Himalayan territory in the northern part of the nation (DDC, 2010). This district is located from 100-1,219 metres above sea level (Fishery Profile, 2010). The main benefit is plain areas comprising the whole district with a regular artisanal water supply. It is renowned as a fish pocket within the nation and government of Nepal just launched a national level program in Chapiya of this district promoting is as an eco-aquaculture tourism area. Many promising fish farmers have been awarded at the national level with high fish production per unit of pond area from the government. This district is recognised as a fertile area for aquaculture development.

At present fish imports to Nepal exceed exports. India is the major partner in fish trading. Being an open border system with India, more than 60% of fish commodities are imported from India both legally and illegally. Furthermore, consumers are deprived of consuming formalin treated long day travelled fish in the local markets as well. If a proper aquaculture management system will be applied, then there is no doubt of successful commercial aquaculture development. Moreover, the Fishery Department of Nepal has launched a Fish Mission programme in this district which is boon to the farmers for improving aquaculture development. Along with this EU funded Agriculture and Nutrition Extension Project has also been working in this district since 2012 on different disciplines of agriculture and nutrition and aquaculture is one of them. Now this project has also added bricks in the development process of the aquaculture sector by mobilising and capacitating poor farmers with different interventions and technologies.

Ram Kumar, social empowerment and enablement

Ram Kumar Tharu, a physically disabled farmer, lives in Shiktahan of Rupandehi District. In the past, he worked in different NGOs as a community mobiliser. Now he is acting as a prime fish farmer with the leading role in different social activities in his area. With the ANE-Project, he is actively

Farmer and his wife picking bitter gourds.

involved from group formation, community mobilisation, excavation of ponds, business plan development, thematic group meetings, collection centers and cooperative as well. He has utilised his pond dike growing different vegetables on a trellis over the water which is quite inspirational to the other farmers living nearby him. He has cultured not only carps but other local native fish species in his ponds. He has collected three quintal of bottle gourds, half a quintal of bittergords and some other green vegetables from merely his two katha of pond dike [1 quintal is ~45kg; 1 katha is ~ 338.6 square metres]. He demonstrated to the other farmers how he can properly utilise his only ten percent of dike area judiciously.

Ram Kumar has also set up a cage cum vegetable culture system, namely IFCAS, with technical collaboration of the Worldfish Center, BAU and CEAPRED through the ANE-project. Now he is rearing fingerlings in the cage and growing vegetables in the pit established in the cage. Locally the technique is called “jhula bagaicha” (floating garden). He has been able to develop his pond as a resource center in this area where he demonstrates low cost technologies using locally available resources to other farmers. Furthermore, he is very active and innovative. He has set up a water fountain in the upper portion of the cage for easy accessibility of aeration and dissolved oxygen. He has also established a simple feeding tray system to prevent wastage of feed. This kind of simple device has deeply influenced the farmers so far. He has placed water hyacinth within the four corners of a bamboo frame with the objective of improving the water quality.

Ram Kumar has mobilised the women farmers’ group of his village in community pond management and restoration processes. Now the women farmers’ group has rented a community pond of one bigha [~0.67 ha] from the Village Development Committee and been rewarded with a good fish harvest generating 300,000 rupees of income. Furthermore, women farmers’ group has started saving and credit in his direct initiative. With his leadership, a collection centre for fish and vegetables has been established in Sahdwaniya Bazaar nearby his home. His team has been able to covert the Market Planning Committee into a cooperative and collected 150,000 rupees from the Village Development Committee. It is a great leap that they have assumed it towards community development processes.

Ram Kumar is the local service provider of ANE-Project and organises many capacity building training courses within the community. He was awarded with first prize in a pond beauty contest in Farmers Field Day, organised by the ANE-Project last March 2014.

Conclusion

Aquaculture development in poor farmers’ context is only fulfilled their dreams with participatory approach, active participation of community people and proper resource utilization. Effective aquaculture resource management with integrated approach will help the poor farmer to overcome their livelihood status and food insecurity problem exists in the community level of rural plain areas of Nepal.

Acknowlegment

Thanks goes to the EU funded Aquaculture and Nutrition Extension Project in Nepal and to progressive fish farmer Ram Kumar Tharu for his untiring effort that could make it happen in the present time. Special thanks go to Murshed Khnodkar E-Jahan, WorldFish Center, Bangladesh for his creative feedbacks and critical comments during the course of writing. Undoubtedly my sincere thanks go to Mr Narayan Pandit, Assistant Professor, IAAS, Paklihawa, Bhairahawa, Nepal.

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Culture modes of giant freshwater prawn in Yangtze River Delta for early harvest

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Giant freshwater prawn *Macrobrachium rosenbergii* is one of the most commercially cultured crustaceans in the world. It has been grown in China for nearly 40 years since it was first introduced from Japan in 1976. Freshwater prawn farming was very popular in many regions in China especially in Yangtze River Delta-the most important giant freshwater prawn farming areas, as many local farmers regarded the farming of the giant freshwater prawn as a good way of making money. Yangtze River Delta produced 85,195 tonnes of M. rosenbergii in 2014, which represents over 60% of the national giant freshwater prawn production. The contribution of giant freshwater prawn farming is important to local farmers for livelihoods and income.

Traditional giant freshwater prawn farming can be operated during the middle of May to early October (five month culture period) thus only one single crop can be cultured in a year in the Yangtze River Delta due to temperature restrictions. However, local farmers adopted the boiler and greenhouse covered with plastic film to raise water temperature. So farmers could stock prawn seed into nursery ponds in early spring (middle March) two months earlier compared to traditional culture methods. This farming practice has made it possible to extend the culture period and achieved remarkable expansion since the early 20th century in Yangtze River Delta. The duration of nursery period usually last for about two months according to the outdoor water temperature, when it is suitable for pond grow-out.

Greenhouse and facilities

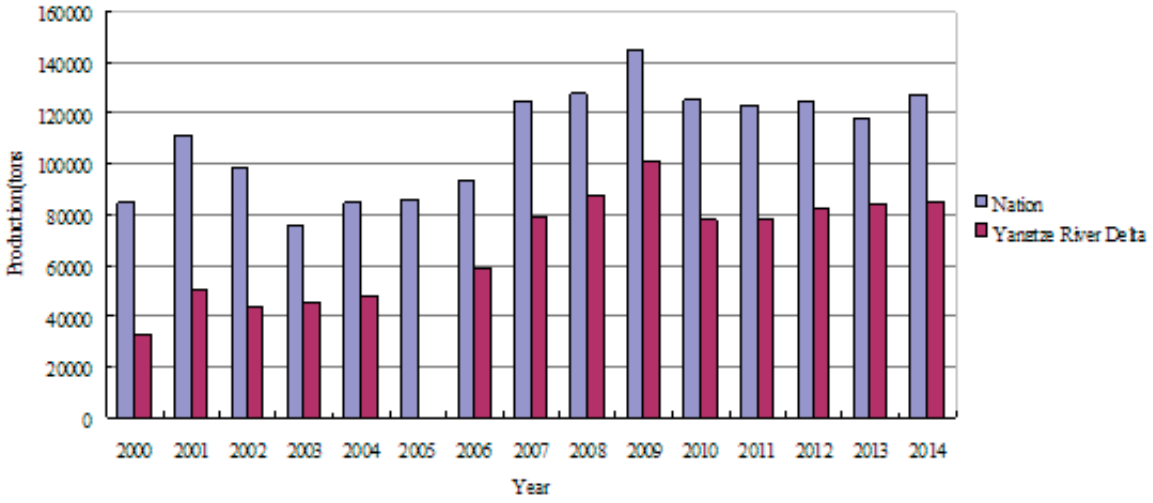
The nursery systems consist of a greenhouse, heating device and aerating apparatus. The greenhouse is placed inside culture ponds having rectangular shapes, with areas varying from 300 to 600 m^2 according to the number of total prawn seeds stocked into culture pond. The main structure of greenhouse is typically built with bamboo and steel pipes, the structure oriented east-west. The vertical bamboo and bent galvanized steel pipe both serves as the structural support of the greenhouse are bound by iron wire. The ropes are bound down around the cambered surface on the greenhouse which is covered with a layer of transparent plastic film. This work is usually done one month ahead of seed stocking time.

The aeration system consists of an air compressor and diffusing equipment. Diffusing equipment is composed of air stones or micro-bubble generators and air transporting soft pipes. The oxygen level is generally kept above 5 ppm. A simple coal-fired boiler and heat pipe comprise the heating system. Water temperature is generally heated above 26°C in the nursery duration. Heating of water can be stopped in the late May as the water temperature rises above 20°C.

Water quality control

The PLs stocking density is high in nursery period, as poor water quality often result in low survival rate in nursery ponds, so water quality plays an important role in this phase. The use of probiotics in nursery period is widely accepted by local farmers. Before stocking, the nursery pond is filled with freshwater water pumped from nearby rivers. Most farmers use probiotics (specifically, algae growth regulators) to stimulate the initial algae bloom, then other probiotics are used to improve water quality and stimulate the immunity of post larvae. The use of probiotics is perceived by farmers to increase survival and growth in the nursery phase, so the use of liquid fertilisers and commercial microbial probiotics is very popular. Pond water is partially exchange during the nursery period according to water quality.

Figure 1. Annual production (tons) of farmed *Macrobrachium rosenbergii* in China.



Common greenhouse used as nursery pond in Yangtze River Delta.

Management strategies

Stocking densities depend on the total seed will be stocked into grow out ponds. It typically varies from 1,000 to 3,000 PL/m^2 in outdoor nursery greenhouses. The addition of substrates can reduce cannibalism and provided more space for prawns, so the survival rate of prawns can be increased by using artificial substrates. Substrates used mostly are constructed of bamboo branches bound into one bundle immersed below the water surface.

The boiler used to heated water.

Commercial Macrobrachium rosenbergii feed.

Generally, if PL are stocked directly in grow out ponds in late May, prawns will be harvested in early October. Thus the grow-out season is short at 120-150 days in the Yangtze River Delta region. However, the stocking time can be brought ahead two months with the application of greenhouse and nursery facilities, so larger juveniles can be stocked into grow out ponds through 60 days nursery duration as grow-out season can be extended to 180-210 days.

From the middle of March, the first batch of PL are stocked into nursery pond. Water temperature is maintained above 25°C by operation of the boiler in this phase. After stocking, PL are provided with pellet commercial feed two times every day. After one month, heating is stopped. The water temperature can be above 20°C due to heat conservation by the greenhouse. A second batch of PL are stocked into nursery ponds at this time. When the outdoor water temperature exceeds 20°C in late May the plastic membrane covering the greenhouse is removed and all juveniles are stocked into grow-out ponds. A third batch of PL is added into grow-out ponds if necessary. After nursery phase, the average stocking density is generally 100 juveniles/m^2 in culture ponds.

Harvest

After one month of rearing, ponds are first harvested in late June using seine nets. Larger prawns reaching 12 grams/individual are selectively removed by hand for sale then the smaller ones are returned to grow-out ponds for further rearing. Marketable animals are harvested using seine nets every 10-15 days. Periodical removal of larger prawns gives the smaller ones a chance to grow to commercial size. At the final harvest time in early October, ponds are drained and all prawns are sold. The average production of this culture mode is 5, 250 kg/ha. Higher production can be obtained by skilled farmers.

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Liquid fertilisers and commercial microbial probiotics used in prawn nursery period.

Air compressor.

Farm workers are examining growth performance of prawns inside nursery pond.

Fish marketing in Kashmir, India - a case study of Srinagar

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Fish is one of the delicacies enjoyed by people of Kashmir. As in many other parts of the country, fish is typically sold by fisher women on footpaths and the lack of organised fish marketing arrangements is conspicuous in its absence.

Fish sold in Kashmir are transported from various sources. Fish of the Wular Lake, the Anchar, the Dal Lake and lower Jehlum are sold by local fish traders. In addition to the arrival of local fish, owing to increasing demand, inter-state fish from neighbouring states such as Punjab and Delhi are also sold in local fish markets in Kashmir. Despite this increase in consumption, no proper marketing arrangements to ensure the freshness of the fish are available, leaving much to be desired. Fish are kept by retailers in specially designed circular open mouthed CGI tubs. As far as grading and weighing are concerned traditional methods such as “trakker” are used instead of modern digital balances. Owing to this practice the consumers are short changed on the weight of the fish they buy. This non-use of electronic balances arise from the traditional mindset rather than any ulterior motives in the use of new technology for weighing the fish.

Fish markets in Srinagar City

Srinagar is the summer capital of the Indian state of Jammu and Kashmir having an area of 294 square kilometres. It lies in the Kashmir Valley, on the banks of the Jhelum River, a tributary of the Indus. The population of district is around 1.236 million (Census 2011). Moreover if 60% of the total population of the Srinagar city is taken as fish consumers (approx. 594,000), then the total demand of fish may be estimated to be around 3,849,100 kg. As currently available fish supplies from both local and imported sources is estimated at 2,230,500 kg, unmet demand may be estimated to be in the vicinity of 1,618,600 kg or approximately 1,618 tonnes (Department of Fisheries, Srinagar). In order to meet the estimated demand for fish necessary steps are required to be taken and developing a good marketing chain is necessary to minimise post-harvest losses. In Srinagar City many local vendors, especially women, go door to door selling fish. Some of the well-known markets are as follows:

Khaniyar Local Vendor.

Chattabal Fish Sale Centre

The Chattabal Fish Sale Centre has been in business even before 1947. This centre acts as the nodal wholesale fish market in Srinagar District where fishes from different areas and districts are bought and sold. Fish from Jammu Division, Ganderbal, Bandipora, Baramullah, Chandigarh and Delhi are also traded here regularly. Even though this centre has a holy history, the arrivals of fish, their transfer, storage and packing are done in a very unorganised and unhygienic manner on the roadside. Being a conduit market the Chattabal Market fish are redistributed and sold in different mohalla (areas) by headloads carried by fish vendors, both men and women. It is to be noted that 5,000kg of fish of different species from various locations are received here and then redistributed. Besides local sales in Srinagar mohallas fish is also sold by retailers in places such as Darish Kadal, Amira Kadal and Maharaj Bazar, Jamia Masjid, Hazratbal, Dal Gate, Khaniyar and Nawabazar.

Darish Kadal Retail Fish Centre

The Darish Kadal fish sale centre is also located in Srinagar. This is basically a retail market and in the process of sales the fish are de-gutted and the offal is dumped in Jehlum River, which adds to the existing pollutionr. One of the unique features of this market is that the fishes are placed on big trays or wooden planks and are left uncovered by the vendors, which is a pointer towards the unhygienic and improper way of retailing fish.

Amira Kadal Retail Fish Sale Market

This market is one of the biggest in the Srinagar city. This again is a roadside market and is controlled by 20 fisher-women who sell their fish in tubs sitting on the Amira Kadal bridge. It may be noted that these fisher women enjoy exclusive rights for selling their fish from this particular location and it connects the two parts of the city. Any other aspiring fisherwomen that would like to use this location for selling their fish is summarily evicted by the incumbents who have operated from this market for number of years. This market also commands fish arrivals from Chattabal and Jehlum. As in Darish Kadal market, the Amira Kadal fish

vendors also de gut the fish and drop the offal in the Jehlum River. The Amira Kadal Fish Retail Market is also famous for dry and smoked fish.

Maharaja Bazar Retail Fish Market

Here also the market is located on the roadside. However there is only one shop which sells fish brought from outside the valley. The other shops sell fish which are sourced locally.

Batamaloo Retail Fish Market

This market is located ideally near the Srinagar City bus stand. Owing to its strategic location, there is a large amount of foot traffic in this market which sell both endemic and exotic varieties of fish.

Soura Retail Fish Market

This market services Pandach, Ahmed Nagar, Umerhair, Buchpora in the North, Illahi Bagh, Mala Bagh in the North east and Ontabhawan and Noushera in the East. This market sells fish sold from the Anchar area. In addition to this source, carp, Schizothorax and Indian major carps are also sold here.

Hazratbal Dargah Retail Fish Market

This market services the population of areas including Rainawari, Saidakadal, Nigeen, Lal Bazar, Habak, Zakura, Batpora, Shalimar and Harwan. Both Teilbal and Dal Lake fishes are sold in this market. This is also an unorganised fish market. But it gains its significance owing to the presence of Hazratbal Shrine which is thronged by hundreds of thousands of people on festival days and on Fridays.

Jamia Masjid Nowhatta Retail Fish market

People residing in and around Jamia Masjid buy their fish from this roadside market. Fish from Dal and Teil Bal including species like rohu, catla and mrigal are sold here.

Dal Gate Retail Fish Market

The location of the market is near a hospital and fisherwomen of the Dal sell their fish in this market. Both dry and smoked fish are also sold here.

Khaniyar Retail Fish Market

The Khaniyar Retail Fish Market services the Dastegeer Sahib locality. Like the Dal Gate market, the Dal Lake fisher women also use this market to sell their fish.

Nowhatta Fish Market.

Qamarwari Retail Fish Market

This market located in Qamarwari Chowk is used by the fisherwomen from Bandipora to sell their fish.

Marketing channels and margins of Dal Lake fish

60 fishers were contacted to understand the marketing channels and margins of Dal Lake fish among the various markets in Srinagar district using a pre tested questionnaire. The following analysis is restricted to serve as a benchmark for transactions of fish both in terms of quantity as well as in value in the Fisherman Colony of Srinagar. This transactional analysis is only indicative and provides a bird's eye view of such transactional deals that would be happening in similar fishing colonies of Srinagar.

Owing to the inadequacy of supply of local fish to the various retail markets in Srinagar District these markets were also supplied by fish obtained from neighbouring states. These inter-state fishes were brought into the market by middle men and then retailed by the local fisherwomen. One of the main features of changes in consumption patterns and demand for fish in the valley may be attributed to the seasonal fluctuations in the arrivals. Arrivals are always heavy during summers and in winters there is always a scarcity of supply of fish owing to severe winters.

The fluctuations in price of the species traded in Srinagar District markets is reflected in Table 1.

The table above reflects the lake gate price of the various fishes obtained by the fishers from the middlemen during summer and winter seasons. Owing to the reduction in the number of fishing trips during winter, the winter the prices of the same species are higher than that of their summer prices. The market margins of wholesalers with respect to fishes sold during summer and winter to the fishermen are as much as Rs20/kg in the case of common carp of 2-3kg size, while there is no difference in the price of the species in the winter season. Market margins are as much as Rs20/kg in the case of large local fishes in favour of fish sold to women in a lot size of 4kg/lot. But in winter despite the transactions happening in the same lot size the women need to pay Rs 60 more per kg when compared to the lake gate price of the same species prices at Rs 220/kg.

Thus the price differentials between the various species across seasons and cost advantages/neutrality in transaction margins are reflected in the other four species like common carp of medium size, small size, local medium-sized fishes as well as local small-sized fishes. It should be noted that the lot size in respect of fish purchased from fishers by the middlemen was a minimum quantity of 15kg every four days while the transaction quantity of fish sold by the wholesaler to the fisherwomen was in lot sizes of 15-20kg.

Owing to the insufficiency of local fish supply to the markets, fish from Delhi and Punjab are channelled into the fish markets in the valley. About 200kg of fish accommodated in 48 boxes and brought in one trip are sold within three days. In this process the middlemen earns Rs 20,000/vehicle and a secure payment is paid by means of a demand draft. Personal communications during this survey revealed that such truck loads of fish arrive in the valley three times a month.

Qamarwari Local Vendor.

Soura Fish Market.

Table 2. gives the transactional values of various inter-state fishes brought into the valley. These transactions happens for species which include golden carp, grass carp, silver carp, rohu and basa. The table also reflects the purchase price and the sale price of these fishes from the inter-state fish traders to the wholesalers and from the wholesalers to the retailers. It can be noted that in general about Rs 50/kg is the market margin that is earned by the wholesaler when the sale takes place to the retailers. But in case of rohu and basa the market margin is Rs 60/kg.

Table 3 gives the transactional prices at the retailer. It can be seen from the table that maximum margins are obtained in the sale of Kashmiri common carp which fetches a margin of Rs 50/kg thus yielding a profit of Rs 500/day for 20kgs of Kashmiri common carp sold. Therefore it is obvious that in terms of volume the common carp has a highest turnover followed by the grass and the silver carp and finally by the Kashmiri common carp. Nevertheless owing to the price differentials and the demand for Kashmiri common carp in the market, the local retailers are earning Rs 500 gross profit from the sale of 10kg of Kashmiri common carp.

Conclusion

This small study was carried out in order to establish the fact that there is a grave need of organised fish markets in Kashmir. Owing to the increasing demand of fish in the valley all the resources needs to be channelled properly in order to develop a proper marketing chain. Despite this increase in consumption, no proper market arrangements in terms of organised fish markets which ensure the freshness of the fish are available. Marketing arrangements also leave much to be desired. Due to lack of proper markets and marketing arrangements the prices are fluctuating. The involvement of various institutions and NGOs can help in the establishment of organised markets. Imported fish can also be sold in separate markets. The existing markets lack infrastructure and management, so government and the Department of Fisheries with the consent of fishers can take up the charge to modify the fish markets and marketing channels in Srinagar.

Table 1: Species, prices and quantity transactions of fish in Dal Lake fish.

Species/Size	Lake Gate Rs/kg		Wholesale Price Rs/kg	
	Summer	Winter	Summer	Winter
Common carp /big (2-3kg)	170	190	190	230
Local/big	200	220	180	280
Common carp /medium (0.5-0.9kg)	110	130	120	200
Local/medium	120	150	140	180
Common carp /small (<0.5kg)	80	100	100	120
Local/small	80	100	90	120

Table 2: Transactional prices of inter-state fish (Rs/kg).

Species	Purchase price		Sale price	
	Small size	Big size	Small size	Big size
Golden carp (common carp)	600/6kg	650/6kg	700/6kg	750/6kg
Grass carp	500/6kg	550/6kg	550/6kg	600/6kg
Silver carp	500/6kg	550/6kg	550/6kg	625/6kg
Rohu	120/kg	180/kg		
Pakas (basa)	120/kg (ws*) 300/kg (rt*)	180/kg		

*Small size <2-3kg, Big size >3kg, *ws = wholesale, rt = retail

Table 3: Transactional prices at the retailer (Rs/kg).

Species	Purchase price	Quantity sold/day	Gross margins/day
Common carp	125/kg	18kg	Rs 300
Grass/silver carp	100/kg	12kg	Rs 200
Kashmiri common carp	200-250/kg	10kg	Rs 500

Hazratbal Fish Market.

Community based integrated fish-duck farming: A boon for rural development in agro climatic conditions of Assam, India

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Focus of group discussion with beneficiaries.

Community-based aquaculture can be an effective and ideal tool for implementing scientific aquaculture programs by organising common interest groups in an informal way, utilising semi-derelict and swampy water bodies and community village ponds. In community-based aquaculture, common interest groups work together by sharing equal responsibilities irrespective of sex and age. Such working groups are essential for aquaculture operations, which involve construction of new or renovation of old ponds, eradication of aquatic weeds and management of culture operations which include fertilisation of ponds, feeding fish, monitoring growth, security, harvesting and marketing, etc.

Livestock production and processing generate by-products that may be important inputs for aquaculture. The main linkages between livestock and fish production involve the direct use of livestock wastes, which function as fertilisers to stimulate natural food webs in fish ponds. Integrated fish farming techniques have been successfully applied in other developing countries and impressive yields have been reported.Today, aquaculture production stands at 50:50 to capture fisheries on a global scale due to the technological advancements such as hybridisation, genetic engineering, formulated diets and integrated agric-aquaculture. In Asia including certain states of India, aquaculture is integrated with livestock providing millions of livelihood opportunities4.

However, Assam is yet to report any significant quantities of integrated aquaculture products despite of having huge natural potential. Considering the economic and ecological contributions of integrated livestock-fish farming as a means of enhancing rural livelihoods, the present investigation has been undertaken to evaluate benefit of duck cum fish farming carried out in a society pond of Gandhibasti village, Malegarh, Bongaigaon District with active participation of villagers (SC community).

Brief description of the community

Gandhibasti village of Malegarh, Abhayapuri, Assam belongs to a fishers community. The main profession of the community is fishing and 95% of the residents are engaged in fishing.

The population of the village is approximately 450 distributed amongst 60 households. The people belong to scheduled castes and the majority of them lack a basic education. About 95% households of Gandhibasti village are below the poverty line. The literacy rate of the village is below 30%. The very livelihood of the community is threatened by the leasing system of the natural water resources of Assam in recent times.

Formation of working groups

On the basis of knowledge of fish farming of the community, ten working groups (consisting of ten to twelve people) were formed in age and gender sensitive manner. For capacity building, and to develop skills, training was given to each and every group on management of the pond productivity through utilisation and recycling of animal droppings, quality control of intensive and composite fish farming for maintaining health of the fish and rearing ponds. Training also covered rearing, health management and production of eggs and ducklings. The society pond of their village, approximately 1.2 ha in size, was taken into consideration for carrying out all the activities of the objectives.

Preparation and fertilisation of rearing pond

In December the pond was drained to remove unwanted species of fish and for fertilisation of pond to enhance productivity. Depending upon the soil pH (6.7) and soil texture of the ponds (both nursery and rearing pond), cow dung and lime were applied @ 1,000 kg and 500 kg respectively. It has been estimated that the pond bottom consisted of about 60% red soil and 40% clay loamy soil. Red soils generally contain less nitrogen, phosphorus and potassium. In this context, practical training was also imparted to the beneficiaries for enhancement of nitrogen, phosphorus and potassium level of the pond utilising dry *Azolla* and cow dung. This practice was also helpful for reduction of red soil from the pond bottom, which was also ploughed to help shuffle the bottom soil and distribute the organic manure.

Construction of duckery

A duckery around 450cm x 360cm in size was also constructed in the northern side of the pond. The duckery was constructed in such a way that 50% of the area lay over the pond and 50% on the dyke. This type of construction is helpful to allow duck litter to fall directly into the pond. The frame of the duckery was made up of concrete; the roof was made up of C.I sheet. However, the wall and ceiling were made up of bamboo for good ventilation. Construction of duckery was also made by villagers themselves.

Selection & release of fingerlings

Advanced fingerlings (7-20 g in weight) of Indian major carps (catla, rohu, mrigal) and a small number of exotic carps (silver carp, grass carp and common carp) as mean for biological

Ploughing of pond bottom for proper mixing of organic manures

Release of fingerlings into the pond.

View of the duckery.

control for excess growth of algal blooms and aquatic vegetation were stocked in the month of April. Depending upon the size, shape and water retention capacity of the pond as well as the load of duck droppings, the ratio of the fingerlings (18,000) were maintained as follows: Catla : rohu : mrigal : silver carp : grass carp : common carp: 1 : 1 : 1 : 0.09 : 0.09 : 0.09.

Release of ducks

Four months after the release of fingerlings, when they had attained an average weight of 40-100 g, 80 ducklings were introduced to the duckery shed. Ducklings were 2 to 3 months in age and average weight of 0.81-0.95 kg. Ducks were fed with branded (Godrej) feed @ 50g/duck x 2 times per day. It has also been estimated that 80 ducks can yield about 3500kg/year of droppings which is found to be sufficient to increase the pond productivity (depending upon the size of the pond) and to provide some direct food for the fishes. Villagers were also trained to manage the feeding and health of the ducklings by inviting a veterinary surgeon to talk with them. The ducks were also given supplementary feeds with locally available ingredients such as rice bran, mustard oil cake, and broiler feed. These ingredients were mixed in a ratio @ rice bran : broiler feed : mustard oil cake : 3 : 3 : 1 and fed three times in a day.

Preparation of supplementary feed

To maintain optimum growth of the fishes supplementary feeding was also given from 2nd month of the release of the fingerlings. The supplementary feeds were also formulated with the locally available ingredients such as rice bran, mustard oil cake, fish meal and molasses. All these ingredients were mixed properly in a ratio @ rice bran : mustard oil cake : fish meal : molasses 2 : 2 : 0.5 : 0.25. Molasses acted as binder of the ingredients. After proper mixing of the ingredients, they were transformed into a food balls (weight: 0.5 kg) and were thrown in the pond @ 20-25 balls /day avoiding rainy days only. Initially, the balls float for about one hour then they gradually sink to the bottom. This practice was employed for proper distribution of the feeds for surface feeders, column feeders and bottom feeders.

Growth of fish

In the present investigation it has been observed that duck droppings increased the growth of all the species of Indian major carps and exotic carp. Catla growth was recorded (maximum 2.5 kg) in one year followed by silver carp attaining the weight of 1.5 kg. However, the growth of rohu and mrigal was recorded at around 1.0 kg each after one year of rearing, which indicates normal growth under the agro-climatic condition of Assam. This has also indicates that the duck droppings had no direct role in the growth of rohu and mrigal. Moreover, the duck droppings increased the zooplankton

View of the pond with duckery.

Advanced ducklings.

Mixing of feed ingredients with proper ratio.

Prepared feed.

Growth of fish after 11 months of rearing.

Fingerlings	Initial weight ± SD(g)	Final weight±SD (g)
Catla	19± 0.79	2340± 96.18
Rohu	14.5± 0.79	1180± 57.01
Mrigal	10.8± 0.57	960± 65.19
Silver carp	16.3± 0.57	1460± 41.83
Common carp	13.7± 0.57	1460± 41.83
Grass carp	16.6± 0.65	960± 41.83

population of rotifers which in turn increased the growth of catla and silver carp as both of them are surface feeders. The observed mortality of reared fishes were recorded almost nil except four individuals of grass carp which died in the later part of experiment, possibly because of the non-availability of plants in sufficient quantity.

Plankton diversity

The level of plankton biomass was estimated maximum after introduction of duck droppings (6,253u/l.) as compared to the plankton estimated before treatment (1,592 u/l). Prior to the application of duck droppings, the population of phytoplankton was estimated 698u/l and after treatment the number of phytoplankton estimated as many as 2,721u/l. The population of zooplankton was estimated 894u/l and after treatment, the number of zooplankton estimated as many as 3,532 u/l. A total of 17 genera of phytoplankton under 9 families and 28 genera of zooplankton under 15 families were recorded after treatment, however, before treatment, 10 genera of phytoplankton under 6 family and 14 genera of zooplankton under 8 families were observed. Amongst phytoplankton, the most common genera were *Chlorella sp, Spirogyra sp, Ulothrix sp, Volvox sp, Anabaena sp, Microcystis sp, Nostoc sp, Oscillatoria sp, Navicula sp, Pinnularia sp, Euglena sp and Trachelomonas sp. Whereas Daphnia sp, Moina sp, Cyclops sp, Diaptomus sp, Asplanchna sp, Brachionus sp* and *Keratella sp* were among the most abundant zooplankton genera. The importance of application of organic wastes of duck droppings in fish ponds for a steady level of primary production and which in turn influence the fish food organisms directly and growth of fish production indirectly.

Conclusion

Duck droppings act as a good fertiliser which helps in producing natural fish food i.e. phytoplankton & zooplankton. Ducks have been termed as 'manuring machine' for their efficient and laborsaving method of pond manuring, resulting in complete savings of pond fertiliser which accounts for 60% of the total cost in conventional fish culture. Ducks loosen the pond bottom with their dabbling and help in release of nutrients from the soil increasing pond productivity. Ducks increase the productivity of water, land and associated recourses; while contributing to increased food production. In integrated fish farming, crop byproducts are fed to livestock, while animal droppings go to fish ponds. Fish utilise the feed spilled by livestock, also devouring their droppings directly. In duck integration, duck get 50–75% of their total feed from the pond in the form of aquatic weeds, insects, mollusks, etc. which do not form the food of the fish.

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Gastropod and bivalve fishery of Kakinada Bay, Andhra Pradesh, India: Management and conservation issues

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Several species of shellfish, both bivalves and gastropods, are regularly fished from the Kakinada Bay in Andhra Pradesh, India. An organised ornamental shell trade and lime industry flourishes in the villages along the Kakinada Bay. The bay opens into the Bay of Bengal on its northern side and is bordered by mainland on the western side, by mangrove forests on southern side and by a narrow sand bar called Hope Island on its eastern side. The bay is shallow and large mud flats are exposed during low tides, on the southern and western sides. The total area fished for molluscs in the bay is about 100 km^2 mostly confined to the southern and eastern sides where depth is 2-4 m and there is no fishing in the northern section where the depth is more than 9 m. The bottom of the major part of the Bay is of soft fine clay with good amount of silt while the eastern side of the bay is sandy and western side is rocky (Narasimham, 2004).

The unique ecology, resources and the bivalve and gastropod fisheries of the Kakinada bay have been described in detail (Narasimham, 1973, Narasimham et al. 1984, Narasimham, 1985, Rao and Somayajulu 1996). Clam culture experiments in the Bay have been described by Narasimham (1980, 1882). In recent times, a significant decline in the landings of the commercially important bivalves and gastropods has been recorded which raises issues of management and conservation of the resources. This study presents the present status

of the bivalve and gastropod fishery of the Kakinada Bay, the management issues and conservation strategies to sustain the bay's valuable bivalve and gastropod resources.

Approach

Catch and effort data of the bivalves and gastropods fished from the Kakinada Bay was collected for 30 months (2011-June 2013) from the Chollangi and Peddavalsala landing centres of Kakinada Bay at fortnightly intervals and monthly production was estimated for the month based on the number of fishing days. Details regarding fishing, utilisation and price were collected through observations and enquiry.

Fishery

Fishermen belonging to 15 villages namely Dummulapeta, Yetimoga, Putrayapakulu, Boddu Chinna Venkatpalam, Lakshmikathapuram, Gadimoga, Bhairavpalam, Girijampeta, Yerragaruvu, Balusutippa, Kothapalem, Mulletimoga, Masanitippa, and Neelaurevu, exploit the bivalves and gastropods from the bay.

Two types of craft are used in this fishery: "kakinada nava" and the "shoe dhoni". On each shoe dhoni, 4 to 6 members live and go for fishing with ring nets and scoop nets. The fishermen also operate gill nets and drag nets for catching fish and shrimp. Generally, men operate the gear (gill nets / drag nets for catching fish, shrimps and crabs) while women and children are involved in hand picking of shells. In all, 40 men, 32 women and 90 children are involved in the collection of bivalves and gastropods from the Kakinada Bay. Fishing is carried out for 25-28 days of the month; fishing is not carried out on festival days and during unfavourable climatic conditions.

The total bivalve and gastropod landings from the Kakinada Bay during 2011-2013 was estimated at 3,192 tonnes and the total effort was 16,753 units. The production during 2011 was 1,490 tonnes which declined to 957 tonnes in 2012 and further to 745 tonnes in 2013. Effort also declined from 8,212 to 5,565 (2012) and 2,976 (2013).

The bivalve fishery of Kakinada Bay

The estimated total bivalves landed from Kakinada Bay during the study period was 1,816.8 tonnes, total effort 16,753 and the catch per unit effort (CPUE) 110 kg. The estimated total bivalves landed from Kakinada Bay during 2011 was 836.9 tonnes, with an average monthly landing of 72.5 tonnes. The total effort was 8212 units and the average catch per unit effort was 131.2 kg (Fig. 1). The species landed were *Anadara sp.* (276.65 tonnes), *M. meretrix* (72.83 tonnes), *Meretrix casta* (24.71 tonnes), *Paphia malabarica* (14.0 tonnes), *Geloina sp.* (9.3 tonnes), *Katelysia opima* (4.5 tonnes) and others (6.6 tonnes). The total clam production was 401.9 tonnes. Oysters landed were window pane oyster, *Placuna placenta* (383.8 tonnes), edible oyster *Crassostrea madrasensis* (51.2 tonnes) and other oysters (5.8 tonnes.) The total oyster production was 435 tonnes. The price of the bivalves ranged from INR 5 to 12 per kg.

The estimated total bivalve landed from Kakinada Bay during 2012 was 914.1 tonnes, with an average monthly landing of 47 tonnes. The total effort was 5,565 units and the average catch per unit affort was 99.5 kg. The species landed were *Anadara sp.* (250.6 tonnes), *M. meretrix* (120.3 tonnes), *Paphia malabarica* (28.9 tonnes), *Katelysia opima* (20.8 tonnes) *Meretrix casta* (3.1 tonnes), *Geloina sp.* (0.75 tonnes), and others (26.1 tonnes). The total clam production was 424.4 tonnes (Fig. 2). Oysters landed were windowpane oyster, *Placuna placuna* (56.4 t), edible oyster *Crassostrea madrasensis* (42.2 tonnes) and other oysters (14.5 tonnes).

Fig. 1. Bivalve & Gastropod production, Kakinada Bay.

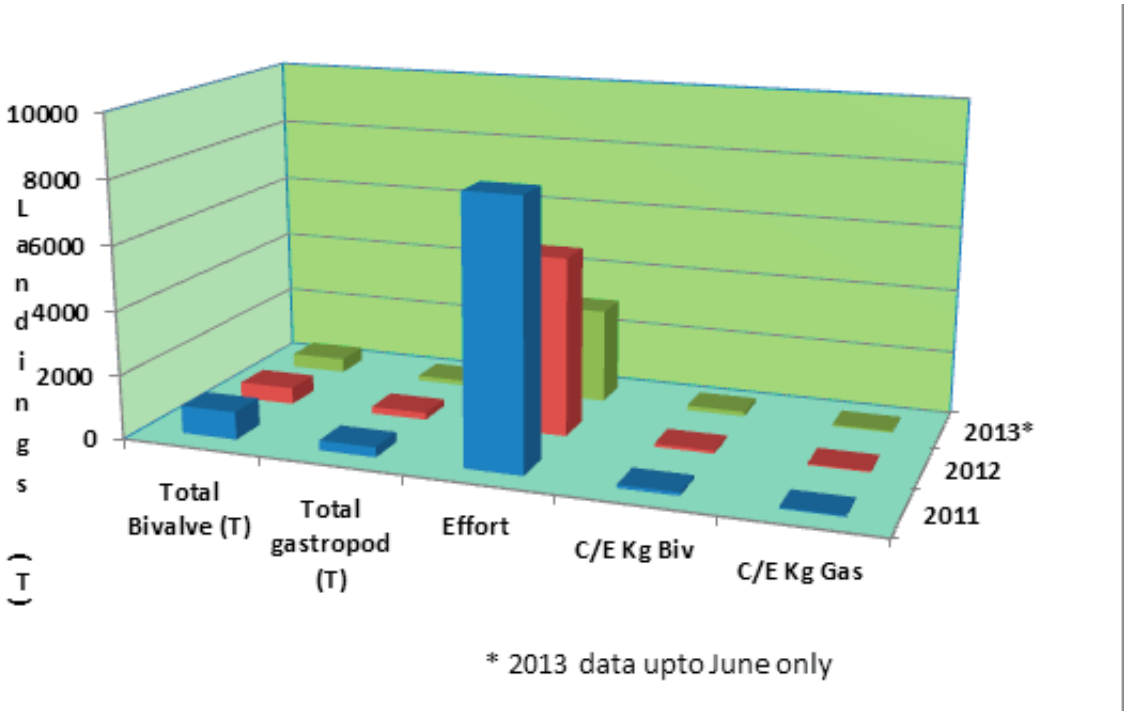
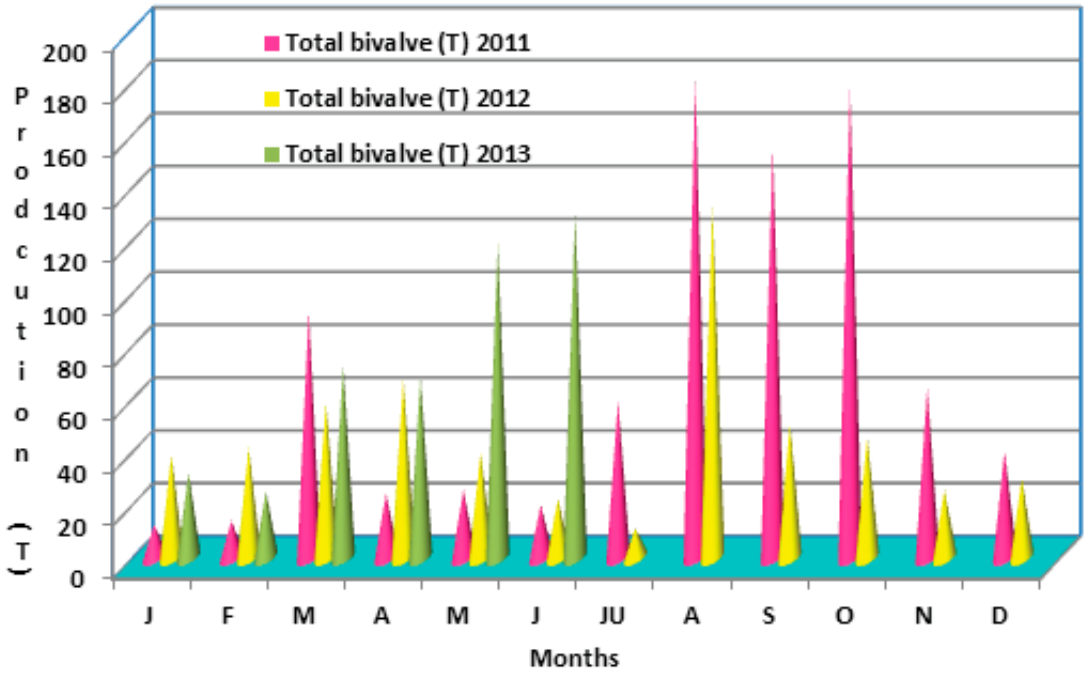


Fig. 2. Bivalves, Kakinada Bay, monthly landings 2011-2013.



The total oyster production was 504.1 tonnes (Fig. 2). The peak landings occurred during August to September (Fig.2). The price of the bivalves ranged from INR 8 to 12 per kg.

The clam production in Kakinada bay increased by 22.6 tonnes (5.6%) in 2012 compared to the previous year. The landings of *M. meretrix* increased by 47.5 tonnes (39.5%), *P. malabarica* by 14.9 t (51.6%), *K. opima* 16.3 tonnes (78.4%). However, the landings of *Anadara sp* declined by 26.1 tonnes (9.4%), *M. casta* by 21.6 tonnes (87.5 %), *Geloina sp.* by 8.5 tonnes (91.9 %) (Figs. 1, 2).

The estimated total bivalve landed from Kakinada Bay during 2013 (up to June) was 449.2 tonnes, with an average monthly landing of 47 tonnes. The total effort was 5,565 units and the catch per unit effort was 142.9 kg. The species landed were *Anadara sp.* (202.8 tonnes), *M. meretrix* (135.4 tonnes), *Paphia malabarica* (22.5 tonnes), *Katelysia opima* (18.6 tonnes) and others (12.6 tonnes). *Meretrix casta* and *Geloina sp.* were not landed during the period. However, nearly 3.6 tonnes of *M. casta* collected from Gautami River were stocked at Pedavalsala. The total clam production was 489.4 tonnes (Fig. 2). Oysters landed were windowpane oyster, *Placuna placenta* (0.8 tonnes), edible oyster *Crassostrea madrasensis* (43.3 tonnes) and other oysters (13.2 tonnes.) About 1.8 kg of *C. madrasensis* was collected from Kakinada Fishing Harbour. The total oyster production was 57.3 tonnes. (Fig. 2). The price of the bivalves ranged from INR 10 to 15 per kg.

The gastropod fishery of Kakinada Bay

The estimated total gastropod landed from Kakinada Bay the study period was 687.4 tonnes, total effort 16,753 units and the catch per unit effort (CPUE) 41 kg.

The estimated total gastropod landing from Kakinada Bay during 2011 was 328.8 tonnes with average monthly landings of 23.4 tonnes. The total effort was 5,010 units and the average catch per unit effort was 48.6 kg. The species landed were *Cerithidea fluviatilis*. (257.7 tonnes), *Telescopium telescopium* (23.7 tonnes), *Thais sp.* (15.3 tonnes), *Murex sp.* (10.3 tonnes) *Hemifusus pugilinus* (9.9 tonnes), *Umbonium sp.* (3.1 tonnes), *Dolostium sp.* (0.3 tonnes) and other gastropods (8.5 tonnes). Maximum landings were during August- September. The price of gastropods ranged from INR 5 to 8 per kg.

The estimated total gastropod landing from Kakinada Bay during 2012 was estimated at 216.9 tonnes with average monthly landings of 18.1 tonnes. The total effort was 2,976 units and the average catch per unit effort was 37.9 kg. The species landed were *Cerithidea fluviatilis*. (99.5 tonnes), *Telescopium telescopium* (26.3 tonnes), *Thais sp*. (15.2 tonnes), *Murex sp.* (20.8 tonnes) *Hemifusus pugilinus* (20.7 tonnes), *Umbonium vestiarium* (14.24 tonnes), and other gastropods (20.2 tonnes). Maximum landings were during March and August - October. The price of gastropods ranged from INR 6 to 12 per kg.

The total gastropod landings declined by 96 tonnes (31%) as against the previous year. The effort declined by 555 units (10%); however the catch per unit effort increased by 10.2

kg (21%). The landings of *Cerithidea fluviatilis* registered an increase of 141.4 tonnes (58.7 %); all other species recorded a decline in landings viz. *Umbonium vestiarium* 11.1 tonnes (78.2 %), *Hemifusus pugilinus* 10.9 tonnes (52.7%), Murex sp 10.5 tonnes (50.5%), *Telescopium telescopium* 3.3 tonnes (12.5%) and *Thais sp.* 1.3 tonnes (8.6%).

The estimated total gastropod landing from Kakinada Bay during 2013 (up to June) was estimated at 160.6 tonnes with average monthly landings of 26.8 tonnes. The total effort was 2,976 units and the average catch per unit effort was 57 kg. The species landed were *Cerithiidea fluviatilis*. (96.9 tonnes), *Telescopium telescopium* (18.4 tonnes), Thais sp. (5.9 tonnes), *Murex sp.* (11.1 tonnes) *Hemifusus pugilinus* (16.1 tonnes), *Umbonium vestiarium* (1.61 tonnes), and other gastropods (10.6 tonnes). The price of gastropods ranged from INR 7 to 10 per kg.

Utilisation

Meat is used for human consumption and also as bait for catching crabs. It is also used as feed for fattening water crabs. Shell is graded as big and small. The small shells are used in the snowcem industry while the big ones are used in the preparation of lime, which is used in shrimp culture ponds, painting of walls etc.

Blood clam *(A. granosa)* meat is sold regularly for human consumption @ INR 40 per kg at Chollangi Landing Centre along with shrimp, crab, fishes and cephalopods. The meat is also used as bait for trapping crabs in ring nets. The meat of *Meretrix sp.* is used as supplement feed by shrimp farmers and in fattening of water crabs. However, although culture of *Penaeus vannamei* is expanding in Andhra Pradesh, clam meat as feed is being discontinued after spread of viral diseases as a result of cyclones.

Dead shells of *A. granosa* are segregated into three sizes; the smaller sized shells fetch higher price compared to the medium and larger shells. Live as well dead shells of other bivalves such as *Meretrix sp., Paphia malabarica, Marcia opima,* edible oysters and gastropods such as *Murex sp., Telescopium sp., Thais sp.* and *Hemifusus pugilinus* are left in the forest land in the bay and allowed to putrefy. Later as per demand the shells are brought to the shore and sold to the buyers after drying.

Placuna placenta collection (though banned) is carried out clandestinely and stocked inside the forest area until putrification. As and when traders from Yanam or Pedavalasa request for the shells, the fishermen are informed and they transport the shells through the bay by motorised fibre boat or Kakinada Nava to the respective areas.

Shell trade

The shells of bivalves and gastropods are in high demand for their ornamental value and the exploitation in the Kakinada Bay is entirely linked to the shell trade in Tamil Nadu, Maharastra, and other States. Shells are measured in baskets. Live shell baskets weigh about 40 kg and are priced at INR 600-700/ for bivalves and INR 300-350/- for gastropods-. Dead shell baskets weigh about 30 kg and are priced at INR 120 to 130/-. Marketing of shells is carried out at Chollangi Landing Centre and merchants buy the shell baskets from there.

Fig. 3: Gastropods, Kakinada Bay, monthly landings 2011-2013.

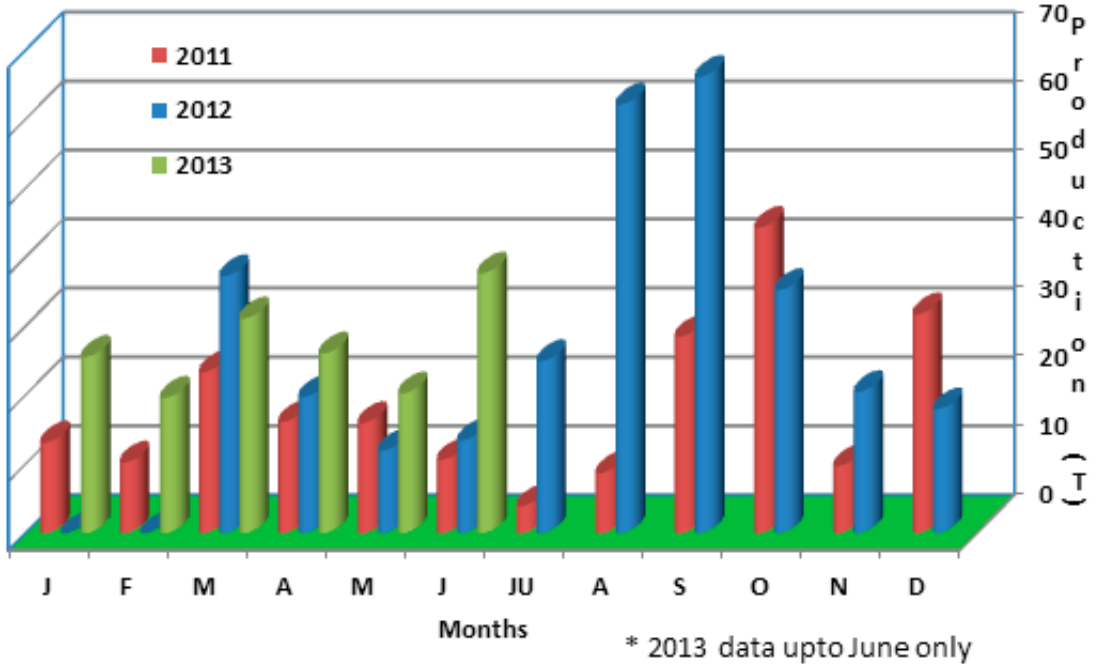
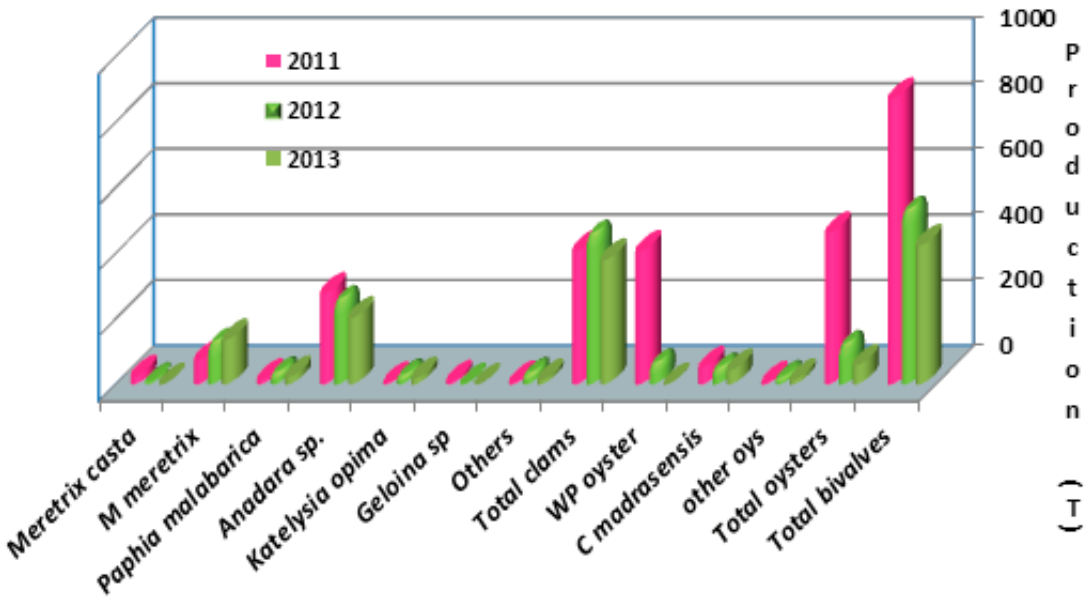


Fig. 4. Bivalves, Kakinada Bay, 2011-2013.



Discussion

Kakinada Bay has historically been a rich ground of bivalve and gastropod resources and supported the livelihood of hundreds of fishers from the nearby 15 villages (Narasimham, 2004). An estimated catch of 6020 tonnes were landed in 1968 (Narasimham, 2004). Major contribution was *Placuna placenta* at 4,000 tonnes and *A. granosa* 1,000 tonnes. (Narasimham, 2004). In 1984, P. placenta landed was 12,420 tonnes, *A. granosa* 6,895 tonnes and *M. meretrix* 1,082 tonnes (Narasimham et al. 1984). The present total production is 745 tonnes (2013) which reflects the decline in landings of almost all the species in the bay.

The average total landings of bivalves and gastropods for the period 1988-93 was estimated at 3,065 tonnes, total effort at 70,697 units and mean CPUE of 43.4 kg (Rao and Somayajulu, 1996). Average landings of bivalves and gastropods for the 2011-2013 period was 1,064 t which indicates a decline of over 65% in 20 years. Significant decline in landings occurred among the major species; *Anadara granosa* declined by 80%, *P. malabarica* (27.3%), *Geloina sp.* (75%), *Cerithidea sp.* (85.3%), *Telescopium sp.* (89.8 %), *Hemifusus pugilinus* (55.7%), *Umbonium sp.* (97.8%) and *Thais sp.* (85.2%) when compared to the 1988-1993 period (Rao and Somayajulu, 1996), *Meretrix meretrix* (26.9%), *Katelysia opima* (52.2%), *Placuna placenta* (50%), *Crassosterea madrasensis* (36.4%) registered an increase compared to the 1988-1993 period. This may be due to the increase in demand for these species. However, there has been a significant decline in the landings compared to two decades ago.

The Coringa and Bhairavpalem Reserve Forest area which includes major part of the Kakinada bay was declared as the 'Coringa Wildlife Sanctuary' in 1998 under the Wildlife Protection Act, 1972. The window pane oyster and blood clam beds fall within Sanctuary which has affected the fishery of these two economically important species. More significantly, it has impacted the livelihood of several fishers dependent on fishing these bivalves. Moreover, the Ministry of Environment and Forests, Government of India, included the window pane oyster *Placuna placenta* in Schedule 1 of the Wildlife Protection Act, 1972 through a notification dated July 21 2001.

Shellfish fisheries management measures need to be urgently implemented in the traditional fishing area of the Coringa Wildlife Sanctuary. The major management and conservation concerns in the bivalve and gastropod fishery of the Kakinada Bay are decline of stocks, livelihood of the fishers involved in the fishery and pollution. The demand for shells in the ornamental shell trade and lime industry has led to the indiscriminate exploitation of very small sized shells *(Anadara sp., Meretrix sp.)*. This has led to the decline in the stock over the decade. Fishermen land their catches on the road side which is a matter of grave concern due to the pollution caused by the putrefying meat. Apart from the obnoxious stench, the public is exposed to health hazards as a result of proliferating worms, flies, insects etc. The following shellfish fisheries management measures are suggested to manage and conserve the bivalve and gastropod resources of the Kakinada Bay which have declined significantly over a period of 20 years.

The traditional fishers can be motivated to adopt the simple low cost method of clam farming / relaying in the bay. Farming of blood clam in the Bay has been successfully attempted earlier (Narasimham, 1982). Window pane oysters also can be cultured in the Bay (Narasimham and Laxmilatha, 1996).

To revive the declined stocks, hatchery produced seed should be re-stocked in the clam and oyster beds. Hatchery technology has been developed by Central Marine Fisheries

Research Institute for *Meretrix meretrix* (Narasimham, 1988), *A. granosa* (Muthiah et al. 1992), *Paphia malabarica* (Sivalingam et al.1996), window pane oyster (Dharmaraj et al. 2004) and the gastropod *Hemifusus pugilinus* (Laxmilatha et al. Pers comm.). Areas should be clearly demarcated for shell fishing by the traditional fishers.

Restrictions on minimum size of exploitation should be strictly enforced to prevent indiscriminate exploitation of small sized clams, oysters and gastropods. The livelihood concerns of the traditional fishers dependent on the Kakinada Bay need to addressed and alternate livelihood options such as farming should be promoted.

Awareness camps and regulatory measures should be implemented to prevent the landing of the shells along the roadside and causing health hazards to the public. These shellfish fisheries management measures will go a long way in conserving and sustaining the abundant and diverse bivalve and gastropod resources of the unique ecosystem in the Kakinada Bay.

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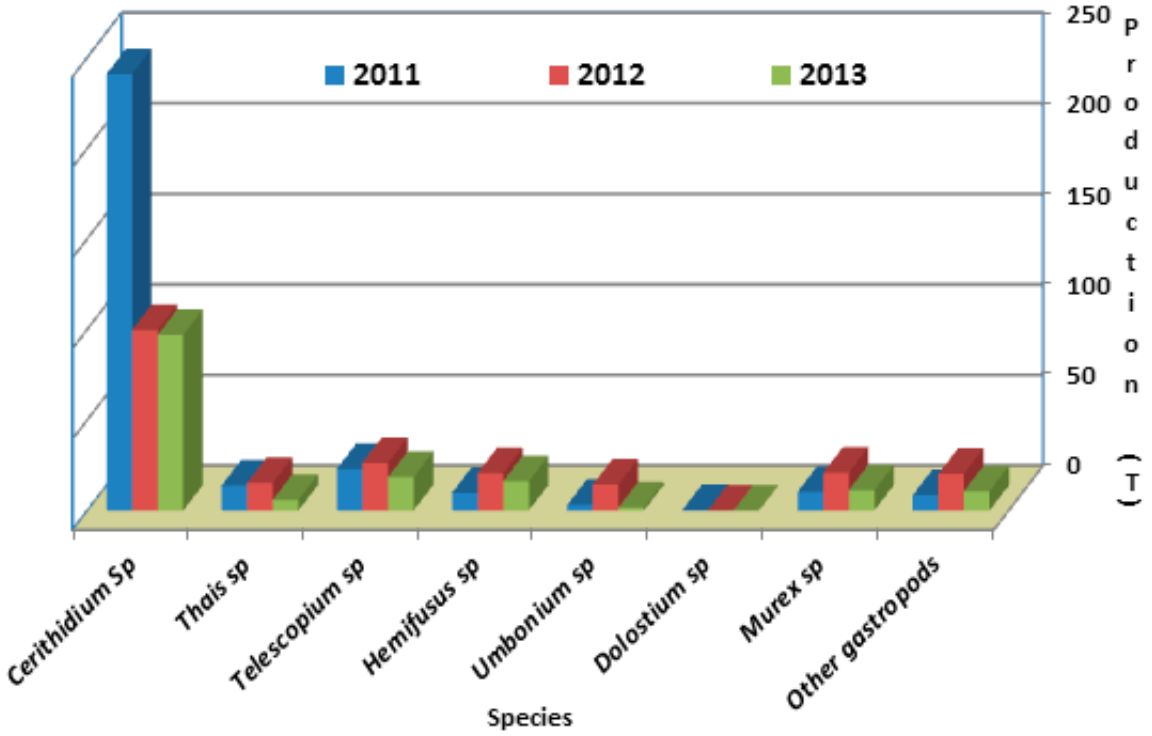
Fig. 5. Gastropods, Kakinada Bay 2011-2013.



NACA Newsletter

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Register for the 11th Asian Fisheries and Aquaculture Forum and GAF6

The 1*1th Asian Fisheries and Aquaculture Forum* will be held from 3-7 August 2016 in Bangkok, Thailand. The meeting provides an international platform for distinguished scientists from all over the world to discuss issues pertaining to sustainable fisheries and aquaculture in the Asia-Pacific Region. The forum will be convened in conjunction with the *ASEAN Fisheries and Aquaculture Conference and Exposition 2016*. Both events will be held in Bangkok International Trade and Exhibition Center.

The forum and exposition are jointly organised by the Department of Fisheries, Thailand, in collaboration with the Asian Fisheries Society, Food and Agriculture Organisation of the United Nations Regional Office for the Asia and the Pacific, GLOBEFISH, INFOFISH, the Network of Aquaculture Centres in the Asia-Pacific, and the Southeast Asian Fisheries Development Center.

Format and programme

Invited speakers from around the world will share their experiences and lessons-learned in fisheries and aquaculture. Participants from all over Asia and elsewhere will showcase recent advances in fisheries and aquaculture research and development in Asia.

The programme will run for three days with a welcome reception on 4 August 2016. It will include:

- Thematic plenary sessions with distinguished speakers from the fisheries and aquaculture community.
- Thematic concurrent sessions with presentations selected from individually contributed abstracts.
- Poster presentations and a poster competition.
- The concurrent ASEAN Fisheries and Aquaculture Conference and Exposition 2016.

Forum theme and thematic sessions

The theme of the 11th AFAF is “ASEAN Seafood for the World & Asian Food Security for the World”. Presentations and discussion will be organised into six themes plus a parallel gender symposium as follows:

Theme 1: Governance: To include legal/policy frameworks, institutional structures and arrangements, planning and compliance for both aquaculture and capture fisheries.

Theme 2: Education and training: To include recommendations from the recent International Symposium on Aquaculture and Fisheries Education (ISAFE2), education and training needs in Asia, innovative and new education and knowledge exchange.

Theme 3: Sustainable intensification of aquaculture: To include CAA5 outcomes and recommendations, feeds & nutrition (especially fish meal issues), breeding & genetic selection, GMOs, hatchery technology, responsible aquaculture (environment), social and economic dimensions, disease management, DAA overview and biotechnology.

Theme 4: Response to impacts of climate change: To include impacts and responses to climate change in both aquaculture and fisheries and biodiversity, building resilience of fishing/aquaculture stakeholders and disaster management.

Theme 5: Sustainable fisheries: To include both small scale artisanal and large scale industrial marine and inland fisheries stock enhancement (including culture-based fisheries, biology and ecology of target species, stock status, management, social/economic considerations and major issues including IUU fishing, by-catch and subsidies.

Theme 6: Seafood, post-harvest technology & food safety: Processing, products, biotechnology, food safety standards, compliance and certification.

6th Global Symposium on Gender in Aquaculture and Fisheries: To include promoting gender equality in the aquaculture and fisheries value chain, understanding the roles of women in aquaculture and capture fisheries, and social and economic issues concerned with fairness and responsibility.

ASEAN Fisheries Exposition

The Forum Marketplace will provide a networking hub where participants can rent a stall or table to display publications, make known their organisation, promote specific projects, exchange proposals and generally make contacts:

- Exposition area 7,750 m^2 with 450 booths (3x3 m).
- More than 10,000 visitors are expected.
- Targeting exhibitors from international fish producers, traders, processors, and equipment suppliers, as well as food service and catering operators.
- Meeting with ASEAN local producers and SMEs.

Registration

Please register your attendance at the forum via the conference website, which also provides guidance on accommodation, transportation and the venue:

http://www.enaca.org/modules/afaf/welcome.php

Key dates

Date	Event
15 October 2015	Marketplace applications open
15 November 2015	Registration / abstracts open
15 April 2016	Abstract submission closes
30 April 2016	Abstract submitters notified
2 June 2016	Regular registration starts
2 August 2016	Final program distributed
3 August 2016	Registration desk opens (PM)
4 August 2016	Exposition and Forum begin
6 August 2016	Last day of Exposition and Forum
7 August 2016	Post-forum tours and departure

For more information, please contact:

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6th Global Symposium on Gender in Aquaculture and Fisheries (GAF6)

Special Symposium at the 11th Asian Fisheries and Aquaculture Forum, Bangkok, Thailand
3-7 August 2016, Bangkok International Trade and Exhibition Center (BITEC)

The special symposium aims to increase the profile of women in aquaculture and fisheries, as well as to increase capacity for gender research and the implementation of gender policy. This year the symposium theme of "Engendering security in fisheries and aquaculture" reflects the multiple facets of security for people in fish supply chains, including the food security theme of the Asian Fisheries and Aquaculture Forum. It goes well beyond food security, however, and broadens the security theme to include other important and connected aspects that impact women and men in fish supply chains, such as access to natural resources, fair livelihoods, environment, natural and climate change related disasters, and domestic violence.

Symposium sessions will vary in format, according to their content and purpose. GAF6 will have opportunities for oral and poster presentations, as well as short workshops, panels and events to stimulate networking. Students are encouraged to participate. The symposium aims to promote interactions between grassroots groups, participants from industry, researchers and educators.

Symposium themes

The symposium will include:

- Special workshop on the implementation of the gender elements of the Voluntary Guidelines on Small-scale Fisheries.
- A proposed "GAF 101" training workshop.
- A panel and networking session on the fish industry, gender and social development.
- Session on regional updates on gender in fisheries and aquaculture.
- Session on gender in fish trade and value chains.
- Session on GAF in Thailand and the Mekong region.
- Competition on "youth and fish".
- Oral and poster sessions on fishing communities and wellbeing, including violence against women; climate change and disease preparedness; thinking beyond the framework of gender and fisheries; gender and food safety; putting gender integration ideas into action.

The first formal meeting of the GAF Network will also be held. Come and join us! For more information including programme updates please see the Gender in Aquaculture and Fisheries website:

https://genderaquafish.org/.

Global Conference on Climate Change Adaptation for Fisheries and Aquaculture

8-10 August 2016, Bangkok, Thailand

A global conference is being convened to provide participants the opportunity to share their practical experiences in understanding vulnerabilities associated with climate change and in identifying, prioritising and implementing adaptation and disaster risk management actions within the fisheries and aquaculture sector and dependent communities.

Worldwide, over 600 million people depend, directly or indirectly, on fisheries and aquaculture for their livelihoods. Fish provides essential nutrition for over 4 billion people and at least 50 percent of animal protein and essential minerals to 400 million people in the poorest countries. Trade in fish and fisheries products is also important for societies and economies: fish products are among the most widely-traded foods, with more than 37 percent by volume of world production traded internationally. Yet, the fisheries and aquaculture sectors are facing many issues, such as over-fishing, habitat degradation and pollution, and climate change and variability have the potential to compound existing pressures on the sector, but can also provide opportunities.

Climate variability and change is already affecting aquatic systems' physical, chemical and biological processes - potentially resulting in changes in fish life cycles, habitats, species compositions, distributions or abundance, which can impact fisheries management, livelihoods, food security and sustainable development. Sea level rise and extreme climate events can also have direct impacts on fishing operations and safety-at-sea as well as on the physical infrastructure of coastal communities and communities along rivers and lakes; destroying or severely damaging assets such as boats, landing sites, post-harvesting facilities and roads. Displacement of populations due to high-dam construction is also an issue. There may also be positive opportunities in fisheries associated with locally improved ecosystem and productivity conditions and in aquaculture with sea level rise and expansion opportunities in salinised coastal margins, or with better temperature conditions for local stocks.

Fisheries- and aquaculture-dependent economies, coastal communities and fishers and fishfarmers are expected to experience direct effects of climate change in a variety of ways, such as increased risks of human diseases (malaria, cholera, etc) relating to increased temperatures and displacement and migration of human populations from low-lying areas to less risky areas or to follow changes in fish distributions. One must note that many fishing (both inland and marine) and coastal communities already subsist in precarious and vulnerable conditions because of poverty and rural underdevelopment, with their well-being often undermined by overexploitation of fishery resources, degraded ecosystems and water scarcity. Fisheries and aquaculture-dependent communities often lack ability to anticipate and adapt to climate change and variability and hence they tend to be among the most vulnerable. Climate variability and change can exacerbate food insecurity in areas currently vulnerable to hunger and malnutrition.

FishAdapt: Sharing practical experiences in climate change adaptation in fisheries and aquaculture

Much can be done at the household, community and sector levels to support the resilience of the sector in a changing climate. For example, fisheries and aquaculture-dependent communities can receive targeted and improved weather and extreme event information, as well as safety of fishing vessels and fishers while at out fishing. The sector can also be supported to improve its monitoring and analysis of local changes and to have access to global information. Other adaptation options include social protection and livelihood diversification as well as support to exit from the sector when needed. Fishing and fish-farming methods and zones can be adapted to the change that is likely to occur and post-harvest processes can be improved to adjust to changing species and to minimise losses due to temperature-related spoilage and disease risks. The adaptive capacity of the aquatic ecosystems can also be improved, such as through implementing the ecosystem approach to fisheries and aquaculture, using natural defences to erosion and storms and minimising negative impacts of harmful fishing and farming activities to support the general resilience of the ecosystems supporting the sector.

Fisheries and aquaculture systems and communities can also be provided with important enabling environments, such as through secure tenure and access rights to the natural resources upon which they depend. Policy makers and managers can implement adaptive fisheries co-management plans, legislate vulnerability assessments within the sector and ensure that management, development and trade strategies and policies are climate and disaster-proofed. It is also essential to ensure that the needs of the sector are included in broader national and regional climate change discussions and that adaptation and mitigation measures in one sector do not negatively affect food security and livelihoods in other sectors, such as fisheries, through reduced water flows or hard irrigation infrastructure impacting aquatic habitats.

FishAdapt will provide the opportunity to share practical experiences in understanding vulnerabilities and in identifying, prioritising and implementing adaption and disaster risk management actions. The focus will be on applied vulnerability assessments and on case studies focusing on real-life community impacts. The conference will be the occasion to showcase adaptation planning and implementation activities that work toward building the resilience of livelihoods, governance frameworks, climate and disaster-proofing development strategies, providing technical and process-based actions, as well as reducing the vulnerability context within regions, countries, sectors and dependent communities and throughout the value chains.

Goals and format

Through a series of panels and presentations, collaborative problem solving, interactive workshop events, discussion spaces, participants will exchange experiences and create

ideas and best practices on which to act to assist the sector in furthering its efforts to reduce vulnerability and improve resilience to climate variability and change. The conference will:

- Provide countries, fisheries and aquaculture institutions and networks, civil society, private sector, development partners, and academic institutions the opportunity to present their work in fisheries and aquaculture climate change adaptation and disaster risk management.
- Foster the exchange of information and experiences from case studies and projects which aim to show how climate change adaptation in fisheries and aquaculture and disaster risk management may be implemented in different regional and ecosystem settings among fishers, farmers, value chains and dependent communities.
- Disseminate the wealth of experiences shared through conference proceedings, which will include selected conferences papers.
- Inputs from the Conference will support the development of policy briefs to inform policy makers on best practices on climate change adaptation and risk management.
- Increase awareness of United Nations Framework Convention on Climate Change (UNFCCC) processes and inform on how efforts may be communicated to the UNFCCC through, for example, the Nairobi Work Plan, the UNFCCC Least Developed Countries Expert Group and the UNFCCC Adaptation Committee activities.

Call for abstracts and posters!

Participants are invited to share your experiences in supporting climate change adaptation within fisheries and aquaculture among the following themes:

- Applied experiences in Freshwater, Coastal or Marine Fisheries and Aquaculture.
- Linking global, regional and national climate change and disaster risk management processes to fisheries and aquaculture
- Communicating climate change issues and potential impacts to policy makers, fishers, farmers, fishworkers, scientist, development partners, industry and others for effective planning, implementation, and monitoring.

Please see the guidelines to authors on the conference website for more detail about the conference themes and preparation of submissions.

Call for special sessions!

The FishAdapt Conference Committee invites you to submit proposals for special sessions to delve more deeply into areas you feel should be discussed, such as water management, gender, or migration. Alternative formats for special sessions such as panels, workshops, marketplaces and facilitated and interactive sessions are welcome.

To organise a special session please submit a proposal to climate@enaca.org including the title, aim and scope of the session, along with the names, affiliations and short bios of the organisers. The proposal can include additional details such as a list of potential contributors and the format of the session. An abstract is required for everyone wishing to organise a special session.

Back to back with the 11th Asian Fisheries and Aquaculture Forum!

FishAdapt will be held just after the 11th Asian Fisheries and Aquaculture Forum and the 6th Global Symposium on Gender in Aquaculture and Fisheries, which will be held in Bangkok from 3-7 August.

Registration and further information

For more information please see the conference website, which provides guidance on registration, accommodation and visa arrangements, or email climate@enaca.org:

http://www.fishadapt.com

A Review of women's access to fish in small-scale fisheries

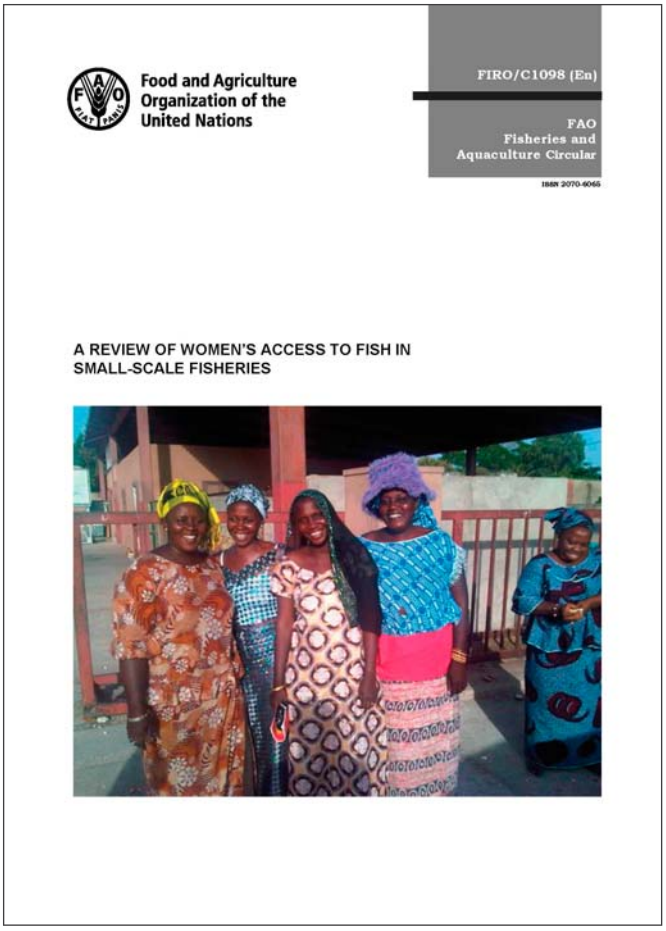
Angela Lentisco and Robert U., Lee (2015).
Fisheries and Aquaculture Circular No. 1098. Rome, Italy.

Women play a critical role in every link of the value chain in small-scale fisheries, although their best-known roles are in processing and marketing of fish and other fishery products. This perception of the highly gender-segregated division of labour (men fishing / women processing) has shaped the generalised approach in supporting development initiatives for small-scale fisheries. More often than not, this approach targets men as fishers, and women as processors and marketers of fishery products. However, this generalisation has also made fisheries governance blind to women's other valuable inputs to the sector. In fact, their roles can and should go beyond postharvest and marketing. However, the lack of utilisation of their additional contribution has deterred, for example, women's participation in fisheries resource management and policy decision-making.

The present review aims to move policy attention beyond the generalised, and perhaps limited, perception of women as fish processors and marketers and in this way enhance their participation in fisheries resource management and decision-

making. The study describes the different ways women have access to fish in small-scale fisheries: as primary users (when they fish by themselves or they finance fishery operations), secondary users (when they access fish through kinship or other close relationships), and tertiary users (when they use capital to buy fish directly from fishers or traders). The review provides case studies to illustrate some of the issues that tend to keep women in marginalised positions along the value chain. Factors and processes that can contribute to improve women's participation and decision-making in small-scale fisheries, such as those that challenge conventional approaches based on traditional or "typical" gender roles and obsolete institutional arrangements, are also given. The document also discusses how participation can be improved by raising awareness on gender equality issues along the value chain through applying a gender lens, by providing appropriate support to women's organisations, including formal recognition of their professional activities, by understanding the socioeconomic context and the particular needs of small-scale fisheries, by giving due attention to power and power relationships, and by taking greater account of the contribution of women in fisheries. As neither women nor men form homogenous groups, the challenge is even greater for women to have access to productive tools and services, which if secured can give them a greater say and control over fisheries resources, thereby increasing their social capital and financial capital. These reflections can be introduced in existing resource management arrangements such as co-management or community based management, and can probably empower women and improve their participation in fishery resource management decision-making.

The reflections in this review can and should be used as guidance and discussion material to develop interventions under the Global Assistance Programme in support of the implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication.



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Aquaculture operations in floating HDPE cages: a field handbook

Cardia, F. & Lovatelli, A. 2015.
FAO Fisheries and Aquaculture Technical Paper No. 593. Rome, FAO. 152 pp.

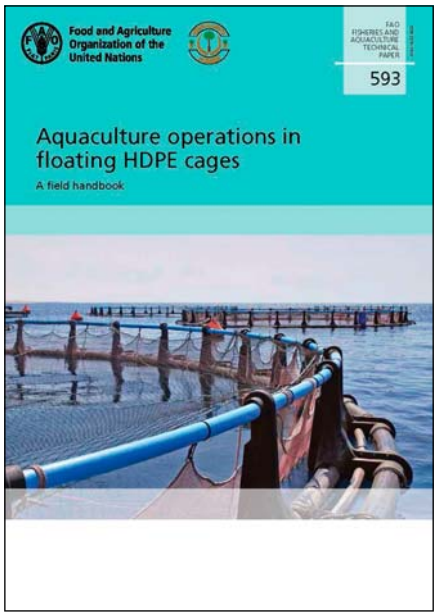
Global aquaculture production has been steadily growing in recent decades, increasingly contributing fish and other edible aquatic organisms of commercial importance entering national, regional and international markets. The growing demand for such products has stimulated the development and expansion of aquaculture production systems both on land and in all waterbodies, covering technologies ranging from the production of seed material to ongrowing structures and other farming support facilities.

In recent decades, the aquaculture industry has also intensified its production output per unit area of space or volume, mainly to compensate, among other things, for the growing competition for land and water surfaces for other uses. The expansion of fish farming in the sea, also referred to as "mariculture", has happened as a result of several supporting factors. These include the acquisition of reproduction and ongrowing technologies for species of interest, and the development of physical structures to contain the cultured organisms. Modern marine cages, whether floating or submersible, represent one such development. These have evolved significantly from basic and rudimental systems to sophisticated and carefully engineered structures.

Many cage designs and models have been developed and are commercially available. Among these, high-density polyethylene (HDPE) cages are widely used, because of the versatility of the materials used, the relative simplicity in the performance of the various farming operations, and the comparatively limited investment capital required. Technological improvements of HDPE cages are evolving with the availability of new materials and the various equipment items needed to service all farming operations. This manual focuses on technical aspects of HDPE cages; however, the

introductory chapter covers the importance of proper site selection in terms of site exposure and environmental parameters that affect the well-being of the culture fish and affect farm structures. Proper siting of a cage farm is of paramount importance with regard to the overall technical and economic success of the commercial operation, and for reducing as far as possible the environmental footprint of the farm.

Prior to describing the characteristics of HDPE cages and elements making up a culture unit, the handbook describes the grid and mooring systems that support the fish cages. Information is provided on the components of the two systems, their technical specifications in relation to farm size as well as on-land assembling and sea installation procedures. A chapter focuses on the floating collar of the cage, describing the components that make up this key farming structure. The technical specifications and design options are provided for the key elements of the collar readily enabling the construction of structures that meet the needs of the operator and are suitable for the environment in which they will be placed. Technical information is then provided on the ropes, netting and net cage design and on determining the appropriate size and shape. Based on procedures developed over years of field experience, practical information on collar and net installation, net changing, maintenance and inspections technique is provided.



The final sections of this publication covers practical procedures related to the stocking of cages with seed material, feeding and managing the fish stock, as well as practical information on pre-harvesting and harvesting methods, fish handling and transportation. Some information is also provided on farm safety procedures, highlighting the potential risks when working on a cage farm either on the floating structures or underwater.

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NACA is a network composed of 19 member governments in the Asia-Pacific Region.

Aquaculture seed and feed production and management in Bangladesh: Status, issues and constraints

This document presents the findings of the Food and Agriculture Organization of the United Nations (FAO) Technical Cooperation Programme Facility (TCPF) Project (TCP/BGD/3301) "Identification and understanding of key technical, economic and social constraints to seed and feed production and management in Bangladesh". The project was initiated by national field surveys to investigate the status and constraints of the aquaculture seed and aquafeed subsectors, followed by field and verification missions including in-depth unstructured interviews and focus-group discussions with the different players in the seed and feed supply chain, by site visits to projects, facilities and farms in several aquaculture-rich districts of the country and through the holding of a stakeholders' workshop. Together, these activities identified the key technical, economic and social constraints hindering the development of the aquaculture seed and feed production and management subsectors in Bangladesh. They also provided recommendations related to improving the four key areas of improved seed quality, improved aquafeed quality, strengthened capacities of farmers to utilise feed efficiently, and increased technical efficiencies of small-scale aquafeed producers.

This publication presents (i) a synthesis of the project's major findings, including the conclusions and recommendations of the field surveys, FAO country field mission and the verification mission (including the stakeholders' workshop); (ii) reports of the field surveys and (iii) the reports of the verification mission. The recommendations contained in this document should lead to a sustained improvement in the technical and economic efficiencies of the main players in the aquaculture seed and aquafeed subsectors in Bangladesh, from the raw material suppliers to the farmers. This is expected to improve their productivity and economic returns and assure the sustainable growth of the country's aquaculture sector.

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