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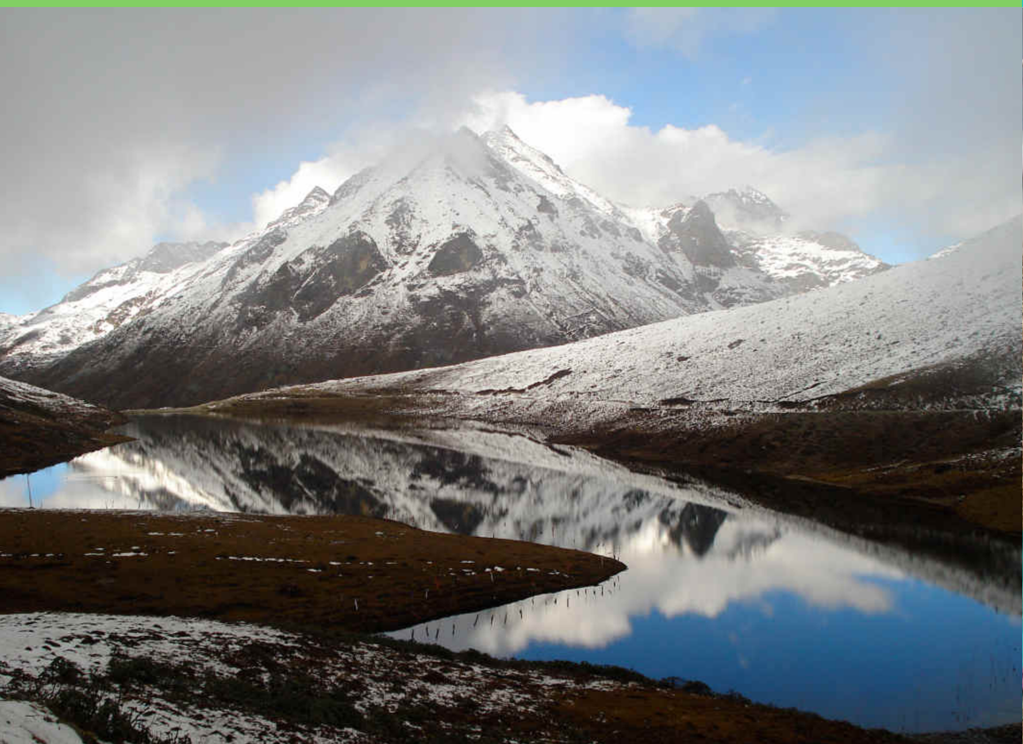
AQUACULTURE ASIA

Trout fisheries in Arunachal Pradesh

Empowering women through entrepreneurship

Snakehead fisheries

Hybrid catfish



Aquaculture Asia

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Editor

Simon Wilkinson
simon@enaca.org

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.

Contact

The Editor, Aquaculture Asia
PO Box 1040
Kasetsart Post Office
Bangkok 10903, Thailand
Tel +66-2 561 1728
Fax +66-2 561 1727
Website http://www.enaca.org

Submit articles to:
magazine@enaca.org

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Regional network on culture-based fisheries and stock enhancement

Culture-based fisheries offer a practical way for rural communities to improve their income and nutritional status. Small water bodies such as village dams are stocked to produce an additional crop of fish, which forage on natural food supplies, thereby producing an additional crop that can be sold or consumed as required. While culture-based fisheries has significant potential in tropical climates the practice is not yet widespread.

Stock enhancement of larger water bodies such as irrigation and hydropower reservoirs also offer opportunities to create employment and improve productivity of existing assets. However, stock enhancement programmes are seldom evaluated in a scientific manner and there is reason to believe that there is room to improve the outcomes.

In view of this situation a proposal to establish a Regional Network on Culture-based Fisheries and Stock Enhancement was discussed and approved by the 28th Governing Council Meeting in Dhaka. The objectives of the regional network are i) to facilitate the development and adoption of culture-based fisheries practices and ii) to promote the improvement of stock enhancement programmes in member states. Participation is open to all interested persons. The network will focus on:

- Technical exchange between NACA members.
- Development of better management practices.
- Science-based monitoring and evaluation.
- Sharing of experience.
- Evidence-based documentation of results, including socioeconomic and nutritional benefits.

As a separate initiative, NACA is developing a contact database of aquaculture experts in the region. The database will be a publicly accessible via the website, with free- and tag-based search tools. Its purpose is to help people find relevant expertise for the purposes of international cooperation, joint project development or simply locating a technical expert that can help solve a problem. The database will also serve to link networks or communities of practice working on specific issues, such as aquatic animal health or the culture-based fisheries network described above.

Personal listings in the database will take the form of a short bio, description of your research interests and key publications. Listing in the database will initially be by invitation from the Secretariat or via nomination by participating research centres; we will be writing to institutional heads in due course to request nomination of key scientific personnel. Once the pilot period is over we may open up listings to broader participation.

AQUACULTURE ASIA

CONTENTS

Trout fisheries in the uplands of Arunachal Pradesh: Resources and opportunities 3
Deepjyoti Baruah, K. Kunal, D. Sarma, A.K. Singh, Kabang Kamut and P.K. Thungon

Empowering young Indian women through entrepreneurship development: opportunities and constraints 12
Vibha Lohani, Bonika Pant and Tarang Kumar Shah

A view on murrel (snakeheads) fisheries in India 14
B. Laxmappa

Hybrid catfish *Clarias batrachus x Heteropneustes fossilis* produced by farmers in West Bengal, India 20
Subrato Ghosh

Backyard fish based pig farming using low-cost feed in Arunachal Pradesh: A success story 23
P.P. Chakrabarti, B.C. Mohapatra, Ajmal Hussan and Arnab Ghosh

NACA Newsletter 29

Trout fisheries in the uplands of Arunachal Pradesh: Resources and opportunities

Deepjyoti Baruah*, K. Kunal, D. Sarma, A.K. Singh, Kabang Kamut[1] and P.K. Thungon[2]

ICAR-Directorate of Coldwater Fisheries Research, Bhimtal - 263136, Nainital, Uttarakhand, India.
1. Department of Fisheries, Govt. of Arunachal Pradesh, Tawang - 790104, Tawang, India
2. Department of Fisheries, Govt. of Arunachal Pradesh, Bomdila - 790001, West Kameng, India
*Corresponding author email: deep_baruah@rediffmail.com

A brief background of the region

Arunachal Pradesh, the eastern most state of India is known as the land of the rising sun. This is the largest state in the north eastern region of the country, sharing international boundaries with Bhutan, China and Myanmar. The States of Assam and Nagaland flank its southern and south eastern borders. The population of Arunachal Pradesh is around 1,383,000 (2011 census) with an average population density of 17 persons per square kilometre. The state is inhabited by 28 major tribes and 110 sub-tribes and is considered to be the 12th mega-biodiversity region of the world[1].

The potential for augmentation of fish production and fish-based eco-tourism in Arunachal Pradesh are immense. The landscape of the state is characterised by lofty mountains with snow-clad peaks, dense forests, turbulent streams, roaring rivers, deep gorges and a rich diversity of flora and fauna. The climate varies from sub-tropical in the south (foothills) to temperate and alpine in the north (upland) with large highland areas experiencing snowfall during winter. The state is divided into five major river valleys: the Kameng, the Subansiri, the Siang, the Lohit and the Tirap. All of these valleys are drained by numerous snow-fed rivers and rivulets originating in the Himalayas.

Trout are an important species, highly regarded all over the world for recreational fishery as well as food fish. Upland water bodies provide suitable habitat for brown trout *Salmo trutta fario* and rainbow trout *Oncorhynchus mykiss* (rainbow trout). However, in Arunachal Pradesh, trout continue to remain more or less in the domain of capture fisheries.

The hilly districts of Tawang, West Kameng and West Siang have a low temperature regime and bountiful resources that offer tremendous scope for trout farming and recreational fisheries.

Snow peaks surrounding Sela lake.

Pangang Teng Tso lake in Tawang District.

Major prospective resources for trout in Arunachal Pradesh: The upland lakes

The entire terrain of the Himalayas in the State of Arunachal Pradesh is bestowed with picturesque views of the alpine mountains and numerous lakes with mesmerising backdrops. Tawang District is one such region with more than one hundred natural lakes, each offering its own attractions, situated between an altitude of approximately 3,000-4500 metres. Many of these lakes remain frozen during winter.

The local community, the *Monpas*, care for the lakes and prohibit undesirable developments, while stocking trout to promote recreational fisheries and associated livelihood opportunities.

Sela lake

Sela lake, some 14 hectares in area, is situated around 90 km from Tawang Headquarters at an altitude of 4,146 metres (27.512 N, 92.098 E), at Sela Pass, one of the highest passes in the region. The lake offers an immense natural beauty in the area attracting any tourist to witness the chill breeze blowing through these mountains all hours. The surrounding peaks remain snowy in most of the time of the year and the lake freezes on the surface during winter with temperatures falling to -10°C. The lake gives rise to Nuranang stream which is an important source of trout. Mature trout suitable for use as broodstock are caught 10 km downstream by the officials of Department of Fisheries for breeding programmes at a government trout hatchery. Brown and rainbow trout fingerlings produced at this hatchery are stocked back into Sela lake on a regular basis to maintain the population, as this is the only fish of its kind to survive the freezing conditions. This lake has scope for development of high-altitude recreational fisheries through the provision of basic tourist amenities, facilities for angling, fish watching and other amusements.

Pangang Teng Tso Lake

Pangang Teng Tso Lake (27.637 N, 91.857 E), another traveller's paradise, encompasses an area of five hectares around 17km from Tawang Headquarters at a height of 3,845 metres. The lake is nestled among picturesque snow-capped peaks and the clear water offer a scenic reflection of these mountain peaks and the path laden with bright rhododendron flowers. This lake provides ample scope to take up recreational fisheries in terms of trout angling and fish watching as it is very popular visited by most tourists. Attempts were made to establish brown trout in this lake in 1995 and 2013 by Department of Fisheries and ICAR-Directorate of Coldwater Fisheries Research (DCFR)[2].

Sangestar Lake

Sangestar Lake (27.723 N, 91.826 E) is situated at an altitude of 3,672 metres and around 45 km from Tawang with an area of 18.1 hectares. This lake is formed as a result of a nearby stream that was blocked by landslides during an earthquake in the 1970's. The special attraction of the lake are the dead remains of tree trunks emerging from the surface, as this place was once said to be a grazing land with plentiful trees. Many of the tourists know this lake as Madhuri Lake, on the name of an actress of Indian cinema, for her screen shots at this lake in the movie Koyla where the lake was featured.

This lake neither dries up nor freezes[2], which makes it a very popular area for recreation of all kinds including fishing and boating.

The Nagula lakes

These are a cluster of lakes in close proximity and are collectively known as Nagula, ranging from 1.0-4.6 hectares in area at an elevation of 4,075-4,209 metres (27.654 N, 91.863 E). These lakes are situated 20-40 km from Tawang township and can be approached by road. The lakes remain untapped for any domestic or commercial use as the area is very thinly populated. Migratory birds are plentiful in the area which has a wide scope to take up recreational fisheries through judicious stocking with trout and provision of amenities for visitors.

Thampysum Lake

One of the lesser known lakes in this region, as spoken by Fishery Officer, Mr Kabang Kamut of the Tawan District Department of Fisheries. The lake, area unknown, (27.675 N, 91.872 E) is not visible from the approach road and can be approached only by trekking uphill for 500 metres. The unique beauty of this lake can be experienced only by witnessing the immense peace and satisfaction on reaching it. The lake lies in a bowl, surrounded by mountains. Trout stocked by the Fisheries Department and ICAR-DCFR can be seen to thrive in this lake as they move around the banks. The remoteness of this lake and freedom from human meddling and together with an organized exertion can make this location a suitable spot for trout angling, boating and trekking point for the visitors all around the world.

The lakes at Bangajang

Bangajang is basically considered as a sacred place in Tawang District. This place can be reached by road, approximately 20 km from Sela pass, a route diverted on the way to Tawang Headquarters. Bangajang place is bestowed with a cluster of small sized lakes. These are mainly visited by pilgrims of the nearby districts to offer prayers as well as tourists across the country and the world. The road for this place remains open for a couple of months per year (August-September) and remains closed in other times due to heavy snow. No effort has been made to stock trout in these lakes to date. They offer tremendous potential for the development of trout fisheries for fish watchers, but fishing may not be permitted by local communities for religious reasons.

Omaling Lake

Around 2-3 hectares in area, Omaling Lake is another little-known upland lake situated in the neighbouring district of West Kameng, to the south of Tawang District. The lake is located between Shergaon and Nagajiji townships near Bhutan. The lake can be approached only by trekking on foot for 3-4 hours walking on snow-covered ground from the

The top view of Sangetsar Lake in Tawang District.

Sangetsar Lake of Tawang visited by tourists for recreation.

Nagula Lake of Tawang District.

Thampysum Lake in Tawang District.

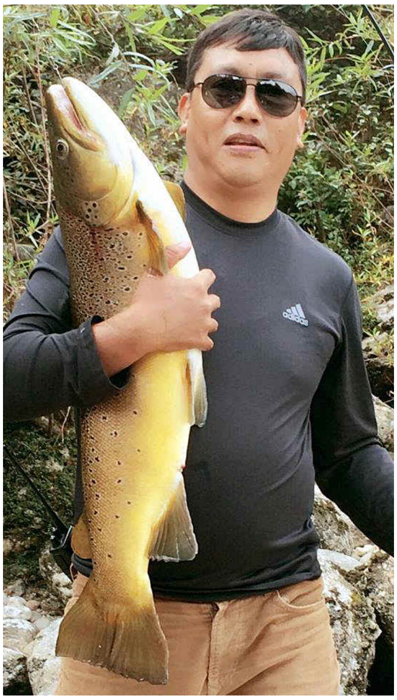
Lesser known Omaling Lake in West Kameng District.

approach road. This lake is also visited by pilgrims of the nearby villages and is preserved by religious devotees. The lake has a great potential for the development of a recreational catch-and-release trout fishery as local communities will prohibit the taking of fish for food. The lake freezes during winter. The water is clear and transparent.

An unnamed lake in Tawang District with picturesque landscape.

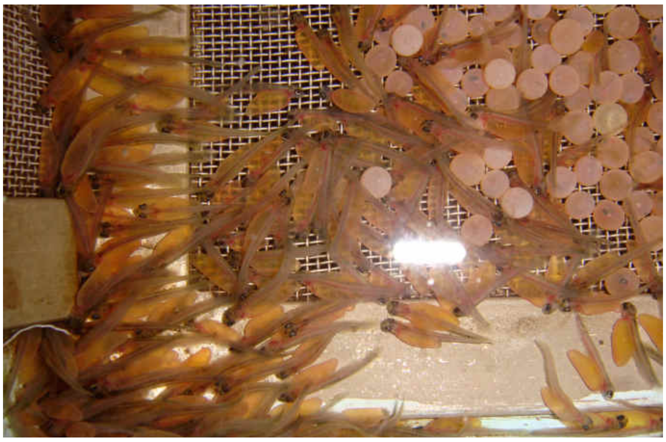
Other upland lakes

As per recent records, trout have now been well established in a few of the upland catchments of Tawang District under the aegis of the Department of Fisheries, Government of Arunachal Pradesh and ICAR-Directorate of Coldwater Fisheries Research[2], commencing in 1994-1995. Some of the larger lakes in Tawang District with greater potential for the establishment of trout fisheries include Klemta (4.5 hectares), Khamakar (4.4 hectares), Chochong (20 hectares) and Tapiumche (27 hectares). Many more lakes could not be



8.5kg brown trout from Yargyap Chu River, Arunachal Pradesh

The trout hatchery at Nuranang.



Alevins of trout at Shergaon Hatchery.

Young ones of trout at Shergaon Hatchery.

A haul of rainbow trout from a trout farm.

A Government trout farm at Nuranang of Tawang District.

known by name and many others could not be approached due to inaccessible terrain and absence of road connectivity. But overall, we felt that the natural grandeur of these lakes make them attractive to visitors and their suitability as habitat for trout provides many options for both recreational fisheries and as a source for nutritional security to the mountain dwellers living in these remote areas of the country.

The upland trout streams

We have observed that the upper reaches of the rivers and streams especially in the districts of West Kameng, Tawang and West Siang, have established trout stocks. These fishes also serve as a source of protein for the mountain communities living along these rivers. Effort has been made by the Department of Fisheries and ICAR-DCFR for rehabilitation of trout populations in these streams, especially the Nuranang stream and Choskorong Kho River, adjoining the two Government established trout hatcheries at Nuranang and Shergaon villages, respectively. Both these rivers offer an excellent scope to invite anglers from around the globe for trout fishing, generating income for the local villages.

River Siyom (locally known as Yargyap Chu) is another major river in West Siang district flowing through the township of Menchukha. This river provides a picturesque landscape to the valley and is known as a home to exotic brown and rainbow trout. Together with the countryside backdrop, the river Siyom has been admired as another paradise for the anglers in search of trout in the State of Arunachal Pradesh.

The trout hatcheries

Two trout hatcheries have been established in the State of Arunachal Pradesh based on the favourable water temperature for trout ranging around freezing point to as high as 20ºC. The first trout hatchery was established along Nuranang stream (27.535 N, 92.050 E) at 3,674 metres in Tawang District, initially importing a consignment of brown trout seed from Jammu and Kashmir. The Sela Lake connected upstream is now the source of trout broodstock in the Government trout hatchery. However, construction of a weir across the lake-river connectivity has caused a sharp decline in trout catch downstream as spoken by the caretakers of the hatchery. This has led to lesser seed production in the hatchery due unavailability of desired pairs of trout broodstock in the stream.

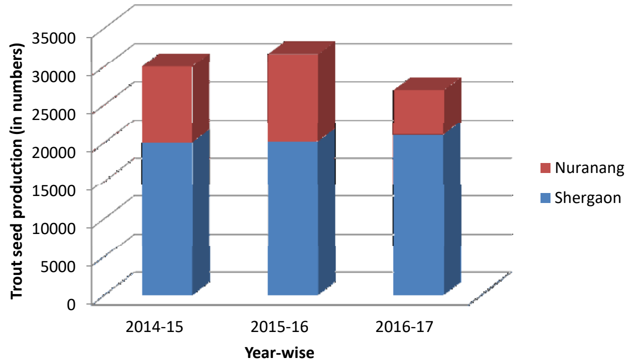
Another hatchery with a production capacity of 50,000 to 100,000 eyed ova was also established at Shergaon (27.133 N, 92.277 E) in West Kameng District during 1979, located at an altitude of about 2,085 metres. However, trout seed are produced at an average rate of 25,000-30,000 in the past three years from both the hatcheries and these seed are either procured by local trout growers or released in nearby streams for rehabilitation of the stock.

Considering the encouraging results in trout seed production, the Department of Fisheries has established a Regional coldwater hatchery and a farm complex at Samtheng, situated 8 km from the hatchery, encompassing an area of 300 hectares, for successful rearing of the trout. ICAR-DCFR has been providing technical guidance and inputs in establishing these hatcheries through up gradation of human resource development, providing technical advice, trout seed consignments and hatching facilities.

The trout farms

The trout hatcheries established for seed production and rearing of fingerlings has encouraged stakeholders to gradually commercialise their trout farms in this region. Privatisation of trout farms by entrepreneurs are mostly supported financially by the Department of Fisheries and technically by research institutes especially the ICAR-Directorate of Coldwater Fisheries Research. This concerted effort has resulted in horizontal expansion of trout farming in the region. It is expected that in the days to come, the scarce supplies of trout feeds and seeds will be made available on a regular basis, which will strengthen trout farming to rise at par in these high altitudinal remote areas. Rainbow trout is the most preferred fish for culture in the region due its ability to adapt in variable aquatic environments with substantial growth performance. On the other hand, brown trout is highly valued as sport fish for angling in trout waters. The other districts of Arunachal Pradesh with potentiality for dispersal and propagation for trout farming and recreational fishing are Lower Subansiri, Upper Subansiri and Anjaw.

Fig. 14: Quantative seed production of trout in Arunachal Pradesh



Source: Department of Fisheries, West Kameng & Tawang districts, Govt. of Arunachal Pradesh

Trout angling

Trout is regarded as the best sporting fish of the coldwater in the country. A considerable population of trout has been reported in upland waters of Menchukha region of West Siang District by an avid angler Mr Dorjee Sona from the area. The river Siyom (locally known as Yargyap Chu) flows through Menchukha region and offers an excellent site for adventure tourism for outdoor enthusiasts with a picturesque backdrop. But very few know about the beauty of this unexplored place as reaching Menchukha by road is quite tiresome. However, a little attention by the government in tourism and fisheries sectors in organising recreational events may invite tourists and explorers all over the world. At present, angling of trout in river Yargyap Chu has remained within the domain of the local anglers. A good number of sizable brown trout of 8-12 kg by weight has been reported from these waters which is an implausible catch among the water bodies of the entire State. Trout thrives well in this river, although the source of the fish remains unknown. The adaptation of the trout in these cold waters provides an excellent opportunity for game fishing in this mesmerising part of the country.

Private trout farms in West Kameng District.

A haul of snow trout by noose and line method at Dirang area.

Aquatic ecology of the upland water resources

The climate of the river valleys and upland lakes varies from severe cold to mild depending upon the altitude of the area and extent of exposure to sun. The temperature in upper reaches in winter falls below 0°C due to heavy snow fall. The normal annual temperature for the upland water bodies is less than 20°C. Dissolved oxygen concentrations increase wherever the water flow becomes turbulent, such as in a riffle area, cascade or a waterfall. The pH values ranged from slight acidic to slight alkaline and medium alkalinity. The total hardness in various water bodies has soft to moderately hard water. Table 1 generalises the water quality parameters of important upland trout water bodies of Arunachal Pradesh. The important species of phytoplankton in lotic water are comprised of *Fragilaria* (30%), *Stigeoclonium* (30%), *Pinnularia* (20%) followed by others viz., *Navicula, Nitzschia, Oscillatoria, Chlamydomonas* etc. Zooplankton are mostly dominated by rotiferans and cladocerans. There are no major sources of organic pollution loading in the rivers and lakes as their vicinities are thinly populated by humans. The low cropping intensity coupled with low agro-chemical dosing and absence of industries also means that the pollution load due to chemicals is quite low. None of the lakes and streams are infested with emergent type of aquatic plants and have clear water.

Table 1: Physico-chemical parameters of major trout water of Arunachal Pradesh

Parameters	Upland lakes	Upland streams and rivers	Upland trout farms and hatcheries
Temperature (°C)	5.37-8.36	11.42-14.09	6.0-14.0
pH	5.04-7.35	6.86-7.90	6.82-8.05
D.O (ppm)	6.20-8.30	8.06-8.13	5.00-6.18
Resistivity (mΩ.cm)	0.043-1.000	0.008-0.060	0.0039-0.064
Conductivity (µS/cm)	0.00-23.00	16.0-124.0	2.0
Actual Conductivity (µS/cm)	0.00-16.00	13.0-96.0	1.00
TDS (ppm)	0.00-12.00	8.0-62.0	1.00
Salinity (ppt)	0.00-0.01	0.01-0.06	0.00
ORP	-80.30-59.70	-42.2-47.50	-15.1-(-62.1)
Ammonium (mg/L)	<0.01	<0.01	<0.02
Nitrate (mg/L)	1.4-5.3	4.0-5.8	4.0-4.5
Nitrite (µg/L)	<5.0-6.6	8.0-10.0	5.0-5.3
Phosphate (mg/L)	<0.01-0.02	0.14-0.90	0.31-0.34
Sulphate (mg/L)	<0.02-0.11	<0.02-0.55	<0.02
Chloride (mg/L)	<2.5	<2.5	<2.5
Iron (mg/L)	0.29-0.56	<0.01-0.12	0.37-0.42
Magnesium (mg/L)	<5.0-23.5	<5.0	<5.0
Calcium (µg/L)	7.0-26.0	17.0-70.0	8.0-8.5
Cadmium (µg/L)	<5.0	<5.0	<5.0
Zinc (µg/L)	<0.20	<0.20	<0.20
Copper (µg/L)	<0.05	<0.05	<0.05
Turbidity (NTU)	0.27-1.72	0.31-0.48	0.37-0.42
Alkalinity (NTU)	4.0-22.0	16.0-52.0	12.0-16.0
Hardness (NTU)	6.0-22.0	14.0-64.0	10.0-12.0

Fish diversity in the trout streams of Arunachal Pradesh

The distribution and diversification of fish species in Arunachal Pradesh can be mainly attributed to altitude and topography. The higher elevations have specific coldwater forms mostly dominated by *Schizothorax* species (snow trout), *Garra* species and *Glyptothorax* species. These Schizothoracine fishes are the important indigenous trout from these upland water resources for capture and are not commercially stocked in ponds and tanks for culture in view of their slow growth rate. Recreational fishing with these snow trout involves a specially designed noose on line method developed indigenously by the local fishers of Dirang region in West Kameng district[3]. These snow fed streams and rivers converge into a common drainage downstream in the foothills and plains, and here the fish composition are mostly comprised of the mighty mahseers, catfishes, featherbacks, eels, carps, barbs and minnows. Altogether, 258 fish species belonging to 21 families and 76 genera have been reported from the coldwater resources and utilised for sports, ornamental value and as food fish[4].

Fisheries development strategies in upland resources

The proposed strategies of fishery development are aimed towards upland resource utilisation by means of propagation and conservation of indigenous and commercially important species of trout. Some of the strategies may be worked out by: i) resource mapping of unutilised upland water bodies for framing developmental policies, ii) establishment of location-specific hatchery units for facilitating seed production and propagation, iii) habitat rehabilitation for trout conservation, iv) awareness and capacity building among mountain dwellers for adopting trout farming to ensure food security, v) promotion of eco-tourism and angling for recreation and income generation, and v) strengthening of human resource development in the public sector to implement these strategies in remote hilly terrains.

Acknowledgements

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Empowering young Indian women through entrepreneurship development: opportunities and constraints

Vibha Lohani*, Bonika Pant and Tarang Kumar Shah

College of Fisheries, GBPUA&T, Pantnagar, Uttarakhand, India, Pin - 263145. Email: vibhalohani29@gmail.com

Women's entrepreneurship can be a boon for sustainable utilization of resources, food security and employment generation. Women entrepreneurship can be defined as the process, in which she thinks to set up a business, gathering all the resources necessary to manage a business venture, provide employment to others and to make a profit along the way while minimising risk. It is a woman or group of women who initiate, organise and run a business enterprise. Kamal Singh, a female entrepreneur from Rajasthan, has defined a woman entrepreneur as "a confident, innovative and creative woman capable of achieving self-economic independence individually or in collaboration, generates employment opportunities for others through initiating, establishing and running the enterprise by keeping pace with her personal, family and social life."

Womens' entrepreneurship can be broadly categorised as follows:

- **Affluent entrepreneurs:** These are women from families with well-established businesses with access to financial resources to start a new business.
- **Pull factor:** These are the well-educated urban women with or without work experience and take help from the commercial banks and financial institutions for establishing a new business.
- **Push factor:** These are the women who take on some business activity in order to overcome financial difficulties. Frequently they are single or widows taking responsibility for their own family business or to start a new business.
- **Rural entrepreneurs:** Typically choose a business which involves minimum investment, low risk, suiting their access to resources and knowledge.
- **Self-employed entrepreneurs:** Women that frequently have little education or that are living below the poverty line may choose tiny enterprises that are convenient to manage and adequate for the sustenance of their families.

Functions of women entrepreneurs

Innovation: Imaginative approaches or original ideas. Introduction of new products in the market and introduction of a new production technology.

Risk-bearing: The function of the entrepreneur as risk bearer is specific in nature. The entrepreneur assumes all possible risk while starting a business which may be include changes in the taste of customer, modern techniques in technology, competence with the existing market product etc.

Organisational: The entrepreneur provides an organizing function, bringing together various factor of production, ensures continuing management and rendering risk bearing functions.

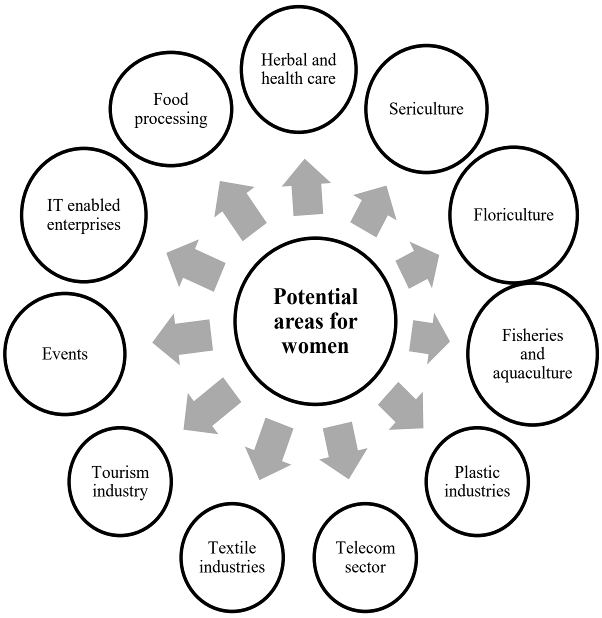
Managerial: Planning, coordinating, directing, staffing, motivating and controlling the enterprise, setting goals, analysing the market, planning production, sales and recruitment

Decision-making: Deciding on the development of the market for product sales, development of new products or changes to existing products, securing adequate financial resources and maintaining good relations with investors.

Policies and schemes for women entrepreneurs in India

The Government of India has over several schemes for women operated by different departments and ministries (Vinesh, 2014). Some of these are:

- Integrated Rural Development Programme (IRDP).
- Khadi And Village Industries Commission (KVIC).
- Training of Rural Youth for Self-Employment (TRYSEM).
- Prime Minister's Rojgar Yojana (PMRY).
- Entrepreneurial Development Programme (EDPs).
- Management Development Progammes.
- Women's Development Corporations (WDCs).
- Marketing of Non-Farm Products of Rural Women (MAHIMA).
- Assistance to Rural Women in Non-Farm Development (ARWIND) schemes.
- Working Women's Forum.
- Women India's Trust (WIT).
- Indira Mahila Yojana.
- Indira Mahila Kendra.
- Mahila Samiti Yojana.
- Mahila Vikas Nidhi.
- Micro Credit Scheme.



- Rashtriya Mahila Kosh.
- SIDBI's Mahila Udyam Nidhi.
- Mahila Vikas Nidhi.
- SBI's Stree Shakti Scheme.
- NGO's Credit Schemes.
- Micro and Small Enterprises Cluster Development Programmes (MSE-CDP).
- National Banks for Agriculture and Rural Development's Schemes.
- Rajiv Gandhi Mahila Vikas Pariyojana (RGMVP).
- Priyadarshini Project- A programme for Rural Women Empowerment and Livelihood in Mid Gangetic Plains.
- NABARD SEWA Bank project.
- Exhibitions for Women, under promotional package for Micro and Small enterprises approved by CCEA under marketing support.
- Support to Training and Employment Programme for Women (STEP), India.

Problems faced by women entrepreneurs in India

There are many problems faced by Indian women to get ahead their life in business. Some of them are given as follows (Kumar, 2006):

- Women often face barriers in accessing credit. India is traditionally a male-dominated society and some men may have the view that it is risky to finance women entrepreneurs.
- Similarly, commercial banks and financial institutions may doubt the skills of women and their entrepreneurial abilities. This is despite that, according to a report by the United Nations Industrial Development Organization (UNIDO), loan repayment rates are higher compare to men but still women face more difficulty in getting loans from banks (UNIDO, 1995b).
- Women in developing nations often have little access to funds, due to the fact that they are concentrated in poor rural communities with few opportunities to borrow money (Starcher, 1996; UNIDO, 1995a). To start up a new business there is need for adequate finance and women entrepreneurs lack working capital and suffer from inadequate funds due to their inability to provide tangible security.
- Family obligations can also be a barrier for women entrepreneurs in both developed and developing countries. Due to responsibilities for children and other dependents on women, it is difficult to devote their whole time and energies to their business (Starcher, 1996). Sometimes the financial restrictions demoralise women entrepreneurs on the belief that they can leave their business anytime and become housewives again. Therefore to start up a business they rely on their own savings and loans from their relatives.
- In India, many women give high emphasis to family and relationships. The business success depends on the support of the family to the women. For married women, the decision of further going into business may depend on the views of their in-laws.
- Women entrepreneurs may employ a greater number of office staff and intermediaries, which may affect the overall profitability of the business.
- Less access to knowledge of the latest technological changes and their applications may also create a problem for them (UNIDO, 1995 b).
- A higher aversion to risk and lack of self-confidence can also be factors affecting women's decisions to get into business. Although risk tolerance of women folk in day-to-day life is high compared to males, investing money, maintaining operations and ploughing back money for surplus generation needs a lot of courage and confidence.
- Fewer opportunities for education may affect confidence, success and advancement.
- The high capital cost, installation of new machinery, expansion of the productive capacity of some business operations may dissuades women entrepreneurs from venturing into new areas.

Conclusion

Independence has brought the promise of equality of opportunity in all spheres to Indian women but for delivery of this promise there remains a need to boost women's empowerment. The role of women entrepreneurs is important in economic development. For the development and promotion of women entrepreneurship, there is a need for a multi-dimensional approach with involvement of governments, financial institutions, commercial banks and last but not the least, the family members of women.

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A view on murrel (snakehead) fisheries in India

B. Laxmappa

Fisheries Development Officer, Department of Fisheries, Telangana, India. Email: laxmappaboini@gmail.com

Channa striatus.

Murrels (family Channidae), also known as snakeheads, are the third most important group of freshwater fishes in India after carps and catfishes. Murrels are the most common and dominant group of air breathing freshwater fishes and are highly regarded as food fish in India. On the roof of the pharynx, murrels have a pair of cavities which have folded linings, richly supplied with blood vessels for taking in air. These organs enable these fishes to survive out of water for a few hours or migrate from one pool to another.

In addition to their value as food, murrel are important in biological control of mosquito larvae and aquatic insect populations in stagnant water pools, helping to protect human beings. They are also well known game fishes as they are easily attracted by lures and caught by the fish by anglers, providing both entertainment for the public and income for those involved in organising such sports.

Species

38 species have been reported globally so far. The Asian genus *Channa*, which presently contains 35 species, is widely distributed in India, Sri Lanka, Myanmar, Thailand, China, Laos, Cambodia, Vietnam, Malaysia, Indonesia, Philippines, Taiwan Province of China, Korea and Southern Russia. In India, fifteen species of *Channa* have been reported and are recognised on the basis of coloration, morphometric characteristics, scale patterns, fins etc. (Table 1).

Table 1: Snakehead species reported in India

Scientific name	Common name
Channa amphibeus	Borna snakehead
Channa andrao	Dwarf snakehead
Channa aurantimaculata	Orange-spotted snakehead
Channa barca	Barca snakehead
Channa bleheri	Rainbow snakehead
Channa diplogramma	Malabar snakehead
Channa gachua	Dwarf snakehead
Channa marulius	Great snakehead
Channa melanostigma	-
Channa micropeltes	Indonesian snakehead
Channa orientalis	Walking snakehead
Channa pardalis	Gorgeous snakehead
Channa punctata	Spotted snakehead
Channa stewartii	Assamese snakehead
Channa striatus	Striped snakehead

Among the genus *Channa, C. striatus, C. marulius* and *C. punctatus* enjoy a good deal of popularity as food fish in many parts of India. Besides the high quality of their flesh in terms of taste and texture, they also have good market value due to the low fat, fewer intramuscular spines, medicinal qualities and availability as live fish.

The various species of snakeheads differ greatly in size. Dwarf snakeheads, such as *C. gachua*, do not surpass 25 cm in length. Most other snakeheads reach between 30 and 90 cm. About five species *(C. argus, C. barca, C. marulius, C. micropeltes and C. striatus)* can reach 100 cm or more.

Murrels being typical "live fishes" and having soft flesh devoid of fat are considered to have medicinal value and provide nutritious food, particularly to the sick. Murrel fingerlings are used as medicine every year in the month of June on the eve

Channa marulius.

Murrel juveniles.

of *Mrigasirakarthi* day for dispensation to asthma patients that gather from all over the country in Hyderabad City since long back.

Cultivable species

However, the high demand and high market value and their capacity to withstand in adverse water conditions make them suitable candidate species for aquaculture. Out of the different species of murrels found in India *C. marulius, C. striatus and C. punctatus* are important from a culture and economic point of view. These are also cultured by most of the farmers along with major carps in many states of the India.

Farming practices

Murrels are predatory in habit and feed on verity of fauna present in the water. The murrel breeds all around the year from rain-fed ditches and shallow water bodies with rich aquatic weed vegetation. Juveniles of these species, under parental care, move in shoals in search of food along the marginal areas of the breeding environment. While moving they make characteristic ripples at the water surface which can be easily noticed from a distance. The entire shoal can be collected easily when it is moving in the marginal weed-free areas using a fine meshed net.

Murrel juveniles and fingerlings are available in rivers, reservoirs, perennial tanks and other derelict water bodies. The present demand for murrel seed is, by and large, met from wild collection. Maximum seed availability is from May to August. The commercial culture of murrels is still not common in India due to inadequate seed availability.

Seed stocking

Murrels permit high stocking density, as they are hardly fishes and tolerate overcrowding due to the additional support of air breathing organs. Presently many farmers are stocking about 5,000 to 8,000 fingerlings / ha. Fishermen usually collect murrel seed from the wild and sell it to farmers. Fish farmers stock these murrel seed along with carp in their culture tanks and allow them to grow for 6-9 months or even more. In exclusive carps culture ponds, farmers stock 300-500 murrel fingerlings per hectare to control, weed fishes particularly tilapia. This gives additional income to the farmers in India.


Healthy murrel juveniles commonly used for stocking in culture tanks.


Hand picking of murrels after total dewatering of culture tank.

Murrel juveniles collected from wild source.

EUS infection

Murrels are easily susceptible to epizootic ulcerative syndrome (EUS), resulting in large scale mortalities. Murrels of all sizes are affected. However, the incidence of infection is greater in the younger ones. Affected murrels with mild lesions may not show any clinical signs, whereas those with marked ulcerative lesions exhibit distinct abnormal swimming behaviour with frequent surfacing.

EUS is characterised by the occurrence of large haemorrhagic or necrotic ulcerative lesions on the base of fins and other parts of the body, which later become larger inflamed areas with acute degeneration of epidermal tissues. Initially, the disease appears as red coloured lesions, haemorrhagic in nature. These red lesions spread and enlarge gradually becoming deeper and assuming the form of ulcers. With further advancement, scales fall off; ulcers become deep necrotising or lesions. The fish starts rotting while still alive and eventually dies.

Harvesting

Although murrels are caught in gill nets, drag nets and cast nets; the gear mainly intended to catch murrels are long line and various types of traps. It is also a common practice to drain or pump water out from pools and ditches where murrels are known to live, for hand picking.

Murrel caught with hook and line from the canal.

Murrels marketing.

Marketing

Murrels are marketed in live condition as they can be kept out of water for several hours in moist conditions. These fish fetch a very high price ranging from Rs. 300- 600 (US $ 5-10) per kg in different markets. In general the prices of murrels are much greater than those of carps and catfishes. Heavy demand for murrels exists in the states of Telangana, Andhra Pradesh, Karnataka, Tamil Nadu, Assam, Bihar, Jharkhand, Uttar Pradesh, Haryana, Punjab and Madhya Pradesh. Some like them for their delicious taste, while others prefer them because of their nutritional and medicinal value. The demand also arises because they are sold live in the market, and can be purchased in a fresh condition.

Production trends

Production of murrels under traditional composite culture systems ranges from 50 to 150 Kg/ha in 8-10 months. On an average, marketable sizes of murrels can be obtained in 8-9 months. The yield is slightly more under semi-intensive culture along with carps. They have scope for development in the country as alternate species but non-availability or adequate seed is the main constraint to increasing production at present.

Financial support

The National Fisheries Development Board (NFDB) was established in Hyderabad in 2006 for the development of Indian fisheries, and is also planning to provide financial assistance for the development of breeding, feeding and culture technology of murrels particularly *C. striatus* in India.

Conclusion

Against the availability of vast freshwater resources, only a limited area is used for murrel farming in different states in India. Many reservoirs and projects constructed on these rivers and their tributaries have left many hectares of land water logged in the vicinity of the canals of the projects and otherwise unfit for agriculture. This vast water logged area is available for fisheries development. As such still there are ample resources for the growth of inland fisheries activities including murrel farming.

The various state governments in India are fully aware of the potential of murrel farming; the technology is a constraint for breeding and feeding of murrel farming in commercial way. There is a good domestic market available for murrels, as returns by adopting murrels as a variety in their fish culture practices. With the proper utilisation of the available resource and the technology, the states can augment the murrel production, and the fish farming community can reap better returns for their products.

C. striatus is the most cultivable species among snakeheads in India. The Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar has developed induced breeding, seed rearing and culture techniques of this species recently.

In tropical countries like India, where there is significant area of water logged land and derelict or under-utilised water bodies, air-breathing fishes like murrels may have a significant advantage for aquaculture as they can very well thrive in this environment. More studies need to be initiated in murrel breeding and nutrition to undergo a commercial large scale production the country due to its significant food value and demand in many parts of India.

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Well grown murrel from culture tank.

Hybrid catfish *Clarias batrachus* x *Heteropneustes fossilis* produced by farmers in West Bengal, India

Subrato Ghosh

122/1V, Monohar Pukur Road, P.O. Kalighat, Kolkata – 700026, West Bengal, India
Email: subratoghosh2007@rediffmail.com

Among the freshwater catfishes, magur *(Clarias batrachus)* is in great demand in eastern and north-eastern India; it is revered as highly nutritious and therapeutic in nature. It contains higher percentage of protein and iron compared to most other edible freshwater fishes. Stinging catfish *Heteropneustes fossilis* or 'singhi' is also commercially significant, known for its invigorating quality that includes taste and nutritional values. Its muscle contains high amounts of protein and iron (226 mg/100 g). These two fishes are very useful for people during recovery from an illness or medical treatment. Both have relatively high haemoglobin content (11.58%), better palatability, medicinal values and live out of water for several hours if their skin is kept moist.

Clarias batrachus broodstock.

During May-June 2016, Sri Sayer Mohammad Sarkar, an experienced Mmgur breeder and seed producer, has achieved success in producing induced-bred hybrid seed of *Heteropneustes fossilis* and *Clarias batrachus*. His residence and magur hatchery is at Vill. Kholomba, Deotala Gram Panchayat, P.O. Dhaoel, Block and PS Gazole, Dist. Malda, West Bengal. Initially he purchased 10-12.5 cm sized *H. fossilis* from market, reared them for eight months in properly-managed ditches of 120-160m^2 area. Floating pelleted feed (2 mm diameter) of Charoen Pokphand (CP) Group was fed to them twice a day. A mixture of minced snail/mussel meat and rice bran can also be used for *H. fossilis*, Sri Sayer stated. The fish attained 20-25 cm in length and weighed 80-90 g. He purchased 7.5-8 cm sized *C. batrachus* fingerlings, reared them for ten months in 360-400 m^2 earthen ponds until they attained 150-220 g weight (22.5-25 cm) individually. Initially he used a non-pelleted mixture of rice bran, mustard oil cake, soybean meal/wheat flour and fish meal as supplementary feed (animal matter : plant matter = 3:1), but later on continued with CP brand pellet-type feed (2 mm diameter). Prior to induced breeding, matured *C. batrachus* were harvested from pond and maintained in cemented rectangular tanks, having a 7.5-10cm thick layer of clay-rich soil on bottom. Sri Sayer provided a soft bottom to protect magur brooders from injury.

To produce the hybrid variety, Sri Sayer used *H. fossilis* females and *C. batrachus* males in the ratio 3 *H. fossilis* : 1 *C. batrachus* during hand stripping. He believed that one testis of a matured *C. batrachus* male (150-180 g) can fertilise the ovulated eggs of three mature *H. fossilis*. Ovary of a 80-90 g mature *H. fossilis* female (2+ years in age) weigh 9-12 g. For induced breeding, he used 0.08ml of WOVA-FH hormone injection to each of *C. batrachus* males (i.e., @ 0.4ml/kg body weight) and 0.1 ml of the hormone to each of *H. fossilis* females (@ 0.9ml/kg body weight). After a latency period of 10-11 hours, when optimum time for stripping was reached, abdomen of male *C. batrachus* was cut open, two milkfish-white testis lobes were scooped out, cleaned and quickly macerated/homogenised using mortar-pestle in 0.85%

Magur x singhi egg incubation-cum-hatching chamber.

Two year old singhi female brooder.

One year old hybrid variety.

NaCl (physiological saline) solution to prepare sperm suspension (about 3ml). Spermatozoa/milt of magur is temporarily preserved in NaCl; spermatozoa remain viable and survive only for 3-4 minutes. Injected *H. fossilis* females were stripped for spawning into a clean and dry enamel tray, eggs were released smoothly. Sri Sayer spread sperm suspension of magur, which was prepared prior to stripping of female singhi, over the stripped eggs. A little freshwater was added to reactivate the spermatozoa; stripped eggs of *H. fossilis* were fertilised artificially within 3-4 minutes with sperm suspension made with macerating the testis of male *C. batrachus*. Freshwater was poured and the tray was tilted for 2-3 minutes to ensure effective fertilisation.

As egg incubation-cum-hatching chamber, Sri Sayer used dug out rectangular earthen enclosures (more than one) of 10-12 m^2 area (2.1 x 1.5 m), over which durable black polythene sheet (waterproof tarpaulin sheet 1-2 mm thick) was lined. Water level in the chamber was maintained at 10-15 cm, sticky demersal-type fertilised eggs were uniformly spread in a single layer. According to Sri Sayer, fertilisation rate was 70-75%. In order to maintain eggs under flowing condition and well-aerated water, a PVC pipe of 2.5-3.25 cm diameter and 1.5 m in length, having 10 drilled pores was fixed at one end of each chamber along its width, 30 cm above from bottom level, and used as water sprinkler into the chamber. Through perforated pipes, the water was divided evenly over water surface in chamber. A slight current of water was maintained to maintain optimum oxygen level. Additionally aeration was provided in each chamber by means of two sets of air tubes and air stones, and a constant stream of air bubbles in the chamber was created. From three female singhi, he could obtain 6,000-7,000 fertilised eggs.

In such a condition, within 25-26 hours, eggs hatched out. Unfertilised eggs and dead egg shells were removed quickly by siphoning. Larvae of the novel hybrid variety produced did not accept feed for the first three days. In the next two

Sri Sayer Md. Sarkar left.

days, for every 5,000 hatchlings, he used two boiled egg yolk as feed daily, in morning and afternoon, crushed by fingers and applied. He also used tubifex cake, a processed, commercially-available solidified form of mass of finely chopped tubifex worms. Sri Sayer then transferred the larvae into a properly-managed 60-120 m^2 pit-type earthen chamber of 30-45 cm depth, having mild shower facilities, at a stocking density of 1,800-2,000 larvae/m^2. For every 5,000 larvae, he used 200 g powder-type floating fish feed daily, in morning and in afternoon. In one month, the hybrid variety reached 1.5 cm (Note: The indigenous pure *C. batrachus* fry reach 1.5-2.0 cm in 14-15 days). These were further stocked in 40-460 m^2 earthen ponds, properly fenced on four sides.

In farm conditions, growth of *C. batrachus* is very rapid in comparison to *H. fossilis*. Sri Sayer mentioned that this hybrid variety has a slower growth rate than *C. batrachus*, but improved growth rate than *H. fossilis*. In six months, it reached 7-8 cm, whereas *C. batrachus* fry reach fingerling stage of 7-8 cm in three months from hatchling stage. For the hybrid variety, he used floating pellet feed of 0.2-0.5 mm size and like *C. batrachus*, it accepts 75% of the feed during night time. Sri Sayer further stated that *H. fossilis* fry reach 3-4 cm in 30-45 days under controlled conditions and at the end of one year, male and female *H. fossilis* reach to size of 8 cm and 12cm respectively. Author Subrato Ghosh met Sri Sayer at his hatchery site on 29th May, 2017 and almost at the end of one year, the hybrids were found to be of 16-17.5 cm size (hatchlings of which produced in June 2016).

In simple terms, Sri Sayer stated that head of the newly produced hybrid in adult form is similar to that of *C. batrachus*; somewhat blackish, broad, not as much depressed like that of *H. fossilis*; but the body is similar to that of *H. fossilis*, elongated, having reddish tinge and a short dorsal fin (unlike magur). At Sri Sayer's hatchery, water replacement in brood stock tanks, aeration facilities in tanks and egg incubation-cum-hatching chambers are electricity-operated; frequently power cut occurs in this remote village and this is a major problem for conducting induced breeding trials. In *C. batrachus* breeding, he experienced that female brooders of 1+ year in age give good response, a high fertilisation rate of eggs is obtained, but at higher water temperature, hatching rate declines to its minimum.

Backyard fish-based pig farming using low-cost feed in Arunachal Pradesh: A success story

P.P. Chakrabarti, B.C. Mohapatra*, Ajmal Hussan and Arnab Ghosh

ICAR - Central Institute of Freshwater Aquaculture, Bhubaneswar 751002, Odisha, India. Email: bcmohapatra65@gmail.com

Hillside pond for integrated pig-fish system at Sonajuli, Papumpare District, Arunachal Pradesh.

It has been accepted across the globe that sustainable development is the only way to promote rational utilisation of resources and environmental protection without hampering economic growth. Integrated farming systems (IFS) are a viable option in this regard as waste is minimised, the by-product of one system becoming an input for others and thus, optimising the use of resources while reducing pollution. IFS are low waste, low cost and low energy production systems in which various compatible agricultural enterprises are blended together to form a unified whole farming system for the purpose of sustainability. IFS can provide a reasonable rural livelihood, a clean environment and adequate food and products with a greater degree of stability in the production process by spreading the risk of production over several activities.

In the north-east hill region, integrated fish farming is one of the best alternatives for improving livelihoods as most of the houses in rural areas have access to ponds and livestock. Among livestock, pigs are a popular choice, particularly for the tribal population of the region, who account for a major portion of the population. Pigs are one of the best feed converters amongst the all domesticated livestock with a feed conversion ratio of 3.0-3.5 kg feed per kg of live weight gain and can fit into diverse systems of management. Pigs can be reared on kitchen wastes, industrial or agricultural by-products, slaughter house offals or commercial feed. Dressing percentage is also very high (65 to 70%) and a sow can produce 16 piglets in a year with short generation interval. These advantages coupled with demand in lieu of changing food habits of Indians, framed integrated pig farming with fish as an attractive venture for rural livelihoods.

Attempts have been made by ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIFA), Bhubaneswar through its Kalyani centre, to disseminate integrated fish farming technology (fish farming with livestock, high-value horticultural crops, etc.) to different parts of the north-east hill states of India, along with technical support. As a part of that effort, integrated pig-fish farming technology has been demonstrated at remote places of Arunachal Pradesh. A progressive fish farmer of Sonajuli, Papumpare District, Arunachal Pradesh, Mr Tana Nikam Tara, started pig-fish farming under ICAR-CIFA guidance in 2014 in a 0.12 ha pond and six of piglets of the Yorkshire variety, along with his other aquaculture ventures. With persistence guidance of ICAR-CIFA and with knowledge gained over time Mr Nikam modified the traditional pig culture system to an improved one, adding components such as a 'swimming pool for pigs' (as he calls it) and low-cost feed.

Management of pigs

Growth of pigs depends upon many factors including breed and strain, but, good management contributes to the achievement of optimum production.

Housing pigs

The pig house was initially constructed with locally available materials such as bamboo and *Licuala peltata* leaf, but the floor was roughly cemented with slight slant towards a drainage canal connected to the pond. With the passing year, side bamboo wall was replaced with a cemented wall and iron fencing. Height of the pig-sty is 1.9 m with sufficient provisions for free movement of air to take care of the thermal requirement of the pigs as they don't have a heat regulating mechanism. An enclosed run (pen) is also provided with a

Pig sty constructed over a pond dyke.

Compartment within pig sty (improved) for keeping male pigs separately from females.

wallowing tank to facilitate the pigs to get enough air, sunlight and space for dunging; and enjoy the shade on hot summer days. Feeding and drinking troughs are constructed both inside the house and inside the pen. On average the pigs were provided with around 5.35 m^2 inside the pig house with pen area of 3.2 m^2 per pig.

Feeding management

Although feed requirement depends upon the types of pig in rearing i.e., dry or pregnant, boar or lactating sow, grower or finishers, etc.; on average it accounts for 65-70% of the total cost of pig farming. Pigs were fed with balanced pig mash @ 2 kg/adult pig/day; twice a day i.e., morning and afternoon. However, as balanced feed is costly raising pigs with that feed was found to be economically unsound. So, he started 'swill feeding' to the pigs, providing leftovers of human food, vegetables, rotten wild fruits, etc. Under technical guidance of ICAR-CIFA, one pig feed has been developed which is well accepted by the pigs and also gives better return on investment from the venture.

To prepare the feed, the ingredients listed in Table 1 (except for the rotten wild fruits) are mixed together, boiled and then cooled. After that, the finely smashed/chopped wild fruits are mixed with the above boiled food and served to the pigs. Green weeds/grasses or sugarcane leaf are provided fresh, separately or sometimes along with prepared feed. Mineral mixture @ 1% is also added periodically with the feed to overcome mineral deficiency. Pigs are fed with this prepared feed twice daily @ 3.5 kg/adult pig/day. This reduced the cost for ration for feed, without any significant impact on growth of the pigs.

Health care

Pig houses and open pens are washed daily to keep the pigs healthy and disease free. Disinfection of pig houses is done with potash ($KMnO_4$) every 15 days while washing the pig house. As pigs often suffer from diseases like swine fever,

Enclosed run (pen) with a wallowing tank attached to pig sty to facilitate the pigs' thermal comfort in hot summer days.

Table 1: Composition of pig feed prepared using locally available, cheaper ingredients

Ingredients	% share in feed
Kitchen waste and spoiled / fresh vegetables & fruits (potato, green vegetables, banana, jackfruit, etc.)	30%
Rice bran/broken rice	20%
Rotten tree bark/branches / roots, parts of banana tree, wild arum, etc.	20%
Maize	12%
Rotten wild fruits *(Ficus glomerata)*, etc.	5%
Low-cost dry fish / spoiled fish/ fish or poultry intestinal waste	5%
Green weeds / grasses (milfoil / water lettuce / duckweed / tapioca / water hyacinth / any green grass) / sugarcane	5%
Tea leaf waste	2%
Common salt	1%

swine plague, swine pox and may be infested with parasites; regular vaccination especially against swine fever (IVRI vaccine) has been conducted.

Fish culture integrated with pigs

Pig houses for use in integrated pig-fish farming were constructed at the embankment of a pond with area 0.12 ha and water depth of 1.6 m. Clearance of unwanted fishes, de-weeding and liming (250 kg/ha) of the pond was done prior to stocking of the pond with fish seed as in the case of composite fish culture systems. After initial fertilisation, the pond was stocked in June 2016 with 1,200 carps (@ 10,000/ha) with a species ratio of 30% catla *(Catla catla)*, 30% rohu *(Labeo rohita)*, 15% bata *(Labeo bata)*, 15% common carp *(Cyprinus carpio)* and 10% silver carp *(Hypophthalmichthys molitrix)*. Washings of the pig house containing pig dung, urine and spilled feed were added to the pond. Pigs under 50 kg body weight on average produce 3.0 kg dung per day and 50 to 90 kg pigs produce 5.5 kg per day with 20 to 25% dry matter. This material acted as an excellent fertiliser and raised the biological productivity of the pond water and consequently increased fish production. Moreover, undigested solids of pig dung served as a direct food source for fishes. No supplementary fish feed or pond fertiliser was provided. To hasten organic decomposition, lime @ 62.5 kg/ha was applied in the pond at two month intervals.

Harvesting of fish and pig disposal

Due to the availability of natural food in the fish-pig pond, a good percentage of the total fish attained marketable size within 6 months. From 6 months onwards fishes were partially harvested from time to time depending upon the size of fish, prevailing market rate and demand of fish in the market. After harvesting partially, stock was replenished with the same number of fingerlings of harvested species. Final harvesting was done after 11 months of rearing. Fish yield ranged 3,700-4,500 kg/ha/year.

Pigs are generally sold out after 5-7 months when they attain slaughter size (70-90 kg weight) and a new lot of 2- 3 month old weaned piglets are brought to the pig house for rearing. As fish raising is done for 10-12 months, two lots of pigs are sold out along with one lot of fish.

Economics of pig-fish integration

Economic return obtained in integrated pig-fish farming in first year in terms of input-output ratio was 1.0 : 1.40 (when balanced pig mash was used as pig feed). In the second year onwards with reduction of feed cost for pig (pigs were fed with feed prepared using locally available cheaper ingredients) input-output ratio from the venture raised to 1.0 : 2.30, and the farmer is getting the same steadily with minor fluctuations.

Rules of thumb for optimum production of fish in pig-fish integrated farming system

- Maintain optimum water level in pond (1.5 m or above).
- Apply lime at regular intervals to hasten organic decomposition.
- Instead of draining pig house waste directly into the pond, it is better to collect the waste in a cemented pit and spread the same in different parts of pond.
- Add washings of pigsties into the pond after sunrise to avoid oxygen depletion; the amount added must be carefully regulated (see below).

Yorkshire variety of pigs and piglets in pig sty.

Feeding of pigs with wilted sugarcane.

Chopping and shredding a banana tree for pig feed.

Cooking locally available, cheaper ingredients to feed the pigs.

Harvesting fish.

- If algal bloom conditions appear on water surface (especially during the summer season) do not add pig dung to the pond; keep it in the cemented pit.

- Monitor water quality periodically, particularly dissolved oxygen (DO) in the morning of summer months. If DO falls below 3.5 mg/ litre, stop further application of pig dung. Exchange water and provide aeration (by aerator/ sprinkling water over pond surface through pumping/ splashing water with split bamboo, etc.).

- As excreta of 30 adult pigs (above 50 kg weight) per ha pond is required to properly fertilise a pond of 1.0 ha, number of 2- 3 month old weaned piglets that are brought to the pig sty for rearing must be doubled (60 per ha water area) to maintain pond productivity. That is, adjust the number of pigs based on their age or looking at the pond condition to maintain a uniform productivity level.

- Stop loading/draining pig manure to the pond a few days (2-3 days) before harvesting of fish.

- De-silt the pond as necessary, or at least at 3-4 years intervals.

Conclusion

Integrated fish farming is the blending of various compatible agricultural enterprises into a functional or unified whole farming system for the purpose of sustainability. It is a low waste, low cost and low energy production system in which the by-products of one enterprise is recycled into another as input. While maximising land use, integrated farming approach reduces cost of input, diversifies food production, and encourages enterprise combination to improve profitability and therefore farmers' socio-economic status. The results of the present study clearly show that integrated pig-fish farming can be a well profitable venture, especially if the feeding cost for pig is reduced through the supply of locally available feed materials. It is a suitable model for villages where pig farming is common and sufficient quantity of pig feed ingredients are available locally.

Acknowledgements

The authors acknowledge the financial support from North Eastern Hills Programme of ICAR-CIFA and provision of facilities by the Director, ICAR - Central Institute of Freshwater Aquaculture, Bhubaneswar, India for the study. The authors are thankful to Mr Tana Nekam Tara, Sonajuli, Papum Pare District, Arunachal Pradesh for farm facilities.

NACA Newsletter

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28th NACA Governing Council, Dhaka, Bangladesh

The 28th NACA Governing Council was convened in Dhaka, Bangladesh, from 25-27 April 2017. Sixteen member governments attended in addition to the Regional Lead Centres for China, India, Philippines and Thailand; the Food and Agriculture Organisation of the United Nations (FAO), the Southeast Asian Fisheries Development Center (SEAFDEC) and the Secretariat of the Pacific Community (SPC). Bangladesh was Chair of the meeting and Maldives Vice Chair.

Member states shared their plans for development of the aquaculture sector and rural communities and collaboration on issues of common interest.

Aquatic animal health was a key concern for all members. In particular, the recent emergence of tilapia lake virus (TiLV) was discussed extensively. Tilapia is not only a significant aquaculture commodity in the region, but as a low-cost fish it is also an important source of animal protein for low-income groups. TiLV had been detected in Egypt, Ecuador, Israel and Colombia and most recently in Thailand, although retrospective testing of samples had revealed that the disease had been present since 2015. It is likely that the virus will have been introduced to other countries in the region via international trade in tilapia seed. A team led by Dr Tim Flegel (Mahidol University) had generously shared a warning notice and PCR protocol (reproduced in this issue) and were also offering to share a positive control plasmid free for non-commercial labs.

A proposal to establish a Regional Network on Culture-based Fisheries and Stock Enhancement tabled by the Secretariat was accepted. NACA has undertaken significant work on culture-based fisheries (CBF) on the years in Sri Lanka, Vietnam, Lao PDR and most recently in Cambodia through the initiative of Prof. Sena De Silva, a previous Director General of NACA.

First Regional Training Course on Culture-based Fisheries: Register now!

There are many initiatives underway which are designed to increase food supply, employment and income opportunities in developing countries, most of which require considerable capital inputs. Often overlooked, are the opportunities to produce more food from the natural productivity of local ecosystems.

Continued on page 2.

CBF offers a practical way for rural communities to improve their income and nutritional status. Small water bodies such as village dams are stocked to produce an additional crop of fish, producing an additional return on existing infrastructure. Capital requirements are extremely low as there is no feeding, with fingerlings left to forage and grow on natural food supplies. Households may use the crop for household consumption and/or sale for cash, depending on their circumstances, and the activity can be sustained by retaining some of the profit to buy seed for the next cycle. While CBF has significant potential in tropical climates the practice is not yet widespread.

The objectives of the regional network are i) the development of culture-based fisheries and ii) the improvement of stock enhancement programmes. The network will focus on:

- Technical exchange between NACA members.
- Development of better management practices.
- Science-based monitoring and evaluation.
- Sharing of experience.
- Crucially, evidence-based documentation of results, including socio-economic and nutritional benefits.

The network will primarily operate via online networking, teaching (video) and information sharing in the first instance to minimise costs, working within the existing development programmes of member states.

A highlight of the meeting was the presentation of a detailed review "The major contributions of the Network of Aquaculture Centres in Asia-Pacific (NACA) to Regional Aquaculture Development", by Prof. Peter Edwards. The review had been commissioned at the request of the 27th Governing Council.

The review presented an overview of the development of the organisation since its inception in 1980 until the present and tracked the evolution of the work programmes in response to emerging issues and the changing requirements of member states.

NACA has illustrated that a functional network mechanism for technical cooperation among developing countries can resolve many of the issues in national research programmes including duplication of effort (and expenses) between states, improvement of interaction between R&D workers and thin coverage of diverse farming systems. With diminishing donor assistance to the region and limited national resources the network has reduced the need to invest large capital and operating costs to set up new institutions or expand existing ones, and improves the return on national resources.

Furthermore, NACA has influenced the development of policy in member states with allocation of increasing resources to the development of aquaculture. The strengthening of national human resources and facilities have made it attractive for various organisations and agencies to participate in NACA's collaborative programmes, thereby contributing to further strengthening of the network and expansion of development activities through bilateral and multilateral projects, resulting in a multiplier effect.

The review will be published as an occasional paper on the NACA website in due course.

Culture-based fisheries are one example of a relatively simple and low cost technology which can deliver nutritional and economic benefits to rural communities, which often have few livelihood options.

The course

The first Regional Training Course on Culture-based Fisheries will be held from 29 October to 9 November 2017 in Nha Trang, Vietnam. It will be held on the campus of Nha Trang University. The course is aimed at development professionals and extension officers working in fisheries and aquaculture or with agricultural communities.

Programme at a glance

The training will consist of lectures, classroom exercises and simulations, covering:

- Current practices and relevance of culture-based fisheries.
- Evaluation of water bodies for culture-based fisheries.
- Establishing a management system.
- Risk and risk management.

- Stocking practices and stock assessment.
- Harvesting and marketing strategies.

Learn from the experts

The course will be taught by world experts in the field, including:

- Prof. Sena De Silva, Deakin University, Australia.
- Prof. Upali Amarasinghe, University of Kelaniya, Sri Lanka.
- Prof. Liu Jiashou, University of the Chinese Academy of Sciences.
- Dr Tumi Tómasson, United Nations University.
- Dr Guðmundur Þórðarson, Marine and Freshwater Institute, Iceland.
- Dr Yuan Derun, NACA.
- Prof. Pham Quoc Hung, Nha Trang University, Vietnam.

Sponsor

NACA wishes to acknowledge the United Nations University Fisheries Training Programme, which has provided financial and technical support to the development and convening of this course. The course is organised in partnership between UNU-FTP, NACA and Nha Trang University.

Registration

The registration fee for the course is US$1,000. The fee includes tuition, materials, working lunches and breaks. Registration closes on 30 September. For more information please download the indicative programme and registration form below. Contact yuan@enaca.org for all enquiries.

https://enaca.org/enclosure.php?id=915

11th Indian Fisheries and Aquaculture Forum, Kochi, 21-24 November

The 11th IFAF "Fostering innovations in fisheries and aquaculture: Focus on Sustainability and Safety" will be held in Kochi, Kerala. The objectives of the forum are to:

- Provide a scientific platform to deliberate on current research outputs and identify the R&D needs of the sector.
- Nurture innovation skills to address issues of sustainability and safety of fish.
- Encourage scientists to think, develop and undertake needs-based research to address core issues affecting the fisheries sector.
- To review the research developments in fisheries science and develop strategies for transfer and refinement of these technologies.

Technical sessions will be held on:

- Fisheries resources: Genetics, biodiversity and management.
- Fishing systems for sustainable fisheries.
- Fishery biology, toxicology and environment.
- Aquaculture production.
- Aquatic animal health management.
- Adding value to fish: Avenues in fish biochemistry and processing.
- Safe fish: Quality, risk assessment and regulations.
- Fishomics and frontier sciences for blue bio-economy.
- Socio-economics, gender, capacity building and livelihoods.
- Fisheries trade, policy and governance.

Submission of abstracts closes **15 September**. For more information, including online registration and accommodation advice please visit the 11 IFAF website: http://11ifaf.in.

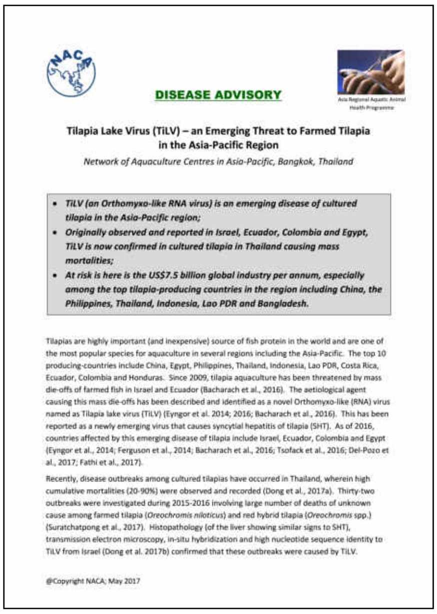
Audio recordings for regional feed consultation now available

As foreshadowed in the previous issue, audio recordings of the technical presentations made at the Regional Consultation on Responsible Production and Use of Feed and Feed Ingredients for Sustainable Growth of Aquaculture in the Asia-Pacific Region are now available from the link below. Recordings may be downloaded or played online.

The consultation was convened by FAO, NACA and the Thai Department of Fisheries, 7-9 March 2017, in Bangkok. The objective of the consultation was to review and share the knowledge on the current situation of aquaculture feed production and use, in respects of production status, demand and supply, sourcing of ingredients, government policies and institutional support, ongoing progress and development gaps. The consultation also tried to put forward regional strategies and develop a plan of action to promote responsible utilisation of feed and feed ingredients for sustainable growth of aquaculture in Asia-Pacific through sharing of available knowledge, technological innovations and scaling up successful practices and further research and technology development.

Access the collection of recordings from: https://enaca.org/?id=886.

Disease advisory: Tilapia lake virus - an emerging threat to farmed tilapia in the Asia-Pacific region



DISEASE ADVISORY

Asia Regional Aquatic Animal Health Programme

Tilapia Lake Virus (TiLV) – an Emerging Threat to Farmed Tilapia in the Asia-Pacific Region

Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand

- ***TiLV (an Orthomyxo-like RNA virus) is an emerging disease of cultured tilapia in the Asia-Pacific region;***
- ***Originally observed and reported in Israel, Ecuador, Colombia and Egypt, TiLV is now confirmed in cultured tilapia in Thailand causing mass mortalities;***
- ***At risk is here is the US$7.5 billion global industry per annum, especially among the top tilapia-producing countries in the region including China, the Philippines, Thailand, Indonesia, Lao PDR and Bangladesh.***

Tilapias are highly important (and inexpensive) source of fish protein in the world and are one of the most popular species for aquaculture in several regions including the Asia-Pacific. The top 10 producing-countries include China, Egypt, Philippines, Thailand, Indonesia, Lao PDR, Costa Rica, Ecuador, Colombia and Honduras. Since 2009, tilapia aquaculture has been threatened by mass die-offs of farmed fish in Israel and Ecuador (Bacharach et al., 2016). The aetiological agent causing this mass die-offs has been described and identified as a novel Orthomyxo-like (RNA) virus named as Tilapia lake virus (TiLV) (Eyngor et al. 2014; 2016; Bacharach et al., 2016). This has been reported as a newly emerging virus that causes syncytial hepatitis of tilapia (SHT). As of 2016, countries affected by this emerging disease of tilapia include Israel, Ecuador, Colombia and Egypt (Eyngor et al., 2014; Ferguson et al., 2014; Bacharach et al., 2016; Tsofack et al., 2016; Del-Pozo et al., 2017; Fathi et al., 2017).

Recently, disease outbreaks among cultured tilapias have occurred in Thailand, wherein high cumulative mortalities (20-90%) were observed and recorded (Dong et al., 2017a). Thirty-two outbreaks were investigated during 2015-2016 involving large number of deaths of unknown cause among farmed tilapia (*Oreochromis niloticus*) and red hybrid tilapia (*Oreochromis* spp.) (Suratchatpong et al., 2017). Histopathology (of the liver showing similar signs to SHT), transmission electron microscopy, in-situ hybridization and high nucleotide sequence identity to TiLV from Israel (Dong et al. 2017b) confirmed that these outbreaks were caused by TiLV.

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As of 2016, countries affected by this emerging disease of tilapia include Israel, Ecuador, Colombia and Egypt.

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Download the advisory from: https://enaca.org/enclosure.php?id=864

Fact sheet: Tilapia lake virus (TiLV): What to know and do?

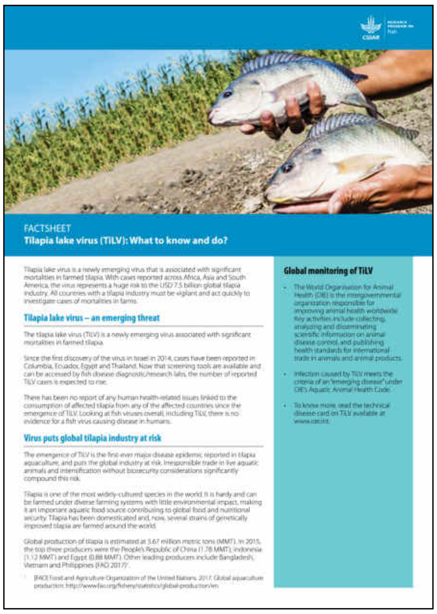
Published by the CGIAR Research Program on Fish Agri-food Systems

Tilapia lake virus is a newly emerging virus that is associated with significant mortalities in farmed tilapia. This fact sheet describes the threat to industry, clinical signs, diagnosis, risk factors, prevention and control options and actions that must be taken to minimise the impact of this disease on the global tilapia aquaculture industry. All countries with a tilapia industry must be vigilant and act quickly to investigate cases of mortalities in farms.

Since the first discovery of the virus in Israel in 2014, cases have been reported in Columbia, Ecuador, Egypt and Thailand. Now that screening tools are available and can be accessed by fish disease diagnostic/research labs, the number of reported TiLV cases is expected to rise.

The emergence of TiLV is the first-ever major disease epidemic reported in tilapia aquaculture, and puts the global industry at risk. Irresponsible trade in live aquatic animals and intensification without biosecurity considerations significantly compound this risk.

Download the fact sheet from: https://enaca.org/?id=871



FACTSHEET

Tilapia lake virus (TiLV): What to know and do?

Tilapia lake virus is a newly emerging virus that is associated with significant mortalities in farmed tilapia. With cases reported across Africa, Asia and South America, the virus represents a huge risk to the USD 7.5 billion global tilapia industry. All countries with a tilapia industry must be vigilant and act quickly to investigate cases of mortalities in farms.

Tilapia lake virus – an emerging threat

The tilapia lake virus (TiLV) is a newly emerging virus associated with significant mortalities in farmed tilapia.

Since the first discovery of the virus in Israel in 2014, cases have been reported in Columbia, Ecuador, Egypt and Thailand. Now that screening tools are available and can be accessed by fish disease diagnostic/research labs, the number of reported TiLV cases is expected to rise.

There has been no report of any human health-related issues linked to the consumption of affected tilapia from any of the affected countries since the emergence of TiLV. Looking at fish viruses overall, including TiLV, there is no evidence for a fish virus causing disease in humans.

Virus puts global tilapia industry at risk

The emergence of TiLV is the first-ever major disease epidemic reported in tilapia aquaculture, and puts the global industry at risk. Irresponsible trade in live aquatic animals and intensification without biosecurity considerations significantly compound this risk.

Tilapia is one of the most widely-cultured species in the world. It is hardy and can be farmed under diverse farming systems with little environmental impact, making it an important aquatic food source contributing to global food and nutritional security. Tilapia has been domesticated and, now, several strains of genetically improved tilapia are farmed around the world.

Global production of tilapia is estimated at 5.67 million metric tons (MMT). In 2015, the top three producers were the People's Republic of China (1.78 MMT), Indonesia (1.12 MMT) and Egypt (0.88 MMT). Other leading producers include Bangladesh, Vietnam and Philippines (FAO 2017)[1].

[1] [FAO] Food and Agriculture Organization of the United Nations. 2017. Global aquaculture production. http://www.fao.org/fishery/statistics/global-production/en

Global monitoring of TiLV

- The World Organisation for Animal Health (OIE) is the intergovernmental organization responsible for improving animal health worldwide. Key activities include collecting, analysing and disseminating scientific information on animal disease control, and publishing health standards for international trade in animals and animal products.
- Infection caused by TiLV meets the criteria of an "emerging disease" under OIE's Aquatic Animal Health Code.
- To know more, read the technical disease card on TiLV available at www.oie.int.

Urgent update on possible worldwide spread of tilapia lake virus (TiLV)

H.T. Dong, R. Rattanarojpong and S. Senapin

Recently, we released a warning of TiLV in Thailand including an improved semi-nested RT-PCR method for rapid detection. The Fish Health Platform in Centex, BIOTEC/Mahidol University has obtained positive test results for TiLV from other countries in Asia where it has not yet been reported. Further, the majority of our archived samples collected from previous disease outbreaks in several tilapia hatcheries in Thailand during 2012-2017 have tested positive for TiLV, indicating the presence of TiLV in Thailand even before the virus became known to science in 2013.

The origin of the disease is currently unknown, but many countries have been translocating tilapia fry/fingerlings prior to and even after the description of TiLV. Based on records we could obtain about such translocations, we have prepared a map that contains a list of 5 countries with confirmed reports of TiLV infections and a list of 43 other countries that we believe have imported tilapia that may have been infected with TiLV. We hope that widespread surveillance for TiLV in the Tilapia industry and in translocated fish will help reduce the impact and spread of this disease.

Recommendations

- We recommend that the 43 countries we have listed quickly initiate surveillance for TiLV in cultured Tilapia, since the virus may have been introduced via direct or indirect translocation of fry/fingerlings from the five countries where it has been reported.
- Biosecurity should be applied to prevent wider spread of the disease especially by countries with no predictive record of TiLV risk.
- Since TiLV infects very early developmental stages of tilapia (fertilised eggs, fry, and fingerlings) when fish immune system is not fully developed, the use of vaccines may not be an effective control approach.
- Research should be promoted for the development of methods to clear TiLV from infected tilapia broodstock and allow production TiLV-free fry/fingerlings.
- Programs should be promoted to develop Tilapia stocks specific pathogen free (SPF) for TiLV and other pathogens as a potential approach to limit impact of Tilapia diseases globally.
- Since TiLV infections result in highly variable mortality (9.2-90%), it is urgent that research should be promoted to discover the underlying reasons (e.g., research on the correlation between TiLV virulence and genetic types or other factors).

Download the update from: https://enaca.org/enclosure.php?id=870


Urgent update on possible worldwide spread of tilapia lake virus (TiLV)

HT Dong[a,b], T Rattanarojpong[b], S Senapin[a,c]

[a]Fish Health Platform, Center of Excellence for Shrimp Molecular Biology and Biotechnology (Centex Shrimp), Faculty of Science, Mahidol University, 272 Rama VI Road, Bangkok, 10400, Thailand

[b]Department of Microbiology, Faculty of Science, King Mongkut's University of Technology Thonburi (KMUTT), Bangkok 10140, Thailand

[c]National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA), Pathumthani, 12120, Thailand

*Contact E-mails: S Senapin (saengchan@biotec.or.th) & HT Dong (hadongntu@gmail.com)

Tilapia lake virus disease (TiLVD) (also known as syncytial hepatitis of tilapia-SHT) is a newly emerging viral disease of tilapia caused by tilapia lake virus (TiLV), a novel *Orthomyxo-like* virus (Ferguson et al. 2014; Eyngor et al. 2014; Bacharach et al. 2016; Del-Pozo et al. 2017; NACA, 2017; OIE, 2017). Occurrence of the disease was officially documented earliest in Ecuador and Israel in 2013 and 2014, respectively (Ferguson et al. 2014; Eyngor et al. 2014). The virus, however, is believed to have been responsible for massive mortalities in farmed tilapia in Israel since 2009 (Eyngor et al. 2014). Infection of TiLV was later reported from Colombia (Kembou Tsofack et al. 2017) and Egypt (Fathi et al. 2017) and most recently from Thailand (Dong et al. 2017a; Surachetpong et al. 2017). Natural disease outbreaks result in variable mortalities ranging from 9.2 to 90%, with tilapia fingerlings and juveniles being more vulnerable than larger fish (Ferguson et al. 2014; Fathi et al. 2017; Dong et al. 2017a; Surachetpong et al. 2017). Unlike other viral diseases of tilapia, TiLV appears to be widely spread and so may be present in many countries where it is not yet recognized.

Recently, we released a warning of TiLV in Thailand, including an improved semi-nested RT-PCR method for rapid detection and we urge those involved in Tilapia culture to test for the virus in their country (Dong et al. 2017b). The Fish Health Platform in Centex, BIOTEC/Mahidol University) has also obtained positive test results for TiLV from other countries in Asia where it has not yet been reported, supporting our appeal for wider testing. Further, the majority of our archived samples collected from previous disease outbreaks in several tilapia hatcheries in Thailand during 2012-2017 have tested positive for TiLV (unpublished data), indicating the presence of TiLV in Thailand even before the virus became known to science in 2013. The origin of the disease is currently unknown, but many countries have been translocating tilapia fry/fingerlings prior to and even after the description of TiLV. Based on records we could obtain about such translocations, we have prepared a map that contains a list of 5 countries with confirmed reports of TiLV infections (red, Fig.1) and a list of 43 other countries that we believe have imported tilapia that may have been infected with TiLV (blue, Fig. 1). We hope that widespread surveillance for TiLV in the Tilapia industry and in translocated fish will help reduce the impact and spread of this disease. To this end, we

Tilapia lake virus (TiLV) - a novel Orthomyxo-like virus

Published by the Office International des Epizooties


WORLD ORGANISATION FOR ANIMAL HEALTH
Protecting animals, preserving our future

TILAPIA LAKE VIRUS (TiLV)–A NOVEL ORTHOMYXO-LIKE VIRUS

PATHOGEN INFORMATION

1. CAUSATIVE AGENT

1.1. Pathogen type

Virus.

1.2. Disease name and synonyms

Tilapia lake virus (TiLV) disease.

1.3. Pathogen common names and synonyms

Tilapia lake virus (TiLV).

1.4. Taxonomic affiliation

The taxonomic affiliation has not been definitively concluded; however, TiLV has been described as a novel virus in the Family Orthomyxoviridae (Eyngor *et al*., 2014).

1.5. Authority (first scientific description, reference)

The virus was first described by Eyngor *et al* (2014).

1.6. Pathogen environment (fresh, brackish, marine waters)

Fresh and brackish water.

2. MODES OF TRANSMISSION

2.1. Routes of transmission (horizontal, vertical, indirect)

Co-habitation studies have demonstrated that direct horizontal transmission is an important route of transmission. There is no evidence of vertical transmission. The biophysical characteristics of the virus are not well characterised so it is difficult to determine the significance of indirect transmission by fomites.

2.2. Reservoir

Infected populations of fish, both farmed and wild, are the only established reservoirs of infection. The original source of TiLV is not known.

2.3 Risk factors (temperature, salinity, etc.)

Disease has been associated with transfer between ponds and thus may be associated with stress (Ferguson *et al*., 2014; Dong *et al*. 2017). No other risk factors (temperature, salinity, etc.) have been identified as potential risk factors.

3. HOST RANGE

3.1. Susceptible species

Mortalities attributed to TiLV have been observed in wild tilapia *Sarotherodon (Tilapia) galilaeus*, farmed tilapia *Oreochromis niloticus* and commercial hybrid tilapia (*O. niloticus* X *O. aureus*) (Bacharach *et al*., 2016; Ferguson *et al*., 2014; Eyngor *et al*., 2014). To date only tilapines have been shown to be susceptible. It is possible that other species will be found to be susceptible.

3.2. Affected life stage

In the outbreak reported by Ferguson *et al*. (2014) and Dong *et al*. (2017) fingerlings were mainly affected. Dong *et al*. (2017) reported approximately 90% mortality in red tilapia fingerlings within one months of stocking into cages. Mortality just over 9% in medium to large sized Nile perch was notes by Fathi *et al*. (2017). Other reports have not commented on different levels of mortality by life stage (Eyngor *et al*., 2014).

3.3. Additional comments

There is some evidence that certain genetic strains of tilapia are resistant. Ferguson *et al*. (2014) noted that one strain of tilapia (genetically male tilapia) incurred a significantly lower level of mortality (10-20%) compared with other strains.

4. GEOGRAPHICAL DISTRIBUTION

TiLV has been reported in Colombia, Ecuador and Israel (Bacharach *et al*., 2016; Ferguson *et al*., 2014; Tsofack *et al*., 2016), and most recently, Egypt (Fathi *et al*., 2017) and Thailand (Dong *et al*., 2017). However, a lack of thorough investigation of all mortality incidents means that the geographic distribution of TiLV may be wider than currently. For example, reports of mortality in tilapia in Ghana and Zambia in 2016 have not been attributed to TiLV but the available information does not indicate that the presence of the virus has been investigated. A partial genome from Thailand showed relatively high variation to strains from Israel (around 97% nucleotide identity) (Dong *et al*., 2017).

TILAPIA LAKE VIRUS (TiLV), May 2017

This disease card published by the World Organisation for Animal Health (OIE) provides information about tilapia lake virus (TiLV), a recently observed pathogen causing significant mortalities in farmed tilapia.

The disease card provides details of the pathogen, modes of transmission, host range, geographical distribution, clinical signs, diagnostic methods, socio-economic significance, transmission risk and a list of available references. We urge laboratories to test for TiLV when abnormal tilapia mortalities occur.

Download the disease card from: https://enaca.org/?id=869

Quarterly Aquatic Animal Disease Report, January-March 2017

The 73rd edition of the Quarterly Aquatic Animal Disease Report contains information from 14 governments. The foreword provides a disease advisory on tilapia lake virus (TiLV), an emerging threat to farmed tilapia in the Asia-Pacific region.

Download the report from: https://enaca.org/enclosure.php?id=918


2017/1

QUARTERLY
AQUATIC ANIMAL DISEASE REPORT
(Asia and Pacific Region)

January – March 2017

Published by

Network of Aquaculture Centres in Asia-Pacific

The OIE Regional Representation for Asia and The Pacific

Food and Agriculture Organization of the United Nations

July 2017

Proceedings of the International Symposium on Aquatic Animal Health and Epidemiology for Sustainable Asian Aquaculture

These are the proceedings of a symposium convened by the ICAR National Bureau of Fish Genetic Resources, Lucknow, India, from 20-21 April 2017. The symposium included presentations from national and international experts on aquatic animal epidemiology and related disciplines to address a range of risk factors that catalyse horizontal spread of disease, spread of transboundary pathogens and increased disease susceptibility, thereby contributing to strengthening of surveillance efforts, especially in the Indian context.

The proceedings may be downloaded from: https://enaca.org?id=924

ICAR-CIBA launched *“Vanami Shrimpapp”* a mobile app on Pacific white shrimp *(Penaeus vannamei)* farming

The Central Institute of Brackishwater Aquaculture, ICAR, has launched “Vannami Shrimpapp”, a mobile application for Android-based phones and tablets. The app facilitates the dissemination of technical information among stakeholders in the shrimp farming sector.

The app provides information on better management practices for Pacific white shrimp *(Penaeus vannamei)* farming in the form of “Frequently Asked Questions” targeted for shrimp farmers and field level extension workers of coastal states. Clients can view the content either topic-wise or through key word search. Clients can also post questions through the app and have it answered by an expert within two working days.

P. vannamei is currently being farmed under varying conditions in India ranging from very low to oceanic salinities with different levels of technology adoption ranging from extensive, zero water exchange to biofloc based intensive systems and formulated feeds with varying protein contents. Currently *P. vannamei* shrimp farming is being practiced in about 60,000 hectares in nine coastal states, mostly by small scale farmers, with a production of 360,000 tonnes leading to an export to the value of around US$3.4 billion.

Shrimp farming provides livelihoods for nearly 150,000 farm families and 200,000 workers in the coastal states of India. The app is currently being translated into additional languages including Hindi, Telugu, Tamil, Oriya, Bengali and Gujarati. The team behind the app was comprised of Dr M. Kumaran, Shri. P.R. Anand, Dr D. Deboral Vimala, Shri J. Ashok Kumar and Dr K.K. Vijayan.

Vanami Shrimpapp was officially launched by Shri Baburaj V. Nair, the Chief Human Resources Officer of ‘The Hindu’ newspaper group in the presence of Dr K.K. Vijayan, Director, CIBA during the occasion of the ICAR-CIBA Foundation Day, 4 April 2017.

The app was developed based on the frequently made questions received from Indian shrimp farmers. It may also be of use in able to shrimp farmers in other south and south-east Asian countries and elsewhere in the tropical belt.

The app is available for Android devices via Google Play.

New NACA website

Finally it’s here! The NACA website has been rebuilt, re-organised, re-edited, re-indexed, re-illustrated and re-coded from scorched earth using the purpose-built Tuskfish Content Management System.

The new site is greatly simplified. The home page now provides a rolling timeline of NACA’s news, projects, publications and everything else, so there is only one page you need to keep track of to stay up to date and you can filter it by subject if you have a particular interest.

Resources include our Email Newsletter, Event Calendar, RSS feeds and contact points for NACA member governments, research centres and committees.

An Experts Database in in preparation, which will provide profiles and contact points for key scientific personnel in participating centres, in order to assist people to find relevant expertise and facilitate technical exchange.

NACA website: https://enaca.org

Email newsletter subscriptions: https://enaca.org/email-newsletter.php

RSS feed: https://enaca.org/rss.php

Pakistan officials train on aquaculture certification

FAO's Pakistan Office requested NACA to conduct a two-week training course for four provincial fisheries officers on Good Aquaculture Practices and Certification in Thailand from 14th to 31st May 2017. The officers were: Anser Chatta, Deputy Director of Fisheries (Punjab); Muhammad Ramzan, Deputy Director of Fisheries (Punjab); Muhammad Imaran, Assistant Director (Punjab); and Abdul Hadi, Assistant Director (Balochistan).

A series of lectures and discussions were carried out by experts from NACA, the National Bureau of Agriculture Commodity and Food Standards and the Department of Fisheries, Thailand. These lectures covered an array of topics ranging from the relevance of good aquaculture practices and certification in relation to sustainable aquaculture development and food safety, standard setting, certification schemes, and implementation of good aquaculture practices.

The participants were also provided with opportunities to visit aquaculture farms and interact with Thai farmers on farming practices and compliance with various standards. They used Thai Good Aquaculture Practices as examples in connection with institutional and farm visits to understand and learn the process for standard setting and implementation, and practiced skills in farm auditing and field sampling.

During the training process, participants were also encouraged to link their work experience and development contexts of Pakistan with training contents to stimulate their thinking about how GAqP should be developed and implemented in Pakistan. In addition, some technical details on tilapia seed production, semi-intensive pond culture, feed production and feeding etc. were intensively discussed on various training occasions.

Participants expressed interest in further collaboration with NACA in areas of technical assistance, capacity building and possible joint research and development projects. Some follow-ups were suggested including a joint effort to appraise and document the current aquaculture development status in Pakistan and NACA's continuous assistance in development and implementation of good aquaculture practices in Pakistan.

Network of Aquaculture Centres in Asia-Pacific

Mailing address:
P.O. Box 1040,
Kasetsart University
Post Office,
Ladyao, Jatujak,
Bangkok 10903,
Thailand

Phone +66 (2) 561 1728
Fax +66 (2) 561 1727
Email: info@enaca.org
Website: www.enaca.org

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