Local knowledge in Asian Sea Bass, *Lates calcarifer* (Bloch, 1790) culture in Raigad District of Maharashtra

S. S. Gangan[1*], V. H. Nirmale[2], S. Y. Metar[3], B. M. Yadav[2], A. K. Balange[4], S. D. Patil[1], K. D. Patil[5] and P. E. Shingare[1]

[1] Taraporewala Marine Biological Research Station, Bandra, Mumbai - 400 005.
[2] College of Fisheries, Shirgaon, Ratnagiri - 415 629.
[3] Marine Biological Research Station, Pethkilla, Ratnagiri - 415 612.
[4] Central Institute of Fisheries Education, Mumbai - 400 061.
[5] Khar Land Research Station, Panvel - 410 206.

Abstract

The present study attempts to explore and describe the local knowledge of the farmers engaged in Jitada farming in Raigad district of Maharashtra. Asian Sea Bass, Lates calcarifer locally known as Jitada is a very famous food fish of Raigad district. Jitada farming is managed by the traditional paddy cum fish farmers to sustain and secure their livelihood. The benefit of local knowledge can be harnessed and improved upon by its appropriate use, establishing validity of such knowledge and integrating it with development programmes. A total of 50 farmers from six villages of Raigad district of Maharashtra constituted the sample size of the study. Local knowledge on layout and construction of the pond, bund construction and strengthening, seed collection from wild, transportation, culture practices has been documented. Besides, the study has identified the polyculture of Indian Major Carp with Jitada in the region signifying the dynamic nature of local knowledge. Similarly, the plight of depleting seed resource of Jitada from the region due to anthropological activities is also noted. An understanding of the traditional culture practices and knowledge offers opportunities for additional scientific inputs and highlights the alarming issue to the policy makers to avoid the degradation of habitat.

Keywords : Asian sea bass, *Jitada*, local knowledge, paddy cum fish culture.

***Corresponding author :** shardul76@rediffmail.com

Introduction

Indigenous, traditional, or local knowledge is the knowledge acquired by people in a given community over a time period by experience, experimentation and handling on old people's knowledge (Berkes, 1999). It is adapted to the local culture and environment, is dynamic and ever changing. As stressed by Veitayki (1997) ancestors took centuries to work out and accumulate traditional knowledge. One aspect of local knowledge is Indigenous Technical Knowledge (ITK) and as defined by Wang (1988) it is knowledge and practices which are based on people's accumulative experiences in dealing with situations and problems in various aspects of life and such practices are special to particular culture. To avoid ambiguity the local knowledge terminology has been used in the present study. Use of local knowledge allow people living in discrete association with their environment to overcome the specific localized problems and use the natural resources in a more sustainable way. Besides the study of local knowledge generates important database and pinpoint essential research needs. Raigad district of Maharashtra occupies around 80 per cent of saline land of Maharashtra state. The farmers in this area are engaged in farming of salt tolerant varieties of paddy and paddy cum fish culture for several centuries. The preferred fish is Asian Sea Bass (*Lates calcarifer*) which is very famous food species of this area and anecdotal information suggest the existence of this practice for over 150 years. *Lates calcarifer* is locally known as *Jitada*. Asian Sea Bass, *Lates calcarifer* (Bloch) is an important coastal, estuarine and freshwater fish in the Indo-Pacific region (Grey, 1986). *Lates calcarifer* is widely distributed in coastal and freshwaters throughout the Indo-West Pacific region including India, Myanmar, Sri Lanka,

Bangladesh, Malay Peninsula, Java, Philipines, Papua New Guinea, Northern Australia, southern China and Taiwan (Greenwood 1976; Moore 1980). A wealth of information on the biology and ecology of this fish is given by Jones and Sujansingani (1954), Jhingran (1963), Jhingran and Natarajan (1966, 1969) and Patnaik and Jena (1976). The distribution pattern of different life stages in different ecosystems such as coastal waters, estuaries, lagoons, brackish waters, and even in fresh water, to aid in seed prospecting and procurements of breeders from wild populations is also known (De 1971; Ghosh 1973) is given. Farmers have been stocking fish, constructing paddy fields appropriate for both paddy cultivation as well as for fish culture and distributing the fish to locals.

Raigad district like other districts of Maharashtra is undergoing social and economical transformations and changes in land use and land availability. Very few systematic studies have been done in recent times in documenting the local knowledge on important aspect of fish culture such as bund construction, seed stocking, and enhancement of natural feed in this particular region. Several aspects of local knowledge practiced in changing landscapes have been found to be threatened or totally vanished. Hence documentation of such information possessed by this community is very essential and urgent, which could ensure that information is not lost as well as scientists and social workers could use such information in restoring former ways of livelihood (Shah, 2013). The tested and proven innovations of our ancestors needs to be valued validated and blended with new technological support. Understanding of the dimension of fish farming technologies helps in asserting the degree and directional change through formal research (Pandey 1996; Das *et. al.*, 2002). The present study therefore attempted to document the local knowledge possessed by farmers engaged in paddy cum Asian Sea Bass culture.

Methodology

The study was conducted in Raigad district of Maharashtra state (longitude 72.55 E and latitude 18.39 N) (Fig. 1) in six randomly selected villages near Dharamtar estuary where most of the farmers are engaged in the paddy cum *jitada* farming. The villages selected for the study include *Sarebhag, Bhal, Vashi (Pen), Poynad, Shahabaj, Urnilee, Sonkhar, Kalve, Johe, Tambadshet* and *Vadav*.

Interviewer administered semi structured questionnaire was adapted for documenting the local knowledge. Data were collected regarding all aspects of *jitada* farming such as seed collection, site selection for culture, type of farming, construction of rice field, culture practices, harvesting from rice fields and economics. Respondents were selected through non-participatory exploratory research survey and snow ball method (Bailey, 1982). Wherever necessary, documentary evidences such as photos, to substantiate the local knowledge were also gathered.

Results and Discussion

Local knowledge in seed collection of *jitada* from wild

Availability of fish seed : *Jitada* seed is collected along the coastal intertidal area of *Dharamtar* estuary from the *Bhal* village to *Shahabaj* village in intertidal pits (Fig. 2) (pit size ranging from $1^{1/2}$ to 4 feet diameter) from the mid May to end of August. Farmers identify the *Jitada* seed by their shiny silvery white colour; with a black strip on the top of the body and slender shape. *Jitada* seed is collected along the coastal intertidal area of *Dharamtar* estuary from the *Bhal* village to *Shahabaj* village in intertidal pits from the mid May to end of August. Farmers identify the *Jitada* seed by their shiny silvery white colour, with a black strip on the top of the body and by the slender shape. *Lates calcarifer* locally known as *Jitada* is widely distributed in tropical and sub-tropical Asia- pacific region. It is a euryhaline and catadromous species inhabiting freshwater, brackish and marine habitat including streams, lakes, estuaries and coastal waters (Greenwood 1976; Moore 1980). The young ones occur in less saline intertidal zones, estuaries and backwaters (Kasim and James, 1986). The *Lates calcarifer* seed is washed into rice fields during high tide and are trapped in pools when the tide subsides (Awang, 1986).

Collection of Jitada seed : A gear locally called as *duf*

(Fig. 3) is employed for collection of seed. The gear comprises of a $1^{1/2}$ to 2 feet long nylon mesh net having mesh size from 1 mm to 12 mm, attached to a circular (dia. ranging from 2 to 3 feet) wooden frame (4-8 feet). The frame is made from branches of a locally available mangrove plant known as called *sari* (*Sonneratia alba*). Seed are collected mostly in the morning as well in the evening time before sunset when temperature is low. *Duf is* usedfor collection of *Jitada* seed catching which is made up from the local mangrove plant. This gear helps in convenient catching of fish seed from the intertidal pits. The material used for making *duf* is easily available and low in cost.

Transportation of seed : After collecting seed from the intertidal pits, seed is stored in the bucket of about 10 litres capacity containing estuarine water (about 3 to 5 litres) and transported to the pond. Depending upon the size (upto 5 cm), *Jitada* seed are stored @ 30 to 35 numbers per bucket. The seed is transported for 30 to 60 minutes duration. The transportation of seed is done for duration of 30 to 60 minutes with or without use of vehicle. Usually the culture ponds are situated more or less nearby the sources from where the seed is caught from wild. Transportation as above can be suitably and conveniently carried out without causing mortality of the fish. The water from the source of wild seed collection is used for transportation which ensures better survival. Similarly if needed the water from the bucket is replaced with new estuarine water. It is evident from this practice that fish farmers are aware of benefits of using estuarine water in which seed are naturally available.

Local knowledge in paddy cum *Jitada* culture

Site selection : Farmers select black clayey soil (*kaali mati)* with good water retention capacity for pond and paddy farm construction. Paddy fields are generally located at a distance of about 0.5 to 1 km from the estuary in plain terrain. The paddy fields act as rainfed ponds. The water in these ponds is *machul.* (Salinity ranges from 1 ppt to 3 ppt).

Most of the respondent farmers (84%) resorted to paddy cum *Jitada* farming system. The size of the paddy fields used for the *Jitada* farming vary from 0.5 to 1.0 acre and are square to rectangular in shape. The bunds surrounding the fields are elevated to a height of 1 to $1^{1/2}$ feet from the ground level. 1 to $1^{1/2}$ feet deep trenches (Fig. 4) are excavated along the inner side of the bund. The black soil from excavated trenches is used for the bund construction. The bunds are generally constructed 2.0 to 2.5 feet wide. Approximately 25 to 100 square meter size circular pits are excavated at the center of the paddy field with a water depth of about 2.0 to 2.5 ft.

Jitada being a euryhaline species can tolerate a wide range of salinity changes. It is traditionally cultured in rainfed existing paddy fields in Raigad district. The soil in rice fields is black and has got good water holding capacity. Minimum water depth required for the growth of *Jitada* seed to semi-adult stage is maintained in these fields during the culture period. The bunds surrounding the fields are raised to desirable height while trenches are dug along the inner side of bunds. Usually the soil from the excavated trenches is used to raise the bunds. This helps in lowering the construction cost for bunds. A circular pit is constructed at the centre. Both the trenches and central pit act as shelter for growth of *Jitada* as well as aid in capture of *Jitada* after the culture period of paddy is over.

Culture practices : Majority of the farmers reported that sowing of rice varieties viz. *Jaya, Ratna, Rupali, Komal, Suvarna,* GR-II, *Karjat*-84 is done in the month of July depending on the rainy condition. ½ ft to ¾ feet height of water level is maintained in the paddy fields with help of overflow drain (2 to 2.2 feet breadth and 2 to 2.5 feet length) during the monsoon season which locally called as *gavana* (Fig. 5). At the time of draining the water from the paddy fields the fishes swim against the current and get stocked in the paddy fields. *Jitada* along with other varieties of fishes such as *khaul*, prawns, catfishes, etc reach the paddy fields situated at a distance of 1.0 to m distance from the estuary. By the end of July and/or start of August a conical bamboo structure locally called as *bagala (*Fig. 6) is fixed at the outlet of the paddy field to avoid the escape of stocked fishes. The diameter of *bagala* is 2 to $2^{1/2}$ feet at one end with the other end tapering. *Jitada* feeds on the forage fishes which naturally get stocked along with it in the paddy fields.

Fig. 1 : Study area in Raigad District of Maharashtra

Fig. 2 : Intertidal pits of Dharamtar Estuary

Fig. 3 : Duf

Fig. 4 : Trenches excavated along inner side of paddy fields.

Fig. 5 : Gavana

Fig. 6 : Bagala

Fig. 7 : Bagali

Fig. 8 : Pitching of bund with black clayey soil

Supplemental stocking of *jitada* seed collected from the wild is done @ 50 -100 numbers per acre of the rice field.

Fish farmers practice traditional integrated paddy cum *jitada* farming. The cropping pattern of paddy is not disturbed but same paddy fields are modified as described elsewhere to accommodate *Jitada* culture. The seed of *jitada* along with other varieties of fish naturally enter the rice fields during wet season and subsequently get trapped at sluice gate due to presence of mesh. Supplemental stocking of *jitada* seed is also carried out. *Jitada* feed on local varieties of fish that get trapped along with it in paddy fields. For paddy culture indigenous paddy varieties are selected. These varieties invariably grown in the region are hardy and require almost no use of harmful chemicals. The *jitada* cum paddy culture is an excellent example of integrated fish farming. The farming system can be improved by scientific modification and sustain this low cost technology of paddy cum Asian Sea Bass culture by making the paddy culture economically viable along with the fish based farming system.

Harvesting : The *jitada* culture in the rice fields is carried out for 3 to 3 ½ months in the side trenches and centre pit having the water depth of 1 to 1 ½ feet and 2 to 2 ½ feet respectively. Harvesting of the paddy crop is done by the end of the September. Fishes are harvested from the trenches with the help of *duf* and cast net from the centre pit respectively during three months. Similarly fishes are also collected with the help of another bamboo structure known as *bagali* (Fig. 7). It is oval in shape with one end of ½ feet diameter which is fixed to the narrow end of *bagala.* The other end is tapering and is closed with the help of coir.

Jitada culture in the rice fields is undertaken for a period of 3 to 3 ½ months in the side trenches and centre pit. Harvesting of the paddy crop is done by the end of the September. Fishes are harvested from the trenches with the help of *duf* and cast net (*pag*) from the centre pit. Due to its dimension and shape, duf can be suitably employed for harvesting the fishes from the trenches. Cast net which forms a large circle upon falling in the water column is used to catch the fish from the centre pit. Similarly *bagali* which is fixed to the narrow tapering end of *bagala* retains the fish inside it by filtration. The unique arrangement of *bagala* and *bagali* is highly efficient in catching the fish when they are used in combination.

Local knowledge in *jitada* farming in earthen ponds

Site selection : Coastal area of Raigad district comprise of black clayey soil having good water retention capacity. Most of the farmers prefer to build earthen ponds in these regions. Coastal area of Raigad district comprise of black clayey soil which having good water retention capacity. The farmers prefer to build earthen ponds in these regions.

Type of farming : Polyculture of *jitada* with *catla, rohu, mrigal* and *Cyprinus* sp. is undertaken by the fish farmers.

Most of the farmers opined that the monoculture of Asian Sea Bass is difficult due to its highly carnivorous nature. Due to its carnivorous feeding habit, feeding jitada in monoculture practice is tedious. There is good local demand for freshwater fishes such as catla, rohu, mrigal and *Cyprinus* sp. By virtue of their experimentation fish farmers have found compatibility of growing a carnivorous fish such as *jitada* with freshwater fishes. This practice had made the farming more economically viable and profitable. Thus the compatibility of growing freshwater fishes with *jitada* is proven in this farming practice. But more scientific investigations need to be done for refining the technology.

Pond construction: Most of the constructed ponds are rectangular (1.5:1.0) in shape ranging from 0.2 acre to 2 acre. Bunds are made up of same soil (black and clay). Distance between pond bottom and top of the bund range from 7 ft to 8 feet. Top width of the bund varies from 5 ft to 6 ft while bottom of the bund is about 9 to10 feet. After every two years, silt is removed from pond bottom and pitched on the inner and top side of the bund (Fig. 8). Application of red laterite soil from hilly area locally called *murum* is done on the top of the bund. Most of the constructed ponds are rectangular (1.5:1.0) in shape ranging from 0.2 acre to 2 acre. By keeping the width of the pond less more pond bottom is covered

when the cast net is operated. Bunds are erected using the excavated soil (black and clayey). This reduces the cost of constructing the bunds considerably. Distance between pond bottom and top of the bund range from 7 to 8 feet. Top width of the bund varies from 5 to 6 feet while bottom of the bund is about 9 to 10 feet.

Due to the heavy rain fall in the region, within two years span bund soil erode and accumulate at pond bottom. Silt from the pond bottom is periodically removed and pitched on the inner and top side of the bund. This practice helps in maintaining suitable depth in pond and also gives compactness to the bund. Application of red laterite soil from hilly area locally called *murum* on the top of the bund to avoid the erosion (*Dhup*) of the bund and facilitate the movement on the bund during monsoon.

Water management : A water depth of about of 4 to 6 feet is maintained in the ponds. About ½ feet diameter pipe, locally called *khola* is fixed at a distance of 1 feet from the top of the bund of ponds, which are rainfed. Over a period of culture, while operating the cast net if the farmers notice black wet mud coming in the net, they opt for total drying of the ponds. This phenomenon is referred to as *dajalele pani*.

A water depth of about of 4 to 6 feet is maintained in the ponds. Water management is mostly related to maintaining suitable water depth in the pond. As ponds are rainfed, there are chances of water overflowing and damaging of bunds. Therefore to maintain the water level during monsoon season approximately ½ feet diameter pipe, locally called *khola* is fixed at a distance of 1 feet from the top of the bund. Over a period of culture, while operating the cast net if the farmers notice black wet mud coming in the net, they opt for total drying of the ponds. This phenomenon is referred to as *dajalele pani*.

Culture practices and pond management : Before stocking the ponds with fish seed, ponds with water depth of ½ to 1 ft are manured with cow litter (*Gomutra*) @15 lit/acre*, Chana dal* flour @ 1½ kg/acre, and jaggery @ 1 ½ kg/acre. The mixture is kept soaking in a container for four days. About 50 to 60 kg of raw cattle dung and 5 kg of urea is applied 15 days before the stocking. By mid or end of June month stocking of *Catla, rohu, mrigal,* tilapia and *Cyprinus* spp. (Seed size is 4 to 5 cm) @ 2000 nos. per acre is carried out. The seed of these fishes is procured from the hatchery. After about three months *jitada* fishes cultured in the paddy fields as described elsewhere are stocked in these ponds @ 200 to 300 nos. per acre. By the end of September the *catla, rohu, mrigal* and *Cyprinus* and other fishes grow to a size of 100 to 150 gms. The size of these fishes is very difficult for Asian Sea Bass to prey upon. Rice bran, ground nut oil cake, poultry feed and *Kani* is given as a feed for fishes other than *jitada*. Feeding is done twice in a day, in the wet ball form as well as by bag feeding. *Jitada* feed on the progeny of tilapia present in the pond. Normal culture period is 8 to 9 months.

Farmers reported that before stocking the ponds with fish seed, ponds with a water depth of ½ to 1 ft are manured with cow litter (*Gomutra*) @15 lit/acre*, Chana dal* flour @ 1½ kg/acre, and jaggery @ 1 ½ kg/acre. Before application the mixture is kept soaking in a container for four days. Also 50 to 60 kg of raw cattle dung and 5 kg of urea is applied 15 days before the stocking. Fish pond manuring is often used in fish farming for the intensification of fish production by balancing the ratio between carbon and other nutrients. Manure can be directly consumed by fish and the released nutrients support the growth of mainly photosynthetic organisms (Moav *et al.* 1977; Little and Edwards, 1999). The ingredients of organic matter as described above undergo fermentation. The nutrients of this compost can be quickly absorbed by the phytoplankton once it is applied to the pond. It consumes less dissolved oxygen in ponds since the organic material is already decomposed after full fermentation. By mid or end of June month stocking of *Catla, rohu, mrigal,* tilapia and *Cyprinus* spp. (Seed size is 4 to 5 cm) @ 2000 nos. per acre is carried out. The size of the stocked tilapia is comparatively bigger and they are procured from local village ponds and tanks. The idea behind stocking of bigger size tilapia is that they grow to maturity and reproduce by the time *jitada* is introduced in the pond. While the seed of *catla, rohu, mrigal,* tilapia and *Cyprinus* sp. is procured from the

hatchery. After about three months *jitada* fishes cultured in the paddy fields as described elsewhere are stocked in these ponds @ 200 to 300 nos. per acre. By the end of September the IMC and other fishes grow to a size of 100 to 150 gms. The fishes are not preyed upon by *jitada*. Rice bran, ground nut oil cake, poultry feed and *kani* is given as a feed for fishes other than *jitada*. Feeding is done twice in a day, in the wet ball form as well as by bag feeding. *Jitada* feed on the offspring of tilapia present in the pond. During culture period branches of coconut tree or mango tree are kept in the ponds. The branches provide shelter to the *jitada* and in the process enhance their growth. Normal culture period is 8 to 9 months.

Harvesting : Partial harvesting is started by the end of 6th month onward i.e. mid December using cast net and drag net. Mesh size of drag net ranges from 14 to 18 mm. The sale of fish is continued till April as per demand.

Partial harvesting of relatively bigger fishes is started by the end of 6th month onward i.e. mid December. Partial harvesting is done to cater to the local demand for fish. It also results in enhanced growth of the remaining fish in the pond. Cast net and drag net are used for the harvesting of fishes. Mesh size of drag net ranges from 14 to 18 mm. The sale of fish is continued till April as per demand.

Conclusion

Two practices of Asian Sea Bass farming are observed in the present study. First major one is integrated *jitada* cum paddy culture which is traditionally practiced in the region. Fish farmers are making use of local knowledge in managing and sustaining the farming system. Most of the farmers engaged in paddy cum fish culture are poor in socio-economic condition which might affect the adoption of modern agriculture and aquaculture techniques. Similarly few farmers have expanded the farming system to include pond culture practice. They have tried to manage the cannibalistic and carnivore behavior of Asian Sea Bass by following suitable pond culture practices with various other species such as Indian Major Carps, Silver carp and *Cyprinus* and make the Asian Sea Bass culture more viable and sustainable. In any case both the farming systems should be scientifically assisted to make them more refined for wider scale adoption and dissemination.

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