India's National Monthly on Aquaculture

RNI Regn. No. 52899/93

Aqua International

Annual Subscription: Rs 600 | Foreign $ 100 | Hyderabad | January 2019

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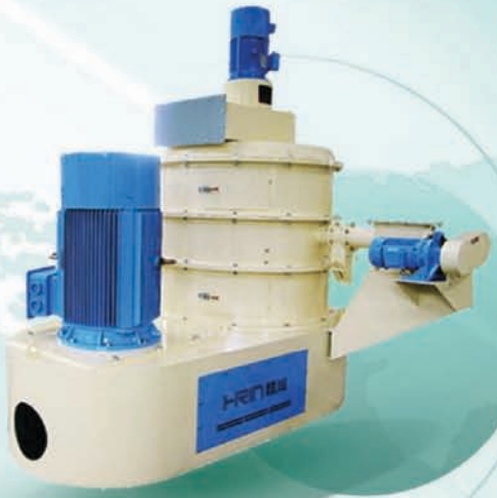

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Aqua International

English Monthly Magazine
(Established in May 1993)

Volume 26 Number 9 January 2019

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E-mail: forum@aquainternational.in
Website: www.aquainternational.in

Annual Subscription

India	: Rs. 600
Foreign Countries	: US $ 100 or its equivalent.

Aqua International will be sent to the subscribers in India by Book Post and to the foreign subscribers by AirMail.

Edited, printed, published and owned by M. A. Nazeer and published from BG-4, Venkataramana Apts., 11-4-634, A.C.Guards, Hyderabad - 500 004, India. Printed at Srinivasa Lithographics.

Registered with Registrar of Newspapers for India with Regn. No. 52899/93. Postal Regn. No. L II/RNP/HD/1068/2018-2020

NRS PUBLICATIONS
www.aquainternational.in

Subscriptions for Aqua International, English monthly, should be sent to:
The Circulation Department, Aqua International
BG-4, Venkataramana Apartments, 11-4-634, A.C.Guards,
I T Towers Lane, Hyderabad - 500 004, India.

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Industry had a setback due to poor quality seed in 2018

Greetings from *Aqua International* for a Happy, Prosperous and Peaceful New Year 2019 to the readers, advertisers and the well wishers. The January 2019 issue of *Aqua International* is in your hands.

In 2018 Indian aquaculture sector had a setback due to poor quality of shrimp seed in most parts of the country and diseases in some parts of the nation. Hatcheries need to be honest enough to produce and supply quality seed at all times, and the farmers must give focus on quality water and pond management. To ensure this, the farmers should make it a point to spend at least six hours a day at their shrimp and fish ponds, besides emphasing on biosecurity.

I am glad to inform you all that *Aqua International* is going to organize India International Aquaculture Expo 2020 (IIAE 2020), an international Exhibition and Conference on Aquaculture sector in January 2020. Details will be informed to you soon.

★★★★★

In the News section, you may find news about – A growth rate of 9% is essential to generate enough jobs and achieve universal prosperity, according to a vision document released by NITI Aayog recently. Towards this, the 'Strategy for New India @75' document recommends a number of steps, including increasing the investment rate, reforming agriculture, and codifying labour laws. "An annual rate of growth of 9% by 2022 - 23 is essential for generating sufficient jobs and achieving prosperity for all," the report, which was launched by Finance Minister Arun Jaitley, said. Later in the report, NITI Aayog said the target should be 8% growth over the period 2018 - 23.

A training-cum-demonstration programme on "Development of value added fish products" was organised by the Institute at Krishi Vigyan Kendra, ICAR Research Complex for NEH Region, Barapani, Meghalaya under ICAR-CIFT NEH component. Dr Manoj P. Samuel, Principal Scientist & Head, Engineering Division and Mr K. Dinesh Prabhu, Senior Technical Assistant, Fish Processing Division co-ordinated the programme. The programme was attended by more than 35 farm women who were sensitized on various fish processing technologies and value added products by means of class room lecturers and method with KVK, Rhi-Bhoi, Meghalaya.

A stakeholder meeting held at the Central Marine Fisheries Research Institute (CMFRI) recently decided to take steps to address the concern of fishermen towards the draft national mariculture policy. As part of this, the draft will be incorporated so as to enable traditional fishermen and their cooperative societies obtaining priority while Mariculture Zones are demarcated in the sea for various mariculture activities

In the Article Section, article titled "**Introductions of Exotic Fish Species and its Prospectus in Indian Waters**" by Sachin Pandit, Chittaranjan Raul discussed about introduction of exotic species have positive impact in aquaculture sector such as L. vennamei was leading production from last five years. Tilapia, common carp become the most dominant food item for in aquaculture sector and these fishes are more suitable for any type of water environment and also demand in market value. The negative impact of exotic fish species on native species can be minimized by following awareness and DAHDF guideline strictly. This topic was helpful to farmers as a lead role of exotic species in the aquaculture sector and their impact on the current aqua sector.

Readers are invited to send their views and comments on the news, special feature and articles published in the magazine which would be published under "Readers Column". Time to time, we shall try to update you on various aspects of Aquaculture industry. Keep reading the magazine regularly and update yourself. Wish you all fruitful results in your efforts.

M.A.Nazeer
Editor & Publisher
Aqua International

NRS GROUP

Aqua International

Our Mission

Aqua International will strive to be the reliable source of information to aquaculture industry in India.

AI will give its opinion and suggest the industry what is needed in the interest of the stakeholders of the industry.

AI will strive to be The Forum to the Stakeholders of the industry for development and self-regulation.

AI will recognize the efforts and contribution of individuals, institutions and organizations for the development of aquaculture industry in the country through annual Awards presentation.

AI will strive to maintain quality and standards at all times.

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Crop Area gone up, but Shrimp Production remained at 55,000 MT in 2018 in Gujarat

Shrimp Farmers in Gujarat State struggled due to poor quality seed mostly, diseases to some extends plus poor feed management.

Valsad: The size of shrimp farming area in Gujarat state has gone up to 8,000 hectares in 2018, an increase of 500 ha than in 2017, but the production of shrimps is almost same as in 2017 with 55,000 tonnes, informed the Gujarat region office of The Marine Products Export Development Authority (MPEDA) headed by Mr Maruti D. Yaligar, Deputy Director based at Valsad. Shrimp production in 2018 could not increase due to poor quality white seed, health issues like White Gut, EHP and White spot in some pockets of the state. EHP was more in Navsari and Valsad districts, he added.

In 2017 - 18, there was no disease problem in the state and every farmer harvested good crop. In 2018 -19 due to poor quality seed supply by the hatcheries besides poor feed management, the shrimp crop in the state suffered a setback, said sources.

Due to less price of Rs 160 per Kg for 100 count till August 2018 the farmers struggled a lot in the state. It was strongly felt that the industry should have 2 to 3 species as an alternative to vannamei, when price was bad it would help the farmers.

MPEDA advised farmers to limit seed stocking density to 3 to 4 lakhs per hectare, and upto 60 pcs per square meter as per CAA guidelines. Biosecurity measures are taken care by the farmers and hatcheries in Gujarat.

Introducing Silver Pompano Fish soon

MPEDA is undertaking demonstration of Silver

Maruti D Yaligar

Pompano Fish, known as American Pomphret in Brackish water ponds in Navsari district. In six month time this fish acquires 350 grams of weight / marketable size. MPEDA developed hatchery technique for silver pompano with a hatchery situated at Trivandiem, Kerala. For details, interested people may contact Mr Christy, Assistance Project Manager, RGCA with Mobile No: 88486 73563.

As per estimation, 95,000 tonnes of feed was sold in Gujarat alone in 2018 with 32,000 lakh seed supply. About 90,000 aerators of 2 hp capacity are used in the state while Rupees one lakh is spent on inputs such as Probiotics, Enzymes and Vitamins per hectare water spread area per crop approximately.

In the last five years MPEDA has trained 5,000 persons in the state on shrimp culture

(eco- friendly and sustainable shrimp farming) and so far 800 persons took up shrimp culture in Valsad, Navsari, Suart, Bharuch and Bhavnagar areas.

Govt listed 15,000 ha new land for allotment

The state government listed 15,000 hectares of new land for allotment and sent to the district collectors for their opinion recently in South Gujarat and Sourasthtra districts of the state.

MPEDA has also programmed to make all the farmers in the state to apply and obtain certificates. Here after harvested material will be lifted from the certified shrimp ponds only to ensure quality of shrimp. Every pond will be tested (pre harvested test) for banned antibiotics. MPEDA established ELISA Lab at its Valsad office. Cost of each test for antibiotic is Rs 15 and they have done 1,000 tests in 2018.

According to reports, processors-cum-exporters from Andhra Pradesh are not testing material for PHT and directly lifting from farmers, and so far they lifted about 30,000 tonnes of material.

The Authority is supporting these stakeholders with subsidy for certification of farmers, hatcheries and feed mills from 2018, and also for infrastructure facilities like Aerators, Generators and Biosecurity measures in the farms.

9% growth by 2022 must to generate jobs: NITI Aayog

The government think-tank pitches for labour reforms, higher women participation, social security

A growth rate of 9% is essential to generate enough jobs and achieve universal prosperity, according to a vision document released by NITI Aayog on Wednesday.

Towards this, the 'Strategy for New India @75' document recommends a number of steps, including increasing the investment rate, reforming agriculture, and codifying labour laws.

"An annual rate of growth of 9% by 2022-23 is essential for generating sufficient jobs and achieving prosperity for all," the report, which was launched by Finance Minister Arun Jaitley, said in the introduction. Later in the report, NITI Aayog said the target should be 8% growth over the period 2018-23.

"This will raise the economy's size in real terms from $2.7 trillion in 2017-18 to nearly $4 trillion by 2022-23," it said. "Besides having rapid growth... it is also necessary to ensure that growth is inclusive, sustained, clean and formalised."

On boosting economic growth, the document identified two key steps for increasing the country's investment rate and the tax-GDP ratio.

"To raise the rate of investment (gross fixed capital formation as a share of GDP) from about 29% in 2017-18 to about 36% of GDP by 2022-23, a slew of measures will be required to boost both private and public investment," it said.

"India's tax-GDP ratio of around 17% is half the average of OECD countries (35%) and is low even when compared to other emerging economies like Brazil (34%), South Africa (27%) and China (22%)."

"To enhance public investment, India should aim to increase its tax-GDP ratio to at least 22% of GDP by 2022-23," the report added.

While demonetisation and GST have and will continue to contribute positively, the document said efforts need to be made to rationalise direct taxes for both corporate tax and personal income tax.

It further said that there was a need to ease the tax compliance burden and eliminate direct interface between taxpayers and tax officials using technology.

"In agriculture, emphasis must shift to converting farmers to 'agripreneurs' by further expanding e-National Agriculture Markets (e-NAMs) and replacing the Agricultural Produce Marketing Committee (APMC) Act with the Agricultural Produce and Livestock Marketing (APLM) Act," the document said.

"The creation of a unified national market, a freer export regime and abolition of the Essential Commodities Act are essential for boosting agricultural growth," it said.

The document also called for a strong push towards 'Zero Budget Natural Farming' (ZBNF) techniques that reduce costs, improve land quality, and increase farmers' incomes.

In the infrastructure section, it said the share of freight transported by coastal shipping and inland waterways will be doubled by 2022-23.

"Initially, viability gap funding will be provided until the infrastructure is fully developed," the document said. "An IT-enabled platform would be developed for integrating different modes of transport and promoting multi-modal and digitised mobility."
In order to enhance rural connectivity and access to government programmes, it said that by the end of 2019 all 2.5 lakh gram panchayats will be "digitally connected" under the Bharat Net programme.

"In the next phase, the last mile connectivity to the individual villages will be completed," the document said. "The aim will be to deliver all government services at the State, district, and gram panchayat level digitally by 2022-23, thereby eliminating the digital divide."

Scientists told to focus on real science

Winter School on Fishery Biology Concludes

Kochi: Scientists should focus on real science and its underlying truth while dealing with fisheries research, said Dr A Gopalakrishnan, Director of the Central Marine Fisheries Research Institute (CMFRI).

"With the advent of modern technologies, studies related to fisheries biology and classical taxonomy have been less prioritised these days", he said while speaking on the valedictory of the 21-day winter school organised by the CMFRI.

"It is sad that many researchers today often get attracted to modern techniques and catchy jargons rather than delving into the real science behind many of our issues", he said.

CMFRI organised the winter school to train young researchers on recent advances in fishery biology, marine certification, biodiversity evaluation and ecological analysis.

He also said that CMFRI is keen on expanding research collaborations in relevant areas with universities and other institutes. "Collaborative research will generate better data sets from every nook and corner of the country. Even small research or academic institutes with minimal infrastructure can do wonders through collaborative programmes", he said.

CMFRI Director Dr A Gopalakrishnan speaking at the valedictory of the 21-day winter school at the CMFRI

Renowned scientists and experts in the area presented lectures on various sessions during the 21-day programme. The practical sessions were conducted in different laboratories of the institute and hands on training in latest software was also provided to the participants as part of the winter school. Researchers from Jammu and Kashmir, Uttar Pradesh, Gujarat, Madhya Pradesh, Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala participated in the winter school.

Course Director Dr Rekha J Nair, Dr V Mahesh and Dr Ambarish Gopi spoke on the occasion.

Distribution of Community Fish Smoking (COFISKI) Units by CIFT to Women Fishers of Meghalaya under Coal India Limited CSR Scheme

The distribution ceremony of 26 units of COFISKI (Community Fish Smoking

Dr M.M. Prasad explaining to the Hon'ble Minister

Units) developed as part of rural technology at ICAR-Central Institute of Fisheries Technology was held at Amlrem BDO, West Jaintia Hills District, Meghalaya recently. The programme organized by CIFT in collaboration with DRDA, Jowai, West Jaintia Hills District, Meghalaya started with a visit to the site by Chief Guest Honourable Minister of Education Mr L. Rymbui, Government of Meghalaya. Mr Rymbui enquired about methods of preparation of smoke cured fish and intricate details

Dr M.M. Prasad addressing the beneficiaries

therein. Dr M.M. Prasad, PI of the project and Head, MFB Division, ICAR-CIFT explained to the Minister how the rural technology was developed by CIFT taking into consideration all the needs for easy maintenance, rigors of regular use and ergonomics of the women fishers. The programme started with welcome address by Mr D.M. Wallang, MCS, PD DRDA, West Jaintia Hills, Meghalaya. In his address Mr Wallang said that he witnessed the systematic development of fishers

Mr Garod L.S.N. Dykes, IAS delivering the presidential address

of Amlarem Block and that could happen due to continuous support of CIFT in the form of, training cum demonstration programmes, awareness campaign on hygiene, skill development programmes etc. Presiding over the function, Mr Garod L.S.N. Dykes, IAS, Deputy Commissioner, Jowai, West Jaintia Hills lauded the efforts made by the scientists and staff of CIFT for the development of harvest and post harvest fisheries in his district. In his address the Chief Guest of the function Mr Rymbui said that malnutrition is scourge in the country especially in remote areas and any intervention in the form of better quality food such as fish and fishery products with longer shelf life will better price and

Mr L. Rymbui addressing the beneficiaries

also help in socio-economic development of the hinterland residents. He welcomed and appreciated the technologies developed by CIFT and requested the beneficiaries to make best use of the COFISKI units given by CIFT. Dr Prasad while addressing the beneficiaries said that the COFISKI units are given under CSR Scheme of Coal India Limited for the betterment of women fishers who are economically under-privileged and belonging to Sc/ST categories. He said fishers of West Jaintia Hills District especially of Amlarem are fortunate enough to get first lot of 26 Units. He said all the women fishers should emulate Mrs Alma who become epitome of success in implementing technologies given by CIFT. Headman of the Umladhkur and other state department officials also spoke on the occasion. The programme came to an end with vote of thanks from Mrs J.U. Kharpuri, MCS BDO Amlarem C & RD Block, West Jaintia Hills District.

Mariculture Policy: Traditional Fishermen to be Given Priority

Kochi: A stakeholder meeting held at the Central Marine Fisheries Research Institute (CMFRI) recently decided to take steps to address the concern of fishermen towards the draft national mariculture policy. As part of this, the draft will be incorporated so as to enable traditional fishermen and their cooperative societies obtaining priority while Mariculture Zones are demarcated in the sea for various mariculture activities.

Refuting the remarks that the mariculture policy was meant for wooing corporates and other industrial giants into open sea farming, the experts, who were part of the

CMFRI Director Dr A Gopalakrishnan speaking at the stakeholder meet held at CMFRI

formulation of draft national mariculture policy, said that the draft included stringent measures to protect the interests of fishermen and fishing zones. "Actually, the policy was meant to ensure an additional livelihood option to the fishermen community at a time when marine capture fishery passes through a stagnation", they said.

Dr A Gopalakrishnan, Director of CMFRI and Chairman of the committee which formulated the draft mariculture policy said the country requires five million tonnes from mariculture production alone to meet the food demand in 2050. "We cannot always depend upon marine capture fishery to meet the food demand and to protect of the lives of fishermen community. Mariculture is a better alternative to increase marine food production and to improve the living standards of fishermen as well. A systematic maricultureپractice is required to realise these goals", he said adding that a national-level policy was need of the hour to promote mariculture enterprises in the country.

The meet, which was attended by representatives of fishermen, boat owners, fish farmers, seafood exporters and hatchery entrepreneurs in Kerala along with marine scientists andFisheries Department officials, also decided to consider mariculture on par with agriculture for enjoying all financial benefits from government and banking sectors. This will be incorporated in the draft policy.

Mariculture activities included cage fish farming, bivalve farming, pen culture, seaweed culture, hatcheries and nurseries based on scientific criteria.

In addition, stringent measures will be incorporated in the draft policy to protect marine ecology. The meeting suggested that State governments should be entrusted to take measures to curb all kinds of organic pollution emanating from cage fish farming in open sea water. The stakeholders may submit their detailed suggestions and proposals based on the draft policy on or before December 27.

Dr A G Ponniah, Dr G Gopakumar, Dr Imelda Joseph, Joseph Xavier Kalappurakkal, P G Soumithran, P B Dayanandan, C K Gopalan, K K Push karan and V Rekha spoke. Dr Shyam S Salim was the moderator.

Training Cum Demonstration on Value Added Fish Products at ICAR-NEH, Barapani

A training-cum-demonstration programme on "Development of value added fish products" was organised by the Institute at Krishi Vigyan Kendra, ICAR Research Complex for NEH Region, Barapani, Meghalaya under ICAR-CIFT NEH component. Dr Manoj P. Samuel,

Opening of fish processing laboratory

Principal Scientist & Head, Engineering Division and Mr K. Dinesh Prabhu, Senior Technical Assistant, Fish Processing Division co-ordinated the programme. The programme was attended by more than 35 farm women who were

Training in progress

sensitized on various fish processing technologies and value added products by means of class room lecturers and method with KVK, Rhi-Bhoi, Meghalaya. An MoU has also been exchanged between ICAR-demonstration. Different value added fish products such as fish pickle, fish cutlet, fish fingers etc. were demonstrated on 'learning by doing' mode. The programme was organized in collaboration NEH and ICAR-CIFT for establishing a fish processing laboratory at KVK under the NEH component. The MoU was exchanged in the valedictory function with Dr Narendra Prakash, Director, ICAR-NEH. Earlier in the inaugural session on 10 December, 2018, Dr S.K.

Distribution of certificate to participant

Das, Head, Fishery Division and Director I/c, ICAR-NEH, Dr A.K. Jha, Nodal Officer, KVKs and Dr A.K. Singha, Director Ic, ATARI, Barapani participated. Dr S.K. Das opened the fish processing laboratory in presence of other dignitaries, trainees and KVK staff.

Participants and dignitaries

Cocanada Aqua Professionals Association formed at Kakinada

Kakinada: Cocanada Aqua Professionals Association, Kakinada was formed on 19.11.2017 with a Committee of President, Vice-President, Secretary, Joint-Secretary and Treasurer and four members of Technical Committee and six members of Co-ordinators. We have formed the Association to the Kakinada area from Yanam to Tuni. All the members are Head quartered at Kakinada. Regisration of the Association has been done under The Registrar of Societies, Kakinada with No.518 of 2018, dated 7th August 2018.

Ch. V. S. Chitti Kumar, Vice-President

We have 150 members in our Association and we have started this association with a motto of developing coordination between all the members with regard to share latest technical developments among ourselves and want to conduct some technical seminars to the Junior members with our Technical Committee to improve their skills in Aquaculture and help the farmers to support

U. N. S. Varaprasad, President

them in culture time.

We are insuring all our members with an Accidental Policy for Rs 5 Lacs. We have conducted a Charity Event on 13.11.2018 at Royyipadu village of VajrapuKothuruMandal of Srikakulam District in A.P to the Titli Cyclone effected people by distributing Blankets to all the families in the village by spending Rs.70,000, which has been raised by our members. This year we have joined all the dealers in Kakinada area also for conducting get-together on 23.12.2018

Dr Rajendra Prasad, Secretary

and made it successfull. We have conducted sports events like Shuttle and Cricket to the members and given Trophies also to the winners and partcipants.

We have just started our operations and we want to do many events like technical seminars, Charity events and most importantly events which are useful to the Aquaculture Industry, said a note from CAPA.

D. Ramprasad, Joint Secretary

B. Satish, Treasurer

T. Madhu Mohan, Tech. Member

P. Shiva Kumar, Tech. Member

B. Surendra Kumar Singh, Tech. Member

G. N. Ravi Kumar, Tech. Member

Amazing Biotech to celebrate 10 years completion this year

Our vision is to support for sustainable aquaculture and help farmers.
We keep on doing lab services and innovating products for farmers requirement.

Chennai: Amazing Biotech Pvt Ltd established in 2010 by a team of aquaculture expertise are celebrating 10 years anniversary this year, informed Dr V. Balasubramanian, Director of the company and said that the company is dedicated towards sustainable aquaculture with a strong and innovative research and development programs. The team has an experience of over 15 years in the field of aquaculture.

The R & D team is consisting of technical experts with 20 years of experience in probiotic and prebiotic formulations. We started our manufacturing unit in the year 2010. We are proud to be one of the

Sasi Kumar G, Director

pioneers to develop unique and innovative products like pH reducer using probiotics, Salinity tolerant Probiotics, Nitrite reducer, etc, which has an amazing performance in aquaculture. We keep on doing our R & D work to develop an outstanding product with affordable price in both Indian and international market, he stated.

With experience and knowledge, we started with a motive of solution provider for the farmer's need. We keep on addressing farmers

Dr Balasubramanian V, Director

problems with our service lab and our products. We have two qRT-PCR labs and one water quality lab across India. We are also doing consultancy services for lab design, erection and training program for both PCR and water quality Lab. So far, we gave consultancy services to five qRT-PCR labs at Ongole, Nellore, Kakinada, Eluru, Thirupoondi and one water quality lab at Thondi, Tamilnadu. In addition to that, we have designed indigenous diagnostic kits for major aquaculture diseases that are having high accuracy. These diagnostic tools are commercialized with reasonable cost-effective prices when compare to competent international market. Currently, we are having WSSV, EHP, IHHNV, EMS and Vibrio (*V. harveii, V. parahaemolyticus*), said

Dr Vinu. S. S
General Manager, Technical

Dr Balasubramanian.

The Chennai based Amazing Biotech is focusing on several research programs related to aquaculture with our collaboration lab. We are also having two trial ponds to try our probiotics formulations in field level experiments. Most of the products are innovative formulations with probiotics and prebiotics. It was proved in both lab trails as well as field trial experiments. Our pH reducer is the first product in the market using only probiotics to control pH problems. Likewise, our recently launched mineral mix is having high Electrical Conductivity (EC) and water solubility when compare with other marketed products. Currently, three research projects are running with our collaborator. We are also conducting training programs for young generations. Several students did their summer projects in our lab. Our vision is to support sustainable aquaculture and help farmers. We keep on doing lab services and innovating products for the farmers need, he stated.

contact@amazingbiotech.in

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Achievements of reputed fish farmer and seed producer Mr Bijoy Roy

Subrato Ghosh

122/1V, Monohar Pukur Road, Kolkata – 700026

Maa Lakshmi Fisheries Pvt Ltd

Established in 1981, Maa Lakshmi Fisheries Pvt Ltd (MLFPL), located at Madhubanpara, Vill. Madhuban, PS Kalna under Kalna-I Community Development Block, Dist. East Burdwan, and West Bengal is a dependable and reputed producer, exporter and supplier of best quality spawn, fry and advanced fry of economically-important freshwater fishes like Indian major carps, Labeo bata, Piaractus brachypomus, Pangasianodon hypophthalmus and exotic carps. Mr Bijoy Roy, S/o Late Gour Ch. Roy, Proprietor/Director of MLFPL is having more than 35 years of experience in fish seed production and table-size fish production sectors. In addition to Chinese hatchery system where fish induced breeding

Entrance at Sri Bijoy Roy's hatchery

is conducted, Mr Roy is presently having fifteen fish farms under his possession for production of quality fingerlings and table-sized major carps. MLFPL is running efficiently and has gained proficiency and good reputation among diverse clients for making available the best quality fish seeds in a time-bound manner.

This fish hatchery has obtained seed certification and accreditation from Department of Fisheries, Government of West Bengal on 26th June, 2014. Best quality of fish seeds are produced from this hatchery and supplied to different areas, both within and outside WB. MLFPL is renowned for freshwater fish culture in WB for about last three decades. In the rearing ponds and grow-out ponds, fingerlings and marketable-sized adult fishes respectively are produced in proper and scientific way with routine wise use of fish feed and judicious use of medicine. With the help of 100-120 skilled and dedicated workers, fish quality at MLFPL is maintained to its very best.

Recognitions

Mr Bijoy Roy has received the Krishak Samman Award from Hon'ble Chief Minister of West Bengal on 14th March 2017 at Nazrul Mancha, Kolkata for his notable contribution in development of fish culture in the state; he received the Meen Mitra Award from Mr Chandranath Sinha, Hon'ble Minister, Department of Fisheries, Government of WB on 7th January 2018 in Bengal Fish Fest programmer. Mr Roy was also felicitated by ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar as a leading and distinguished fish farmer on 10th July 2017 in National Fish Farmers' Day programmer.

Hatchery set-up

Mr Roy, Director of MLFPL has established the Chinese carp hatchery complex (which is about 1km from Kalna Railway Station), with two rectangular chambers where 200-250kg matured major carps can be kept in each prior to injection for induced breeding, one circular breeding pool, eight egg incubation-cum-hatching chambers having outer diameter 4 meter, rectangular egg-cum-spawn collection unit and overhead tank/reservoir. A unique feature was observed. Four big rectangular perforated tray-like structures (1.60 x 0.80 sq.mt each) are positioned one above another, keeping a height of 1.5 feet in between, at one meter above the upper rim of concrete overhead tank. Groundwater meant to be supplied to hatchery is drawn out and lifted up to the topmost rectangular tray; water passes down through pores in each tray, is dispersed and in the process carries atmospheric oxygen. It is finally poured down into the overhead tank and overhead tank water becomes enriched with dissolved oxygen (DO). Such water with sufficient DO concentration will be very helpful and ideal for the hatched-out larvae and growing larvae (till spawn stage) in each of egg incubation-cum-hatching chambers. The nursery

Highlight Points

Mr Bijoy Roy is an elderly and largely-experienced fish seed producer-cum-fish farmer, renowned not only in East Burdwan district of West Bengal but also in the state. Mr Roy has recently earned two prestigious awards; the Krishak Samman Award from Hon'ble Chief Minister of West Bengal on 14th March 2017 for his significant contribution in development of fish culture in the state and the 'Meen Mitra' Award from Hon'ble Minister, Department of Fisheries, Government of WB on 7th January 2018. Author had an opportunity to converse with Mr Roy at his fish hatchery site at Kalna, Dist. East Burdwan on 21/9/2018.

IMC fry transportation containers

Author with Sri Bijoy Roy

ponds are located at 500-750mt distance from this hatchery site, which is the seed production or 'spawn' unit.

Spawn and fry stages of Indian major carps are transported and supplied to fish seed traders at Sujapur in Malda district, Jangipur in Murshidabad; subsequently are supplied to Gangarampur in Dakshin Dinajpur, Katihar in Bihar and other places. Fry stages are also supplied to fish farmers at Moyna in Purba Medinipur and to local customers in East Burdwan and Hooghly districts according to demand. Large seed transportation containers of 2500lit capacity, made of galvanized iron sheet are used. Each holds 50-60 Bati (140ml each) spawn. Fry stages of Pangas catfish (2000-3000nos. / kg) and Rupchanda Piaractus brachypomus (1000-1200nos. / kg) are supplied to Rajendranagar fish seed market at Naihati, North 24 Parganas. Fry stages of pangas catfish are sold @ Re 0.35-0.55/- / piece, also supplied to Andhra Pradesh and Tamil Nadu by means of oxygen packing. Farmers of Bihar take bigger stages (1000nos. / kg) without oxygen packing. Spawn and fry of IMC were earlier supplied to different parts of Bihar, Chattisgarh and Assam from Maa Lakshmi Fisheries Pvt Ltd, but now carp hatcheries have been established at those places. In order to avoid inbreeding in Indian major carps during seed production, Mr Roy has brought advanced carp fingerlings from Bangladesh and from Odisha and those have been properly maintained and developed up to brooders' stage. Old brood fishes are replaced by new ones.

Grow-out culture and ponds

The Andhra Pradesh model of grow-out culture of major carps is followed and practiced by Mr Roy. Yearlings 100-250gm in size (12-14 months old) are stocked. Mr Roy has eight nursery ponds each 66 decimal in size and 12 rearing ponds meant for fingerling production (total area of rearing ponds: 1386 decimal). Early fingerlings 10-12gm in size are reared for 3 months till those attain 100gm. In addition to yearlings, such stages are also stocked in grow-out ponds for marketable and table-sized fish production. Carp fingerlings are even sold to fish farmers. In grow out ponds, 700-750nos. Labeo rohita (only Jayanti Rohu variety), and 150nos. Cirrhinus mrigala and 100nos. Catla catla are stocked / 33 dec water area. On an average his fishes attain 900gm in six months and 1kg in 6-8 months. Breeding of Cyprinus carpio is done but not grow-out farming. Mr Roy is presently having 95 bigha (3135 decimal) of grow-out fish ponds (15-18 bigha or 495-594 decimal each) in his possession and 120 bigha separately in partnership venture, located at about 25-70km distance from the hatchery-cum-office site. Only 10 bigha of his own grow-out pond area is located near his hatchery, the rest at distant places.

Feed management

For the Indian major carps in grow-out ponds, a mixture of rice polish or de-oiled rice bran (80kg), maize dust and groundnut oil cake (total 20kg) is used in every quintal of supplementary feed, fed @ 8-10% of body weight daily in every morning in perforated bags. Commercial pelleted feed (2-4mm) of CP brand is used during evening. For the 100-150gm stage, feed is used @ 5-6% daily; it is used @ 3-4% and 2% daily for growing 250-300gm and 600-700gm stages respectively. In the beginning, 25-30kg feed is used for every 500-600kg fishes. During later period of culture, 60kg feed used daily for every 3000kg fishes, Mr Roy explained. In the one-day Scientists-Fish entrepreneurs' interactive discussion-cum-awareness programmer organized by ICAR-CIFA Regional Centre on 17th July, 2017 at Kalyani, WB, Mr Roy reported good performance of Jayanti Rohu with growth rate of 7-8gm/day and its resistivity to diseases. Good acceptance of feed by Jayanti Rohu in winter month resulted in better growth in the same season.

Part of hatchery structure at MLFPL

Oxygenation method in OHT water

End note

In a conversation with present author, Mr Bijoy Roy opined that aquaculture should be transferred from a domestic activity to commercial venture, aiming at large-scale production. Target of fish production has to be fixed by Government which will usher more enthusiasm among fish farmers. Many water bodies are with some less-actively functioning Fishermen Cooperative Societies and fish production can be enhanced if those are leased out to progressive fish farmers. Mr Roy is maintaining only Jayanti Rohu, no normal Rohu and seeds (spawn) are brought from ICAR-CIFA, Bhubaneswar every year. Mr Roy has visited China, Thailand, Bangladesh and Malaysia during 2006-2007 and 2012 to learn the advanced technologies of seed production and farming of commercially-important fishes. Stripping method is followed here for seed production of fishes and total 20,000 Bati spawn (spawn measuring cup; 140ml each) of Indian major carps is produced here annually. Commercial probiotics and Liv-52 (which is a growth promoter and improves FCR in fishes) are used in fish feed and he is planning to set up Re circulatory Aquaculture System at Maa Lakshmi Fisheries Pvt Ltd in near future. In all, Mr Roy is maintaining 15 freshwater fish farms (that includes rearing ponds and grow-out ponds in each) mostly in single ownership located in East Burdwan, Hooghly and Birbhum districts. Mr Roy is one of such fish farmer, who has made West Bengal proud for his zealous and diligent hard work. Like others, he has been innovating conventional fish pond management practices to become a successful farm entrepreneur. Author Subrato Ghosh is grateful to Mr Bijoy Roy and Mr Ashis Mukherjee, elderly farm technician for patiently talking with author and providing a description of the fish breeding activities and farm structure at MLFPL.

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Conservation measures of Sea Turtle in Rushikulya rookery - A Myth Behind It

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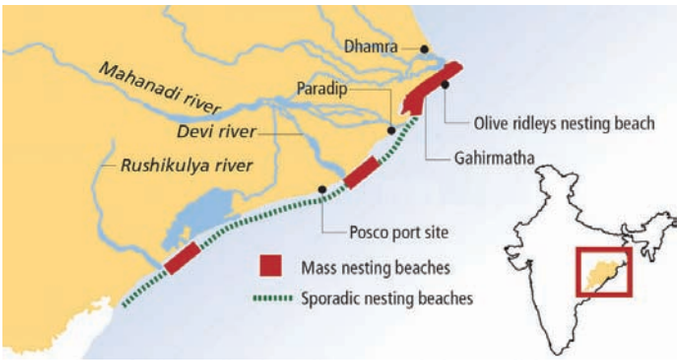
Introduction:

In India, the Odisha state is one of the largest Arribada sites for sea turtle among all. In the state, Gahirmatha is the largest rookery site followed by Rushikulya and Devi river mouth. Rushikulya rookery is the nesting site of sea turtle i.e; Olive Ridley (Lepidochelys olivacea). The arrival of Olive Ridley turtle starts from 1st November to the inshore area of the coast. There are 5 coastal villages viz. Kantiagarha, Gokhurkuda, Purunabandha, Nuagaon, and Arjipalli are located adjacent to the olive ridley turtle congregation site at Rushikulya rookery.



Sites of Olive Ridley breeding ground along Odisha coast

The mythology behindconservation practice:

Here the community-based conservation measure for sea turtle protection gives an outstanding result. This can happen due to the religious nature of the villager's and their faith in the mythology of turtle which relates to Lord Vishnu. The awareness among the villagers is being spread through a myth which is related to the Hindu religious text i.e; Puranas-a part of Vedas.

The interaction with Mr. L. Chandrasekhar Rao revealed the myth i.e; during the time of SamudraManthan which was took placed between the Asuras or demons and Devatas or gods, where the Ratnas were originated from the Kshirasagara (ocean of milk). Among them, one Ratna was the Halahala- the poison, which appeared in a Patra(bowl). The poison was consumed by Lord Shiva and the bowl was placed in the ocean. The origin of Jellyfish begins from the left out poison which was stuck to that bowl. So, the presence of jellyfish in the aquatic environment is harmful to the fish population as well as to the fisherman community. Their thought was that to regulate the harmful jellyfish population, the only way is to increase the population of sea turtle. As per scientific study was made, the turtle predate upon the jellyfish due to their jaws, which are adapted for crushing and grinding of food.

F Rushikulya Sea Turtle Protection Committee (RSTPC)

The villagersthink that, if they harm the turtle, then they were going to do miserable sins for which they will repent back for that in this life or after getting the resurgence. The turtle is the second incarnation of Lord Vishnu for the betterment of the society and for the establishment of Dharma. So the villager's started for conserving the sea turtle very eagerly, for which they stopped fishing activities during the arrival of sea turtle. Mostly the youth of the villages are actively participating in the conservation programme of the sea turtle. The villagers were thinking that by saving the life of a turtle, they would gain some Punya in their life. The wildlife scientist Dr. BivashPandav creates scientific awareness among the villager's and also established the Rushikulya Sea Turtle Protection Committee (RSTPC) in 1998 with the help of youth. In 2003, RSTPC officially registered as an NGO and this provides a boosting to the conservation programme in Rushikulya rookery.

Conclusions:

This write-ups help to other states of India where there are some conservation is required to save the vulnerable or endanger species form the ill effects of human activities. This type of community-based conservation techniques can be implemented in those protected areas and address the mass by creating some relevance myth which was related to those species which are to be protected. Government and NGOs can use this method of protection for the wellbeing of the community as well as for vulnerable or endanger species.

Highlight Points

- **Gahirmatha is one of the largest Arribada sitesfor Olive Ridley (Lepidochelysolivacea).**
- **The arrival of Olive Ridley turtle in Odisha coast starts from 1st November every year.**
- **Religious nature and mythological faith improvise the community-based conservation practices.**
- **Mythological conservation method can help to saveOlive Ridley as well as other vulnerable or endanger species.**

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More Reference can be provided on request.

Environmental Flows: keeping river alive

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Introduction

Water, besides being the very basis of the existence of life on the planet earth, is one of the most critical resources of all kinds of human development, i.e. economic, cultural and spiritual. The rivers have been dammed for exploitation of water.

The consequent changes in biophysical structure, ecological function, services of rivers and river associated wetland ecosystem, has its impact on human, especially on the river dependent communities, resulted in the realization of the need for maintaining certain flows in the rivers. Environmental Flows (e-flows) is the timing, quality and quantity of the water flow, required for the freshwater and estuarine ecosystems to sustain and for the wellbeing and human livelihoods that depend on these ecosystems. From 20thcentury precisely 1960s, water management in developed nations is focused largely on maximizing flood protection, water supplies, and hydro power generation. In the 1990s, scientists realized that the biological and social systems which are supported by the rivers are too complicated and cannot be summarized by a single minimum flow requirement. During 2003 a survey was conducted to measure perceptions of e-flows, according to which, out of 272 respondents,88% agreed that the concept is essential for sustainably managing water resources for the sustainable development. By the year 2010, many countries across the world had adopted environmental flow policies, even though their implementation remains a challenge. Till date, there are more than 200 methods for assessing environmental flows which can be broadly classified into four categories viz Hydrological, Hydraulics, Habitat stimulation and Holistic methods. One of the Holistic methods is Building Block Methodology (BBM); the most comprehensive and are suited to Indian context will be discussed in detail with the Indian and global scenario.

Environmental Flows

- It describes the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystem and the human livelihoods.

Highlight Points

- **Recognising the values of different ecosystems, and investing in them accordingly will help in the livelihhod generation of poor people those are solely dependent on the river.**
- **Environmental flow can serve as an important link between environmental conservation process and poverty alleviation.**
- **The limitations of water flow to energy and food production as well as for navigation under climate change will necessarily reconsider for water allocation.**
- **Environmental flows management can ensure the refilling of aquifers, wetlands, and can restore floodplain connectivity to act against the damage of floods.**
- **Prpoer managemant of e-flows will help the farmers for irrigation and crop cultivation.**

- More than the half of the world's large rivers are dammed, and it continues to increase.
- In India, about 40-50 new planned Dams are in the pipeline in Uttarakhand alone.
- Construction of dam leads to the change in the downstream flow patterns and affects temperature, water quality, sediment movement and deposition, fish and wildlife, and ultimately affects the livelihoods of people dependent on healthy river ecosystems.

Figure: the Environmental flow of upper Ganga

Evolution of environmental flow concepts and recognition

- During the 1960s, developed nations focused largely on water management policies in order to maximize flood protection, hydropower generation and water supplies.
- In the 1970s, the ecological and economic effects of these projects forced the scientists to search new ways to modify the operations of the dam to maintain certain fish species by adopting the concept of "minimum flows" and, "in stream flows,".
- In the year 2007, the Brisbane Declaration on Environmental Flows was endorsed by more than 750 practitioners from more than 50 countries. The outcome was to work together to protect and restore the world's rivers and lakes.

Flows are affected - reasons are many

- Construction of Dams – It blocks, fragments and regulates the river flow – alter the magnitude, duration and frequency of flows
- Diversion of water – the complete/

partial diversion of river or stream

- Deforestation - Degradation of the river catchment area leading to reduced flows – Most of the rivers are affected due to deforestation of the catchment area.
- Mining in the catchments – Example: Goa
- Sand mining on river bed – Western Ghats Rivers are affected by this.
- Pollution – Yamuna river basin
- Glacial melt – occurs due to climatic change – Example: Gangotri
- Flow regime and components
- Extremely reduced flows occur during drought are associated with reduced connectivity and limited species migration. Temperature, adequate habitat, dissolved oxygen, and chemistry for aquatic organisms maintainby low flows. It also sometime known as a base flow which occurs after the precipitation and is contained within the natural banks of the river. High flows lead to decreased water temperature and increased dissolved oxygen. High flows provide a source of gravels for the native and recreational fish spawning and hinder the growth of non-native fish populations, algae, and beaver dams.

Dam removal projects in the United States

- 1973 - Lewiston Dam
- 1997 - Marie Dorian Dam,
- 1999 – Edwards Dam
- 2004 - Embrey Dam,
- 2007 - Marmot Dam, Sandy river Oregon
- 2012- Elwha Ecosystem restoration Ecosystem project on Started in 2012, The (33 m) Elwha dam and the 210 ft. (64 m) Glines Canyaon Dam were removed to restore stocks of Pacific Salmon and trout species.

Dam Nation is a 2014 advocacy Documentary film about the changing attitudes in the USA concerning the large system of dams in that country.

Different EF Assessment Methodologies

Assessment Method	Basis	Cost/time	Confidence	Example
Look-up tables	Hydrology	Small	Low	Tennant
Time Series models	Hydrology	Small/ Medium	Low	IHA
Rated X-Section models	Hydraulics	Medium	Medium	Intermediate (SA)
Habitat Models	Hydraulics / Ecology	High	Medium	IFIM
Regional	Hydrology / Ecology	High (initial)	Medium	ELOHA/ Desktop
Holistic	Hydraulics / Ecology b/ Geomorphic / Social / Water Quality	High	High	BBM/DRIFT/ Benchmarking

Principles of Environmental Flow Assessment (EFA)

1. EFA's are only predictions.
2. EFA methodologies are the frameworks for organising available data and information.
3. Any EFA methodology can only provide accurate high confidence recommendations if the available information is detailed and accurate.
4. Hydrological data and hydraulic habitat data are critical to accurate and high-confidence flow recommendations
5. Rapid EFA methodologies provide flow recommendations and general motivations, but comprehensive EFA methodologies provide specific reasons for the recommended flows.
6. Any EFA team should only use a methodology with which one or more of the specialists have wide experience.
7. Assessing the consequences of different flows in rivers is a scientific process, but deciding on environmental objectives is a societal judgement.
8. An EFA and its implementation should be an adaptive process.
9. Stakeholder understanding and involvement in the EF process is essential for successful implementation.

Possible developments for e- Flows in India

- Centralised coordination of E Flows activities under a single authority.
- Training courses (one team per state).
- Development of E Flows policy/legislation
- Development of a classification system for the environmental state of rivers.
- Consistent (but flexible) framework for EFA's
- Regional preliminary assessment of E Flows for all rivers (e.g. using IHA)
- Centralised E Flows database and library
- Communication and promotion programme for E-Flows
- Pilot E Flows implementation programme
- National River Health Programme.

Conclusion

Healthy riverine ecosystem helps to maximise the social and economic welfare of all water users in an equitable manner. It provides livelihood especially to the poor communities those are living near to the land water interface. Presently ecosystem services have real economic importance in mitigating future problems as well as economic losses related to climate change. To preserve the benefit from these services, the water manager should ensure that environmental flow regime is maintained in rivers, streams and wetlands.

Green Leaf Meal: An Alternate Strategy to Combat Depletion of Fish Feed Resources

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INTRODUCTION

Aquaculture is currently one of the fastest-growing food-producing sector worldwide, rising at an average rate of 7.1% per annum. Despite contributing to 46% of total food fish supply, it has a long way to go. Its major constraints are the availability of good quality seed and feed. Also, we know that the global catch fishery is stagnating and is assumed to be suppressed to its limit thus, opening a wide possibility for the innovations and research to be done to enhance fish farming. The major constraint regarding this is the availability of low cost, locally available, sustainable and nutritionally rich fish feed ingredient. Due to the shortage of feed ingredients, the aquafeed industry has to compete with poultry and another animal husbandry. So, now there is a great need to find out new, non-traditional feed ingredients for fish feed. Also, we know that the global population is rising tremendously and is expected to keep growing. The growth amounts to around 83 million annually or 1.1% per year. The global population has grown from 1 billion in 1800 to 7.616 billion in 2018.

To feed the growing population, aquaculture plays a major role, and it seems to be as a savior for the over-burdened food industry. To enhance the production, use of advanced technologies, improved culture systems and incorporation of cheap ingredients in the fish feed that may be plant based which is locally available and nutritionally rich is of much importance. Nutrition is critical in fish production because feed represents more than 50% of the total variable costs. Most of the small-scale farmers depend on traditional feed ingredients such as rice bran, wheat flour, maize bran, mustard oil cake, etc. for aquaculture. Sometimes due to scarce of these sources or use by animal husbandry and for human consumption fish feed industry has to compete with them which may lead to an expensive feed. Aside from these issues the main problem is the lack of awareness and knowledge of benefits of using substitute, i.e. green leaf meal such as sweet potato leaves, *Leucaena leucocephala* leaves, *Cajanus cajan* leaves, *Pawpaw* leaves, banana leaves, *Sesbania* leaves, *Cassava* leaves, *Helianthus multiflorus* leaves, cabbage leaves and ash from kitchen fires. Also, they are not aware of the importance of adherence to a proper feeding schedule.

In India; as we know aquaculture is mainly dependent on carp culture as it is a landlocked state thus, freshwater culture can only be practiced. Major species being cultured are both IMCs and EMCs (Rohu, Catla, Mrigal, Common carp, Grass carp andsilver carp); catfishes (*Clarias batrachus, Heteropneustes fossilis, Wallago attu*), etc.. Apparently, use of fish meal as a protein source increases the input cost of feed and the majority of small-scale fish farmers in rural areas can barely afford. In a quest to enhance aquaculture production which subsequently improves food security, and reduce the level of poverty in developing countries, a search for affordable and locally available feedstuffs is being advocated.

Many locally available plants and plant-based products have been evaluated for inclusion in poultry and livestock feeds. However, only a few have been evaluated for their potential use as fish feeds. When these leaves were examined for their nutritional composition by performing the proximate analysis by the method of AOAC (1990), it was found that some of them contain high crude protein and low crude fiber content. This showed that potential exists for using plant sources as feed ingredients in fish culture. This concludes that the transformation of plant feedstuffs into affordable and high quality feed can make a tremendous contribution in improving fish production. Here, we are going to discuss some

Highlight Points

Aquaculture serves to feed the human population from time immemorial. The Industry largely depends on the fish feed for its growth and development. Plant protein source that has potential to be used in the feed industry has been found to have various advantages like its availability, sustainability, cost effectiveness, etc. Numerous plant leaves like *Sesbania, Leucaena leucocephala, alfalfa, Medicago sativa, Glycine max.* (rubber), *Manihot esculenta* (cassava), *broad bean, Carica papaya (Pawpaw)*, cucumber, squash, azolla, water hyacinth, duckweeds, water lettuce, duck lettuce, bur-reed, water fern etc. have been used in the fish feed industry. They are processed and used in the form of fresh and raw, dried, powdered, cooked, fermented, concentrates, etc. which helps to remove the anti-nutritional factors present in the leaves. This can be used to feed the herbivorous fish directly or can be used to partially or completely replace the fish meal which will make it cost-effective without compromising with its nutritional quality. Here, this is an attempt to bring into notice the potential use of various plant leaves as ingredient in fish feed industry.

of the locally available plant leaves and their nutritional values (moisture, crude protein, crude lipid, crude fiber, NFE and ash percentage/crop residue).

LEUCAENA LEUCOCEPHALA (SUBABUL)

Leucaena leucocephala is a medium sized fast growing tree belonging to the family Fabaceae. It is native to Southern Mexico and Northern Central America. In India, it is popularly known as kubabul or subabul. Here it is commonly cultivated in the garden as an ornamental, avenue and forage crop. The various parts of this plant like root, leaves, stem, bark, wood and seeds are very useful for human beings and animals. The leaves are used as an animal feed because of its high nutritional value. It is often described as the **'alfalfa of the tropics'**. *L. leucocephala* leaves is a cheaper plant protein source with high nutritive value thus, offers a great potential for use as a fish feed.

GLYCINE MAX. (SOYBEAN)

Glycine max is fast growing herbaceous plant, annual native to Asia and it is commonly known as soybean. Soybean leaves and stems can be grazed, ensiled or dried to make hay. The foliage is very palatable to cattle and has a high nutritive value and good digestibility (Koivisto, 2006). Soybean leaf meal is also being used as a fish feed ingredient as it contains high protein.

MEDICAGO SATIVA (ALFALFA)

Medicago sativa is a flowering plant cultivated as an important forage crop. It is known as Lucerne grass in south Asia. It is widely grown throughout the world as forage for cattle due to its high protein content. Fresh and dried leaves of this plant are used in fish feed formulation. It is used as a supplementary fish feed ingredient along with the traditional ingredients.

SESBANIA LEAF (AGATI)

Sesbania leaves can easily be grown abundantly in India with little cost and agronomical care. Its high herbage yield and protein content may make it a promising feed for aquaculture, as it is much cheaper than other essential feed ingredients like fish meal. Sesbania is a good source of vitamins and proteins. Mainly tilapias are targeted fish species for this feed.

MANIHOT ESCULENTA (CASSAVA)

Cassava leaves contain diverse types of proteins compared to eggs and soybeans. It is made of lots of Arginine, Lysine, Valine, Leucine and Isoleucine. It contains up to 10 times the amount of proteins found in the roots. On an average, the meal prepared from cassava leaves contains (on a dry matter basis) 210 g kg−1 crude protein, 250 g kg−1 acid detergent fiber, 85 g kg−1 ash, 14.5 g kg−1 calcium and 4.5 g kg−1 phosphorus. Cassava leaf protein is well balanced, except for a deficiency of sulfur-containing amino acids. The presence of hydrocyanic acid and tannins is considered, but a leaf meal with low levels of these anti-nutritional factors may be prepared using simple processing techniques.

CARICA PAPAYA (PAWPAW)

Papaya fruit (when unripe), bark, leaves and seeds, contain a proteolytic enzyme, papain that degrades proteins into amino acids and is used to tenderize meat. Papaya (*C. papaya*) is a common human fruit; available throughout the year in the tropic. It is stated as the "medicine tree" or "melon of health", also papaya is rich with nutrients. It contains medicinal properties and the main active ingredients recorded include, carpine, chymopapain and papain, a bactericidal aglycone of glucotropaeolin, benzyl isothiocyanate, a glycoside sinigrin, the enzyme myrosin, and carpasemine. *Carica papaya* leaf meal could be a good source of protein due to its rich amino acid profile. Leaf meals have attracted some interest because of their high protein level (upto 30%).

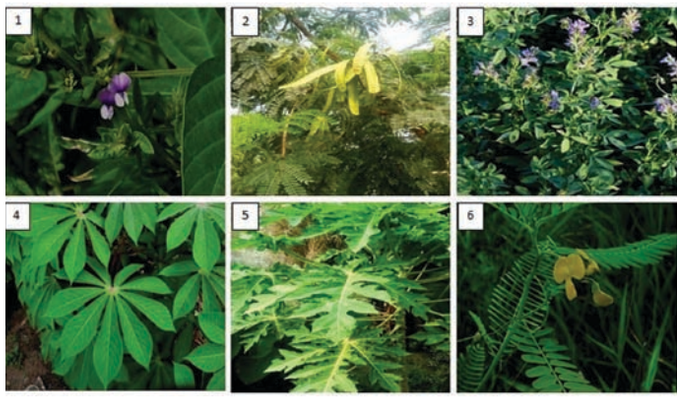
Proximate Composition of Some Locally available feedstuffs

Feedstuff	Protein (%)	Fat (%)	Fibre (%)	CHO (%)	Dry Matter (%)	Mineral (%)
Maize (white)	9.3	5.0	2.4	70.9	88.0	1.8
Maize (yellow)	10.8	3.6	3.5	71.2	88	1.9
Cottonseed cake	40.1	8.3	31.9	12.4	91	5.1
Rice Bran/Husk	9.9	4.4	40.2	8.7	91	21.8
Groundnut Cake (Industrial)	48.0	13.2	8.1	18.9	93	6.3
Groundnut Cake	40.6	23.4	6.0	19.0	93	6.2
Soybean meal	48.1	23.9	4.1	20.7	90	7.9
Brewer's Waste	22.8	17.8	18.8	46.4	93	-
Cassava Leaves	14.7	8.4	15.6	45.2	88	16.1
Duckweed meal	24.8	-	12.06	-	92.3	-
Distiller's Grains	29.0	3.7	7.8	-	91	-
Canola meal	38	3.8	11.1	-	91	-
Wheat grain	13.5	1.9	3	-	88	-
Cocoyam	25.1	-	28.56	-	87.0	-
Cowpea	16.6	19.0	4.3	40	-	-
Cassava (flour)	1.6	0.5	1.7	83.3	-	-
Sugar Cane Fiber	1.3	0.64	0.0	55.4	-	-
Banana (whole)	6.5	1.8	5.3	79.2	-	-
Paw-paw leaves	32.6	0.8	17.2	18.38	-	-
Paw-paw fruits	4.1	0.6	11.5	24.6	-	-
Banana peels	7.9	11.6	13.4	14.1	-	-
Sweet potato	5.4	0.5	1.0	28.1	-	-
Sweet Potato leaves	24.7	3.6	11.5	12.5	-	-
Rice (Unpolished)	7.5	0.5	0.2	79.9	-	-
Spinach	2.1	0.2	0.8	4.5	-	-
Groundnut shells	4.0	1.0	46.7	46.3	-	-

Source: Udo and Umoren (2011); Eyo et al (2004); Okanlawon and Oladipupo (2010); Gabriel et al (2007); Sikiru et al (2009); Agbebi et al (2009); Otubusin et al (2009)

The above mentioned table gives us the holistic idea of the proximate composition of some of the locally available plant-based resources that has the potential to be utilized as fish feed ingredients. This can help to reduce the dependency on capture fisheries for more protein and can help out in the formulation of new feed and can be used to serve as an alternate to the traditionally used ingredients. The aim of this study is to find out a nutritionally rich feed with an objective to develop a cost-effective feed. This study based on plant sources can help to provide an alternative approach to cope up with the situation when it is a high alarming time as the marine capture is stagnating and we can't harvest beyond its limit. Fish meal is considered to be the best ingredients among the most commonly used feed ingredients, due to its compatibility with the protein requirement of fish. Because of rising cost and uncertain availability of fish meal, there is a necessity to replace the fish meal by less expensive ingredients of plant origin in fish feed. Inclusion of feedstuffs with relatively high levels of carbohydrate in formulated fish feed is preferred in view of its protein-sparing action that may make the diet more cost effective.

According to Rumsey (1993), increased use of plant protein supplements in fish feed can reduce the cost of fish meal. The purpose of study is to focus on utilizing less expensive and locally available resources, mainly green feed meal to replace fish meal, without compromising with the nutritional quality of feed. The formulation of low-cost balanced diet using locally available agro-industry by-products is needed for commercial culture of fishes. Recently fish meal has become the most expensive protein ingredient in aquaculture feeds.



A pictorial representation of some locally available leaves that are being used as fish feed ingredients: 1. Glycine max.; 2. Leucaena leucocephala; 3. Alfalfa; 4.Cassava leaves; 5. Pawpaw leaves; 6. Sesbania leaves

Many studies have shown considerable success in partially replacing fishmeal with soybean meal and other soybean products in diet for various fish species. Many researches are still going on to find out an alternate solution to the declining fish feed resources and to develop a cost-effective but nutritionally rich and balanced feed. Now it's high time to think about it and come up with new innovations and substitutes to the traditional feeding methods.

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More Reference can be provided on request.

Introductions of Exotic fish Species and its Prospectus in Indian Waters

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Abstract:

Over the past two decades, the aquaculture entrepreneurs, stakeholders, farmers and ornamental fish culturist have been demanding the importation of alien fish species in view of competition in world and domestic trade market. In the present review revealed the presence of over 300 alien species imported intentionally or illegally; 291 ornamental species, 31 aquaculture species and two larvicidal fishes was recorded in Indian scenario. The use of exotic or alien species is one of the means to enhance production and value from aquatic ecosystems. Pangasianodon hypophthalmus and Litopenaeus vannamei into Indian waters have changed the face of finfish aquaculture in India. In other hand, alien invasive species are now recognized as one of the most significant threats to aquatic biodiversity. Rapid infrastructure development and growing urbanization of India which consequently devastate the native fish population and depletion of their ecosystem. However, environmental, economic, biodiversity issues and transmission

Highlight Points

Introduction of exotic species is have positive impact in aqua industry suchas L. vennamei was leading production from last five years. Tilapia, common carp become the most dominant food item for in aquaculture sector and these fishes are more suitable for any type of water environment and also demand in market value. The negative impact of exotic fish species on native species can be minimized by following awareness and DAHDF guideline strictly. This topic was helpful to farmers as a lead role of exotic species in the aqua industry and their impact on thecurrent aqua sector.

of disease are important considerations for authorities to check and regulate importation of such alien fishes in India. The benefit, risk of alien species were analysed based on availability of data and impact was assessed through FIST (Fish Invasiveness Screening Test). The present review based on past information, we conclude that, alien species, despite possessing some attractive culture characteristics, generally decline the availability of native community and consequently adversely affecting fish biodiversity and ecosystem, Thus we developed strategic regulation and quarantine procedure and all stakeholders, entrepreneurs or aqua culturists has to follow them strictly to control potential and plausible menaces.

Key Words: Alien Species, Impacts and challenges, Assessment, Management

Introduction:

Exotic fish is alien species which is not native and belonging by nature or origin to another part of the world or brought in from abroad or strange. The use of exotic species for fisheries and aquaculture diversification has been practiced since the middle of the 19th century. The first attempt to document fish introduction global scale was undertaken by FAO under stewardship of Dr. Robin Welcome. A number of terms have been in use to describe fish introductions. These include term such as Exotic, Non Indigenous, Introduced, and Non native, Alien, Nuisance and Invasive. Convention on Biological Diversity defines Alien species as species that has been transported by human activities, international or accidental, into a region where it does not naturally occur. IUCN defines alien invasive species as an alien species which becomes established in natural or semi natural ecosystems or habitat, an agent of change, and threatens native biological diversity. In India, over 300 alien fish species including 291 ornamental species, 31 aquaculture species and 3 larvicidal fishes are recorded (Mandal, 2011). Inland aquatic diversity of India offers several potential cultivable species for aquaculture development. In addition, to alien aquaculture species, more than 4000 freshwater fish species and 1400 marine fish species traded internationally each year Whereas in Indian Scenario, Major markets of ornamental fish trade such as Kolkata, Mumbai, Chennai. There have been incessant effort to diversify aquaculture through alien fish species in India in recent years; Total fish production has grown nearly 12 folds in last five decades and stands at 11.41 MMT, of which 7.77 MT from inland fisheries sector (2016-17). These introductions are deliberate activity of human being, which may be artificial or occasional. Both types of introductions can cause bio-invasions i.e., introductions assisted by humans and natural range expansions.

The use of alien species in aquaculture and ornamental fish trade is increasing order due socio- economic importance whereas such unauthorized introduction causing indiscriminate spreading of alien invasive species and it is one of the major causes of erosion or devastation of the native fish biodiversity in aquatic ecosystems (Singh and Lakra, 2011). However a provisional list of species based on literature and their impacts on native community and habitats shows the occurrence of 20 plants, 1 mollusc and 38 fishes (Muralidharan, 2017). In the past, no attention or observation was paid to the risks of invasive species and also lack of planning and management, often because of that negative impacts of the alien fish species became apparent only after introduction and established in the ecosystem. Recently, researchers have been focusing on the global aspects and evaluations of introducing alien species, analyzing and attempting to define their impact (De Silva et al., 2009). The introductions of alien fish species have been important both in their positive and negative consequences for fishery management as well as for the native components of the ichthyofauna of natural ecosystems (De Silva et al., 2009). The complex interactions of invasive species with native ecosystems make invasion ecology an interesting and important area of research. Despite the growing worldwide research, awareness and analysis of alien species invasions, India still lacks specific legislation to regulate the introductions of potentially invasive species into the country (Hire math and Sundaram, 2013). This review assesses the current knowledge of impacts of exotic species on aquatic systems with management strategy for effective management of invasive, which will be helpful in restriction on spread of potential invasive species and building up regulatory mechanism for aquaculture activities.

Reason of introduction:

- Improving local fishery potential and for broadening
- Species diversity in Aquaculture Programme
- Sport Fishing
- For aquarium keeping
- Improving Aquaculture and open water fishery productivity
- Controlling of unwanted organism.

Traits of Exotic Species:

- Fast growth
- Rapid reproduction
- Phenotypic plasticity
- Tolerance of a wide range environmental condition
- Ability to live of a wide range of food type

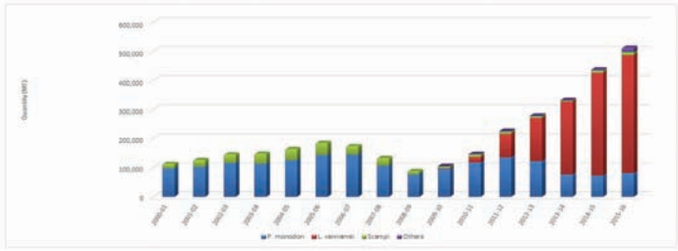
Benefits of Exotic Aquatic Species Introduction:

Introductions are a valid means to improve production and economic benefit from fisheries and aquaculture. The use of exotic species for fisheries and aquaculture diversification has been practised to deal with food and nutritional security. Introduction and transfer of fish species from one hydro geographic region to another have characterized the development of aquaculture. For example, in composite fish culture comprises three exotic major carp (Silver carp, Grass carp, and Common carp) with Indian major carp (Catla, Rohu, Mrigal) and many other compatible species used for utilization of niche and enhance production. The recent introduction of Sutchi cat fish, and White leg shrimp into Indian water have changed the scenario of Indian Aquaculture. Production of the Pacific white shrimp (*Litopenaeus vannamei*) has taken the lead with a total production of 4,06,018 MT (2014-15) recording an increase of 52,605 MT (14.88%) from the previous year 3,53,413 MT (2013-14) and contributing about 81% of the total export oriented aquaculture production in the country. Increase in the growth trend was maintained for last seven consecutive years, since its introduction into India. Approximately 17% of the world's finfish production is due to alien species. Production of the African cichlid tilapia is much higher in Asia (>700,000 tonnes) than in most areas of Africa (about 40,000 tonnes) in global scenario.

Some important fish species and their impact in Indian waters:

During last many decades, more than 300 species introduced in India for aquaculture, species diversification, recreational fishing purpose, Ornamental fish keeping, Mosquito control. Several exotic species well established in natural water bodies and increasing in aquaculture trade due to socio economic importance whereas it also show deleterious, adverse impacts of exotic fishes in the Indian aquatic ecosystems. The information compiled on the historical perspective of artificial or occasional and illegal introduction of alien species in India is summarized and presented in "Table 1" and "Table 2". Some important fish species and their impacts as below with figure:

- ***Hypopthalmicthys molitrix:*** Introduction of silver carp in Govind sagar, Himachal Pradesh has devastated the native population of IMC. This reservoir has now predominant fauna of exotic silver carp (60- 65% of total catch) followed by IMC (20-25%) and minor carp and mahaseer species each contribute (8-10%).
- ***Cyprinus carpio:*** It feeds by browsing on submerged vegetation uprooting plants on which other aquatic species thrive and feed, muddying the waters and destroying food and cover needed by other fish. Catches of Loktak Lake displaces the catch of native species Osteobrama belangeri whereas in Dal Lake, it significantly destabilize the native community of schizothoracids. But in Govind sagar,, it forms a lucrative fishery despite of dominating silver carp
- ***Gambusia affinis:*** To control burgeoning malaria as it feeds on mosquito larvae. And also causing ecological imbalance due to voracious feeding habit. Due to the prolific breeding and voracious habit of this fish has been labelled as "Fish Destroyer" (Myer, 1965).
- ***Oncorhynchys mykiss:*** Rainbow trout, major predators of eggs and young ones of native species. However, there is no organized study to assess the impact of this kind of unplanned introductions of trouts in open water. Whatsoever may be the impact of such introductions; the recent mass mortality in rainbow trout in Himachal Pradesh during 2002 possibly on account of severe problem has indeed drawn attention of the scientists calling for quarantining need and ecological concern (Swain et al., 2017).
- ***Tilapia:*** In India, four species of tilapia such as Oreochromis mossambicus, Oreochromis niloticus, Oreochromis urolepis, Tilapia zilli. The first two species predominantly available in the country. Oreochromis mossambicus first introduced in pond ecosystem in 1952. There after stocked in several reservoir of south India for production enhancement. It is abundantly found in almost all reservoirs of Tamilnadu, Andhra Pradesh, Kerala and Punjab. It also caused havoc to native fish population due to their prolific breeding habit and deterioration of the natural water bodies.
- ***Pangasianodon hypophthalmus:*** It is a voracious carnivore fish which is big threat to the native ichthyofauna. It has very popular in Indian aquaculture especially in state of west Bengal and Andhra Pradesh. It show first growth rate and can be farmed intensively. But in polyculture with carps, it has been shown harmful to local native species. Intensive monoculture with this cat fish was associate with various disease like Haemorrhagic septicaemia and bacillary disease.
- ***Litopenaeus vannamei:*** The increasing growth trend consecutively from last 7 year for the aquaculture since its introduction into the country, because of increased productivity, relatively disease free nature, higher yields in processing However, presently only SPF stocks are allowed to be cultivated which is a good management practice in India.



Source: (Aqua aquaria- 2017)

- ***Clarias gariepinus:*** African catfish grow fast, culture management is easy and farmers prefer it to local species. African catfish have been shown to possess attractive culture characteristics, such as fast growth approximately 600 gram in six month of culture period (Singh and Lakra 2011). This species has found to possess highly carnivorous feeding habit. There was a loss to the carps in the range of 78.2–86.3% when C. gariepinus was cultured under polyculture with carps due to their feeding habit. (Lakra et al., 2008).
- ***Liposarcus multiradiatus:*** Sailfin Catfish or Black Sucker, It was captured along with other native species in West Bengal pond, Salt Lake City. This is an aquarium fish and native to South America but able to proliferate in Indian water very well. This may be a case of accidental release but certainly a threat to native ichthyofauna since the fish can easily avoid predation owing to its leathery body and spiny outgrowth.

Fig 1. Some exotic species in Indian Water:

Silver Carp

Common Carp

Rainbow Trout

Mosquito Fish

Tilapia

Thai Magur

Sutchi Cat fish

Sutchi Cat fish

Whiteleg Shrimp

Table 1: Historical perspectives and status of deliberate or artificial introduction alien fish species in Indian aquaculture.

Sl. No	Common name	Species	Year	Source	Place where originally introduced	Reason of introduction
1	Brown Trout	*Salmo trutta fario*	1863-1908	England Japan	Nilgiri (TN), Harwan, Kerala	For planting reservoirs lakes and streams
2	Loach Leven Trout	*Salmo levensis*	1863	England	Nilgiri (TN)	-do-
3	Rainbow Trout	*Onchorhynchus mykiss*	1909	Srilanka, Germany	-do-	-do-
4	Steelhead Trout	*Salmo gairdneri irideus*	1867 1940	Europe England Srilanka	Nilgiri, Kashmir Kerala	-do-
5	Steelhead Trout	*Salmo gairdneri shesta*	1941	England	Kerala	-do-
6	Lake Trout	*Salvelinus fontinalis*	1959	Canada	-do-I	-do-
7	Splake Trout	*Salvelinus namaycush*	1968	Japan	Nilgiri	-do-
8	Sock-eye Salmon	*Onchorhynchus nerka*	1968 1970	Canada	-do-	-do-
9	Atlantic Salmon	*Salmo salar*	1968	North America	Kashmir	-do-
10	Golden Carp	*Carassisus carassius*	1974	England	Nilgiri	Experimental culture
11	Tench	*Tinca*	1870	England	-do-	-do-
12	Gourami	*Osphronemus gourami*	1856	Java	Kolkata	-do-
13	Silver Barb	*Puntius gonionotus*	1972	Indonesia	West Bengal	Aquaculture
14	Mozambique Tilapia	*Oreochromis mossambicus*	1952 1982 1985	Indoneisa Bangkok Srilanka	West Bengal Tamilnadu Rajasthan	-do-
15	Common Carp (Scale carp)	*Cyprinus carpio communis*	1939 1957	Srilanka Bangkok	Cuttack	Composite fish culture
16	Mirror Carp	*Cyprinus carpio specularis*	1939 1957	Srilanka Bangkok	Nilgiri	Aquaculture at high altitude
17	Leather Carp	*Cyprinus carpio nudus*	1939 1957	Srilanka Bangkok	Cuttack	Aquaculture
18	Grass Carp	*Ctenopharyngodon idella*	1959	Japan	Hongkong Cuttack	-do-
19	Silver Carp	*Hypophthalmichthys molitrix*	1959	Japan Hongkong	Cuttack	-do-

Table 2: Illegal and unauthorised culture of alien fish species (reasons for introduction, year and source, and place of original introduction) in India

Species	Common name.	Reason	Year/ Source	Place	Present status	Remark
Oreochromis niloticus	(Nile tilapia)	Aquaculture	Possibly 1987 from Thailand and Israel	Tamil Nadu, West Bengal, Rajasthan	Natural population exists in rivers and reservoirs	Adverse impact perceived
Tilapia zilli	Red belly tilapia	Aquatic weed control in irrigation systems	1986 Thailand	Indira Gandhi Canal, Rajasthan	Present in freshwater farms in addition to the Indira Gandhi Canal in Rajasthan	Impact not perceived,but introduction was unnecessary
Aristichthys nobilis	Bighead carp	Aquaculture	1980 Possibly Bangladesh and Nepal	West Bengal	Widely cultivated , Present in natural waters	A banned species, Significant adverse impact perceived
Ictalurus punctatus	Channel catfish	-do-	1990	Thanjavur, West Bengal	Limited occurrence	Unauthorized trials were not successful
Clarias gariepinus	African catfish	-do-	Possibly 1994	West Bengal	Widely cultured and some are present in natural waters	A banned species in Aquaculture. Significant adverse impact perceived
Pangasianodon hypophthalmus	Sutchi catfish	Aquaculture and aquarium purpose	Possibly 1997	West Bengal	Cultured in Coastal states. And in natural waters	Adverse ecological Impact perceived. Government considered its regulated culture
Mylopharyngodon piceus	Black carp	Aquaculture and mollusk control	Possibly 2005 from Bangladesh	24_N Parganas of West Bengal	West Bengal and spread throughout north India	Limited culture and impact not perceived
Litopaeneus vannamai	White leg shrimp	Aquaculture	2001 Probably from Thailand	Andhra Pradesh, Tamil Nadu	Aquaculture mostly in Andhra Pradesh	Government culture under bio-security

Mechanism of introduction of new species:

Exotics species spread in many ways, introduction can be artificial or accidental. After establishment in a new environment, they have to fulfil major criteria like arrive, survive and thrive. There are many mechanisms which help to exotics in new environment. Generally these mechanisms fall into two categories namely; Species based and ecosystem based. Former one for mechanisms which focus on exotic species and later one focus on invaded ecosystem (Raman et al., 2013).

- **Species based mechanism:**

  It focuses on competition among different fish species. While all fishes are able to compete in some manner in order to survive and persist. Invasive species have specific traits or combinations of specific traits that make them especially good competitors. In some cases, it can be simple as ability to grow and reproduce rapidly while in other cases, it can be better adaptability to local environmental condition.

- **Ecosystem based mechanism:**

  It is mainly focus on aquatic resource i.e., the amount of resources available, and how much of those resources are being used. In a stable ecosystem, all of the species can enough to survive in their respective habitat. But in case of spare ecosystem, this mechanism describes a situation where the invaded ecosystem in question has unfilled niches. Unfilled niches promptly filled by invaders and which cause harm for rest of the species in aquatic ecosystem due to lack of predator and competitor.

Impact of alien species in water bodies:

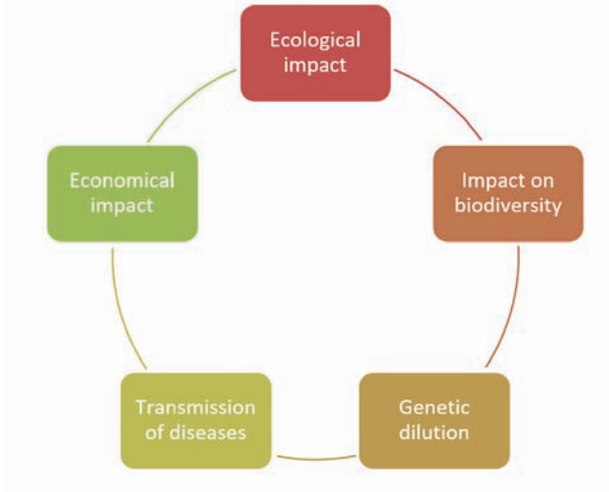


Fig. 2

- **Ecological impacts:** Competition with natives, Predation on natives Change in ecosystem process by upsetting natural balance, Habitat alteration (Ujjania et al., 2015).
- **Economical impact:** Total economic returns declined for capture fisheries. Damage and control cost of invasive species - $138 billion annually in US. In aquaculture-Vennamei Shrimp export estimated value – Rs. 13, 154 crore (2015-16) in India.
- **Impact on biodiversity:** Invasive species cause loss of biodiversity including species extinctions, and changes in hydrology and ecosystem function.
- **Genetic impact:** Introgression through hybridisation, Extinction through hybridisation, Loss of trait, Genetic bottle neck, Inbreeding depression.
- **Transmission of disease:**

Parasite	Host	Record
Tripartiella copiosa	Common carp	Das and Halder (1987)
T. obtuse	Grass carp	Das and Halder (1987)
Trichodina nigra	Tilapia	Mukherjee and Halder (1982)
Trichodina reticulate	Silver carp	Mishra and Das (1995)
Neoergasilus japonicus	Grass carp	Das and Halder (1988)

Challenges in introduction of exotic fish species:

Impact of invasions on the aquatic systems in India, has not been perceived as a major issue however is likely to emerge as a serious problem because, the severity of the invasions on resources is not felt as of now. Globalization has prevalent economic ideologies, which could serious impact on pristine habitat and also harmful to fish species. We have failed to realize the importance of habitat in the era of urbanization and infrastructure development. Many alien species take benefits from reduced competition and that follows habitat degradation. Some adverse impact of alien aquatic species through homogenization, hybrid superiority and also invasive meltdown.

Homogenization :

It is a threat to indigenous species; it is commonly asserted that exotic species promote the homogenization of biological communities by influencing community composition (Nentwig, 2007). Freshwater fish fauna that are highly differentiated and isolated lose their uniqueness resulting in the loss of local and regional distinctiveness.

Hybrid superiority :

It is due to disturbances in gene regulatory mechanism, which showed morphological variation i.e., improved or increased function of any biological quality in a hybrid offspring, e.g. Sucker mouth cat fish exhibiting Hybrid superiority through successive invasion.

Invasive meltdown :

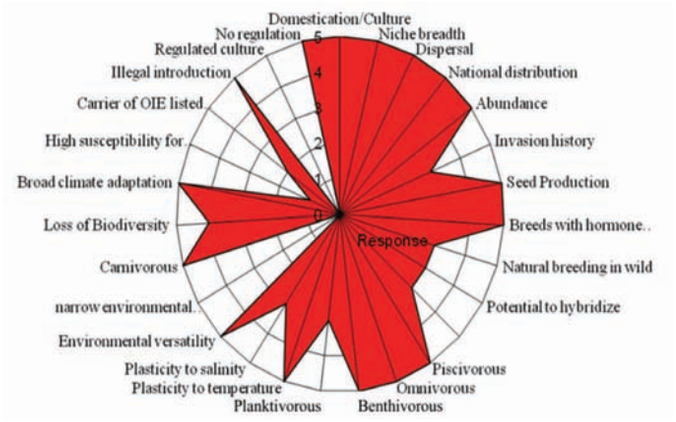
Exotic species are known for their adaptive traits and in course of their evolution have developed strategies by sharing habitat and resources mutually with local residential species, which is referred as 'Invasive meltdown'. Porphyrio porphyrio a water bird sharing their habitat with invasive species Eichhornia crassipes i.e. that usually nests in mass of floating debris or amongst matted reeds slightly above water level utilizes invasive water hyacinth foliage in the absence of native fauna, it is also said to facilitate the proliferation of the weed.

Due to such adverse impact of alien species on aquatic ecosystem, it will ultimately hamper the native fish species and extirpation of their habitat. Often because of invasive

species have capable of tolerance of wide range of temperature variation or any climatic condition. Removal of certain invasive species needs fundamental knowledge of population ecology which is lacking for many exotics. Further control of parasitic infections in introduced culture species is another challenge as it could be spread to native forms (Dash et al, 2008). Measure based on biological and chemical control on invasive, which is not appropriate for all time because it could have harmful for other native population. Therefore implementation of control strategies and measures should be taken for combating the impact, after due to consideration to safety aspect of environment and population.

Risk Assessment:

Before, implementing strategic plan for reduction of unauthorized introduction of alien species or impact of alien species, we should follow the risk assessment test. Risk assessment is one of the core element for protecting fish diversity and food safety (Singh et al., 2013). Impact of introduced species assessed through FIST (Fish Invasiveness Screening Test). It is a science based screening test which include screening of potential biological features such as Growth, Culture level, History of establishment, Breeding in wild, Competition for food with native Plasticity (Temp and salinity tolerance), Disease and dispersal ability. The cumulative value of each screening criteria analysed using statistical software Statistix version 8.1 and ranking for each criteria was determined based on the CV %. The frequency distribution percentage value (FD %) of screened criteria for each species was calculated. The risk level for the assessed species was classified on the basis of the value calculated for FD %.



Source: (Singh et al., 2013)

But lack of data is general constraint for risk assessment of alien species introduction to new ecosystem. Therefore we should followed various database like DIAS- Database of Introduced Aquatic Species, GISD- Global Invasive Species Database, Fish base, National Biological Information Infrastructure of USA, which is useful as reference for further assessment.

Management and control strategies:

To coordinate, monitor and management of introduction of alien species, several central and state organisation bodies are responsible such as ICAR, NBFGR, NFDB, Directorate of fisheries whereas International agencies like NACA, World fish centre and EIFAC are responsible for effective management of planning at global level. However certain aspects, generally accepted worldwide such as;

- Prevent the introduction through ballast water &hull fouling by finding proper treatment technologies.
- Minimize transport &exchange of species.
- Undertake research surveys to detect introduced species early.
- Monitor introduced species and their impact on local environment.
- Increase knowledge &awareness about introduced species.
- Control as early as possible,
- International collaboration of problem is essential.

Guideline and Certification:

- 1. Under 4th five year planning period, Govt. Of India initiated new scheme AQCS- Animal Quarantine and Certification Services is to prevent the ingress of dangerous exotic diseases into the country through imported livestock and livestock products. Main objective of this scheme is - to prevent ingress of any exotic live stock disease through importation and to provide International Certification Service. In 1999, Under ministry of agriculture, DAHDF developed strategic guideline for dealing aquatic exotic and quarantine to NBFGR which comprises mainly of pathogen to be considered, Disease diagnosis, Disease zoning, Disease surveillance reporting, Contingency planning, Import risk analysis .
- 2. The ministry of Agricultures authority to regulate the importation and interstate movement of invasive animal species, take measures to prevent the introduction and dissemination of disease under livestock importation act-1898 (amendment, 2001).

Conclusion:

Despite the growing concern for the impact of invasive species, exotics are constantly released as we have not completely halted activities promoting such introductions. The introduction of exotic species result in competition for limited food, space, ecological niche and may results in genetic erosion, predation and pathogen entry. The biology of invasive species and lack of site specific information on its ecology are major bottlenecks in developing effective tools for its management. In light of adverse impact of alien species, strategic regulation and quarantine procedure has been developed and aqua culturist has to follow them strictly to control potential and plausible menaces.

Acknowledgement:

Authors are grateful to the Dean COF, CAU (I), Lembucherra for providing facility. Consistent encouragement of Dr. Rani Dhanze, Professor & Head, and Dept of FRM is greatly acknowledged for providing valuable suggestions. We would like to thanks Suraj Ku. Pradhan and Chittaranjan Raul for their assistance during work. We also thank Lalit Mahanand for providing idea regarding title and photos.

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