JULY/AUGUST2013
Volume 9 Number 4

# AQUA CULTURE

## Asia Pacific

Acute Hepatopancreatic Necrosis in Shrimp explained

Indonesia Lifts Shrimp Production

Ocean raised Seabass branded with Singapore

Economical Value of Raw Materials in Tilapia Feeds

A Changing White Fish Market in Europe

MICA (P) 008/10/2012 PPS1699/08/2013(022974)

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- We strive to be the forum for the development of self-regulation in the Industry.

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21-22 August 2013

## TARS 2013

The third of the Aquaculture Roundtable Series (TARS2013) will be held in Singapore from 21-22 August. TARS 2013 will focus on **Finfish Aquaculture-Industrialisation and Sustainability**. For more information and updates on this all important meeting, visit www.tarsaquaculture.com

# From the editor

## Industrialisation into the Future

For shrimp farming, countries like Thailand and China are already reaching limits to growth. These countries are challenged by the lack of suitable coastal land while current farming technology limits the output per hectare land area without putting the system and the whole country at the risk of disease. For Asian aquaculture to move to the next phase, we need to address this challenge and the answer lies in industrialisation. Here is where a paper presented at FITA, Lombok, Indonesia fits in.

Pak Atjo of Sulawesi shared his contribution to 'Industrialisation and the Blue Economy'. He has run four cycles of super intensive culture producing more than 100 tonnes per ha per crop. He reiterates that the system is more important than the infrastructure. The objective is to provide at least 60% of the oxygen to the shrimp while the strategy focuses on operating just under the system's carrying capacity. Whenever this level is beached, partial harvesting is practiced to reduce the biomass. The tactic involves the paddle wheels pushing the waste towards a central catchment area where the organic load is siphoned out four times a day. Pak Atjo integrates all these components into his system.

In the case of freshwater and marine fish in Asia, we have the choice of many species but industrialisation requires almost complete knowledge of the single target species along the supply chain. Companies such as Barramundi Asia and Marine Life Aquaculture in Singapore (featured in this issue) are examples. Both emphasise on starting with vaccinated stock, disease prevention, control on monitoring water quality and conditions, and costs. At the other extreme, we have the high density production of the pangasius in Vietnam, a single species but lacks sufficient information along the supply chain, especially on its nutrition. Due to its low ex-farm prices and high production costs, the prevention of diseases via vaccination becomes unaffordable but this poses the question of the chicken and the egg – which should come first?

Where is the common ground? From the days of Henry Ford producing one model (the model T) along an assembly line, it is all about producing a single Stock Keeping Unit ( SKU) and efficiencies of scale. In aquaculture, this translates to a single species and volume production which allows for amortisation of the investment. The heavy capital investment can then be translated to a lower cost per kg of shrimp or fish. This volume of production alone will create a market for support segments from genetic selection to feed and vaccines. This will catalyse the development of the supply chain. It is also about control and monitoring of the environment such that the animal is always in its comfort zone.

At high stocking densities, the system is operating at close to its maximum capacity and a small environmental change can have a large impact on the aquatic animal so the water conditions must be monitored 24 hours daily. Asia has a lot to learn from how a country like Norway with a high cost of living can be a major producer of salmon. Norwegian salmon farms are run by very few people but are highly automated. Yes – automation is high investment but again when depreciated over a large volume, the cost per kg is very competitive. We have learnt in plant and animal culture, disease management is about prophylaxis where prevention is better than cure. Once a disease outbreak occurs, containment and therapy may help but the damage is already done. The above five criteria seem to be good measurements of industrialisation.

We have begun to see new investments in modern infrastructure and design for shrimp and finfish farming in Asia. The hardware is in place and now we need the software and systems to complement and maximise the capability of the hardware. Without this software, we will likely end up with first world infrastructure hindered by third world mentality.

Zuridah Merican

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**Abstract submission deadline:** early January 2014
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# Early mortality is now a disease or AHPND

**The causative agent of EMS has been identified as a strain of the bacteria *Vibrio parahaemolyticus* and polyculture with tilapia is proposed for its prevention during a workshop at Nong Lam University.**

Since 2009, EMS or early mortality syndrome affecting both *Penaeus vannamei and P. monodon* during the first 30 days of culture has devastated the industry in China, Vietnam, Malaysia and more recently, Thailand in 2012. Asia's supply of farmed shrimp has dropped an estimated 11% in 2012 as a result of EMS outbreaks. In affected countries, production dropped by as much as 80% during the first year of the outbreaks. More recently, some countries have reported improvements in production, such as Vietnam, where industry expects a 25% increase in production in 2013 over that in 2012, as farms adopt various management protocols.

In August 2012, a consultative meeting of experts and industry organised by NACA gave a definitive definition and named the syndrome acute hepatopancreatic necrosis Syndrome (AHPNS). No specific causative agent has been reported until May 2013, when the research team at the Aquaculture Pathology Laboratory at the University of Arizona (UAZ-APL) determined the infectious nature of the syndrome and identified the EMS/AHPNS pathogen as a unique strain of a relatively common bacterium, *Vibrio parahaemolyticus*, that is infected by a virus known as a phage, which causes it to release a potent toxin (http://www.fao.org/news/story/en/item/175416/icode/). With this, AHPNS is now a disease, acute hepatopancreatic necrosis disease or AHPND.

## Workshop in Vietnam

Given the high interest expressed by industry on the discovery, Nong Lam University, Ho Chi Minh City, Vietnam organised a half day workshop in English and Vietnamese on 28 June 2013 to share recent updates on the progress of EMS research. In the three presentations, **Dr Donald V. Lightner** documented the progress in research, **Loc Tran**, a Nong Lam University graduate and PhD candidate who is working on EMS at UAZ-APL detailed work on infectivity and determination of the causative agent, and **Dr Kevin Fitzsimmons** discussed including tilapia in shrimp farming as a preventive measure against EMS.

Efforts to study EMS, identify its pathology and respond to EMS were supported by a coalition of partners including: University of Arizona, Food and Agriculture Organisation (FAO); World Organisation for Animal Health (OIE); World Bank; Network of Aquaculture Centres in Asia-Pacific (NACA); Global Aquaculture Alliance (GAA); Ministry of Agriculture and Rural Development of Viet Nam; CP Foods; Minh Phu Seafood Corporation; Grobest Inc.; and Uni-President Feed Company. More than 500 participants attended the workshop which was sponsored by regional and local industry partners, including: ShengLong, Olmix, Alltech, GeneReach Biotechnology, Vinh Thinh Biostadt, US Soybean Export Council and Behn Meyer.

In his presentation documenting the progress of research, Lightner said, "AHPND has two distinct phases. In the acute phase, the R (fat storage), B (secretory) F (basophilic), and later E (mitotic) cells in the hepatopancreas show loss of function. This is followed by sloughing of the hepatopancreas (HP) epithelial tubule cells. During this phase, bacteria are not abundant but in the terminal phase we see an abundance of opportunistic bacteria, likely to be responsible for the ultimate destruction of the hepatopancreas and death of shrimp.

*Juvenile Penaeus vannamei from Vietnam, top with EMS, bottom appears normal. Picture from D. Lightner, UAZ-APL.*

"Indicative gross signs of EMS/AHPND are pale, yellowish or white HP in affected shrimp and in the terminal phase, black spots or streaks are visible. There is atrophy of the HP to as small as 25% of the normal size. The HP cannot be squashed easily between the thumb and finger in comparison to that of a normal HP. Affected shrimp have an empty stomach and an empty mid gut. The histology of the acute phase showed necrosis of the haemocytes and sloughing, and no R and B cells, and in the monodon shrimp sample, a more severe effect with acute sloughing and moderate inflammation,"said Lightner.

"The pathology starts with proximal part of the HP tubules and in the late acute stage, the haemocytes accumulated with lesions and bacteria will come. The nuclei are enlarged. In the terminal phase, with bacterial destruction, it looked like any other disease.

"In the early terminal phase, the large amounts of bacteria are secondary infection by opportunistic bacteria including the *Vibrio* species. The pathology is acute progressive degeneration of HP, from medial to distal with dysfunction of all HP cells, prominent necrosis and sloughing of the tubule cells and at the terminal stage, inter and intratubular haemocytic inflammation and development of massive secondary infections that occur in association with necrotic and sloughed HP tubule cells."

## Route of infection

Initially, the search was for toxins or toxicants in the pond environment (feeds, sediments, crustacides) that would result in loss of tubular structure or cell morphology in the HP. Experiments eliminated these as causes during 2012. The toxicity of dominant algae was also eliminated as the algae population is similar in EMS and non EMS affected ponds. Infectivity studies carried out since 2011 using frozen tissues of EMS-infected shrimp did not infect other shrimp. The freezing and thawing of the samples inactivate the suspected EMS agent.

In his presentation, Loc described the work to determine the infectious route and nature of the agent of EMS. On-site in Vietnam, Loc observed that farmers cut off feed in EMS-affected ponds and

managed to reduce mortality. Polyculture with tilapia, and biofloc system may reduce EMS in affected areas and antibiotics may reduce mortality or prevent EMS.

"These support a bacterial etiology for EMS. Very likely EMS is an enteric bacterial disease. EMS might be transmitted via an oral route. Our *on-site* infectivity studies using reverse gavage and intramuscular injection of inoculums from infected fresh shrimp (never frozen) in Vietnam did not induce infections of EMS.

"In June-July 2012, we showed that with per os (by mouth) EMS pathology was induced in SPF vannamei shrimp fed infected fresh monodon shrimp tissue for 5 days. In a co habitation experiment with 3 EMS infected *P. monodon* and 6 SPF *P. vannamei*, the AHPND pathology was shown and this means the transfer is by an oral route", said Loc.

## The infectious agent

In December 2012 and January 2013, the work in Vietnam confirmed that a bacterial agent found in the stomach of infected shrimp caused EMS. The dysfunction of the HP is initiated by bacterial toxin(s) produced by bacteria colonising shrimp gastrointestinal tracts and that the agent is waterborne.

"In Vietnam, our immersion studies and feeding studies used bacterial isolated from the HP or stomach. Only bacteria from the stomach of infected shrimp induced mass mortality and shrimp showed typical AHPND pathology similar to that of field samples. In UAZ-APL, immersion challenge with mixed bacteria from the stomach induced mortality. Follow-up immersion challenge studies with the most dominant bacteria also induced mass mortality," said Loc.

Lightner summarised, "**EMS is now a disease and the bacterial agent is a strain of *V. parahaemolyticus* found in the stomach**."

These studies provide answers to some questions. The use of infected monodon shrimp to infect SPF vannamei shrimp showed that the infectious agent is common for both species. A phage infecting the *V. parahaemolyticus* strain is suspected to be associated with AHPND but more infection studies are required. The possibility of vertical transmission from broodstock to postlarvae cannot be ignored. The research will continue to look at cell to cell signalling for toxins, bacterial phage or a plasmid which could likely be involved in the virulence of the *V. parahaemolyticus*, characterisation of toxins and mechanism governing its production, characterisation of toxin genes, possible pathogenicity of the agent to other aquatic species, vertebrate health implications, PCR diagnostics, and methods to control EMS.

## Preventing EMS with tilapia polyculture

Among the various protocols recommended for the prevention of EMS, polyculture with tilapia was the focus of the presentation by Dr Kevin Fitzsimmons. The role of tilapia as a biomanipulator in aquaculture is well known, in particular in shrimp ponds in the Philippines.

"The tilapia can be an insurance against EMS. We get an increase in green algae when we grow tilapia. The fish graze on excess feed. There seems to be some kind of probiotic or natural antibiotic substance which is coming from the skin or gut of the tilapia. It seems to suppress the growth of *V. harveyi* in shrimp ponds and could possibly do the same for *V. parahaemolyticus*. There is no strong data yet but an Indonesian colleague is working on this. Tilapia helps to moderate the pH swings between night and day," said Fitzsimmons.

In the 1990s, the polyculture of tilapia in brackishwater shrimp ponds was common in the Philippines and Ecuador to prevent white spot syndrome virus (WSSV). In Negros Island, crop rotation or tilapia polyculture in shrimp ponds was common. Tilapia was kept in hapas or loose with the shrimp in the pond. In Indonesia, tilapia, milkfish,

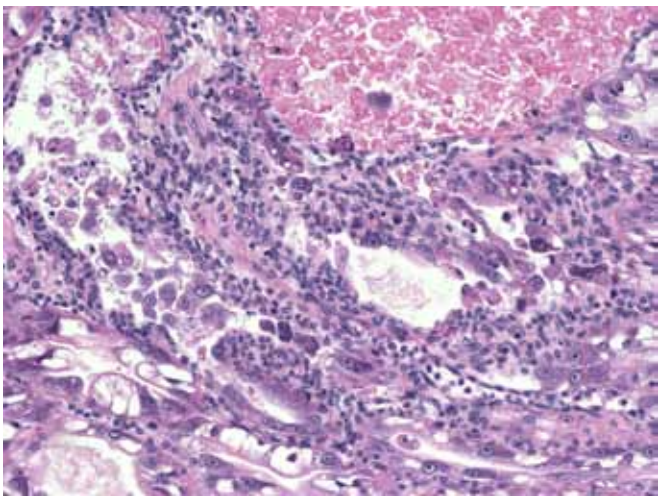


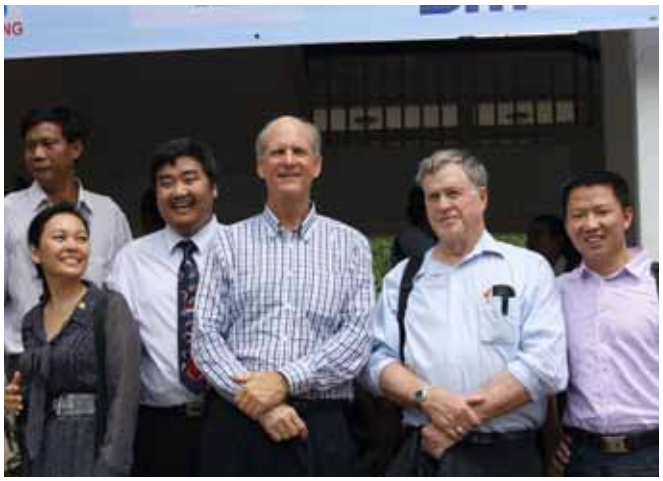
*Image of an experimentally infected P. vannamei shrimp. Lesions show acute sloughing and necrosis of tubule epithelial cells and hemocytic infiltration (Picture from D. Lightner, UAZ-APL)*

*Gracilaria* seaweed polyculture reduce *Vibrio* counts from $10^4$ to $10^1$ CFU/mL.

Amongst these methods, Fitzsimmons recommended the recent one developed by Minh Phu Seafoods, a top seafood producer in Vietnam. Here the water is first disinfected and then stocked with postlarvae (PL12-15). Some 10-12 days later, 2-3 g tilapia fingerlings (non-sexed reversed) are stocked at 0.05 fish/$m^2$.

Fish are allowed to grow for 2 months to 50 g. Fish are then killed with saponin and removed. Saponin does not affect the shrimp. Alternatively Fitzsimmons recommended stocking tilapia in hapas or cages in shrimp ponds. The stocking density should be 10% of pond surface area, stocking 40 fish/$m^2$ in ponds with aeration. The fish could be harvested at 500g.

(For more details, refer to Loc Tran, Linda Nunan, Rita M Redman, Leone L Mohney, Carlos R Pantoja, Kevin Fitzsimmons and Donald V. Lightner. Determination of the infectious nature of the agent of early mortality syndrome (EMS) affecting penaeid shrimp, Diseases of aquatic organisms (in press); Lightner, D.V. *et al.*, 2012. Early shrimp mortality syndrome in Asia, Global Advocate, Jan-Feb, 2012; Loc Tan *et al.*, 2013. EMS/ AHPNS: Infectious disease caused by bacteria, Global Advocate, July/August 2013.)



*Dr Donald V. Lightner (second right), Dr Kevin Fitzsimmons (middle) and Loc Tran (third left) with some participants after their presentations at Nong Lam University*

# News in Brief

## Fifty percent less shrimp in Thailand

The Thai shrimp industry is facing a serious shortage of raw material for processing due to early mortality syndrome (EMS). This is coupled by higher labour costs and the appreciation of the Thai Baht. The Nation reported that many shrimp processing plants in the east and south of Thailand have temporarily reduced or suspended production. The EMS outbreak began in late 2012. Production has dropped by more than 50% from the normal level of 200,000 tonnes to about 90,000 tonnes in the first half of 2013. Production was 63,000 tonnes in Q1 and estimated at 29,000 tonnes in Q2. The Fisheries Department is working on the problem, which it hopes to resolve in Q4. In June, ex-farm prices of shrimp have climbed from THB 160/kg to THB 240/kg for size 50/kg and that for size 100/kg increased from THB 100/kg in 2012 to THB 150-160/kg. The Thai Frozen Foods Association has estimated that the volume of Thai shrimp export will drop by 30-40% in 2013.

## Sturgeon caviar in Vietnam

The Tam Long Da Mi Company, part of the Vietnam Sturgeon Group is now marketing caviar from the Russian sturgeon. In 2012, the Group sold around 1 tonne to some five-star restaurants in the country. The fish was first bred in the Da Mi Hydropower Reservoir in the central province of Binh Thuan in 2008. Le Anh Duc, chairman of the Group said that it takes 4-5 years for sturgeon to produce eggs in the highly controlled freshwater environment and the caviar quality can be as good as that produced in the Caspian Sea or Lagoda Lake in Russia. The caviar is marketed as Caviar de Duc with prices between USD1,000 and USD 6,000/kg. The company has 200 tonnes of sturgeon and it has recently invested USD14 million for laboratories, freezers and processing factories. It has also has expanded to the central province of Binh Dinh, the highland province of Dak Lak and the northern province of Son La. Future markets for the black caviar are France and Russia (saigon-gpdaily.com.vn/gourmet-asia.com).

## Grouper export target of 15,000 tonnes

Indonesia's Ministry of Marine Affairs and Fisheries has a target to export 15,000 tonnes of grouper in 2013 to various countries. Director General of Aquaculture, Slamet Subjaktosaid said, "In 2012 the grouper export volume reached 10,200 tonnes which is about 30% of the demand from various importing countries, especially China and Hong Kong." In Indonesia, grouper production is dominated by ten major producing provinces: North Sumatra, Riau Islands, Nangrooe Aceh Darussalam, Lampung, Southeast Sulawesi, East Java, West Papua, West Nusa Tenggara, North Maluku and Maluku. Zoning of the marine waters is being proposed to create a conducive culture and business environment.

## First off shore marine farm in Sri Lanka

Sri Lanka will have its first marine fish farm with the participation of the Oceanpick Company which has invested USD 2.5 million in this business. The project will farm mainly Asian sea bass in the open seas off the Trincomalee coast. The target is 1,000 tonnes over the next several years. Its partner is a Scottish farming company which pioneered oceanic farming in the North Atlantic and produces salmon, rainbow trout and halibut. Oceanpick plans to produce the fish as per the standards of its partner. To ensure freshness of all its produce, the project intends to vertically control the entire cold chain process (dailymirror.lk)

## Mingling of shrimp prices in India

In mid-June, the Business Standard reported lower ex-farm prices in Andhra Pradesh in comparison to Tamil Nadu. Ex-farm prices for vannamei shrimp was INR 240/kg for size 40/kg in Andhra Pradesh while it is INR 340/kg in Tamil Nadu for the same size. I P R Mohan Raju, president of the Prawn Farmers Federation of India said that previously it was INR 320/kg in AP. In 2012, Andhra Pradesh farmers produced 160,000 tonnes of vannamei shrimp whereas this year, production rose to 200,000 tonnes. "Besides Tamil Nadu, exporters offer farms in Odisha, Gujarat, West Bengal, Kerala and Maharashtra international prices while exporters from Andhra Pradesh pay very low rates and enjoy huge margins on shrimp exports," Raju added. He also said that the majority of shrimp processing and cold storage units in Andhra Pradesh are owned by big exporters. However, the Seafood Exports Association of India countered that the situation is due to over production in Andhra Pradesh. Tamil Nadu exports its shrimp to Japan where prices are usually high in comparison to the US and Europe where exporters in Andhra Pradesh largely send their shrimp.

## Highest CVD announced for Malaysian shrimp

In May, the US Commerce Department (DOC) set preliminary countervailing duties (CVD) on shrimp imports from Asian countries and Ecuador. The highest is for Malaysian producers and exporters at 62.74% whilst the sole respondent, Asia Aquaculture (M) Sdn Bhd has 10.8%. China's rate is 5.76% while in India, Devi Fisheries and Devi Seafood have a rate of 6.1% and 5.91%, respectively, whereas other producers and exporters have a rate of 5.91%. Thailand's Thai Union share the same rate as all others in Thailand at 2.09% but Marine Gold Products has a rate of 1.75%. In Vietnam, the rate for Minh Qui and Nha Trang Seafoods is 5.08% and 7.05%, respectively, whilst others have a rate of 6.07%. In the case of Indonesia and Ecuador, DOC found that the amount of subsidies was low and no duties will be imposed, although that decision could be reversed in the Department's final determination.

The DOC investigation was in response to the December 2012 petition by the US Coalition of Gulf Shrimp Industries alleging that producers and exporters of China, Ecuador, India, Indonesia, Malaysia, Thailand and Vietnam have received financial assistance from governments. However, duties could be revised after both the DOC and the US International Trade Commission (USITC) make affirmative final rulings scheduled on August 12, 2013. The USITC will make its final injury determination on September 26, 2013.If the ITC determines that imports from the five countries are materially injuring, or threatening material injury, to the US domestic industry, DOC will issue countervailing orders on October 3, 2013.

In 2011, the year used for the DOC assessment, shrimp imports from Thailand totalled 106,602 tonnes, Ecuador, 72,683 tonnes, Indonesia, 59,559 tonnes, Vietnam, 30,474 tonnes, India 44,965 tonnes and Malaysia, 27,618 tonnes. The duties are a setback for Indian shrimp exporters as the US is their biggest market after Europe. In 2012, the proportion of frozen shrimp imported into the US from India rose 39% to 62,643 tonnes but declined for those from Thailand, Vietnam and Malaysia.

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# A buoyant shrimp business in Indonesia

**SCI members are taking shrimp farming to new levels with controlled production methods. Short supply from EMS affected countries coupled with the preliminary findings for zero US countervailing duties drove up ex-farm prices in June.**

As they join forces to make improvements in culture technology, production by members of the Shrimp Club Indonesia (SCI) has been on an upward trend. In 2013, Iwan Sutanto, president of SCI is expecting an increase of 25% in national production. This will come from better harvests by SCI member farms and from traditional farms while lower production is expected from Indonesia's largest shrimp integrator, PT CP Prima. In 2012, production from SCI members which number about 300 throughout the archipelago accounted for 30% of national production.

"We are glad that we have not had any reports on early mortality syndrome (EMS), although we still face the threat of infectious myonecrosis virus (IMNV) in shrimp farming. We have been learning to manage production well. SCI has achieved this through our technology transfer on best practices to members. We can now say that we do not have any idle ponds in Java. Overall, only vannamei shrimp is farmed in semi and intensive systems in Java. We have pockets of farms culturing black tiger shrimp in Kalimantan," said Iwan.

The recent jump in prices is a boost for farmers with stock in their ponds as industry is uncertain how long these high prices will remain. This is possibly a consequence of reports of low supply from Thailand, Malaysia and Vietnam due to outbreaks of EMS. Additionally, the preliminary ruling by the US Department of Commerce accorded Indonesia and Ecuador zero countervailing duties. In general, prices have risen 20% since July 2012. Indonesia's shrimp farms produce sizes 70/kg to 30/kg for export markets, mainly Japan and the US. The smaller size 100/kg is for the small domestic market. In mid-June, prices were IDR 51,000/kg for size 70/kg to IDR 65,000/kg for size 40/kg. Production costs average from IDR 36,000 to 37,000/kg for size 70/kg but this is expected to increase soon, as the government increased diesel prices by 22% on 21 June.

*Iwan Sutanto (left) with Prajadi Agus Winaktu (SCI, Lombok) and Dr Farshad Shishehchian, Blue Aqua International, Thailand (right).*

"We also expect our exports to the US to remain stable. The decision on the countervailing duties is good news for us and demonstrates that we do not have any subsidies. We hope that this will be upheld in the final decision in September," said Iwan.

"At the same time we now have another challenge. There is a general shortage of skilled farm technicians because new aquaculture graduates are not interested in farming shrimp. This is because of several factors, including the impact of IMNV on the industry in past years as well as poor compensation, both of which drove many away. Now we have to restart again and will have special programs to upgrade the technical levels of at least high school graduates."

## Clear with SOP

Most members are now quite clear on the standard operating procedures (SOP) required for consistent yields and the steps to address IMNV. These have been the result of a learning process among the new generation of foreign educated farmers, replacing the pioneering group now in their late fifties and sixties. The former have the additional business acumen to shrimp farming in contrast to the latter's passion, which started with black tiger shrimp farming. SCI has been active with at least three non-commercial seminars per year to upgrade the technology base of its members. According to Iwan, "We are all clear on how to control IMNV. We advocate a plankton based system in the early part of the culture cycle and later a bacteria based

*These insulated trucks transport shrimp from Lombok to processing plants in Java*

*Sampling tray with 30g shrimp*

culture system. Controlling blue green algae is most important to avoid IMNV and during the colder season, we do expect lower production."

Among SCI members, production targets and actual outputs vary with the size of farms. The general trend is that the fixed targets can be very high from 25 to 60 tonnes/ha/crop for small and medium size farms with up to 60 ponds. Managers running several farms with total number of ponds of more than 100 ponds prefer to have targets of 15 tonnes/ha/crop. The production target will also depend on location. In 2011, official data (DPKI, 2012), showed that the major shrimp production areas are Sumatra (149,617 tonnes), Java (104,688 tonnes), Sulawesi (50,339 tonnes), West Nusa Tenggara (45,707 tonnes) and Kalimantan (15,486 tonnes). According to those in the industry, production is affected by water quality which improves towards the east of the archipelago and farmers take this into consideration in planning production targets. Depending on the stocking density, harvesting can be partial with 4-5 harvests or just one harvest, to maintain the carrying capacity in each pond.

In Selayar, East Lombok, Tri Prametu manages one of the two family farms. At this 15-year old farm with 61 ponds of 3,000 $m^2$ each, there will be two crops/year leaving a long period of one month for pond preparation for the next crop. With a high stocking density of 150 PL/$m^2$, partial harvesting is necessary to keep to the carrying capacity of the ponds. The practice is some 4-5 times of partial harvesting, starting at 60 days for size 80/kg and ending with size 25 g shrimp. There are 6 technicians, each handling 14-15 ponds and 50 workers. All of them follow closely the SOP developed at the farm to reach production targets and achieve consistent yields. In these ponds, constructed in 1998 with cement sides and bottom and 1.5 m deep, aeration, delivered through paddlewheels and long arm aerators, is above normal at 20 HP for these 3,000 $m^2$ ponds.

*Tri Prametu (third right) with SCI members and participants, during the visit to his farm, from left, Safwin (Medan), Robert Kusnadi (Jakarta), Dr Chumporn Soowannayan (Centex Shrimp, Thailand), Atet (Lampung), Hartono Ali (Lampung) and Robin (Banyuwangi)*

*These 3,000 m² ponds have 20HP of aeration from 1 to 2HP paddlewheels and long arm aerators*

"Some of the SOP at the farm include the daily addition of fermented bacteria to the semi biofloc ponds to stabilise pond conditions. Waste is removed daily via an underwater piping system. Feeding is manual as we tried using autofeeders at one time but found that this method resulted in a higher feed conversion ratio and large variation in shrimp size. I am also not sure whether autofeeders will work with the crumbled feed which we use for the first 30 days of culture," said Tri.

"We have been successful with these protocols but the main worry is when we have smaller shrimp in ponds and the temperatures go down in July and August. When shrimp are large, temperature changes do not pose a major problem. In Lombok, we often face brown-outs and when this happens, the staff is ready to quickly switch to the generators."

Within the industry in Indonesia, there is a general optimism that production will be better in the future. The main concerns include unpredictable weather conditions, such as for producers in Lampung who expect a poorer crop with a survival rate of 60% because of uncharacteristically high rainfall and temperature fluctuations in recent months.

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# Industrialisation with a super intensive system

## An innovation by SCI Sulawesi targets production of 100 tonnes/ha/crop

During the session on innovations at FITA 2013, held from 11-13 June in Lombok, **Dr Hasanuddin Atjo**, head of SCI Sulawesi showed how Indonesia can be a key player in the global shrimp industry. Super intensive culture of vannamei shrimp is the way towards ' Industrialisation in the Blue Economy', said Atjo who is a hatchery consultant and owner of CV Dewi Windu hatchery in Makassar. Atjo was a consultant in hatchery management from 1986 to 1990 and from then on embarked in farming, initially with extensive, followed by semi-intensive culture technology from 1997 to 2010 and then moving on to intensive culture in 2011.

According to Atjo, the culture system practised in Indonesia is far from ideal. He says, "The country has been producing only 332,000 tonnes of shrimp, whereas its capacity can be much more. It exported only 148,000 tonnes of shrimp. In 2010, the top five corridors, Sumatra, Jawa, Bali, Papua and Kalimantan produced only 247,900 tonnes out of a capacity of 491,600 tonnes. The situation in Indonesia is rather different than in other countries. Industry stakeholders face high interest rates for bank loans such as 11.9% in comparison to 3.3% in Thailand and 6.6% in Malaysia. There is also the logistics of distribution where transport costs are the highest in the region. As the industry has moved from subsistence to commercial production, he said that the industry should now look at industrialisation, 'from start to finish, and along the supply chain profitability and quality".

This is the paradigm shift Atjo proposes for Indonesian producers: moving towards industrialisation and focusing on market orientation and value adding with high technology and specialisation.

*Dr Hasanuddin Atjo (right) with Dr Nyoman Adi Asmara Giri, Department of Aquaculture, Ministry of Marine Affairs and Fisheries*

## Super intensive culture

Since April 2011, Atjo has run four cycles of his super intensive culture system in a pond located in CV Dewi Windu, Desa Kupa, north of Makassar. He described the construction of the cement pond of approximately 1,000 $m^2$ (35m x 30m) and 2.6 m deep. Water for the pond is drawn in directly from the sea using a submersible pump with a 6 inch (15 cm) pipe. Pond specifications include a central outlet system to remove solid and liquid wastes. This system comprises several 2-inch waste 'catchers' and a central 12 inch air outlet, a central siphon area and 6 inch suction pipe.

## Basic pond dynamics

Going back to basic pond dynamics, Atjo emphasised that within the water ecosystem in a pond, there are competing demands for oxygen by shrimp and organic wastes (nitrogen, ammonia to nitrate and carbon dioxide cycles). Within the soil ecosystem, there will be the anaerobic and aerobic bacteria in the hydrogen sulphide and ionic sulphate cycle.

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*The central drain*

*The positioning of the blowers*

The simple objective is getting 60-70% of the oxygen to the shrimp. He achieves this by a total aeration of 19.5 HP for the pond using 4 units of turbo jets of 2 HP, a root blower of 5.5 HP and 6 units of paddlewheels. The paddlewheels push the water towards the central waste catchment area. Feeding is with a 150 kg capacity autofeeder with two separate controls for time and frequency of feeding. Feed and soil probiotics and supplements with enzymes and minerals are included in the protocols.

"Super intensive shrimp culture is an extension of intensive culture, except that for each component (seed, environmental health, technology and management), one needs to delve deeper and integrate these well," said Atjo. In his philosophy on shrimp farming, Atjo has a diagram on the 'Black Box' for shrimp culture which include certain prerequisites, including: specific pathogen free post larvae from a recognised brood stock centre, infrastructure of ISO standards, accredited standard operating procedures (SOP) and biosecurity which is executed well and proper recording.

## Carrying capacity is critical

In 2011, Atjo started with stocking shrimp at 300 PL/$m^2$ (240 PL/$m^3$) in an earthen pond with a depth of 130 cm. As he progressed into the 4$^{th}$ cycle, water depth increased to 260 cm (pond depth 300 cm) with density increasing to 720 PL/$m^2$ (280 PL/$m^3$). In the first two cycles (SD from 300-375 PL/$m^2$), partial harvesting was not carried out and production reached 4 tonnes of size 72/kg and 5.4 tonnes of size 70/kg (40 tonnes/ha/crop and 54 tonnes/ha/crop, respectively).

In cycles 3 and 4, the pond was cemented. Feeding was carried out through an autofeeder, and there were 3 partial harvests producing 10.4 tonnes of size 60-90/kg and 15.30 tonnes of size 45-90/kg (104 tonnes/ha/crop and 153 tonnes/ha/crop, respectively). Shrimp survival ranged from 94% to more than 100%. Atjo reported a survival rate of 120% as in Indonesia, it is a normal practice for post larvae suppliers to provide more than purchased.

"The carrying capacity was judged at 10,000 kg and as soon as the stock appears to reach this, I conducted a partial harvest of 20-30% of the stock to reduce biomass. This was repeated 3-4 times depending on conditions. This is the most critical factor in super intensive culture," said Atjo. "The organic load was reduced by siphoning four times daily. Oxygenation was kept at a minimum of 3 ppm and measured at dawn (0500-0600 hr). The temperature is 29-31 ºC, except in June to August, when there is a 4°C difference. Transparency is kept at 20-30 cm, ammonia and hydrogen sulphide at 0.1 ppm, alkalinity at 130-170 ppm and pH at 7.4 to 7.8."

The calculation for the partial harvest was based on the following; homogeneity in the pond with no stratification and that 60-70% of the oxygen is available for the shrimp. With 20HP, and each HP providing for 500 kg of shrimp, the carrying capacity is 10,000 kg.

"The breakdown for the partial harvests in the last cycle was 2.6 tonnes (size 90/kg), 2.6 tonnes of (size 76/kg), 2.7 tonnes (size 66/kg) and 7.4 tonnes (size 45/kg) which totalled 15.3 tonnes. If I had done 5 partial harvests, I could have produced 20 tonnes!" said Atjo.

In the last cycle, the cost of production was IDR 20,740/kg, calculated from sales minus operational costs only. Income is also generated by capturing the waste from moulting for chitosan production and organic waste for compost. A replica of this system in the provincial office in Sulawesi, where a former milkfish pond was converted for super intensive shrimp farming on a small scale (300 $m^2$) already showed growth of shrimp to 6 g within 60 days when the stocking density was 377 PL/$m^2$.

Atjo's message to industry is that if the super intensive shrimp farming technology is to be adopted by industry, it will be necessary to develop SOP with the inputs from government and stakeholders.

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# Zero water exchange in shrimp farming in Bangladesh

By S. M. Nazmul Alam

## How can this be adopted to minimise disease risk for extensive shrimp farms?

Shrimp farming is an age-old traditional practice in southern Bangladesh. Shrimp are mostly cultured together with fish and other crustaceans in large and extensive polyculture systems characterised by low productivity. These polyculture systems are basically stock, hold, and harvest systems with little or no feed or material inputs and the annual yield ranges from 100-200 kg/ha. Shrimp farmers under extensive culture systems are experiencing occurrences of diseases on a large scale since 1994.

In many cases, the only viable solution to viral diseases is to keep out diseases from the culture system, and when ponds are infected, how to clean up and disinfect. Shrimp diseases can easily find their way into a shrimp pond by one or more means: post larvae, water sources, pond intruders including birds and mammals, feeds, people and equipment. However, certain solutions to overcome shrimp disease problems have been developed around the world. The technological advancements in shrimp grow out pond are still in progress. Recently in Bangladesh, some farmers have changed their pond culture practices and are enthusiastically adopting new innovative shrimp farm management technology to reduce incidences of diseases. These changes include:

- Using certified and disease free post larvae
- Zero water exchange
- Development of bio-secure systems
- Improvements through closed system
- Preparing a reservoir pond
- Fencing around the total farm
- Feeding the shrimp

However, these new innovations will require that farms follow some mandatory protocols until harvest.

## Pond preparation

The preparatory stage includes pond construction and water preparation. Ponds can be new or old ones. The dykes should be level and compact to ensure that there is no water seepage. The dykes should be at least 1.5 m high from the bottom with a slope ratio 1:2. The crest of the dyke should be 1 m wide to facilitate walking and carrying materials. The pond bottom should be level and smooth and should slope towards the point of harvest. The water in the pond should be 1 m high even at the shallowest point. This is a totally closed culture system with no aerator fixed in the pond. A fine mesh net with a height of 2 feet or 58 cm is fixed up all around the farm to keep away crabs and other unwanted creatures.

## Reservoir

There should be a separate reservoir pond, which constitutes 30% of the total pond area. The reservoir will hold treated water to supply to the grow-out pond to compensate for water loss due to evaporation. The reservoir and the pond are first filled up by tidal water and left for a few days for sedimentation to take place. The water is then treated with bleaching powder at 600 kg/ha.

## Culture stage

After bleaching, it takes 7-8 days to dissipate the chlorine. Fertilisers (urea and triple superphosphate **(TSP)**, are then added to promote the development of natural food for the post larvae. It takes 20 days to have the pond ready for stocking. Certified disease free post larvae (PL) tested by PCR from the hatchery is then stocked (6 PL/$m^2$) with acclimation to farm temperature and salinity. The post larvae are fed a balanced feed throughout the 90-day culture period. At the end of each cycle the yield will be from 600-1,200 kg/ha.

*A modified extensive shrimp farm in Bangladesh*

## Monitoring

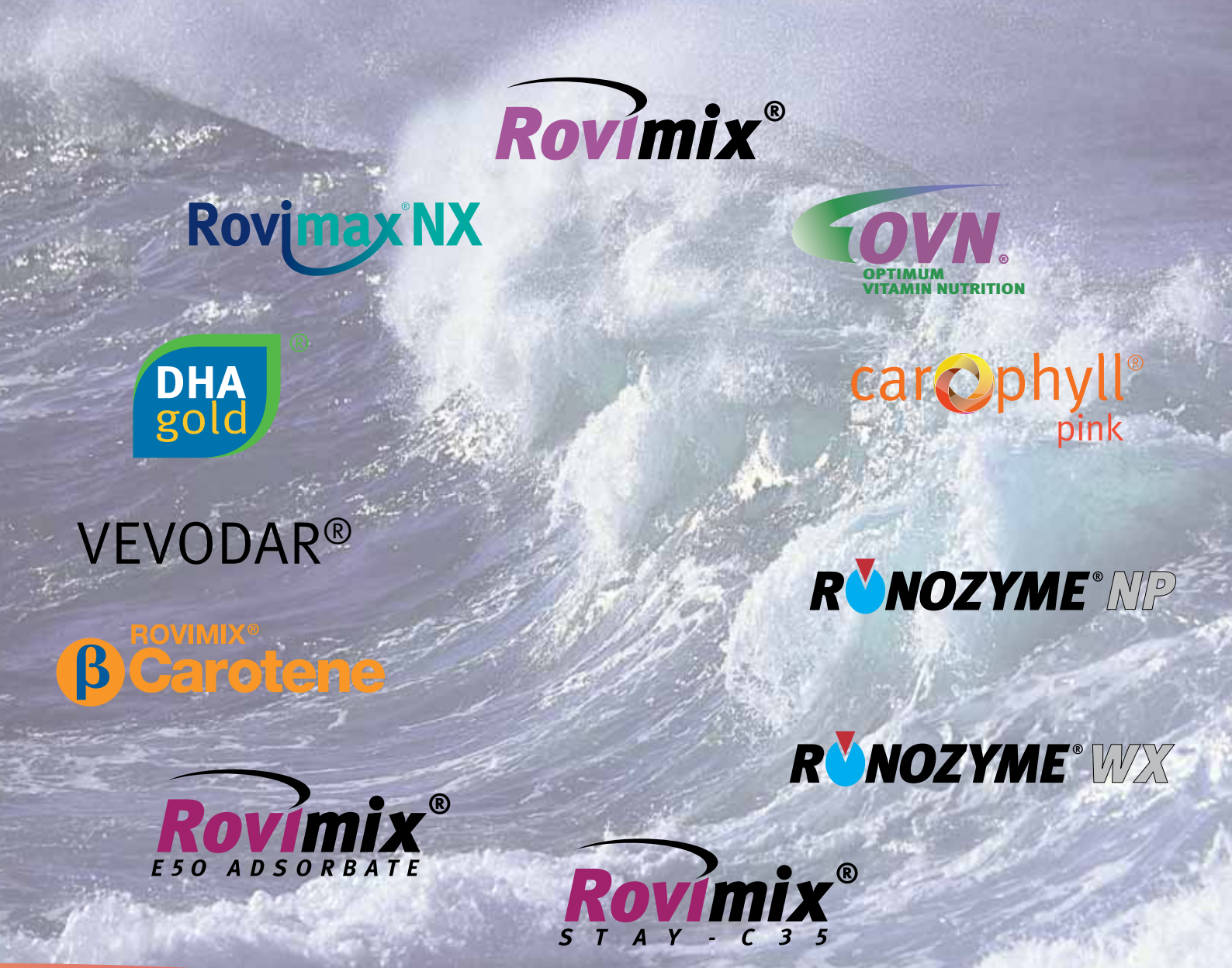
Growth and water quality parameters along with biosecurity (Box-1) measures are monitored strictly and continuously. The basic difference between the innovated technology and the existing practices of shrimp culture in Bangladesh is given in Table 1.

## Conclusion

Zero water exchange with feeding and no aeration facilities in extensive shrimp aquaculture is a new concept and is popular in Bangladesh. However, although yields from this system can be sustained while minimising disease risk and environmental impacts, small scale farmers are not able to afford such culture practices without external financial support.

### Box 1: Biosecurity measures

- Visitors are restricted from walking around the farm at liberty.
- A gate is built to keep out trespassers (humans and animals).
- Hands, arms and feet are disinfected before entering the farm.
- Equipment and tools are sterilised and cleaned, and remain on the farm during the culture period.
- Feeds, chemicals, and fertilisers are stored in a dry and secured place.
- A net is fixed around the farm and ponds to keep crabs and other animals from entering the farm. Nets must be monitored at regular intervals.
- Dykes are compacted to stop seepage.

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| **Farm preparation** | | |
| Culture system | Closed system with manageable water area. | Open system with large surface water area. |
| Dykes | Dykes are compact and level, and should have a slope ratio 1:2. Dikes should be 1.5 m high and 1 m wide at the crest. No seepage all along the dykes. | Dykes are loosely compacted, with no specific slope ratio, height and width. Seepage is common. |
| Bottom topography | The bottom is level and smooth. No drying and tilling are required. The slope is towards the point of harvest. | Bottom is dried and tilling is done. The bottom is irregular and often overgrown with grass. No slope is maintained. |
| **Water preparation** | | |
| Reservoir | 30% of the farm area is the reservoir area for sedimentation of water to take place. Bleaching powder is applied at 600 kg/ha to sterilise water. | No reservoir and no treatment of incoming water. Tidal water enteres directly into the pond. |
| Water exchange | No water exchange. Only filtered water is added from the reservoir to adjust for water loss. Water should be at least 1m deep. | Water is exchanged twice a month with lunar cycle and discharged to flushing canal. Water height varies ranging from 6 inch to 2 feet (15 cm to 58 cm) |
| **Fences and gates** | | |
| Fencing | A fine meshed fence with at least 2 feet height (58 cm) surrounds the farm to prevent entry of crabs and other living creatures. | None. |
| Gate | A main gate to keep out animals. | No gate. |
| **Fertilisation** | | |
| Types of fertilisers | Only urea and TSP are added to promote natural food. | Inappropriate dose of cow dung, TSP, urea, Diammonium Phosphate (DAP) and muster cake are used. |
| Liming | No lime is applied. | Liming is done during preparation of land. |
| **Stocking** | | |
| Sources of post larvae | Certified and disease free (PCR tested) from hatchery. | Wild and hatchery. |
| Stocking density | 6 PL/$m^2$ | 1-2 PL/$m^2$ |
| Stocking frequency | Single stocking | Multiple (>6 times) stocking |
| Survival rate | 70% | 20-35 % |
| Acclimation | Acclimated to the pond salinity and temperature. | Appropriate method is not followed. |
| Aeration system | None | None |
| **Feeding** | | |
| Types of feed | Formulated feed throughout the culture period. | No feeding |
| **Health management** | | |
| Frequency of health checking | Regular monitoring of growth. | Random checks on growth. |
| Physico-chemical parameters | Regularly analysed | Not analysed |
| Biosecurity measures | Regularly followed | Not followed |
| **Harvesting** | | |
| Method | Cast net is used | Trap and cast net |
| Size at harvest | 30 shrimp/kg | 50-70 shrimp/kg |
| Frequency of harvesting | Single | Multiple (>5 times) harvesting year round |
| **Production** | | |
| Yield from shrimp | 600-1,200 kg/ha | 100-200 kg/ha |
| Gross yield | 600-1,200 kg/ha, as only one species is cultured | 200-450 kg/ha, as other shrimp and finfish are also produced with target species. |
| % Shrimp in total biomass | 100 % | 45-60 % |

*A concrete built catchment area for shrimp harvesting*

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# All the good things for ocean reared seabass

By Zuridah Merican

**Now integrated with a hatchery, Barramundi Asia is set to increase production and marketing of the fish branded with Singapore.**

The Asian seabass has been closely associated with Singapore. With a local and transient population of 5 million, as well as a significant number of tourists and business visitors, the country saw an annual per capita fish consumption of 21kg in 2011 (Straits Times, 2012). The chilled fish trade is channelled through two fishery ports, which also serve the moving cruise ship and tourism industry, ship chandelling and local markets. The 130 cage and land based farms in Singapore supply 3,500 tonnes of the total demand, which in 2011 was 51,800 tonnes. Farmed Asian seabass or *Lates calcarifer* is one of the top three popular farmed marine fish and accounts for 10% of locally farmed fish. The largest single producer is Barramundi Asia, which will produce 250 tonnes in 2013 and will expand production to 1,200 tonnes in 2014.


*Joep Kleine Staarman*

"Singapore's attraction for the tourists is the chilly crab and most tourists will not leave Singapore without sampling this dish. One day, I would like to see the same for ocean raised seabass from our waters. Imagine, the market expansion for Singapore's industry," said Dutch national Joep Kleine Staarman, the part owner and CEO of Barramundi Asia.

"Our goal is to have the seabass always on the menu and associated with that from Singapore waters. We are working with chefs to develop a recipe to bring out the best from our seabass; one that can be as iconic as the Singapore chilly crab."

## From MH to BA

Barramundi Asia first appeared in the local marine finfish farming scene in June 2008, when a group of ex-Marine Harvest colleagues decided to 'put out some nets and start a fish farming business in Asia.' They chose the waters off the south coast of Singapore backed by the strength of their experience in the marine fish farming business accrued whilst in Marine Harvest, the world's largest seafood company with farming operations in Norway, Chile, Scotland, Canada and Ireland.

The farm was set up in 2008 and a full production cycle was achieved during the years from 2008 to 2011. However, the mean survival rates dropped from 70% to only 40% due to scale drop syndrome in 2011. The company took a stand to 'hibernate'. After a 1.5 year hiatus, Barramundi Asia is now back in production since June 2012. Today, the team comprises Staarman, production manager, Vis Dirk Erik and controller Seewun Wee.

"We harvested our last crop after 5 months when fish reached sizes of 400 g to 800 g for the local and Malaysian chilled fish markets. Later 2 kg and above fish will be sold as fillet to the cruise ship market through Jurong Fishery Port or fresh to Australia for fish farmed here from fry imported from Australia. We are proud that our fish can be harvested, transported and delivered to Australia in less than a day; in comparison to the farms within Australia which may take 3 days! Our future target is international markets where our vision is to be a supplier of ocean raised seabass to the Middle East, Australia, China and the US," said Staarman.

## Now integrated with hatchery

The initial group at Barramundi Asia may have found out the hard way, the challenges of seabass farming in Asia. Putting these aside, the Staarman/Erik/Seewun team is now well positioned in the supply chain. Upstream, there is now a land based hatchery cum nursery on Pulau Semakau some 5km from the farm site and provides the farm with 40-50 g vaccinated fish ready for stocking into grow out cages. Downstream facilities include a harvesting boat. Processing is now outsourced and is planned to be a future addition when production gears up.

Aside from the tanks of various sizes for larval rearing, nursery and brood stock, the hatchery cum nursery has a recirculation system as a backup system for all units in case there is a problem with water quality. This can also allow for a change in salinity when required. There are also three generators, one running and two as back up. The hatchery and nursery operations follow an all-in all-out protocol.

*The vaccination team at work*

Australian Andrew Hamilton oversees the work from hatching to day 25 larvae (D25) whilst M.D Julhas, from Bangladesh, is responsible for the stages from D26 to 50 g fingerlings. The fry undergoes a bath vaccination at 2 g and later injection vaccinations from sizes 15-20 g. During the early stages, feeding starts with larval feeds from Japan ranging from 75 to 150 microns with 60% crude protein and later starter feeds from France of 300 microns and larger are used. All feeds including those for grow-out are kept in a chilled feed store on the island.

"At the moment, the eggs are purchased locally. We already have tanks with brood stock which will enable us to start some selective breeding. In 20 $m^3$ tanks, we have about

*From left, Vis Dirk Erik, Andrew Hamilton showing D20 larvae and M.D Julhas starts feeding with floating feeds when fry reach 0.5g*

*Fish are graded prior to being returned to the tank*

100 brood stock which are about 15 months old and weigh more than 3 kg each. These have been selected from the farm at size 200 g. Over the years, we have been working on the technology for hatchery and culture systems and although we will continue to change these as we go along, we think that it is also time to get the fish out!" said Erik. "We also buy fry from Australian hatcheries. The Australian barramundi are the fastest growing we have seen so far."

In larval rearing and nursery tanks, diffusers oxygenate the tanks. Staarman said that this is a major advantage of being in Singapore where oxygen supplies are readily available. This is essential as the stocking density at the hatchery is intensive at 40 kg/$m^3$, although this is still far below that of Australian seabass hatcheries which stock at 100 kg/$m^3$.

"The biggest cost is not having fish to sell. Therefore we are willing to spend on oxygen rather than face a situation where we do not have any fish to sell," said Staarman.

## Academia link for vaccines

Once, when the company was ready to restart production, the strategy was to use only vaccinated stock. At that time, vaccines against *Streptococcus* have been developed by the then Intervet team in Singapore but Staarman said that unfortunately, other vaccines were not readily available. Apart from *Streptococcus* and *Iridovirus*, it also had to look for vaccines against *Tenacibaculum maritimum* or *T. mar.*

"We began to work with Nanyang Polytechnic, which helps us to develop an autogenous vaccine using bacteria from our own fish. AVA gave us a limited registration for this vaccine as it is tailored for our farm only. Arising from our vaccination program where 100% fish are vaccinated, the survival rate is now 90%," said Staarman.

Every two months, Erik will organise vaccination for fish more than 20g over a two week period. Part-time workers are recruited from mainland Singapore to vaccinate a total of 200,000 fish. The vaccination table is located over the nursery tanks and fish are anaesthetised prior to vaccination. Vaccinated fish are graded and returned to the tanks. Vaccination raises the cost of production by SGD 20 cents per fish, but Erik says that this is better than losing all the fish!

## Farming in Singapore

The farm comprises a mixture of cages: 10 square cages of 15mX15mX10m deep; 4 large circular cages of 25 m diameter and 10 m deep; and small nursery cages. The grow-out carrying capacity is 15 kg/$m^2$. The production capacity of the 2 leases that Barramundi Asia holds is 6,000 tonnes per year. Currently, grow-out is managed by a multinational group of three workers, from China, India and Bangladesh. This is efficiency at its highest for a production of 250 tonnes, according to Staarman. They dive to check the nets for gaps every day, as well as clean up and change nets every 3 months and feed the fish using a blower feeder from a boat. Harvesting is three times a week with a harvest boat. After attacks from sharks and barracudas which accounted for a number of escapees in 2010, there is now a double layer of nets. Some algae are also allowed to develop on the nets to hide fish from these predators.

"Often we have been asked on the choice of Singapore to start a farming venture. After 5 years in this business, we can see many advantages here. Our fish can be harvested at 30 ºC and cooled down to 2-4 ºC in an ice slurry and processed and kept continuously at this temperature during export as Changi airport has a good cold chain system which was initially developed for the fruit industry. Singapore is also ideal as it sits on the equator and does not have natural disasters such as earthquakes, typhoons, tsunamis, etc." said Staarman.

Erik added, "One advantage is also the strong knowledge base in Singapore which we tapped when we had the problems with vaccine development. Now we have a grant to look at feeding systems from the Agri-Food and Veterinary Authority (AVA) Food Fund. We do not have any doubts on water quality which is monitored regularly by DHI, a commercial water and environment management company. AVA conducts quarterly checks on the fish. We also have responsible neighbours. Recently Shell provided additional water treatment equipment when they channelled a pipe near our hatchery."

The disadvantage in Singapore is procuring experienced part time workers. Unlike in Europe, it is not a norm for students to do regular part time work. As such, to attract local part time workers for the vaccination work, Erik had to offer above market rates.

## All the good things

When there are no business or technical problems, fish will grow well at 28-30 ºC waters. "Our fish have all the good things; they are farmed in clean seawater at 30 ppt at a low density, have a sweet taste and flesh

*Brood stock tanks*

*Larval rearing section*

*D25 fry*

which is not too soft nor too firm due to favourable culture conditions of currents of up to 1.5 knots. As we came from Marine Harvest, we have continued to implement their farming principles, we use good feeds, but not the cheapest in the market. At the farm site, we have full control on conditions," said Staarman.

"We are concerned on traceability and that is the reason why we have continued with feeds from Skretting; grow-out feeds with 42-44% crude protein and 12% lipid for the final stages are produced in Indonesia by PT Sinta Prima and hatchery feeds from France. Feed conversion ratios range from 1.4 to 1.5 but we will need to improve on this," added Erik.

Barramundi Asia is also proud of the economies of scale obtained for the current production cycle. "The 100% use of vaccination gives us 90% survival. Imagine once we get to our 6,000 tonnes target, we will be cheaper than the small farms in Singapore. If we take the lesson from Marine Harvest - in fish farming, we must be the lowest cost producer," said Staarman.

"In the case of Barramundi Asia, integration and cooperation are the ways forward to build value through the supply chain and the end product as opposed to competing just in one particular segment. Farmers farming seabass in cages in the sea, with traceability and food safety systems in place, should distinguish themselves from pond farmed fish. After all, the fish are really better and taste sweet and delicious."

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# Variation of raw materials impacts nutritional and economical value of tilapia feed

By Dhanapong Sangsue, Karthik Masagounder and Rob Payne

**A comparison of diets formulated using book values with a safety margin versus that based on routine analyses support the latter with significant cost savings**

Tilapia is one of the main farmed species groups and according to the FAO (2010, Yearbook), approximately 2.54 million tonnes of the Nile tilapia were produced globally in 2010. Indonesia, Malaysia, Thailand, and the Philippines are the largest producing countries in Southeast Asia and represent almost 31% with an annual production of 786,261 tonnes. Based on feed conversion ratios (FCR) of 1.2-1.5 for tilapia grown to 800g, an approximate 1.06 million tonnes of compound feed are needed to produce tilapia in Southeast Asia. Assuming an average diet cost of USD 600 USD/tonne, this represents an investment of USD 636 million.

This demonstrates that feed is a significant contributor to total production costs. As such, tilapia producers should strive to ensure that: Firstly, their feed costs are minimised without sacrificing performance and secondly, their feed quality is consistent to provide predictable fish growth performances.

Feed cost and final feed quality are directly influenced by the ingredients used and there are 3 main factors affecting ingredient value. These are cost per tonne, nutrient content and nutrient variation. Ingredient cost per tonne is largely driven by the balance in supply and demand, and while important, it is not an area of emphasis of this paper. The objective of this paper is to better understand how nutrient concentration and variation impacts nutritional and economical value of tilapia feed.

## Nutrient content

There are several methods available to obtain the amino acid values in feed raw materials and these include book/references values, regression equations, wet chemistry analysis, and near-infrared spectroscopy (NIRS) prediction. Each method has its pros and cons, which must be considered when deciding the best method for a particular production system.

The decisions for which method to use and for the frequency of analysis for each raw material should be based on input from the nutritionists, purchasers, etc. who will be using this information. Often though, budget and resource restraints (people, time, laboratory capacities) often play significant roles in the ultimate ability of a feed producer to really know their specific ingredients and manage their nutrient variation. For example, a producer may ideally want to analyse all samples via wet chemistry as this is the gold standard for amino acid analyses, but it is also the most expensive analysis to conduct. Then the costs of doing so may actually limit the number of analyses which can be completed. The result of such a situation is that the producer either has to be very selective on which ingredients to analyse in this way or they have to look for alternative (less expensive) methodologies.

## Nutrient variation

In an ideal situation, the level of nutrients in each batch of a given raw material would be the same. This consistency would make prediction of growth performance much easier as the complete feed would be uniform from batch to batch. However, this is rarely if ever the case as demonstrated in Table 2. Evonik analysed 15,314 samples of soybean meal, rice bran, blood meal, corn gluten meal and fishmeal in 2012. These analyses indicate that the crude protein and amino acid contents varied from as low as 1.51% (Trp in corn gluten meal) to 44.60 % (Ile in blood meal).

**Table 1:** Pros and cons of different methods to obtain amino acid contents in feed raw materials

| 1. Book/Reference Values | |
|---|---|
| Pros | Cons |
| Provide starting points | Single points in time |
| Provide historical review | May not always be representative of your ingredients |
| Allow comparison/validation of different ingredients as well as against own information | Often unclear of variation |
| Provide standard for quality control programs | Often unclear of number of observed statistics |
| 2. Regression Equations | |
| Pros | Cons |
| Allow custom prediction of nutrients based on crude nutrients | Considerable information required to make robust |
| Rapid and easy prediction of nutrient levels | Can become outdated quickly |
| Typically built on table of value information | Assume linear relationship |
| 3. Wet Chemistry Analysis | |
| Pros | Cons |
| Gold standard for analysis | Expensive |
| Actual measurement of nutrient contents in specific ingredients | Time consuming |
| All predictions in book values are based on wet chemistry analysis | Can only measure a few constituents at a time |
| | Require highly trained technicians |
| | Significant opportunities for error |
| 5. Near-Infrared Spectroscopy (NIRS) Analysis | |
| Pros | Cons |
| Prediction of nutrient levels in specific ingredients | Considered expensive set-up costs |
| Quick and easy to use | Only as good as supporting information |
| No chemical reagents needed | Reliable calibrations are a must to work properly |
| Multiple constituents can be measured at the same time | |

**Table 2:** Contents and variation of dry matter (DM), crude protein (CP), and amino acids in soybean meal (SBM), rice bran (RB), blood meal (BM), corn gluten meal (CGM) and fishmeal (FM) from Indonesia, Malaysia, Thailand, and the Philippines in 2012 (as is basis)

| | | SBM | RB | BM | CGM | FM |
|---|---|---|---|---|---|---|
| | | 10,886 | 2,742 | 26 | 732 | 928 |
| DM | Average, % | 89.01 | 89.68 | 92.15 | 91.40 | 92.69 |
| | CV, % | 1.18 | 0.83 | 1.63 | 0.51 | 1.67 |
| CP | Average, % | 47.82 | 13.06 | 92.27 | 63.11 | 61.46 |
| | CV, % | 5.95 | 6.61 | 2.50 | 4.59 | 7.95 |
| Lys | Average, % | 2.93 | 0.59 | 8.25 | 1.08 | 4.35 |
| | CV, % | 6.16 | 8.02 | 2.81 | 3.01 | 13.11 |
| Met | Average, % | 0.65 | 0.26 | 1.06 | 1.50 | 1.57 |
| | CV, % | 6.25 | 7.31 | 14.28 | 5.13 | 13.23 |
| M+C | Average, % | 1.36 | 0.55 | 1.93 | 2.61 | 2.11 |
| | CV, % | 6.27 | 6.28 | 12.31 | 3.65 | 12.01 |
| Thr | Average, % | 1.86 | 0.50 | 4.17 | 2.14 | 2.47 |
| | CV, % | 5.96 | 6.12 | 10.73 | 4.12 | 9.31 |
| Trp | Average, % | 0.64 | 0.16 | 1.49 | 0.36 | 0.64 |
| | CV, % | 6.29 | 7.25 | 2.15 | 1.51 | 14.52 |

| | | SBM | RB | BM | CGM | FM |
|---|---|---|---|---|---|---|
| | | 10,886 | 2,742 | 26 | 732 | 928 |
| Arg | Average, % | 3.50 | 1.02 | 3.83 | 2.11 | 3.43 |
| | CV, % | 6.36 | 7.41 | 6.55 | 2.76 | 8.30 |
| Ile | Average, % | 2.15 | 0.45 | 1.07 | 2.53 | 2.39 |
| | CV, % | 6.06 | 6.70 | 44.60 | 5.26 | 11.67 |
| Leu | Average, % | 3.62 | 0.92 | 11.98 | 10.30 | 4.25 |
| | CV, % | 5.94 | 6.56 | 4.12 | 7.04 | 10.64 |
| Val | Average, % | 2.25 | 0.71 | 7.97 | 2.88 | 2.87 |
| | CV, % | 6.06 | 6.89 | 5.96 | 3.47 | 10.49 |
| His | Average, % | 1.27 | 0.37 | 6.01 | 1.31 | 1.78 |
| | CV, % | 5.99 | 5.79 | 5.97 | 2.21 | 29.30 |
| Phe | Average, % | 2.41 | 0.59 | 6.50 | 4.01 | 2.33 |
| | CV, % | 6.33 | 7.07 | 4.38 | 6.26 | 9.94 |

These results show that raw materials are not static or homogenous. Their nutrient content varies greatly, and the impact of this variation on final feed quality and resulting growth performance can be significant and thus should not be underestimated. The data also highlight that book or reference values for these types of ingredients would not be the best choice of data to use if producing consistent feed is a key goal. Highly variable ingredients like these need more routine analysis, which make methods such as wet chemistry or NIRS essential to understand and account for this variation.

## Application of data

Let us now examine the impact of amino acid variation in feed ingredients on final diet composition. For this purpose, a tilapia starter diet was formulated to meet or exceed the essential amino acids requirements of tilapia according to NRC (2011) as well as to contain 4, 6, and 12% of fat, fibre, and moisture, respectively. The diet was formulated in two ways: A diet based on book values for the amino acid content of the protein containing raw materials or a diet based on results from routine analysis (NIRS or wet chemistry) for the amino

**Table 3:** Comparison of the tilapia starter diets formulated based on nutrient values taken from book value, book value plus 5% safety margin, or routine analysis[A,B]

| Ingredients, % | Book value | Book value with 5% safety margin | Routine analysis |
|---|---|---|---|
| SBM 48% | 32.24 | 32.20 | 32.26 |
| Corn gluten meal 60% | 22.69 | 22.78 | 21.21 |
| Rice bran | 17.91 | 17.67 | 19.72 |
| Tapioca | 15.75 | 15.82 | 15.43 |
| Fish solubles (de-hydrated) | 2.50 | 2.50 | 2.50 |
| Blood meal | 1.50 | 1.50 | 1.50 |
| Fish oil | 2.00 | 2.00 | 2.00 |
| Dicalcium phosphate | 3.19 | 3.21 | 3.08 |
| Calcium carbonate | 1.56 | 1.55 | 1.64 |
| Vitamin & Mineral premixes | 0.25 | 0.25 | 0.25 |
| MetAMINO® (DL-Met) | 0.10 | 0.13 | 0.10 |
| L-Lysine HCl | 0.30 | 0.39 | 0.31 |

| Nutrient levels (DM basis) | Book value | Book value with 5% safety margin | Routine analysis |
|---|---|---|---|
| Dry matter, % | 89.03 | 89.04 | 90.50 |
| Crude protein, % | 39.46 | 39.57 | 38.95 |
| Crude fiber, % | 4.53 | 4.51 | 4.58 |
| Ether extract, % | 7.00 | 6.96 | 7.16 |
| Gross energy (kcal/kg) | 4,605 | 4,604 | 4,530 |
| Calcium, % | 1.80 | 1.80 | 1.77 |
| Phosphorus, % | 1.40 | 1.40 | 1.38 |
| Digestible Lys, % | 1.60 | 1.67 | 1.60 |
| Digestible Met, % | 0.70 | 0.73 | 0.70 |
| Digestible M+C, % | 1.15 | 1.18 | 1.16 |
| Digestible Thr, % | 1.10 | 1.10 | 1.10 |
| Costs/tonne (USD) | 542.54 | 545.84 | 537.69 |

[A] Raw material prices were taken from the Thai feed mill association in July 2012 and personal communication.
[B] Book Value with 5% safety margin is formulated based on book value with safety margins of 5% on dry matter basis for Met and Lys.

acid content of the protein containing raw materials. Safety margins are often used to minimise the impact of the nutrient variation if a diet is formulated based on book values, so to replicate this practice 5% safety margins were added to the nutrient levels for Met and Lys of the book value diet.

## The diet formulated based on book value

Theoretically, safety margins help reduce the risk that the diet may not fully meet the nutrient requirements of the fish. However, this is not guaranteed as it is still possible for the nutrient variation to exceed the safety margins. If we look closely at Table 2 again, there are several cases of essential amino acid concentration in these ingredients with variation much higher than this 5% safety margin applied. Safety margins also add cost to the diet, which in this example equaled USD 3.30/tonne (USD 545.84- 542.54). Although this additional cost is essentially an insurance premium to avoid performance issues, one must consider if this is the best use of this money versus investing in better analytical procedures to get more accurate estimates of the nutrient contents of these raw materials.

## The diet formulated based on routine analysis of the raw materials

Conversely, we now consider an alternative where the nutritionist has the capability to base formulations on routine analyses of his raw materials for digestible amino acids, and moisture. These routine analyses allow the nutritionist the opportunity to regularly update his nutrient matrix, which means feed costs and quality are optimised. Additionally, since he is using actual values for his raw materials, there is no longer a need for safety margins. As a result, growth performance is maintained and possibly improved due to better control of animal variation and diet cost is significantly reduced. In this example, this change results in diet savings of USD 8.15/tonne, which is broken out to USD 3.30/tonne because of a safety margin and USD 4.85/tonne (USD 542.54-537.69) from a better knowledge on the nutrient content of each ingredient.

In this article, we have explained that nutrient concentration in feed ingredients is variable and the impact of this variation on fish performance and diet costs should not be overlooked. To be cost effective, environmentally sustainable and to optimise fish performance, nutritionists should strive to efficiently use the nutrients in these feed ingredients. To do that, it is critical to establish a quality control program which routinely analyses these ingredients and then to implement those analytical results into feed formulations. Formulating diets using wet chemistry or NIRS analyses of ingredients can result in significant diet cost savings as well as provide more consistent fish performance.

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# Aflatoxins are a serious threat to the shrimp industry

By Pedro Encarnação

**The pathological forms of aflatoxicosis and threats to feed consumption and growth performance are described.**

Mycotoxin contamination in feeds is becoming particularly important to the aquaculture industry due to the negative impact exerted on the growth and health of fish and shrimp, which can result in significant economic losses. For the most part, mycotoxin contamination in aquafeeds is widespread, especially in countries with humid tropical climates, particularly where most of shrimp farming is carried out. This is due to many factors, among which are climatic conditions permissive to mold growth and inappropriate methods of feed processing and storage. Among all known mycotoxins, aflatoxins are the best characterised and most investigated due to their acute and chronic toxicity on aquatic species. Aflatoxin $B_1$ ($AFB_1$) is the most biologically active toxin known and has been found to produce hepatotoxic, carcinogenic, mutagenic and immunosuppressant effects in aquatic animals including shrimp.

The extent of the damage produced by aflatoxins depends on the toxin concentration present in feeds and also on the time period of exposure, as well as animal species susceptibility (Santacroce 2010). We can describe three pathological forms of aflatoxicosis: acute, subacute and chronic.

## Acute aflatoxicosis in shrimp

This as well as in fish, occurs when moderate to high doses of aflatoxin are ingested. Signs of acute aflatoxicosis in shrimp were reported for levels between 500-2500 ppb (Ostrowski-Meissner, et al., 1995; Boonyaratpalin et al., 2001; Gopinath and Raj, 2009; Tapia-Salazar et al., 2012). Besides a significant reduction in feed intake and weight gain, a significant increase in mortality was observed for shrimp fed diets with aflatoxin levels between 1000 and 2000 ppb.

Acute aflatoxicosis is also marked by severe histological changes and function in the hepatopancreas of shrimp fed diets containing $AFB_1$ at concentrations of 500–2500 ppb. These included abnormal hepatopancreatic development with severe necrosis of tissue cells, extensive fibrosis and severe degeneration of hepatopancreatic tubules (Ostrowski-Meissner, et al., 1995; Boonyaratpalin et al., 2001; Gopinath and Raj, 2009).

There is also a significant reduction of lipid storage in the hepatopancreas when aflatoxin levels were higher than 500 ppb (Tapia-Salazar et al., 2012). Shrimp exposed to these aflatoxin inclusion levels also exhibited impaired immune function with reduction of haemocyte count and ability to eliminate pathogens (Boonyaratpalin et al., 2001).

## Sub acute aflatoxicosis

Shrimp affected by subacute aflatoxicosis display several symptoms that commonly include moderate to severe hepatopancreas damage, reduced feed conversion ratios, and impaired immune responses. Several studies have shown that levels of $AFB_1$ above 50 ppb will result in a significant damage to the hepatopancreas at the histological level. Histological changes are directly related to a corresponding increase in $AFB_1$. Important changes in the hepatopancreas are: a reduction in the number of R cells, B cells and F cells, loss of structure of cells and tubules, desquamation in the tubules, fibrosis, necrosis, cellular inflammation, haemocytic nodule formation and haemocytic infiltration (Fig 1), (Ostrowski-Meissner, et al., 1995, Gopinath & Raj, 2009). Other affected organs include the gills, lymphoid organ and antennal gland.

## Chronic aflatoxicosis

This occurs when low to moderate doses of aflatoxins are ingested over a long period of time. Generally, it is difficult to recognise or diagnose this condition because of its slow, subclinical trend. The majority of clinical signs are related to chronic, impaired hepatopancreatic function, such as reduced feed efficiency and increased susceptibility, to secondary infectious diseases, which are due to immunosuppression.

Histological analysis clearly shows the disruption of the digestive functions of the hepatopancreas by $AFB_1$ even at low levels (10-20 ppb). According to Burgos-Hernadez et al. (2005), at low levels of contamination (10-50 ppb), $AFB_1$ toxicity in shrimp results in the modification of digestive process and abnormal development of the hepatopancreas due to exposure to the toxins. These effects might be due to the alterations of trypsin and collagenase activities, among other factors, such as the possible adverse effect of these mycotoxins on other digestive enzymes (e.g. lipases and amylases) (Burgos-Hernadez et al., 2005).

A recent study (Tapia-Salazar et al., 2012), reported modifications in B-cell and mitotic E-cell activity at $AFB_1$ levels of 10-60 ppb (Table 1). These disruptions can upset the normal function of absorption and storage of nutrients due to the reduced number of R-cells, production of digestive enzymes by F-cells and secretion of enzymes by the B-cell, culminating in the disruption of the digestive, metabolic and detoxification functions of the hepatopancreas.

Differences in the toxic effects of aflatoxins are a result from both the dosage and duration of exposure, but these are not necessarily the only dominant factors. Other factors including age, species, and stress levels can also affect aflatoxin toxicity (Ostrowski-Meissner, et al., 1995). These factors, or others, might affect the toxicity to shrimp. For example, it was observed in many trials that feed consumption varied inversely with $AFB_1$ levels.

## Threats

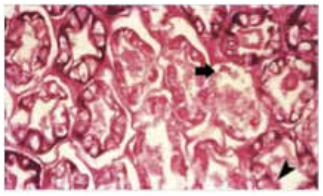
In the presence of $AFB_1$, a reduction in feed consumption may be related to unfavourable palatability or reduced appetite caused by damage to the digestive organs, including the hepatopancreas. From a practical perspective, it is possible that shrimp may be more likely to avoid $AFB_1$ contaminated feed, than to consume and be poisoned by it. If so, their behaviour may serve to ameliorate the problem of $AFB_1$ contamination to a considerable extent, but this will ultimately result in a reduction of performance.

Aflatoxins also pose a significant long-term health threat by acting as a potent immunosuppressant. The shrimp industry is constantly vulnerable to outbreaks of bacterial, viral and/or parasitic diseases and

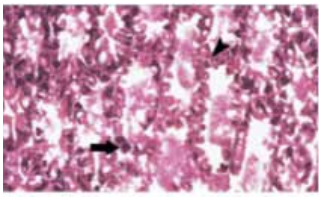
also by environmental and nutrition-related diseases. The presence of aflatoxins in the feed creates an additional constraint by reducing the capacity of the shrimp to fight against opportunistic pathogens present in the pond environment, which often results in secondary infections.

In summary, although acute intoxication in shrimp gives rise to poor health generally, the major clinical findings also show a sharp loss in productivity, reduced weight gain, reduction of feed efficiency, immunosuppression and higher mortality. Other more insidious, pathological signs that occur as a consequence of prolonged exposure, affect growth performance, apparent digestibility coefficients, and cause physiological disorders and histological changes, in particular on hepatopancreatic tissue. Thus, $AFB_1$ contamination in shrimp feed, even at low levels, may very well cause economic losses by lowering the production of shrimp.

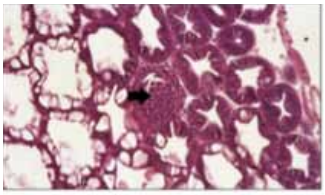
Figure 1. Histological damage of AFB1 in shrimp hapatopancreas when fed at levels of 50 and 100 ppb for 4 or 8 weeks. Source (Gopinath and Raj, 2009)



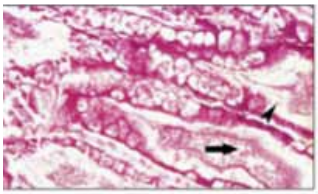
*Hepatopancreas at 4 weeks given 50ppb AFB1, revealing a change in structure of tubules (arrow) and loss of brush border appearance (arrowhead)*



*Hepatopancreas at 8 weeks given 50ppb AFB1 showing desquamation of tubules (arrow) and loss of cells (arrowhead)*



*Hepatopancreas at 100 ppb AFB1-treated shrimp at 4 weeks revealing cellular inflammatory response (arrowhead) and loss of cells*



*Hepatopancreas at 100 ppb AFB1-treated shrimp at 8 weeks revealing necrotic changes (arrow) and loss to tubules (arrowhead)*

## Combating mycotoxins

Although the presence of mycotoxins in feed represents an increased threat to aquaculture operations, there are a number of options available to feed manufacturers and farmers to prevent or reduce the risk of mycotoxicosis associated with mycotoxin contamination. These range from careful selection of raw materials, maintaining good storage conditions of feeds and raw materials, to the use of an effective mycotoxin binder/deactivator product to combat the widest possible range of different mycotoxins that may be present.

A common way to counteract aflatoxicosis is the utilization of adsorbents (binders) added to $AFB_1$-contaminated feed in order to bind the toxin in the gastro-intestinal tract before its absorption. Critical parameters concerning the use of adsorbents for the binding of mycotoxins include their efficacy, specificity, as well as the mechanism of the adsorption process (chemisorption/physisorption). Extensive studies on the efficiency of different binder materials pointed out that different materials have different efficiency to adsorb $AFB_1$.

In addition, different mycotoxin groups vary in their chemical structure and therefore it is impossible to equally deactivate all mycotoxins using only one single strategy. Although adsorption works perfectly for aflatoxin, less, or non-absorbable mycotoxins (such as ochratoxins, zearalenone and the whole group of trichothecenes) have to be deactivated by a different approach. The Mycofix® product line is the result of years of research and its efficacy has been proven in numerous scientific and field trials. It guarantees a protection against a wide range of adsorbable and non-adsorbable mycotoxins by combining three strategies – adsorption, biotransformation and bioprotection.

**Table 1.** B-cell activity, mitotic E-cell activity, tubular epithelial atrophy, and hepatopancreatocyte sloughing in shrimp fed with experimental diets. Different letters in the same column show significant differences at $P < 0.05$. Values in parentheses indicate average severity grade based on a scale of 0 to 4.(Source, Tapia-Salazar et al., 2012)

| | B cell activity (%) | Mitotic E cell activity (%) | Tubular Epithelial atrophy (%)* | Hepatopancreatocyte sloughing (%)* |
|---|---|---|---|---|
| Trial 1 | | | | |
| 0 µg $kg^{-1}$ | $78^{b}$ | $68^{c}$ | $35\ (0.6)^{a}$ | $9\ (0.13)^{ab}$ |
| 500 µg $kg^{-1}$ | $60^{a}$ | $55^{bc}$ | $100\ (2.3)^{b}$ | $4\ (0.04)^{a}$ |
| 1000 µg $kg^{-1}$ | $53^{a}$ | $49^{ab}$ | $79\ (2.2)^{b}$ | $27\ (0.79)^{c}$ |
| 2000 µg $kg^{-1}$ | $52^{a}$ | $34^{a}$ | $79\ (1.8)^{b}$ | $38\ (0.59)^{bc}$ |
| Probability | 0.006 | 0.001 | 0.000 | 0.008 |
| Trial 2 | | | | |
| 0 µg $kg^{-1}$ | $83^{c}$ | $77^{b}$ | $33\ (0.7)^{a}$ | $33\ (0.5)^{a}$ |
| 10 µg $kg^{-1}$ | $66^{bc}$ | $45^{a}$ | $33\ (1.0)^{a}$ | $50\ (0.8)^{a}$ |
| 20 µg $kg^{-1}$ | $67^{bc}$ | $57^{ab}$ | $92\ (2.1)^{b}$ | $50\ (0.6)^{a}$ |
| 40 µg $kg^{-1}$ | $40^{a}$ | $43^{a}$ | $100\ (2.2)^{b}$ | $75\ (1.0)^{a}$ |
| 60 µg $kg^{-1}$ | $56^{ab}$ | $42^{a}$ | $100\ (2.0)^{a}$ | $50\ (0.8)^{a}$ |
| 120 µg $kg^{-1}$ | $54^{ab}$ | $50^{ab}$ | $100\ (2.4)^{b}$ | $92\ (1.1)^{a}$ |
| Probability | 0.000 | 0.014 | 0.000 | 0.117 |

Percentage of tubular epithelial atrophy and hepatopancreatocyte sloughing were calculated from the number of organisms that presented damage and divided by the total number of shrimp for each and multiplied by 100.

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# Functional feeds *as effective strategies against EMS*

By Peter Coutteau and Tim Goossens

**These contain natural feed additives combining direct bactericide/bacteriostatic action and Quorum Sensing inhibition properties.**

Penaeid shrimp production has been under continuous threat by bacterial and particularly viral infections which have caused disastrous collapses of the industry. Early mortality syndrome or acute hepatopancreatic necrosis disease (EMS/AHPND), is presently disrupting production in the three major shrimp producing countries China, Thailand and Vietnam. EMS was first reported in China in 2009, it has spread to Vietnam, Malaysia and Thailand, and now causes annual losses of more than USD 1 billion. EMS outbreaks typically occur within the first 30 days after stocking a newly prepared shrimp pond, and mortality can exceed 70%.

Recently, a research team led by Donald Lighter at the University of Arizona found that EMS is caused by a bacterial agent, which is transmitted orally, colonises the shrimp gastrointestinal tract and produces a toxin that causes tissue destruction and dysfunction of the shrimp digestive organ known as the hepatopancreas. Lightner's team identified the EMS/AHPNS pathogen as a unique strain of a relatively common bacterium, *Vibrio parahaemolyticus*, which is infected by a virus known as a phage, which causes it to release a potent toxin. A similar phenomenon occurs in the human disease cholera, where a phage makes the *Vibrio cholerae* bacterium capable of producing a toxin that causes cholera's life-threatening diarrhoea.

So far, the main diseases in shrimp production were associated with viruses, with the white spot syndrome virus (WSSV) being the most notorious. Prevention of WSSV in Asia consists of bio-security measures including the use of specific pathogen-free (SPF) larvae and avoiding infected vectors coming into the farming system. In the Americas, where the implementation of biosecurity in large, open farms is difficult, shrimp producers have managed to improve the survival of the shrimp in the presence of the virus from less than 20% during the early outbreaks to currently 60-75%.

This has been ascribed to some extent to the increased resistance against the virus of surviving shrimp stocks. However, more importantly, farmers have learned how to reduce the impact of the WSSV outbreaks on the shrimp survival. Years of field experience, supported by recent scientific work under controlled lab conditions, have shown that many factors affect the mortality induced by WSSV outbreaks, including genetics, quality of the postlarvae, climate fluctuations, environmental stress, bacterial co-infections, quality and stability of the culture conditions. This knowledge has resulted in production protocols that do not eliminate the pathogen but rather reduce the risk for triggering mortality events.

EMS, being caused by a *Vibrio* that is difficult to eradicate from the production environment, will require a very different approach than WSSV for maintaining biosecurity in Asia. Avoiding early contamination through the brood stock and larvae, combined with continued control of the microbial developments particularly during the initial month of the cycle, will be crucial to control EMS. In this regard, intensive nursery/pre-growing systems are now being explored by the industry to produce juvenile shrimp throughout the critical stages affected by EMS. These systems allow superior control over nutrition and microbial environment compared to direct stocking into the grow-out ponds. The use of antibiotics to control microbial developments throughout the production process is not desirable due to the risk for building up resistance and its rejection by legislators and consumers.

## Gut modulation

The shrimp industry requires alternative ways to control the microbial ecosystem in production systems. Shrimp are actively 'grazing' and are therefore highly exposed to exchanges of microflora between the environment and the digestive system. Sustainable approaches to modulate the gut microflora in farmed animals include the use of selected bacteria to inoculate the gut (probiotics) and specific natural compounds (so called 'botanicals' or 'phytobiotics') capable of modulating the microflora towards a favourable composition. Provided the botanical formulation is heat stable, it can be easily incorporated into the feed at the feedmill and therefore be present in every meal from the starter feed onwards, without requiring major adaptations of the production protocols at the nursery or farm. Phytobiotics promoting a healthy gut microflora furthermore enhance the establishment of probiotic bacteria and therefore enhance the effects of probiotic inoculations in the production system.

Functional feeds containing gut health promotors allow to deliver with every meal an adequate concentration of natural antimicrobial activities into the shrimp gut. These feeds could be an important component of any strategy to prevent EMS. However, the success of this approach will depend on the efficacy of the selected gut health promoter against the pathogenic bacteria involved in EMS. Synergistic blends of natural compounds can be selected based on their bacteriostatic and bactericidal properties against a specific range of pathogenic bacteria *in vitro*. In this way, different *Vibrio* species, including *Vibrio parahaemolyticus*, appeared to be highly sensitive to a natural feed additive composed of a synergistic blend of antimicrobial compounds (Sanacore® GM, Table 1).

Table 1: Efficacy of a natural botanical product (SANACORE®GM) against aquaculture pathogens (MIC, Minimum Inhibitory Concentration) (Nutriad Technology Center, inhouse results 2012).

| Pathogenic species | strain | MIC (% extract Sanacore GM) | Host range | QS documented |
|---|---|---|---|---|
| *Flavobacterium columnare* | LMG 10397 | 0.06% | Tilapia, freshwater fish spp. | |
| *Listonella anguillarum* | LMG 4411 | 0.23% | Most marine fish spp. | QS+ |
| *Photobacterium damselae* | LMG 7892 | 0.47% | Sea bream, sea bass, sole | |
| *Vibrio harveyi* | BB120 | 0.47% | Sea bream, common snook, penaeid shrimp | QS+ |
| *Vibrio alginolyticus* | LMG 4409 | 0.94% | Sea bream, grouper, most marine fish spp. | QS+ |
| *Vibrio parahaemolyticus* | LMG 4423 | 0.94% | Marine fish, penaeid shrimp (EMS) | |
| *Edwardsiella ictaluri* | LMG 7860 | 1.88% | Catfish | |
| *Edwardsiella tarda* | LMG 2793 | 1.88% | Turbot, tilapia | QS+ |
| *Pseudomonas fluorescens* | DVK1 | 3.75% | Stripped bass, white perch, yellow tail | |
| *Pseudomonas putida* | DVK2 | 3.75% | Ayu, freshwater fish spp. | |
| *Yersinia ruckeri* | LMG 3279 | 3.75% | Salmonids, mainly rainbow trout | |
| *Aeromonas hydrophila* | LMG 2844 | 7.50% | Salmonids, cyprinids, catfish, freshwater fish spp. | QS+ |
| *Aeromonas salmonicida* | LMG 3780 | 7.50% | Salmonids, cyprinids, freshwater fish spp. | QS+ |
| *Streptococcus iniae* | CCUG 27303 | 8% | Trout, tilapia and other freshwater fish spp. | |

## Antimicrobial compounds

Recent research show that apart from direct bactericide/bacteriostatic effects, selected combinations of antimicrobial compounds are at the basis of more complex mechanisms to steer microbiota composition. In human medicine, compounds active in Quorum Sensing (QS) disruption are increasingly investigated as potential alternatives to antibiotics due their efficacy at low concentrations and the low chances on bacteria developing resistance against these non-lethal molecules (see insert). Our own research has shown that synergistic blends of natural antimicrobial compounds can function as powerful interrupters of bacterial QS signaling in a typical aquaculture pathogen such as *Vibrio harveyi* at concentrations well below minimal inhibitory concentrations (see box).

## Quorum Sensing (QS), an innovative mechanism to tackle pathogenicity

Quorum Sensing (QS) is a form of bacterial communication, based on the production and secretion of signaling molecules which can be detected by adjacent bacteria. When population density rises, these molecules will accumulate in the extracellular environment, thereby providing a means for bacteria to quantitatively monitor the presence of other bacteria. These signaling molecules will, when reaching a certain threshold concentration, initiate intrabacterial signaling that culminates in the activation of specific genes. In most pathogenic bacteria from which the QS system has been studied, QS has been associated with pathogenicity, such as biofilm formation and the production of proteases, invasion factors or other virulence factors (Defoirdt, et al., 2011). In recent years, research focusing on ways to disturb QS signaling (also called quorum quenching) is therefore gaining particular interest. Blocking bacterial communication is a novel way of preventing them to trigger pathogenicity, without exposing them to a selective pressure to survive. Initial studies of quorum sensing in aquaculture organisms are very limited but point out exciting results. Halogenated furanones isolated from red marine algae, for example, have been demonstrated to reduce QS-regulated gene expression in Vibrio and to protect fish and shrimp from vibriosis (Rasch et al., 2004; Defoirdt et al., 2006). At the Nutriad Technology Center, QS technology is being applied in a novel generation of natural feed additives capable of modulating gut micro flora. Compounds are tested for their capacity to inhibit QS-signaling using an array of genetically modified bacterial biosensors and QS-dependent infection protocols in simple model organisms. Using these sensitive assays, potent QS modulators, able to shut down QS signaling at concentrations far below the minimum inhibitory concentration, are being identified

Bactericides, antibiotics: decrease the number of bacteria

Quorum Sensing inhibition: disturb signaling

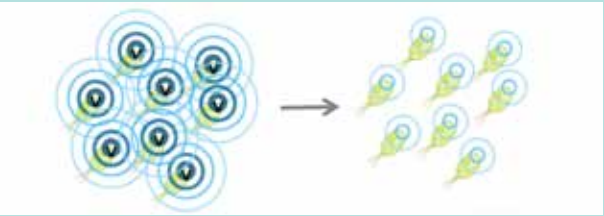
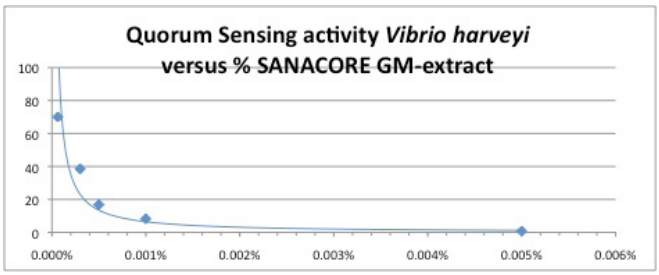


Figure 1: Dose – response of a synergistic blend of natural compounds with anti-microbial activity (Sanacore® GM, Nutriad) on QS signaling activity of *Vibrio harveyi*. Graphs show signaling activity in QS biosensor system *Vibrio harveyi* BB170, relative to control, exposed to different dilutions of the product extract (Nutriad Technology Center, inhouse results 2012).




Recent scientific studies have shown that QS-disrupting compounds are capable of increasing survival of crustaceans challenged with *Vibrio harveyi*, including larvae of the giant freshwater prawn *Macrobrachium* (Pande et al., 2013) and the brine shrimp *Artemia* (Defoirdt et al., 2012). Similarly our research has shown that strongly diluted extracts from a synergistic botanical product can protect *Artemia* during a challenge with *Vibrio harveyi* (Figure 2). The determination of *Vibrio* concentrations in the different challenge treatments showed that the strong bactericide effect of the botanical product was responsible for

this protection at the highest concentrations of the botanical product. However, the negligible effect on *Vibrio* concentrations in *Artemia* as well as in the culture water in the treatment exposed to the lowest dosage indicated that the QS disruption mechanism was responsible for the protective effect of the botanical extract at lower concentrations.

Figure 2: Effect of different concentrations of an extract from a synergistic blend of natural compounds with anti-microbial activity (Sanacore®GM) on survival in an axenic challenge test of *Artemia* with *Vibrio harveyi* (Nutriad Technology Center, in-house results 2012).

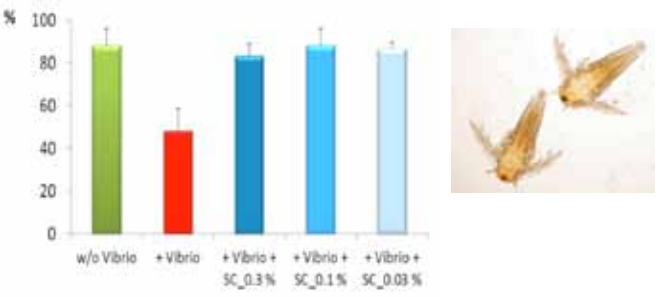
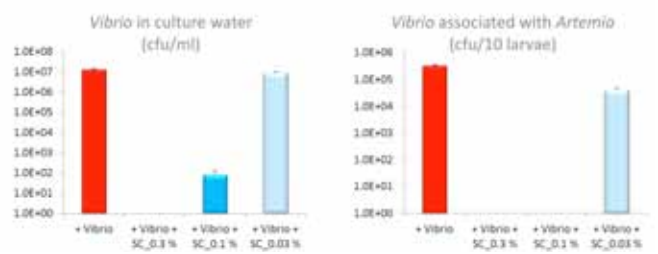



Figure 3: *Vibrio* counts in culture water and in homogenised *Artemia* larvae exposed to a challenge with *Vibrio harveyi* in the presence of different concentrations of an extract from a synergistic blend of natural compounds with anti-microbial activity (Sanacore®GM) (Nutriad Technology Center, in-house results 2012).




Natural products promoting gut health have proven to be effective in improving shrimp growth under controlled lab conditions in the absence of pathogens, and to enhance survival under challenging field situations where shrimp are exposed to pathogens. The supplementation of Sanacore®GM promoted growth significantly in healthy shrimp growing under controlled lab conditions, showing a remarkable 20% increase of weekly weight gain and 4% improvement on food conversion (Coutteau et al., 2010).

The inclusion of this botanical feed additive in a pelletized feed under standard industrial conditions at the feed mill improved survival under production conditions in a semi-intensive shrimp farm in Panama with 24% and 18% compared to the control group during two independent production cycles (Cuellar-Anjel, et al., 2011). Natural feed additives combining different action mechanisms against *Vibrio* species such as direct bactericide/bacteriostatic properties as well as Quorum Sensing inhibition properties at concentrations below MIC, are interesting candidates to investigate on their potential contribution to prevention strategies against EMS.

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References are available on request

# Transforming marine fish fry production

**Scaling up production in a biosecure and larger facility brings MLA in Singapore closer to its vision to be a leader in industrial marine fish fry production.**

Segmentation in the farming of marine finfish is efficiency at its best for the region's industry and this was how Aqua Culture Asia Pacific introduced the raison d'être of Marine Life AquaCulture (MLA) in Singapore in an article in 2011. Since then, the company is progressing well towards its aim to be the region's leader in the supply of quality fry and fingerlings using the bio-exclusion method. Being recognised for the supply of 1 inch (2.5 cm - 45-day old) vaccinated (by immersion) Asian seabass (*Lates calcarifer*) quality fry to major producers in Indonesia, Malaysia, Vietnam and Singapore is another feather in its cap.

In early 2012, it moved to this new land-based facility on Pulau Ketam, an island off the north eastern coast of Singapore which was developed at a cost of SGD 2.65 million. Here, production will increase to 2.4 million of D80 or 12 g juveniles and 12 million of D40 or 0.2 g fry from 9 million in 2012. It will be mainly vaccinated seabass fry. MLA was set up in 2009 by a group of friends led by Frank Tan, now its COO and Tan Kay Heok, chief scientific officer. At this new hatchery, they voiced out how they see further developments.

## Economies of scale

MLA's business model is quality fry supply to support the growth of marine finfish aquaculture in the region. It works at achieving economies of scale and to lead industrialised monoculture, in particular of the Asian seabass with vaccinated fry. Demand has been good as book orders are already complete for 2013.

"Our expansion plans are still underway. We already have 66 eight-tonne tanks and 20 twenty-tonne tanks for nursery and larvae rearing and we are looking forward to expand with another 20 tanks and an isolated vaccination room with enhanced bio-security features. Fry is kept in the pre nursery area until they reach 2 g. The first vaccination is immersed bath at 2 g and only when fry are fully developed at more than 8 g, can we do injection vaccination. Production is now at 100,000 fry/month. With more tanks, we can progress to 100,000 fry/cycle of two weeks. Our production is continuous for 3 months and we have achieved 85% survival after D35 in comparison to the industry average of 60%," said Frank.

"Here biosecurity is assured as our new neighbour is only the natural reserve cum bird sanctuary. The environmental impact is minimised by channelling hatchery effluents to a disused pond on the island for sedimentation before slowly entering the sea. This is part of the requirements for accreditation as a sustainable aquaculture company."

*The new nursery area consists 20 units of 20 tonnes FRP (fibreglass reinforced plastics) tanks for nursing of seabass fry till 12g*

*Seabass fry, D40 and 0.2g*

*Seabass fry, D35 and 0.1g*

## Water quality and climate change

Since 2009, Kay Heok has been developing his unique and proprietary water treatment technology to produce and continuously maintain the desired water quality parameters. This is continued in Pulau Ketam except that he now has to work with larger volumes of water. The main treatment is a pressure sand filter and chlorination with 25 ppm of chlorine powder. Because of safety concerns, liquid chlorine is not allowed by the government. Ultraviolet (UV) treatment ensures pathogen free water which is confirmed by an independent laboratory. Treated seawater is stored in 9 units of 500-tonne lined reservoirs. Prior to pumping for use in the production areas, this water will go through a secondary filtration and ultra-sterilisation process from 30 to 5 microns, depending on the requirements of the different production stage.

"The challenge is not just water quality control from within our hatchery but of the surrounding water body. We also need to be constantly aware, anticipate and react fast to climatic changes. The monsoon patterns have changed; the rains from the north east monsoon this year was longer with a shift in pattern. All these changes

*Tan Khay Heok (left) and Frank Tan*

have brought a large variation in temperatures. An atmospheric temperature change by 10 degrees will result in 4-degree changes in the water. These changes have a large impact and disrupt our production as a 2-degree variation alone has an effect on larvae performance. In the last quarter in 2012, this had an impact in our hatchery and brought down fry production. Thus, when we were planning for the construction of the hatchery we have already planned for heaters and an enclosed area," said Kay Heok.

Added to this, Kay Heok has to remain vigilant and ready with preventive measures with changes in the waters surrounding the farm, such as algae blooms. The recent changes in the Serangoon/Punggol River for flood mitigation have affected the biodiversity of the seawater.

## Focus on the seabass

MLA started with the production of the Asian seabass which now represents 90% of its fry production. According to Frank, the life cycle, culture technology and health management of this species is already well known and thus an excellent species for an industrialised monoculture business.

"We also sell 35-day old fry (D35) of 0.1 g to some farms which have their own nursery. Our survival rate from egg averages 40% to this stage. Quality is maintained as we throw away slow growers which account to almost 15-20% in each batch," added Frank.

"However, we see a challenge with feeds and feel that gaps still exist in its nutrition. We have attributed some of the poor performance during some crops to issues with feeds. We then source for new feed types, run trials before including them into our production protocol. As a hatchery operator, I see that we do not fully understand the feeding requirements at the juvenile stage. That is why we are still dependent on the expensive and high-end feeds from Japan and France. We know they work well for larval rearing. When we move to cheaper feeds, nutritional problems will appear.

"Feeds are the largest contributor to our cost of production at 42%, followed by labour at 15% and fuel at 10%. In the hatchery we emphasise on technical aspects to achieve the best quality and do not compromise even if production costs goes up. The intensification level here is less than half that of hatcheries in the west."

## Benchmarking in 2012

In the farming of the Asian seabass, fry are stocked either in ponds or cages. The stocking size is usually more than 12 g fish (3 inch or 7.6 cm in length) in either system. Growth is much faster in the ponds at 3.5 to 4 months and 6 months in cages for a marketable size of 400-600 g. MLA supplies both pond and cage farms. It is an independent

*D80 12g juveniles, picture by MLA*

*High wall and large 120 tonnes FRP tanks with nano-sterilization and de-gasser tower for larval rearing*

supplier to farms and has no alliance with any feed company.

"The market for quality fry has been rising but on the supply side we still face some challenges in the consistency for mass production. Cost of production is on the rise for us, led by higher costs of feeds. I would say that the increase is about 20% since we started production in 2010," said Frank.

"Our selling price for fry (3 inch or 7.6 cm) is SGD 0.55 which is SGD 0.15 more than the price sold by hatcheries in Malaysia at MYR1.00 (SGD 0.40). The vaccination material adds SGD 0.14 to the cost of each fry, not including labour costs.

"Although our prices are relatively higher than competing hatcheries, farmers now realise that buying quality vaccinated-specified pathogen free V-SPF fry is important as profitability depends on production yield, even when ex-farm prices dip. The feed prices are also on the increase but if feed conversion ratio (FCR) is good, coupled with good survival rate and growth rate, it shows efficiency," said Frank.

"We are now recognised for our quality fry. At the farms, we get reports that the survival rate of our fry is high for 400-600 g fish. How do we benchmark our fry? Now farmers are reporting mean survival rates of our fry at 70-80% as compared to before when they used fry from local hatcheries which gave 20-50% survival rates."

Kay Heok added, "Aside from quality, our next level is a second shield from pathogens, through vaccination. We want to push out the V-SPF model that all MLA fry have been vaccinated. This will give secondary protection against pathogens. Even in our biosecure facility in the hatchery, we are still open to horizontal contamination, so imagine the threats out there in open cages.

"The seven types of production diseases in marine fish production will continue to be threats to industry. As a supporting industry, we will need to be a step ahead. We know that viral nervous necrosis (VNN) can be controlled and eliminated with vertical sterilisation. We are still open to the scale drop syndrome (SDS) and parasitic infestations. Vaccination against streptococcus and iridovirus adds to the cost of fry and we are looking at reducing these costs. Then there are the labour costs. One day we hope to see experienced vaccination teams supporting industry."

## Productivity

Both the Tans admit that labour costs are high in Singapore and so they constantly assess production yields as efficiency is key to their success. For the 13 staff at the hatchery, nursery, brood stock and netcage culture farm, their productivity should parallel that of an electronics factory.

"We need to be extremely efficient in our mind set, fully engaging in disease control measures and applying correct methodologies. However, we have the advantage of being in Singapore with its efficient air and sea logistics and proximity to the larger farms, in Peninsular and East Malaysia and Indonesia. Technically, we have the support from the Aquatic Section of the Agri-Food Veterinary Agency (AVA) and the MSD Laboratory. MLA works closely with both, the former for its laboratory services and the latter for disease diagnosis and vaccination protocols.

## Downstream venture

The 4-6 year old (7-12 kg) Asian seabass brood stock as well as other brood stock are kept in floating cages in the channel separating Pulau Ketam from mainland Singapore. This is where Kay Heok prepares the new strain of brood stock for future fry production and test the performance of the new offspring produced at the land based hatchery. Cages of 4mx4m are used to hold brood stock and 30mx11 m are used to farm some fish. Smaller cages are used for the nursing of seabass. Farmed species include the trevally and four-finger threadfin, from fry produced at the hatchery. All fish, with the exception of the brood stock are fed commercial diets. These are marketed at 400-600 g in Jurong and Senoko fish markets in Singapore. MLA is the only producer in Singapore for these two species. In 2013, they expect a production of 150 tonnes of four finger threadfin as well as other species.

"This is driven by a good demand and prices for the four-finger threadfin are good at SGD 8.50 to SGD10/kg ex-farm. The highest price reached was SGD13/kg while in retail markets, prices rose to SGD 14/kg. The four-finger threadfin is air freighted to China. The farm also produces large sized seabass which is sold fresh chilled. We will be expanding the annual production from the farm from the current 150 tonnes to 300 tonnes. Our vision is to produce 3,000 tonnes through alliance partnership.

"The smaller cage farms in Singapore are facing tough times with poor economies of scale and competition from fish imports from China. Fish prices are high during peak demand. In general, farm gate price has dropped by 20% in 2012 due to over production and consumer preference to dine out less and to prepare meals at home. However, farmers continue to produce the tonnage as per their license requirements. In the future, I see that the local and regional industry will consolidate with bigger farms expanding and producing larger quantities and smaller farms merging," said Frank.

As he perfects the production of Asian seabass fry, Kay Heok seeks the challenge of commercial fry supply of other species such as the shortfin pompano. Despite the challenges with rising costs, Frank says that with this hands-on hatchery business, MLA will continue to expand within Singapore."

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# Pangasius farming in the Philippines

By Rafael D. Guerrero III

**The objective is to be self-sustainable with this rising star**

The Mekong catfish *Pangasius hypophthalmus* was introduced in the Philippines by the Bureau of Fisheries and Aquatic Resources (BFAR) in 1981 as a potential food fish for culture. The fish was bred in 1985 through induced spawning by Adelaida Palma at the BFAR's National Inland Fisheries Technology Center (NIFTC) in Tanay, Rizal.

As a new species in the country, there was no market for the pangasius as a food fish in the 1980s and 90s. The fingerlings produced by the BFAR-NIFTC ended up in aquarium shops then as the ornamental 'freshwater hammerhead shark'. With the emergence of pangasius in the 2000s as a major aquaculture food commodity in Vietnam, which was farmed mainly for export, pangasius fillets were imported by Philippine seafood distributors to supply local high-end hotels and restaurants. It was a lower-priced white fish substitute for expensive marine fish. Since then, as much as 820 tonnes/month of pangasius fillet worth USD 2.25 million have been imported from Vietnam to fill the local demand, according to the Philippine Department of Trade and Industry (DTI).

## Impetus for pangasius farming

Thus, came the impetus for its farming in the country. One of the local companies that responded to the need in the mid-2000s was Vitarich Corp., a major producer of livestock, poultry and fish feeds. Vitarich engaged freshwater pond operators in the country as contract farmers of pangasius. The company provides the fingerlings, feeds and grow-out technology to farmers and buys back the market size fish (1-1.2 kg each) at PHP 50/kg (USD 1.08/kg) after 6 months of culture. Farmers are assured of a 10-20% rate of return and equity of PHP 5-15/kg of fish produced.

Vitarich has a processing plant for the pangasius in Marilao, Bulacan which produces fillets and other value-added products such as fish sweetened bacon, sausage and spring rolls for local markets. The fillets are priced from PHP 220/kg (USD 4.70/kg) to PHP 270/kg (USD 5.85/kg).

## Pangasius for job generation

To reduce the import of pangasius fillets, develop a local industry and for job generation, the Philippine Government, through the DTI and in partnership with BFAR, which has a package of technology in breeding and grow-out of the fish, embarked on a nationwide program to farm the pangasius.

The DTI has made pangasius farming in the country one of its 10 Flagship Programs. It successfully pilot-tested the breeding and grow-out technology initially in four regions in Mindanao, namely, Northern Mindanao, Central Mindanao, Western Mindanao and Southern Mindanao. The program was later expanded in three regions in Luzon (Central Luzon, Southern Tagalog and Bicol) and one region in the Visayas (Eastern Visayas).

From 2008 to 2012, the Bureau of Agricultural Statistics of the Philippine Department of Agriculture reported that the top producing regions are Central Luzon (Pampanga), Bicol (Camarines Sur) and Southern Mindanao (South Cotabato). Annual production increased in 2010 but remained relatively stable in 2011 and 2012. As local production of the fish rose, imported volume of fillets from Vietnam, dropped by 28% in 2011 compared to that in 2010.

DTI estimates that the total investment for the local pangasius farming industry was PHP 202.4 million (USD 4.9 million) in 2011. The industry provided jobs for 915 people working in hatcheries, nurseries, grow-out farms and processing plants.

An industry assessment reported that in five pangasius producing regions (CAR, Cagayan Valley, Central Luzon, Southern Tagalog and Central Mindanao), there were 97 ha of pond area with an annual production of 2,264 tonnes. There are 10 hatcheries capable of producing 272 million fingerlings and five processors with a production capacity of 2 to 6 tonnes of fillet per day.

## Exotic species

In May 2012, the Philippine Department of Agriculture issued Fisheries Administrative Order (FAO) No. 243 for Guidelines on the Environmentally Sound Culture of Pangasius in the Philippines. Among other provisions, the FAO limits the culture of the fish only in fishponds that are not prone to flooding and prohibits its cage culture in lakes and natural inland waters as well as its introduction in the same waters for fisheries enhancement. In general, the fish is considered a 'low risk' foreign species and a 'suitable alternate species for freshwater aquaculture'.

Dr Adelaida Palma, chief of the BFAR-NIFTC, says that the pangasius is an indigenous catfish of the Mekong River Delta from the Tibetan Plateau through China's Yunan Province, Myanmar, Thailand, Laos, Cambodia and Vietnam, and cannot spawn naturally in the Philippines. "The pangasius is fast-growing and can tolerate poorly-oxygenated waters because of its ability to breathe surface air. We breed the fish that are at least three years old through induced spawning with injections of catfish pituitary gland extracts during the rainy season from May to October".

The fertilised eggs hatch in 27-32 hours with a water temperature of 28-31°C. The larvae start to feed on live zooplankton 2 days after absorption of the yolk. On the third day, the fry can be fed with a powdered feed or stocked in nursery ponds with natural food. The fingerlings are ready for stocking in grow-out ponds after a month of rearing.

*Harvest of 3.8 tonnes of pangasius from 200m² pond after 7 months, picture courtesy of Socorro Castro.*

*Pangasius fingerlings for pond stocking, picture courtesy of Socorro Castro.*

*Socorro Castro holding a pangasius brood stock.*

## Grow-out and marketing

Grow-out ponds measuring 0.1 to 0.3 ha with water depths of 1-1.5m are stocked with the fingerlings at 1-5/m$^2$. For extensive culture, the fish can be polycultured with nile tilapia and given supplemental feeds such as rice bran, freshwater snails and chopped vegetables. The fish is fed with commercial extruded feeds for intensive culture. The fish attains a market size of 1-1.2 kg after 6-8 months of culture with 90-95% survival.

Tateh AquaFeeds, a local aqua feed manufacturer and supplier, produces six feed formulations for the pangasius at its various growth stages, namely, pre-starter 1, pre-starter 2, starter, grower 1, grower 2 and finisher. The suggested retail prices (SRP) quoted for the feeds are USD 0.89/kg, 0.83, 0.78, 0.73, 0.68 and 0.64, respectively. It claims feed conversion ratios (FCR) of 1-1.5.

At harvest, the fish are brought live in containers to the processing plant for filleting and/or preparation for value-added products. Fillet recovery is 30-35% of body weight. The remaining parts of the fish (i.e., head, skin, entrails and fins) are processed into fish meal. The frozen fillets are sold to upscale hotels, restaurants, fast-food chains and supermarkets. The good quality white flesh of the fish without intramuscular bones is prepared into a number of exquisite dishes.

The selling of whole fresh pangasius in local wet markets is still limited. Fresh pangasius chunks or steaks, however, are gaining acceptance among buyers in some Metro Manila wet markets. Fresh skin-on fillets and steak cuts for grilling are popular buys. The head and belly of the fish are cooked in a local stew known as 'sinigang na miso'. The skin is also made into 'chicharon' (crackle).

One of the major players in the thriving pangasius farming industry of the country is BayCove International. According to its CEO, Jimmy Cacayan, the company has already invested PHP100 million (USD 2.4 million) for its integrated operations since it began only a few years ago. Its hatchery facility in Victoria, Laguna produces 5-6 million fingerlings a year and will soon scale up its production to 10 million. The fingerlings are sold at prices of PHP 1.50 (USD 0.04) and PHP3.00 (USD 0.08) a piece for 2 cm and 5 cm fingerlings, respectively. The company has 100 ha of fishponds measuring 0.2-0.3 ha each in Gapan, Nueva Ecija. With stocking of 7-10/m$^2$, the fish is grown to an average weight of 1.3 kg after 6-8 months of culture with survival rates of 95-96%. "Our cost of production of PHP 30/kg (USD 0.73/kg) for the fish enables us to sell our fillets at PHP 125/kg (USD 3.05/kg) with 30% recovery," Cacayan said.

BayCove has a processing plant in Santa Maria, Bulacan with a production capacity of 15-20 tonnes of fillets a week. Besides supplying local markets, it is also eyeing the export market. It has already received an order for 168 tonnes from South America.

Socorro Castro who operates the Norberto-Carmen Fishfarm in Calauan, Laguna has been achieving some success in her farm. Through induced breeding, she produces fingerlings and grows them to market size. In a 200m$^2$ pond, she obtained 3.8 tonnes of the fish after 7 months of intensive culture. "My work on the pangasius started in 2007 immediately after the first catfish conference in Ho Chi Minh City. I met Dr Greg Domingo in Davao, Philippines. He had more than a thousand of sexually-mature pangasius. I did the transfer of technology on induced spawning of pangasius in his hatchery facility. In return for the help, he gave me 90 pangasius females and 60 males. This is how I started," said Castro.

In the Expanded Commodity Road Map for the pangasius prepared by the DA-BFAR with DTI, the country expects to produce 6,000 tonnes of fillets (35% recovery) from 17,200 tonnes of whole fish weighing 1 kg farmed in 290 ha of ponds for total import substitution.

Considering the strong support of the government and the active involvement of the private sector, the future is bright for the pangasius as the rising 'star of Philippine aquaculture.'

*Dr Adelaida Palma, BFAR-NIFTC*


*Jimmy Kuan of Bluebay Aquaculture with pangasius fingerlings*

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# Vietnam's pangasius catfish reaches maturity in 2013

By Vo Hoang Nguyen

As with the nature of any product, pangasius is reaching its maturation stage in its product life cycle in 2013. What would be the status in the near future? Will it continue to grow and the industry reach a new height in a new increased growth cycle with significant efforts to self-restructure?

## Reaching the highest height

Throughout the 12 years of its development (2000-2011), pangasius production has become a key part of Vietnam aquaculture. Starting as a backyard culture for poor farmers' daily food consumption in the 90's, today this industry has grown 35 times in terms of production (from 37,500 tonnes in 2003 to 1,300,000 tonnes in 2011). Pangasius fillet export increased 40 times (from 17,000 tonnes to over 660,000 tonnes in 2011, figure 1) Export revenue increased 45 times, from USD 40 million to USD 1,856 million in the same period. The estimated production for 2012 reached 1.09 million tonnes. The Vietnamese government sets target production in 2020 with 1.5 – 2.0 million tonnes of pangasius, an addition of 4.8% a year, according to Vietnam Association of Seafood Exporters and Producers (VASEP)

## Weaknesses and threats

This 'belle vue' development has not been smooth. Positioning it as a cheap product will not allow the industry to grow sustainably. The farm gate price in 2000 was at VND 11,000/kg and at that level, farmers could get VND 4,000/kg benefit and processsing plants could easily sell fillets to the US at USD 4/kg. In June 2012, with every kg of fish produced, farmers lost VND 1,000 with a farm gate price of VND 19,000 to 20,500/kg. This price variation might depend on the scale of production. Normally large size farms get better prices, according to VASEP. The benefit is not fairly shared along the value chain. Exporters might retain a certain margin by price dumping, but the feed millers are currently trying their best to survive.

A negative sign for the development of pangasius farming can be described via the feed price and feed conversion ratio (FCR). In 2005, on average, one kg of feed cost VND 5,800. It increased to VND 11,400 in 2010 and gradually reached VND 14,500 in 2013. Meanwhile FCR also increased significantly from 1.5 in 2005 to 1.65 in 2008 and 1.8 in 2012 (Nhu Van Can, 2013). For this reason, small scale farms cannot compete with integrated farms where feeds are procured at lower prices due to the quantity purchased and better FCR, thanks to better management.

As a result of global warming, salinity incursion into the Mekong River causes negative effects to pangasius culture. Furthermore, the setup of hydropower dams in upstream regions of the Mekong River results in low water discharge and contributes to the high salinity of the low basin areas.

Most areas show increases in salinity of about 1-2%, except for those areas with salinity >32 ppt where the increase is 6.7%, but this is only in a narrow area along the coastline with high salinity. Climate change could also increase the extent of the areas with saline intrusion but the increase in these areas is smaller than that in the areas of flooding (MRC, 2009).

Saline waters from CuaTieu rivulet mouth in Tien Giang province had moved over 45 km inland, posing risks to more than 10,000 ha of padi and other crops in the district. In Kien Giang, saline water is intruding along the 200-km long coastal strip, impacting thousands of hectares of farmland, according to the Provincial Irrigation Sub-department. Meanwhile, in Ben Tre coastal districts, especially Binh Dai and Ba Tri, over 1,400 ha of rice and hundreds of hectares of other crops are being affected by saline water, according to a report in the Saigon Times.

*Feeding with floating feeds. In 2012, there are about 26 major producers of pangasius feeds, comprising those selling into the open market and those belonging to large integrators.*

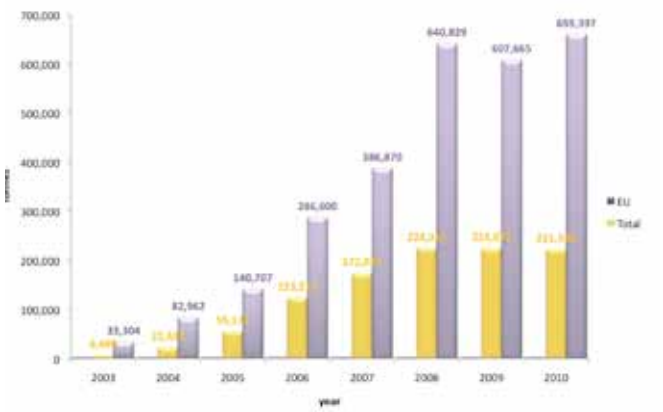
## Positive signs toward the future

Product diversification should be a suitable strategy to get out from the current difficult situation. The traditional pangasius may remain unchanged as the cash cow of BCG matrix (low growth, high market share). Necessary actions should be taken to prevent it moving to 'Dogs' position (low profit due to low selling price with high production cost). A new diversified pangasius product must be created in the 'question mark' quadrant and to move to 'Star' with lessons learnt from traditional pangasius. The new product can be in the form of a functional food such as high Omega- 3 pangasius fillet, or a firm texture fillet of high salinity tolerant pangasius raised in brackish water. Climate change could narrow the area for pangasius culture with high salinity water. This is a risk but at the same time an opportunity for Vietnamese pangasius to develop a new product for a more diversified portfolio.


*Pangasius BCG matrix*


*Product forms for the pangasius at the European Seafood Expo in 2012*

Figure 1 Pangasius export volumes in tonnes.




Source: Nguyen Huu Dzung, 2012. Vietnam Pangasius Farming Towards Sustainable, presented at ESE 2012, Brussels, Belgium

In order to produce pangasius with least costs , the integration system has been developed in the pangasius industry. Small scale farms are now shutting down operations or are taken over by larger companies. More large scale farming companies are being established with semi-integrated to fully-integrated systems figure 2.

'La vie' might be always 'en rose' if we do not adopt more suitable strategies. The pangasius industry in Vietnam now starts to face the difficult situation with a positive point of view. The Vietnam Government has issued a national program for pangasius production development (2010-2020) with targeted production in 2020 of 1.5-2.0 million tonnes of pangasius (+ 4.8% a year). This rate is somehow of lower level compared to the production in previous years. The trend toward integration with larger diversified range of product is the most adaptive strategy for the Vietnam pangasius culture for a sustainable future.

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Figure 2: Farming areas and Integration

Current status : total farming area (2012): 5910 ha (source: MARD)


Integration in 2010: Ratio of integrated pangasuis farming area: 65%

| Ratio of integrated pangasuis farming areas in top-5 provinces. | |
|---|---|
| Ben Tre | 90.0% |
| Dong Thap | 61.9% |
| An Giang | 58.0% |
| Vinh Long: | 46.5% |
| Can Tho | 23.0,0% |

Source: Nguyen Huu Dzung, 2012. Vietnam Pangasius Farming Towards Sustainable, presented at ESE 2012, Brussels, Belgium


## Pangasius 26 Q&A

This is a publication of the Vietnam Association of Seafood Exporters and Producers (VASEP) which gives an insight into the industry in Vietnam. It gives basic information on the commercial species, techniques of farming and processing, quality management, information on importers and government regulations for the industry which covers all the regulations in its farming, processing and exporting products. The booklet also details the development of the industry from the initial trials in its breeding to the present situation with most production in ponds. It looks at farming models for the pangasius. It lists out several regulations on food safety and how the government regulates and carries out inspections of processing plants. The booklet is available online at http://www.pangasius-vietnam.com/Uploads/image/Luu-Viet-Thang/file/Pangasius26QA.pdf

# The European white fish market: Recent and expected trends

By Jose Fernandez Polanco

**Quality expectations and perceptions still have their role as price sensitivity has increased with restrictive household budgets**

White fish constitute a much diversified market involving a large number of species, harvested using alternative technologies and produced in several different countries all around the world. The white fish industry includes producers of all possible scales, operating in countries with different economic and social conditions, facing the challenges of the same keen competitive market.

Volumes of production allow for a broad classification, according to commercial criteria, in two main groups. A large number of white fish species are produced and consumed locally. High valued fresh local species, usually caught by artisanal and small scale fishermen, are focused on niche markets and high income local restaurants. On the other hand, there are species with large volumes of production around the world, which fit with the requirement of mass consumption markets.

Groundfish and aquaculture species are relevant components of this second group. Increase in catches and financial turbulences in the fish farming industries have dropped the prices of wild species and raised those of several farmed fish. The trends in prices have caused increased market competitiveness of wild species which is further reinforced by the better consumers' quality perceptions compared to farmed species.

*Asian seabass and pompano at the booth of Lee Fish during the European Seafood Exposition in Brussels in April 2013.*

## Groundfish

Cod, hake and Alaska pollack are the main commercial species of white fish marketed within the European Union (EU). Cod is a very traditional and one of the most popular species for consumers all over the continent, especially in the countries by the Atlantic coast. Within the EU, Portugal, Spain and the United Kingdom are the main markets for cod. This species can be found in many kinds of presentations, allows several different preparations and scores well as a high quality fish in the minds of consumers.

Hake consumption is mainly concentrated in the Southern countries, Spain being the most relevant market for fresh European catches and imported processed hake products. France and Italy are also important markets for this species. Alaska pollack supply comes exclusively from imports, the mayor suppliers are the US, Russia and China. The popularity of surimi meat and fillets has increased in the European market in the last decade. It is present in many white fish preparations such as fish fingers, balls or burgers, as well as frozen plain fillets. Germany and the UK are the countries with the fastest rates of penetration.

The great majority of fisheries providing these species to the EU market are sustainably managed, certified or in process of certification. Catches are not expected to stagnate in the short and medium term and could even continue raising their outputs. Domestic catches of hake and cod have increased in recent years, resulting in a corresponding decrease in prices at all stages of the supply chain. The cod fishery recovered from overexploitation and today domestic landings of cod increased 17.8% between 2007 and 2011, setting the end of a descending cycle since the beginning of the new century.

Norway and Iceland, the top cod suppliers for the EU market, increased their own landings 33.2%, surpassing half million tonnes in 2011. Imports of fresh cod also increased 25.9%, while the price per kilo dropped 26.7% from €4.4 to €3.3/kg. European landings of hake also increased 50% in the same period, resulting in a decrease of local prices becoming more competitive and affecting the volumes of imports from outside the EU. Imports of fillets and meat of Alaska pollack remained stable in the same period but the composition, according to countries of origin, changed with an increase of imports from China (19.1%) and declines from Russia (-18.4%) and the US (-13.6%). The price of Alaska pollack frozen fillets rose 15% since 2007, from €1.9 to €2.1/kg.

## European marine fish farming

Despite the technical success with several new species, seabream and seabass are the only two white fish species farmed in the EU with relevant volumes of production. The production of these two species is concentrated in the Mediterranean countries, as well as the bulk of the market. Turkey and Greece are the two leading producers setting the trends in quantities and prices, followed by Spain and Italy. Besides minor production of fillets, the majority of the bream and bass consumed in the EU are marketed fresh and unprocessed. The bass and bream industry failed to surpass the geographical limitations of the regional market and the low levels of ready to eat processed products makes it difficult to be competitive in the markets of Northern Europe.

The industry used to face cyclical crises, resulting in alternative periods of expansion and constriction in production. These cycles have their corresponding fluctuation in prices, which rise or fall according to the evolution of supply. However, in spite of the economic crisis hitting the Southern EU countries, total production in the Mediterranean increased by 30%, led by Greece and Turkey, and with important new contributions from countries like Egypt. The effects on trade resulting from this increase in production vary according to the species.

Seabass exports from EU countries, mainly Greece, increased 20% since 2008, while imports from outside the EU decreased about 50%.


*Prices of white fish in a market in Spain in June were as such (from left) hake (merluza) €4.90/kg; cod and pangasius fillet at €7.50/kg; seabass (lubinas) and seabream (dorados) at €8.40/kg. As we move north within the EU, hake prices rise and cod prices should decrease. Pangasius fillets are defrosted and in a traditional market the prices will be higher. €4-5/kg is a more reasonable price for frozen fillets at supermarkets.*

As a result, the volumes of trade remained stable, but the price has increased 14%, from €4.9 to €5.6/kg. Despite some stagnation in 2011, trade in seabream increased 33.8% in the same period, while prices followed the same trend by 23.8%, from €4.2 to €5.2/kg.

## Exotic freshwater species

With regards to exotic freshwater species, the pangasius, nile perch and tilapia, marketed commonly as frozen fillets, are also present in the variety of fish available to European consumers in different quantities. Pangasius is by far the most popular and even after stagnating in the last two years, its traded volumes are far larger than the other two imported farmed species. In spite of several conflicts and issues derived from unfair discredit campaigns organised by certain groups of local producers, pangasius fillets still hold a good reputation across consumers, but the retail price have fallen, decreasing retailers margins. Anyway, it still remains as a profitable commodity for importers as long as prices at the origin do not rise.

Imports of frozen pangasius fillets from Vietnam to the EU reached a peak of 216,000 tonnes in 2009 and started descending to 183,000 tonnes in 2011. Price per kilo grew from €1.8 to €1.93 in the same period. Recovery of the volumes of trade will depend on the ability of Vietnamese exporters to contain the rise in price and keep European traders margins at optimal levels. Some communication effort, clarifying the available information regarding the species and creating a favourable image across consumers may also be required.

## Summary

The future trends will be conditional on the evolution of prices and product perceptions. Evidence suggest that the EU seafood market is price sensitive, especially at the middlemen level. Price sensitivity may have increased at all levels due to restrictions in the household budget resulting from public austerity policies but quality expectations and perceptions still have their role.

Research conducted across European consumers indicates preference for wild versus farmed fish in countries with the highest tradition of seafood consumption. This is a handicap for farmed species with increasing prices, like bass and bream, and will limit the ability of raising the prices of pangasius. Local and traditional species are also preferred than exotic and imported, which results also in a handicap for Alaska pollack if its prices keep on rising. The descending trend in prices may favour sales of cod and hake in the short term, but as wild species, the ability of growth is limited to the maximum sustainable yield of the corresponding fishery. In the short term, wild species are expected to increase their ratios of market penetration. But this trend may change if the fish farming industries are able to hold down the rise in prices.

**Table 1.** Total EU Imports of farmed white fish in tonnes

| Year | Seabream | Seabass | Pangasius |
|---|---|---|---|
| 2007 | 35,289.6 | 428,661.9 | 15,4249.4 |
| 2008 | 44,078.2 | 497,046.8 | 206,801.7 |
| 2009 | 49,833.1 | 456,688.1 | 215,839.0 |
| 2010 | 50,065.3 | 450,188.7 | 208,991.5 |
| 2011 | 47,219.7 | 461,863.9 | 183,077.4 |
| Source: Eurostat | | | |

**Table 2.** Price (€, CIF) trends for white fish in the EU. Note: Retail price can vary according to the various market structures.

| | Fresh cod | Alaska pollack (fillets) | Seabream | Seabass | Pangasius |
|---|---|---|---|---|---|
| 2007 | 4.41 | 1.91 | 4.23 | 4.92 | 2.12 |
| 2008 | 3.95 | 2.03 | 3.60 | 5.14 | 1.84 |
| 2009 | 3.00 | 2.46 | 3.88 | 4.69 | 1.80 |
| 2010 | 3.10 | 2.37 | 4.46 | 4.88 | 1.75 |
| 2011 | 3.35 | 2.20 | 5.24 | 5.61 | 1.94 |
| Source: Eurostat as reported by customs | | | | | |

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# Black tiger shrimp from unique aquaculture improvement initiative

Blueyou Consulting has announced the official launch of Selva Shrimp®, a premium black tiger shrimp that delivers high quality product coupled with strong sustainability and traceability verification program. This unique program features black tiger shrimp that are sustainably grown in mangrove forests in southern Vietnam. By maintaining a functional ecosystem of mangrove forest and aquatic species, the shrimp are raised using the natural productivity of the surrounding forest habitat with no external inputs such a feed, fertilisers and chemicals. With little intervention, shrimp grow to large sizes and poses a succulent flavour and natural, vibrant colour.


This black tiger shrimp not only offer a sustainable seafood choice, but also create a direct link between consumers and small holder farming communities in Southeast Asia. Through this direct link, the program creates economic incentives to support and improve the conditions for small scale shrimp farmers and the more effective conservation of mangrove forests in coastal habitats. Local experts from Blueyou Consulting are working with small scale farmers and local authorities to foster improvements in shrimp farming practices and mangrove conservation. The Selva Shrimp® initiative ultimately aims at achieving the standards of the Aquaculture Stewardship Council (ASC). A set of transparent criteria is used as guidance for the referring aquaculture improvement process, which also involves the development of an internal control system (ICS) for farm clusters.

The criteria are subject to an independent on site verification process. The improvement project in Vietnam also features direct interaction with the farmers and shrimp processors to build a traceability system in addition to the sustainability improvements. The program combines round-level aquaculture improvement work in Southeast Asia with business to business services for sustainable shrimp sourcing and consumer marketing worldwide; offering markets a rare opportunity for a sustainable source of black tiger shrimps.

"We believe that our initiative has made a significant step towards achieving the sustainability goals that the market has been seeking," says An Pham, the local project manager for the program in Vietnam. "Our major goal is to build relationships with the farming communities and local authorities to foster the sustainable development of this unique shrimp farming sector and we hope that our efforts in Vietnam are rewarded in the marketplace."

As a first step, these efforts have been officially recognised by leading NGOs, with Selva Shrimp® being the first and only farmed black tiger shrimp to achieve a 'Best Choice' ranking by the Monterey Bay Aquarium's Seafood Watch® program (United States) and the Ocean Wise™ (Canada) stamp of approval.

"We are extremely happy to see leading NGOs recognising the assets and the environmental benefits of our aquaculture improvement initiative in Vietnam," says René Benguerel, managing director of Blueyou Consulting. "This clearly shows that sustainable shrimp farming is possible and that there are indeed choices available for environmentally conscious consumers. The challenge is now on our team to commit seafood businesses and build solid relationships between buyers and the participating farming communities in Vietnam."

Marketing efforts for Selva Shrimp® products will be focused on Europe, North America and Australia, with the food service sector being a primary target for these high quality shrimps. The plan is to feature these at the launch of Canada's first National Sustainable Seafood Day event at the Four Seasons Hotel in Vancouver with celebrity chef Ned Bell and at the Monterey Bay Aquarium's cooking for Solutions event with celebrity chef Elena Hernandez, both in May 2013.

Blueyou Consulting is an internationally recognised consulting and service company focused on sustainable fisheries and aquaculture and their related seafood supply chains. The Blueyou team of consultants includes professionals in the field of fisheries and aquaculture as well as those in supply chain management, logistics and marketing. The group works within an extensive worldwide network, which includes government and non-government organisations, scientific research institutions as well as private companies in the seafood production and market sectors.

More information: Web: www.blueyou.com/www.selvashrimp.com.

# Current practices in juvenile mud crab rearing

By Kwong Kok Onn

**In Malaysia, the growing interest in farming of the mud crab is hampered by supply of hatchery reared juveniles.**

*A juvenile mud crab after several moults following the C1 stage, ready to be stocked into growout culture. Picture courtesy of Muhamad Syahmin Aiman.*

The genus *Scylla* includes the species *Scylla serrata, S. tranquebarica, S. olivacea* and *S. paramamosain*. The four species can be differentiated through their external morphology. *Scylla serrata, S. tranquebarica* and *S. olivacea* are common in the Philippines whereas *S. paramamosain* is common in Vietnam, Indonesia and Thailand. All species are suitable for aquaculture and are farmed commercially. In Malaysia, the most common species are S. *olivacea, S. tranquebarica,* and *S. paramamosain*.

Mud crabs have shown great possibility as a commercial aquatic product in many Southeast Asian countries. However, the farming is mostly carried out on a small scale by local fishermen, and is mainly based on the rearing of wild captured crablets to marketable sizes. This crustacean is regarded to be among the best eating of crab species, and predictably, wild stocks of *Scylla* in many countries are overfished and overexploited. World aquaculture production of crabs increased from 44,766 tonnes in 1995, to 254,395 tonnes in 2010, with a value of USD 228,636 and USD 808,448 respectively (FAO, 2012).

Currently, mud crab aquaculture is an upcoming industry in Malaysia. The average price for mud crabs selling at a typical farm in Malaysia is currently MYR 13–16/kg (USD 4.1-5.1/kg) for 200-290 g crabs, MYR 20-23/kg for 300-390 g, and MYR 31-51/kg for 400-500 g. Average wholesale price in 2010 was MYR16.73/kg, and retail price was MYR 19.86/kg (Department of Fisheries, Malaysia). A berried mud crab can cost MYR 30-40 each (USD 9.7-12.9).

Currently, the insufficient supply of mud crab juveniles from wild stocks is one of the main reasons for the decline in mud crab aquaculture in Malaysia. Production declined from 600 tonnes in 1999 to 29.53 tonnes in 2010 (Fishstat Plus and DOF, Malaysia). In order to promote its aquaculture, hatchery raised juveniles are required.

## Life cycle

The mud crab begins its life as a zoea after hatching from an egg, and this phase has five stages, termed zoea 1 to 5. Zoea 5 then transforms into the megalopa and the first juvenile or crablet stage (crablet 1 or C1) through another two moults. It takes 23-24 days at 26-29 ºC for the zoea to develop into the C1 stage, 4-5 days from zoea 1 to zoea 5, and 6-7 days from megalopa into the C1 stage. The zoea stage is the planktonic phase and megalopa stage is the start of the benthic phase. The mud crab then undergoes a series of moults to reach the adult stage. This takes around 3 to 4 months to attain the market size of above 250 g.

The nursery stages of *Scylla* include one megalopa (M) stage and several crab instar (C) stages. This article will mainly cover nursery culture from the M to C1 stages, as this is considered the critical period, where mortality during molting can be high (mud crabs are fairly hardy once they reach the C1 stage and beyond). Previous survival rates from M to C1 obtained at the Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia (USM) ranged from 5.0-58.0%.

## Nursery practices

In the Phillipines, megalopae are cultured in concrete tanks or in net cages set in brackish water ponds. Ponds are prepared for culture using the original protocol of Trino and Sarroza (1995), as follows: the pond bottom is sun dried for 5 to 7 days or until the soil cracks. After application of agricultural lime and chicken manure at 1 tonne/ha each, the pond is filled with water to around 30 cm depth. When a good bloom of phytoplankton is obtained, water volume is increased to 80 cm deep over a 3- day period. In order to sustain plankton growth, pond water is fertilised with the same dose of fertilisers every 10 days. Ponds are advantageous because they provide wider surface areas for the scattering of the megalopae, assuming that the ponds are predator free and have enough natural food. Net cages (mesh size 1 mm, bottom surface area 20 $m^2$) are set in the ponds for the megalopae. Bamboo poles are used to hold up the cages and the net bottom is buried 3-5 cm into the pond soil. A good bloom of phytoplankton and zooplankton is achieved around 7 days following the use of organic fertiliser at 1 tonne/ha and inorganic fertilisers, urea (45 - 0 - 0) at 75 kg/ha and ammonium phosphate (16-20-0) at a ratio of 1: 2 (urea to ammonium phosphate) or 75 kg to 150 kg/ha, respectively.

*Figure 1. (A) Scylla paramamosain at the megalopa stage. (B) The first crablet stage of Scylla sp. Pictures were taken from CEMACS.*

## Megalopa to crablet

Three to five day-old megalopae (around 4.0-6.4 mg initial body weight) are transported in plastic bags at 200-300 ind/L stocking density. Megalopae are transferred to the pond area, and are slowly acclimated to the pond water salinity (24-30 ppt) and temperature (25-30 °C). The targeted pH in the pond is around 7.5-8.5. Megalopae are then stocked in units of 20 $m^2$ (4 m×5 m) net cages installed in a 1,000 $m^2$ brackish water nursery pond.

The net cages have 1 mm mesh size and the inner side of the upper end of each net fitted with 30 cm wide plastic sheet (gauge 14) to prevent juveniles from escaping. Bamboo poles are used as support to these cages. Six dried coconut fronds are positioned in the water column in each cage serving as hides for the megalopa or C1 stage. Megalopae are stocked at a density of 30/$m^2$, and water depths are maintained at 60-80 cm. About 30% of the water is changed every week. In addition to ponds, nursery culture can also be done in tanks. Cement composite tanks, and earthen flat-bottomed tanks with plastic lining, with surface areas of 1-10 $m^3$ have been used successfully in Vietnam. To reduce cannibalism, the stocking density of 3-5 day-old megalopae in nursery tanks is reduced to 1,000- 2,000/tonnes of water (10-20 ind/$m^2$). Black, nylon and bunched netting are placed at the bottom as shelter, and some are allowed to float in the water column.


*Figure 2. (A) One tonne tanks for mud crab nursery culture. (B) Substrates inside tanks for juveniles. (C) Culturing mud crab megalopa to the crablet stage in tanks, with megalopa visible on the tank bottom. Pictures were taken from CEMACS.*

## Feeds and feeding

A summary table of various feed types used by various culturists to culture M to C1 stages is presented in Table 1. From the C1 stage onwards, *Scylla* are fed minced trash fish, mussel, or small shrimp *Acetes sp.* two times a day to satiation. Feed rations are equally divided and given at 0800, 1300 and 1700 h daily. Furthermore, zooplankton species can be sampled inside and outside the net cages. The plankton samples are preserved in 5% buffered formaldehyde for examination under a microscope, and the dominant species noted. The survival rates from megalopa to several instar stages are 35–50% in hapa nets within earthen ponds, and 50% in pens.

**Table 1.** The regime used during the megalopa stage as adopted by various culturists in the nursery culture of *Scylla*.

| Crab species | Initial stocking density (nos/L) | Feeding rate (nos/mL or % BW/ day) | Survival (%) M – C1 | Author |
|---|---|---|---|---|
| *S. serrata* | 20 – 30 | 25 A + AF5 | | Jamari (1991) |
| *Scylla sp.* | 100 - 300 | 5 – 10 A + AF6 | | Ngoc-Hai (2011) |
| *S. serrata* | 30 - 50 | 5 A | 32.8 ± 4.8 | Quinitio et al. (2001) |
| *Scylla sp.* | 50 | 0.5 - 3 A | 30.0 – 50.0 | Quinitio et al. (2002) |
| *S. serrata* | 10 – 30 | 30 MM1 | 48.3 - 53.3 | Rodriguez et al. (2001) |

A: *Artemia sp.* AF5: SUTIMAL, feed for giant freshwater prawn (protein 55 %, fat 8 %, ash 7 % and moisture 5.5 %), at 7 - 12 g/ ml. AF6: Frippak, Lansy, 150 – 500 µm, 1 – 5 g/ m3 daily. MM1: marine meat macerated brown mussel meat (*Modiolus metcalfei*) or fish.

During the culture period, pond water depth is held at 60-80 cm. About 30-50% of the pond water (26-30 ppt.) is replaced daily during the first 5 days, and every 2 days thereafter, taking opportunity of spring tides. Using many hatchery tanks for nursery culture at low densities is not cost effective, because these tanks are better utilised for larval culture, which can have a shorter culture period. Pond water salinity, temperature, pH and dissolved oxygen are monitored three times weekly at 0900 h, with targeted salinities of between 24-30 ppt.

Weight sampling of crablets is done by lifting the net cages after 20 days of culture. After 30 days, crablets are harvested by discarding 70% of the pond water and lifting each net cage. Survival and mean individual body weight of the crablets is determined in each cage. Mass weight is also determined from the total weights of crablet in each cage. The survival from M to C1 (1-3 g body weight (BW)) after 30 days in hatchery tanks or pond cages is around 30-50%. A large number of C for grow out can be obtained if megalopae are cultured in net cages within ponds. The duration of nursery culture from M to C1 stage can take up to 9 days. The survival rates is during the nursery culture phase, which is usually from the megalopa to several crab instar stages.

Currently, one of the major constraints worldwide to the expansion of the mud crab culture industry is the bottle neck in juvenile supplies from hatcheries. Although some research groups have some success in the mass production of mud crab juveniles, consistent and reliable commercial culture has not yet been achieved so far. Therefore, further research and development are required before commercial mud crab hatchery culture becomes economically viable and widely adopted.

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# Home grown aquafeed producer is now 25 years old

## From zero to good. Now from good to great for Indonesia's PT MS

In 1988, Pinoto Prijadi founded PT Matahari Sakti (also known as 'MS') as a family business in Surabaya, East Java to produce the *Feng Li* brands of shrimp feeds. Daughter Puspita Dewi Prijadi took over the business in 1991 and is now owner and president director. Since then it has progressed to become one of the leading fish and shrimp feed producers in Indonesia.

On 22 June PT MS had a large celebration for its 25th anniversary with 1,200 guests, comprising customers, agents and feed users, representatives from the government, academia from local universities, industry organisations and partners and employees who have contributed to the success of the company. President Director Puspita Dewi attributed the successful development of PT MS to support from the aqua farming industry in Indonesia and to the dedication of staff located in all corners of the archipelago, from Sumatra to Papua.

"We are proud of our achievements. Our products are sold all over indonesia and we are the first local company to enter the international fish and shrimp markets of Malaysia, Brunei Darussalam, Bangladesh and Africa, although this is still small at 5% of output. In 2013, MS can produce an average of 15,000 tonnes per month or approximately180,000 tonnes per year," said Puspita Dewi.

The company now produces a range of feeds for shrimp and fish. Aside from aquafeeds, it also produces pet feeds. Currently, there are two feed factories in East Java,in Surabaya and Gempol, Pasuruan, A new plant is being built in West Java.

## A right time

The establishment of the shrimp feed business was appropriate as in 1988, shrimp farming was booming and amidst several feed companies, there were only a small number of home grown companies. However, as Iwan Sutanto, president of Shrimp Club Indonesia, who at that time was also starting shrimp farming in Lampung, said. "Farmers were then looking for quality feeds. Together with the rising industry, MS worked with us, farmers, as we faced one challenge after another from white spot syndrome virus (WSSV) and later the hard times with the infectious myonecrosis virus (IMNV)."

Puspita Dewi said, "We have a role to play in national development. With a large population, Indonesia is a huge market for food products, particularly fish. Fish consumption from year to year continues to increase. In 2010, nationally, fish consumption was 30.48 kg/capita/year, and for 2013 the target is 33 kg/capita/year. The increase per capita consumption is driven by public awareness that fish is a nutritious food, beneficial for human health.

"We have been together with industry and the government. The Ministry of Marine Affairs and Fisheries has set a target of aquaculture production amounting to 16.9 million tonnes for 2014, and MS will strive to contribute to this target."

MS is also recognised for its role in the development of marine and freshwater fish feeds. It is one of the few companies producing and marketing marine fish feeds. Today it markets the *Megami* brand and has become one of the top suppliers of feeds for the production of various species of groupers in Indonesia and Malaysia. In 2000 it started the production of pelleted feeds for freshwater fish feeds, namely for the *Clarias* catfish and tilapia. It was the first local company to produce extruded feeds for tilapia in 2002. Other firsts have been the launching of the ISO 9001:2000 program for feed quality in 2007 and later its upgrading to ISO 9001:2008.

## QINS

In her speech outlining the progress and achievements of the company, Puspita Dewi said the success was a result of its core values: Quality, Innovation, Nurture and Smart Solutions or QINS.

"Our special strength is to always maintain the quality of our products with good raw materials. Our creativity and small organisation structure allow us to develop close relations between customer and company. We can do this as we synergise with farmers and work with them to constantly develop innovations for the market. For example, we develop feeds for the different shrimp culture systems. We nurture farmers to reach success and with smart solutions, MS works closely with industry to find ways to increase production efficiency. We have launched a new *Clarias* catfish hybrid called 'Lele MASAMO' to maximise production.

## New logo

As it is already in the international markets, the next step is to be go full gear . A new logo was launched at this 25th anniversary celebration.

"The name PT Matahari Sakti was derived from the Indonesian language; Matahari means sun, while Sakti means 'mighty'. Today, we have a new logo which will be the vehicle for our future expansion," said Puspita Dewi. "The new logo signifies a new spirit to welcome the next phase of growth."

The new management team comprises Tsang Joshua Ardy, Rudy Purwono, Teddy Njoto and Felice Prijadi. There is also a new website (www.mighty-sun.com)


*Puspita Dewi Prijadi (second left) with, from left, Teddy Njoto, Tsang Joshua Ardy and Purnomo*

## CSR role

During the celebration dinner, MS presented awards to the 11 most loyal customers who sell or use MS products and three of the most loyal employees. As part of its Corporate Social Responsibility (CSR) program, MS gives donations to seven social foundations and scholarships to eight students from four state universities in Indonesia- Brawijaya University in Malang, Airlangga University in Surabaya, Gadjah Mada University in Yogyakarta and Bogor Agricultural Institute.

"In the industry, we have evolved from zero to good. Our mission is to achieve excellence." After 25 years Puspita Dewi and her team are ready to transform MS from 'good to great.'

# Certification and market compliance at ESE 2013

The 21st edition of the European Seafood Exposition in Brussels was larger with 1694 exhibitors and visitors from 140 countries. Various stakeholders made the most of this largest gathering of the global seafood product industry to conduct their annual conferences and other trade events. This year, the new additions were the Department of Fisheries (DOF), Thailand which conducted a seminar on 'Thai Seafood Industry in compliance with the EU requirements'. The Sri Lanka government had a press conference on 'Fisheries Sector Developments in Sri Lanka' to bring to the attention of market players the latest developments taking place in the industry which is complying with international standards.


*Vinh Hoan Corp's Fish' in Wrap was in the finals for the Prix d'elite in 2013. It is marinated pangasius fillet lemon pepper in pastry leaf. Seated, Anton Immink, Sustainable Fisheries Partnership (right) with Vo Duc Phu, Vinh Hoan Corp.*

The Vietnam Association of Seafood Exporters and Producers organised a press conference with the title 'Vietnam Fisheries Aquaculture: Clean in Farm - Clear Informed'. In organic aquaculture, there was an open discussion of risks and potentials of Europe's organic aquaculture regulation organised by the SEAT (Sustaining Ethical Aquaculture Trade), Naturland and Organic Services. Loni Hensler presented a case study of Bangladesh shrimp and showed how the organic aquaculture has transformed the value chain. The Seafood Prix d'elite which names the best new retail and foodservice seafood products of the year and also recognizes innovative seafood companies with special awards for health and nutrition, retail packaging, originality, convenience and seafood product line had Vietnam's Vinh Hoan Corp's Fish' in Wrap as one of the finalists.

## New name for 2014

In 2014, the European Seafood Exposition will be renamed Seafood Expo Global. It will be held from 6-8 May 2014 in Brussels. The name change is part of the 2014 global rebranding and marketing initiative planned by the exposition's producer, Diversified Business Communications.

"This rebranding initiative is more than just giving new names to our quality seafood events," said Mary Larkin, vice president, Seafood Expositions. "It unifies all Diversified events serving the global seafood industry under one recognisable strong brand including the new website www.seafoodexpo.com. Asian Seafood Expo in Hong Kong will serve the Asian region and Expo North America in Boston the North America region.

*Dr Wimol Jantrarotai, director general DOF Thailand (left) at their seminar*

## Solutions for aquaculture buyers

At its annual news conference, Kristian Moeller, director GLOBALG.A.P. shared the latest developments in aquaculture traceability and several new solutions. There is the holistic approach to farm assurance with food safety, animal welfare and traceability with GlobalGAP. "However, when a producer says that this is too much, there is a subset or entry level LocalGAP. We have designed a customised subset for example removed one part such as animal welfare. This is new in aquaculture but has been used in crops and produce where the entire South African retail industry has joined this set up for their small growers."

GlobalGAP is the specialist on the farm but with several other standards around, a major achievement for the aquaculture industry as a whole is the collaboration agreement with the other two leading aquaculture certification program and labels, the Aquaculture Stewardship Council (ASC) and the Global Aquaculture Alliance (GAA).

Moeller also announced the first aquaculture certification in North America. All eggs produced by Troutlodge's operations in Washington State, USA will be certified under this program, as the company believes demand for GlobalGAP - certified eggs will continue to grow in the coming years. Andrew Barfoot, vice president of sales and marketing for Troutlodge said, "We began this process at the request of two key customers in Turkey who are certified under this program, and thus require that their egg supplier also obtain the same levels of certification. We are glad to be able to meet their needs, as well as the needs of a growing number of our customers who are considering certification under this and similar programs."


*The QR code for Aquaculture at the GlobalGAP booth*

Some solutions for aquaculture buyers were introduced. The QR Code for Aquaculture will give consumers instant re-assurance with the new


*Label Rouge shrimp from Madagascar at the Bureau Veritas booth. It also presented ASC certifications to Vietnam's pangasius producers, Godaco, To Chau, Cuu Long and Hung Ca*

GlobalGAP Design QR code. Using their GGN, the Design QR code links straight back to the database which instantly confirms the validity of their certificate. Consumers will be able to tell if there have been some problems with the product. GlobalGAP Bookmarking is a timesaving management tool which by bookmarking their registered producers, suppliers and buyers can generate online lists of their certified producers supplying them, including the respective GGN and products covered by the certificate, which make it easy to manage and monitor the certification status of their certified producers on a regular basis. With Bookmark Sharing, suppliers and buyers can share their bookmarking lists with selected business partners throughout the supply chain. As these lists are online, the displayed certification status and other information remain up-to-date.

## Building momentum

At the Aquaculture Stewardship Council (ASC) conference, **Chris Ninnes**, CEO outlined the achievements and developments in the last 12 months. The conference also included talks by China Aquatic Products Processing and Marketing Association (CAPPMA) and the Sustainable Trade Initiative (IDH).

Over the last year, ASC has built momentum and to date, the ASC (MSC) chain of custody (CoC) which opened in February 2012, has 17 certifiers accredited for CoC audits and 3 accredited for farm audits. With regards to the Tilapia standard, 24 tilapia farms have successfully gained certification for meeting the robust ASC standards. These are in Indonesia, Malaysia, Vietnam, Taiwan, Ecuador, Honduras and Costa Rica. Ten more are in the process of certification.

Accreditation for the Pangasius standards opened in April 2012. Some 68 certified tilapia products are available in European and North American stores. There are 240 certified pangasius products available in stores in Europe, 113 of them in the Netherlands. ASC Pilot on all other species covers 14 countries with 3 farms, each for the abalone and bivalves, 5 farms for the trout, 11 farms for the salmon and 12 farms for the shrimp.

Some recent initiatives are the Feed standard. "The standard will set out the requirements for the aqua feed industry to operate on a more environmentally sound and socially responsible basis," said Ninnes. "ASC's approach will look to also invite other certification platforms to participate in the development of these requirements, and ultimately use them so that we can collectively promote responsible feed use. This initiative will be managed by the ASC, will follow ISEAL protocols, and will encourage broad stakeholder participation. We expect to have this work concluded by the end of 2015."

**Dr Cui He**, vice executive president and secretary general of CAPPMA gave an analysis on 'China Tilapia Production and Trade Situation in 2012.' In 2012, trade was affected by the economic situation in the US and Europe, lower prices coupled with the appreciation of the Chinese Yuan and increasing costs such as for labour. The production was 1.45 million tonnes in 2012 and 1.44 million tonnes in 2011. In 2008 and 2009, production was lower because of the cold spells. As profit margins are decreasing, some tilapia farmers have been moving to other species. Most of China's tilapia production is for export.

The total export volume in 2012 was 362,000 tonnes. However, margins of the processing companies have been relatively lower than previous years. The value of the Chinese Yuan went up by 30% whereas labour costs doubled.

"In 2012, the market share of the Chinese tilapia in the US rose to 48% versus 42% in 2011. The market share in Europe has dropped which could be due to the requirement for certification. The EU-China Aid project 'Greening the Supply Chain of Chinese Tilapia' is focussed on production in Hainan Island which supplies 62% of the export volume to Europe," said He.

## Shrimp farmers in transition

IDH, the sustainable trade initiative is working towards responsible farming by building coalitions of companies, NGOs and governments. It designs programs for mainstream impact in sustainable production, and sourcing and provides co-funding private investments of up to 50%. In her presentation at the ASC and GlobalGAP press conferences, **Esther Luiten** Senior Program Manager Aquaculture, said that IDH started the Farmers in Transition Fund (FIT Fund) to support farmers to implement more sustainable practices to meet buyer requirements and help improve social and environmental performance of the sector. The shrimp farmers in transition program aims to accelerate shrimp farmers transition to farming methods that deliver responsible and traceable shrimp. Depending on the business profile, the shrimp species produced and the type of production system, the FIT Fund can provide for specific technical or financial support. The fund partners retail and food service companies to encourage suppliers to improve farming practices. The focus is on Vietnam, Indonesia, Thailand and Ecuador. The targets are 115,000 tonnes of responsibly produced shrimp by 2015. The second call for proposals will be by September 30, 2013

"Public funds are now available for shrimp farmers and feed suppliers and we are open to proposals from companies who see the value of making a change for supplier. Certification either through GlobalGAP, ASC or ACC can be targeted. In turn, this will give them greater access to national and international markets."

*At the ASC conference, from left, Cui He, Esther Luiten and Chris Ninnes*

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# ISMAF-2013: 'Mud crabs' renamed as 'Mangrove crabs'

Mangrove crabs (genus *Scylla*) are economically important brachyuran crab species. Their rapid growth, high market value, ease in post-harvest handling, make them an attractive alternative to shrimp farming in coastal areas. However, the exploitation of this valuable component of small-scale coastal fisheries in tropical and subtropical Asia has increased in recent years. Unless effectively managed, mud crab populations will result in increased fishing pressure and subsequent decline in the natural habitat.

*Mature mangrove crab at RGCA*

To meet these challenges, the Rajiv Gandhi Centre for Aquaculture (RGCA), the R & D wing of the Marine Products Export Development Authority (MPEDA) organised an International Seminar-Workshop on Mud Crab Aquaculture and Fisheries Management (ISMAF-2013) in collaboration with the Aquaculture Department of the Southeast Asian Fisheries Development Center (Philippines) at Sirkazhi, Tamil Nadu, India from 10 to 12 April, 2013.

The main aim of this 3-day event was to bring together mud crab scientists, industry practitioners/stakeholders, and academia from various parts of the globe to discuss the present status of the industry, share insights on relevant issues and identify the problem areas for further research and developments on mud crab aquaculture and fisheries management for a sustainable mud crab industry. The seminar cum workshop included presentations on the status of mud crab aquaculture in India, Philippines, Myanmar, Thailand, Indonesia, Bangladesh, Malaysia and China, and technical sessions on biology, ecology and physiology, genetics, domestication and selective breeding, husbandry, nutrition and diseases, fisheries resource management, post harvest product development and marketing.

*RGCA officials showing mature crabs to the ISMAF delegates*

*Interaction between delegates and presenters.*

This was the first of its kind of seminar cum workshop in India related to mud crab and the previous symposia on mud crab were held in Australia (1997), Philippines (1998, 2004), Vietnam (2001) and China (2009). The event witnessed a strong representation from India and abroad. A total of 110 Indian and 28 foreign delegates representing twelve countries (Philippines, China, Myanmar, France, Thailand, Australia, Kenya, Malaysia, Indonesia, Palau Island, Bahrain and Bangladesh) participated.

ISMAF-2013 was inaugurated by Dr B. Meenakumari, deputy director general (Fy), ICAR held at the Technology Transfer, Training and Administrative Complex of RGCA. In her address, Leena Nair, chairman of MPEDA and president of RGCA, pointed out the significant transition from shrimp-centric aquaculture to diverse species aquaculture and how the heavy disease-induced losses to shrimp farms have aided this shift. She highlighted the importance of the innovative research and role of MPEDA as a whole and RGCA in particular in mud crab research. India's great philosopher and scientist, Dr E.G. Silas later delivered the keynote address and co-related the current issues and future perspectives of the mud crab industry and research in India.

The workshop also had nine poster presentations which covered several aspects of mud crab aquaculture and fisheries management in several countries. The poster presented by Ganesh et al., RGCA entitled 'soft shell crab production using hatchery produced mud crab *Scylla serrata* seeds' was awarded first prize for its overall presentation and unique idea of using hatchery produced mud crab seeds for soft-shell crab production.

The seminar was followed by two workshops. The first was on biology and husbandry comprised a group discussing biology, genetics and ecology led by Dr Fe Dolores P. Estepa, P. Mohanasundaram and Dr A. Gopalakrishnan. The hatchery and soft shell group was chaired by Dr Emilia T. Quinitio, Dr E. G. Silas, Dr Ketut Sugama and Jerome Genodepa. Delegates raised several issues and also cleared some doubts regarding various aspects of mud crab research. The second workshop was on mud crab fisheries management and was chaired by Dr Jurgenne H. Primavera and co-chaired by Dr Junemie Hazel Lebata Ramos. This covered the area of mud crab and aquasilviculture.

There was also a panel session where members discussed various issues raised during the whole seminar, gave their views and provided valuable suggestions to the participants and delegates. During the session, the 'mud crab' was renamed as 'mangrove crab' by the delegates and it was decided to form a network of mangrove crab countries whose secretariat would be at RGCA-HO, India. The full report is available from RGCA, email: rgcacgl@gmail.com

# World Aquaculture 2013

**"Strike a Chord for Sustainable Aquaculture" was this year's theme for WA 2013 held at the Nashville Convention Centre, Tennessee, USA from 21-25 February 2013.**

By Eric Roderick

The "music city" hosted this year's Triennial, the largest aquaculture event anywhere in the world with just over 2500 participants registered from over 70 countries, including invited delegations from Pakistan and Nigeria and almost 1000 speakers in 15 concurrent sessions, making it a truly global event.

This year brought together a number of sponsoring and supporting organisations, which held their annual meetings here. These include the World Aquaculture Society (WAS), the National Aquaculture Association (NAA), the US Aquaculture Suppliers Association (USASA), American Tilapia Association (ATA), Striped Bass Growers Association (SBGA), and U.S.Trout Farmers Association. There were also special sessions run by the Aquacultural Engineering Society and the International Association of Aquaculture Economics and Management. **Jesse Trushenski**, the Steering Committee chair and his team produced a very diverse program, and all aspects of aquaculture were covered in the talks, the posters and also at the trade show. New sessions added this year include ones on open ocean aquaculture, integrated multi-trophic aquaculture, bio-fouling, conservation and restoration aquaculture, genetically engineered fish and shellfish, tuna, a history of aquaculture, ocean acidification and certification.

This year's keynote speaker was **Edward Allison** whose background is mostly from the fisheries sector, but he has aquaculture experience too, which enabled him to offer a broader perspective. In September he takes up a professorship at the University of Washington. He spoke on "Aquaculture in a Changing Climate" focusing on the implications of global and environmental change, and ocean acidification. Nutrition research was also a key issue with feed companies providing innovative solutions but which need to be shared with NGO's and development agencies particularly in developing countries. With aquaculture now producing over 50% of all fish and shellfish consumed globally and with more and more pressure on wild stocks, fish farmers need to look at all options for increasing production to feed an ever increasing global population. Despite the huge diversity of species, systems, and locations, aquaculture faces common challenges that everyone needs to work together to overcome.


*David Pullins and Huy Tran at Pentair Aquatic Eco-Systems which launched a range of commercial aquaculture products, including filters and pumps in March 2013. The new range has the controls as part of the pump unit.*

There was a full session organised by **Aquaculture Without Frontiers (AwF)**, the Global Charity started by Michael New from the UK. Speakers included Bill Mebane (MBL Sustainable Aquaculture Programme -Woods Hole USA) who discussed the current situation in Haiti, highlighting the main impediments to increased aquaculture production there, which included the lack of fry production and availability; poor fish feeds and the need for training and outreach projects. Other speakers included Kevin Fitzsimmons, Roy Palmer and David Little.


*The Zeigler team with Matthew Ziegler and Tom Welch presented new hybrid bass diets. They said that the fastest growing for aquaculture is Asia, especially Vietnam and India.*

Certification, as always, was a very important topic at the conference, with Aquaculture Stewardship Council (ASC) Global G.A.P. and the Global Aquaculture Alliance's, Best Aquaculture Practices (BAP) competing directly for clients on a global basis. The ideal scenario would be a single standard, to enable producers and consumers to have a more transparent view of the sector. David Little from Stirling University gave an overview of the SEAT project (Sustainable Ethical Aquaculture Trade) which is a decision support tool, based on unbiased third-party research, which gives information about sustainable seafood to supermarkets and other stakeholders. SEAT works with some of the certifiers above to provide feedback from consumers to farmers, so they can better understand the consumers' requirements.


*Darryl Becker and Bob Annan at the Extrutech booth said that there was more interest in this show than in past years.*

There were also sessions on Sustainable Aquaculture, Best Management Practices (BMPS), and Environmental Impacts of US Aquaculture with lots of lessons learnt after the BP oil spill. Traceability was another keyword, highlighting the importance of being able to track the fish from farm to plate. On the day the conference started, USA Today, ran a story on its front page with the title "Fishy fakes common in stores and restaurants" with a new study showing that fish fraud is "off the scale". This was a 2-year report conducted by Oceana, the world's largest ocean conservation group, where fish samples were collected from 674 supermarkets, restaurants and sushi counters in 21 US states. They found that 87% of snapper samples were not snapper, and white tuna was mislabelled 59% of the time. Between one-third and one-fifth of the halibut, grouper, cod and Chilean sea bass tested were mislabelled. The story was also covered during the day on CNN, highlighting the importance of traceability and food chain management.


*Niels Bengt at the Andritz Feed and Biofuel A/S. Its main markets are in Latin America, especially Chile and Asia.*

Nutrition featured prominently, with replacements for fishmeal discussed, along with many alternatives to live feeds (artemia) for larval rearing. Biofloc systems featured too. Algae is the new buzzword in aquaculture nutrition, and recent research indicates that algal extracts can replace fish oils in many fish diets. Nutrition and larval rearing are seen as the major obstacles to the farming of many new species, and as such attract much industry research funding. Alltech, which had a large prominent booth at the trade show, is currently very focused on algae research having purchased a big algae production plant to enable large scale production of algae for inclusion in fish and animal feeds. They also sponsored several of the conference sessions along with Novus, Merck and Tyson.


*Joe Kearns (left) and Curtis Strahm at the Wenger booth*

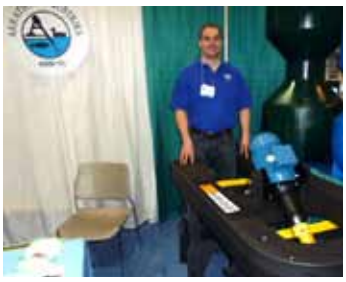
The tilapia sessions which included the **American Tilapia Association** annual meeting was well attended, and the ATA president Bill Varano, gave an overview of the tilapia situation in the USA. Global tilapia production reached 3,770,000 tonnes in 2012 but only 5% of the tilapia consumed in the USA (total value of USD 838 million) was home produced, with 95% being imported and there were calls to try and expand domestic production. With production costs at an all-time high, and prices of tilapia relatively stable, it was a difficult time for US producers, and many of them focused on the live markets, which gave them a premium price for their product. It was agreed that the ATA needs to become more involved in marketing locally produced tilapia, to try and compete with lower cost imports from less regulated non-American sources.

All WAS shows feature the Employment Booth as always run by John Ewart, and this is often a bellwether for the health of the industry showing whose hiring, and how many are looking for work. Overall there were plenty of jobs advertised, but some very well qualified people looking for work too.

The trade show covered every product for aquaculture perhaps many, you did not know you needed until you saw them. Talking with many of the 160 exhibitors, it was a much busier show than the previous 2 years, hopefully showing an upturn after the global recession. At the Skretting, booth, the team said that the show had been busy for them. Their current focus is on sustainability and they are also focussing on the growing market in China. They gave a presentation on their new microdiets at the show. At their booth, the Wenger team of Joe Kearns and Curtis Strahm reported a higher attendance than normal with good footfall. "Interesting presentations and good contacts made," said Kearns.

One of the largest and most elaborate booths at the show was the Pentair Aquatic Eco-Systems booth. Since taking over Aquatic Eco-Systems and Point Four Systems recently, and taking on Tom Losordo and Dennis Delong, Pentair is showing their commitment to the future of aquaculture through aquaponics and recirculation aquaculture systems (RAS). Pentair LLC is a global giant. The increased investment has also enabled AES to run workshops and offer greater technical support to the industry.

At Aeration Systems, Marcos Kroupa said that they could interact well with people. Vietnam is a growing market and they are trying to expand the Asian market generally. The new product is the Aire-O2® U- Float which offers significant freight savings as more can be fitted into a standard shipping container with the U-Float design. With the World Aquaculture Society conference in Jeju, South Korea in 2015, a trade delegation from Korea came to Nashville. This included two Korean companies exhibiting for the first time in the USA. They were A-mi Corporation which specialises in airblowers, diffusers submersible pumps etc, and Dae Yang Airstone Company Ltd which produces a full range of air stones and diffusers for all aquatic uses.



*Marcos Kroupa at Aeration Systems*

*John Cooksey*

The WAS conference manager, **John Cooksey** has been managing these events for many years and as always he and his family and their team ensured everything ran smoothly and on time. This year John received the Exemplary Service Award for services to WAS which he received on behalf of his family and Mario Stael who runs the trade shows.

From talking to a broad spread of delegates from industry, academia and government institutions, there is a general consensus that aquaculture is weathering the global financial situation better than most and there is overall optimism amongst the stakeholders.

Next year Aquaculture America will return to Seattle (7-11 Feb 9) and the World Aquaculture meeting will be in Adelaide Australia from June 2014.

**Eric Roderick** is CEO of Fishgen. At this event, he introduced the YY male tilapia technology developed by Fishgen. He is involved in projects in more than 30 countries. Email: eeroderick@aol.com

# Custom research feeds and National Exporter of the Year Award

**Zeigler Bros.,** Inc. has announced that it will provide extrusion capabilities for pilot and custom research feeds. In a press release, it added that the latest generation of extrusion technology from Wenger Manufacturing provides flexibility for unique processes requiring extreme operating parameters. Along with Zeigler's formulation and processing support, the company can offer a range of solutions for custom and pilot manufacturing needs. This service will open an important new avenue to researchers, farm owners and managers and anyone in both the public and private sector seeking high tech custom diets.

In May, Zeigler also announced that the U.S. Department of Commerce, the U. S. Small Business Administration (SBA) and the State of Pennsylvania have extended awards to the company for its export achievements. As one of ten regional finalists, Zeigler then was selected as SBA's National Exporter of the Year during World Trade Day in Denver. At the federal level, Zeigler has also been chosen as a 2013 recipient of the President's National Export or "E" Award presented by the Department of Commerce in Washington D.C.

Zeigler, a third generation family-owned business specialises in the formulation and manufacture of high-end, specialty feeds for the aquaculture, pet and bio-medical research industries. The company also operates a franchise program that transfers technology to international partner feed mills.

The company's quality program is ISO 9001:2008 certified and produces over 300 products ranging from microscopic liquid diets for shrimp larvae to feeds for exotic reptiles. Continuous innovation and pursuit of new markets are fundamental to Zeigler's strategy and its recent success in expanding international sales. International markets have played an important role in Zeigler's business.

Recently growing demand and aggressive market expansion have drastically helped spur international sales to where the company now exports to over 40 countries. Sales in well established markets throughout Latin America continue to grow, and new efforts to expand business elsewhere are proving successful, particularly in West Africa and Southeast Asia. Zeigler's franchise program presently has active operations in Los Mochis, Mexico (Nutrición Marina S.A de C.V.), Guadalajara, Mexico (Los Belenes, Pronua S.A. de C.V.), and a third plant in Ecuador (PCO Cia. Ltda), scheduled for start-up later this year.

"Over the past four decades, we have retained a strong emphasis on innovation," explained Tim Zeigler, vice president, sales and marketing. "Our father instilled this philosophy back in the late 1960s when the commodity feed market was going through difficult times. He recognised the need to innovate and seek out niche markets. As a result, the company began to take on new challenges, travel to different places, understand global needs, and identify unique opportunities where we could deliver sustainable value."

Zeigler was founded in 1935 by brothers Ty and LeRoy Zeigler. In 1967, leadership passed to LeRoy's son, Dr Thomas Zeigler, who transitioned the company from a manufacturer of farmed feeds to an internationally recognized producer of specialized animal feeds. Beginning in the 1980s, the company started to license nutritional and manufacturing technologies globally under its Zeigler brand. Today, with Dr Zeigler supporting R&D efforts, his sons Tim, and Matt Zeigler, direct the company's operations with a renewed spirit toward technology and innovation.

A strong reputation for innovation and customer satisfaction has been critical to Zeigler's success, all made possible through a dynamic team dedicated to the company's mission to be recognized as a global leader. Zeigler is able to attract and retain skilled team members specializing in manufacturing, nutrition, biology, international business and logistics. Knowledgeable and passionate employees are absolutely essential to Zeigler's highly diverse and unique product offerings. More information: www.zeiglerfeed.com Email: info@zeiglerfeed.com

## New Appointment

### Strengthening technical support

**Dr Philippe Sourd** has recently joined the AQUATIV team as a Fish Health Specialist to support the health benefits demonstration of their products.

Aquativ is part of DIANA group, world leading natural ingredients manufacturer and provides feed manufacturers with competitive and local products. The company offers a unique range of marine based functional hydrolysates (liquids and powders) bringing an exceptional functionality to the feed. In addition, thanks to its scientific resources, Aquativ is today the sole player able to demonstrate the hydrolysate bioactivity and health benefits.

Philippe will provide scientific communication linked to the health benefits of Aquativ products and will also be the world referent for fish technical support for the Aquativ activity. Philippe qualified as a vet in France and specialised in aquaculture and fish health just over 10 years ago. He then moved up to the North of Scotland to work for Fjord Seafood. After 4 years in this role, he joined an independent fish vet in France to build up in 5 years one of the most successful fish vet consultancy service in continental Europe, bringing health services to the aquaculture industry across the whole of Europe and North Africa. Email: psourd@diana-aqua.com Web: www.aquativ-diana.com

# Strategic alliance to research aqua nutrition

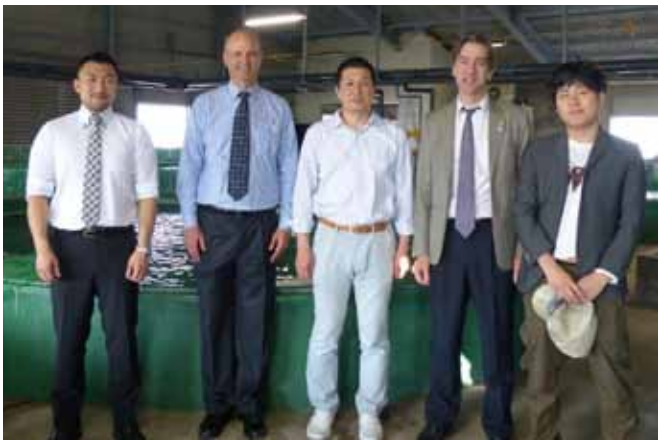
Global animal health and nutrition leader Alltech and Kochi University have signed a five-year strategic research alliance to study yellowtail and amberjack nutrition.

"Alltech has been successfully partnering with top academic institutions in the form of research alliances throughout the world with the common goal of finding long-term solutions to the key issues facing our industry. We are very excited to work with Kochi University in researching natural ways of increasing production efficiency in the aquaculture sector, particularly since aquaculture is one of the most promising industries for growth as we look to feed an increasing global population," said Dr Karl Dawson, chief research officer at Alltech.

This five-year agreement underscores applied research alliances as one of most valuable public-private partnerships, which create value and drive development in the Japanese aquaculture sector and beyond. Kochi University has a cooperative agreement with the city of Konan and plans to rent a large aquaculture facility that belongs to Konan city from this July. The facility has 18 tanks (30 $m^3$ each) and many small tanks for smaller fish (0.25 $m^3$, 0.5 $m^3$, 0.8 $m^3$ and 1$m^3$), which provide sterile borehole seawater with a permanent temperature of 16-28°C.

Alltech will share its more than 33 years of high-end research in improving meat quality of different animal species to jointly develop special nutritional diets to improve the meat quality and shelf life of amberjack and yellowtail marine water species. Supported by Dr Satoh from Tokyo Marine University, Alltech and Kochi University will further study the application of Aspergillus niger extracts to reduce FM inclusions in yellowtail and amberjack diets.

"The Japanese aquaculture industry is facing difficulties such as low fish market prices and high feed costs. We are delighted to work with Alltech, a company who has developed unique products and effective solutions to meet the challenges of the aqua farming industry. By researching the animal diet, we hope to be able to help farmers and producers reduce their feed cost and produce healthier fish. We strongly believe that the research alliance program will help us reinforce our contribution to the industry and further more to the whole society," said Dr Haruhisa Fukada, Associate professor.



*Kei Nakayama, Keith Filers, Prof. Haruhisa Fukada, Serge Corneillie and Hiroshi Yabuki launching the research alliance partnership Alltech-Kochi aqua facility in Konan city, Kochi, Japan*

In 2012, Alltech and the Norwegian Institute of Food, Fisheries and Aquaculture Research (Nofima) entered a three-year strategic research alliance. Nofima is working with Alltech in the understanding of microalgae in modern feed formulations and their role in health, performance and flesh quality. Alltech Algae in Winchester, Ky., one of the largest algae production facilities in the world, is exploring the applications of algae in animal nutrition and aquaculture.

By the close of 2013, Alltech anticipates signed research alliances with 17 academic and research institutes around the world; to date, more than a dozen alliances have been formalized. More information: www.alltech.com

# New aquaculture data app

YSI, a Xylem brand has made available its new AquaViewer® App for download from the Apple App Store. For customers already using any of its continuous water quality monitoring instruments, YSI 5200A, 5400, and 5500D, they can now get access to crucial data in real-time on their iPhone, iPad, and iTouch devices.

"With so much invested in their livestock, we're always looking for innovative ways to get critical water quality data into the hands of our customers," says Tim Grooms, YSI director of Water Quality Products. "The YSI AquaViewer app displays the data they need, like real-time sensor and auxiliary data, from virtually anywhere with wi-fi or internet connectivity."

YSI continues to make easy-to-use, easy-to-understand, and easy-to-configure products. Setting up the YSI AquaViewer is straight-forward. Contained in the app are easy-to-follow display screens for set-up, for the instrument being monitored, and for the sensor in use. A colour-coding system is used to provide a quick visual understanding of the tanks' or ponds' conditions. Red indicates an alarm condition, yellow indicates a control condition, and green and black are used to indicate an acceptable operating range system condition. Communication occurs either by directly connecting to the YSI instrument via internal ethernet device or via communication connection to a PC running AquaManager PC software. The AquaViewer app download contains a user guide that includes: system/user requirements,app screen descriptions and configuration and operating instructions. To download YSI AquaViewer App, visit the Apple App Store and search for 'Aquaviewer'" (More information:www.ysi.com/aquaviewer)

# First to comply with new ASC-standard

The BioMar factory in Brande, Denmark, which among other products produces fry feed for all of BioMar's markets in Europe, is the first feed plant in the world, audited and found to comply with the new ASC-standard for salmon and trout.

"We are very pleased about this approval, as it means, that fish farmers, who want to become ASC certified, can utilise our feed, says Ole Christensen, managing director for the BioMar factory in Denmark. Christensen notes with satisfaction, that the systems, BioMar has put in place to document responsible purchasing of e.g. fish meal, fish oil, and soya, are working according to the intentions.

The ASC-logo gives an assurance to consumers, that fish products originating from aquaculture, have been produced in a socially and environmentally responsible manner. The Aquaculture Stewardship Council (ASC) is as an independent, not-for-profit organisation co-funded by the World Wildlife Fund (WWF) and The Sustainable Trade Initiative in 2010 to manage the certification of responsible fish farming across the globe.

Chris Ninnes, CEO, ASC, explains that the feed sector plays an enormously important role in securing the success of the ASC and also that of the fish farming sector when it takes on the challenges that are posed in only buying feed from demonstrably responsible sources. Some of the efforts required by the feed suppliers are to ensure that all raw materials are traceable to source; that it can be demonstrated that they do not contain species of conservation concern, or are derived from illegal operations.

Some of the major source materials used in feed can have significant environmental impacts and these need to be reduced. Adoption of best practices will do much to reduce these impacts and the concerted efforts of the feed producers and fish farmers will be pivotal to drive these changes, says Chris Ninnes.

While the ASC logo is still new and relatively unknown it can be compared to the MSC eco-label, which has in just a couple of years become a well-known symbol guaranteeing that the wild caught fish and fish products originates from sustainable fisheries and has been manufactured in a responsible manner. After the initial launch of the ASC standard for pangasius and tilapia, it is now the time for trout and salmon to be certified and a large number of fish farmers are going for the ASC –certification. (www.biomar.com)

# Mycotoxin Survey Program 2012

The 2012 drought in the US and the recent aflatoxin scandal in Europe has raised awareness once again of the mycotoxin problem facing the industry. With more than 4,000 samples collected worldwide and almost 14,500 analyses conducted in the past year alone, BIOMIN has released its most complete and comprehensive mycotoxin report on the market to date.

Biomin has been conducting extensive studies documenting the occurrence of mycotoxins worldwide since 2005. Once again, the Survey Program 2012 details the distribution of mycotoxins according to their region of origin and commodity type. From January 2012 until December 2012, a total of 4,023 samples collected worldwide were analyzed. In total, 14,468 analyses were carried out for the most important mycotoxins in terms of agriculture and animal production – aflatoxins (Afla), zearalenone (ZEN), deoxynivalenol (DON), fumonisins (FUM) and ochratoxin A (OTA).

In addition to these mycotoxins, European samples were analysed for T-2 toxin (T-2). Due to lab regulations in other parts of the world, the presence of this mycotoxin was not tested for in other regions. Samples tested were diverse, ranging from cereals such as corn, wheat, barley and rice to processing by-products, namely soybean meal, corn gluten meal, dried distillers grains with soluble (DDGS) and other fodder such as straw, silage and finished feed. In the more than 4,000 samples analysed, Afla were present in 25 %, ZEN in 46 %, DON in 64 %, FUM in 56 % and OTA in 31 %. Average contamination levels of all samples were 34 ppb for Afla, 251 ppb for ZEN, 1088 ppb for DON, 1350 ppb for FUM and 5 ppb for OTA. Compared with data from the previous year, an increase in the occurrence of fusariotoxins (DON, FUM and ZEN) was observed together with a slight decrease in Afla.

The survey confirmed once more that mycotoxins are a ubiquitous problem as 82% of the analysed samples show the presence of, at least, one mycotoxin. The presence of more than one mycotoxin in 50% of the samples raises attention to another problem - the synergistic effects caused by multiple mycotoxins in animal feeds.

The full report is availbel at www.biomin.net or get the Mycofix® app, for instant access to worldwide data on mycotoxin occurrence and information on the possible risks resulting from mycotoxins. The app is optimised for all iOS (Apple) and Android smartphones and tablets and is available in the iOS App Store and on Google Play.

# 2013 Asian Seafood Exposition

**3-5 September**
**Hong Kong**

The Asian Seafood Exposition announced that there will be a special focus on premium seafood products when the show returns to Hong Kong this year from September 3-5, 2013. The expo will take place at the Hong Kong Convention and Exhibition Centre. This trade event annually attracts over 6,000 buyers from 50 countries and more than 150 exhibiting companies from 25 countries including China, Japan, Korea, Australia, Canada and the United States.

Mary Larkin, vice president of Seafood Expositions at Diversified Business Communications, organiser of Asian Seafood Expo, said, "This focus on premium seafood such as lobster, shellfish, finfish is a result of the demand from buyers attending the event. Our plan is to have the Asian Seafood Exposition serve as the meeting place to conduct business with a diverse roster of companies interested in the entire Asian seafood market, not just mainland China. Specifically, we see demand in Asia for products from many countries including Australia, Canada, and United States.".

Research indicates that there is a strong link between income growth and seafood consumption.

"Rising wealth and income levels in China are creating an increasing appetite for premium seafood products, both domestic and imported, which in turn is providing new opportunities for producers and exporters of high-end fish and seafood products."

Hong Kong was selected as the location the annual Asian Seafood Exposition and Larkin remarked that the territory is well positioned as a re-export centre for seafood products in Asia.

"The Asian Seafood Exposition connects exhibitors with attendees not only from China but from across the globe. Hong Kong possesses a modern and efficient port terminal and free port status, making it a critical hub for the Asian seafood market. In fact, 30% - 40% of seafood imported into Hong Kong is re-exported to markets such as the United States, China, Macau, Taiwan and Vietnam."

Larkin also points out that Hong Kong itself enjoys a growing and competitive seafood market.

"The Asian Seafood Exposition is in its fourth year and still a newer exposition, compared to our other seafood events like Seafood Expo North America in Boston, United States and Seafood Expo Global in Brussels, Belgium. The exposition benefits from Diversified Business Communications (the producer of these expositions) network of over 200,000 seafood professionals worldwide. Nevertheless, the Asian Seafood Exposition has gained a great momentum. Attendees and exhibitors alike see the opportunity to grow their business in the Asian market and benefit from the level of international involvement and focus on premium seafood. We are committed to providing a forum for buyers and sellers to meet in this region," said Larkin. More information: www.asianseafoodexpo.com

APA13
POSITIONING FOR PROFIT

# Internship Challenge

Novus International, Inc. has announced the sponsorship of the Novus World Aquaculture Society (WAS) Internship program. Aquaculture has a bright future, as it represents the fastest growing animal production industry. Novus recognises the need for the industry to attract and educate talented individuals to become future aqua research scientists and nutritionists. This internship program represents an investment by Novus into the future of the aquaculture industry. All eligible candidates are encouraged to apply.

Health problems continue to challenge aquaculture development and expansion. Viral, bacterial, fungal or parasite infections whether from new emerging pathogens or well-known diseases, often leave producers with few available treatment or prevention options and significant losses. To be considered for the internship, please present a proposal that includes the following:

- Choose a model disease and suggest an experiment aimed at testing a novel possible preventive or treatment solution.
- Provide background literature review on the pathogen, pathogenesis, epidemiology and/or host pathogen interactions etc. as appropriate to support experimental designs and hypotheses.

Proposal to be submitted by **August 16, 2013** describing an innovative testable proposal in the area described above. Proposals should be limited to two to three typewritten pages plus references. A one-page CV of the candidate should be attached to the proposal. Applicant must be enrolled in a University MSc or PhD program at the time of application.

The selection of the Novus intern will be announced at Asia Pacific Aquaculture 2013 (APA 2013) in Ho Chi Minh City, Vietnam. A digital photograph of the intern will be needed for the announcement. Following the selection, the four-week internship will be scheduled from June to August, 2014.

The intern will work with The Novus Aquaculture Research team on a current project being carried out at the Novus Aqua Research Center in Vietnam. Vietnam is the third largest aquaculture-producing country in the world. Our Novus Aqua Research Center is integrally connected to the aqua industry and will allow the intern to learn about and experience aquaculture in Vietnam through interactions with the Novus research and operations teams. The award will include:

- Travel to and from Ho Chi Minh City, Vietnam
- Lodging in a university student dormitory in Vietnam during the internship
- USD1,000 to help with living expenses in Vietnam

Submit proposals by email to Lorraine Magney at Novus: Lorraine.magney@novusint.com

# What to look forward to in AQUA Culture Asia Pacific in 2014

As we celebrate our tenth anniversary in 2014, we will continue to bring you issues relevant to the industry, predict trends and update you with technologies to help the aquaculture industry in Asia Pacific move to the next level.

| Volume 10 2014 | | | | | | |
|---|---|---|---|---|---|---|
| Number | 1 – **January/February** | 2 – **March/April** | 3 – **May/June** | 4 – **July/August** | 5 – **September/ October** | 6 – **November/ December** |
| **Issue focus** *Recent developments and challenges for the next step* | Aqua Feed Production | Health Management | Hatchery & Breeding technology | Industrialisation | Sustainable & Responsible Aquaculture | Culture technology |
| **Industry Review** *Trends and outlook, demand & supply* | Marine Shrimp | Tilapia | Marine Fish | Catfish | Marine fish | Freshwater Fish/Prawn |
| **Feeds & Processing Technology** *Technical contributions influencing the final value of aqua feeds* | Feed additives Processing technology | Novel feed ingredients | Phyto ingredients Feed management | Feed enzymes Product quality | Feed probiotics Good manufacturing practices | Nutrition & Formulation |
| **Production Technology** Technical information and ideas | Culture & Biosecurity | Genetic Improvements | Recirculation Aquaculture Systems | Hygiene & Food Safety | Certification and Regulations | Health Management |
| **Aqua business** Feature articles | Experiences from industry, including role models, benchmarking and opinion articles in shrimp/fish culture | | | | | |
| Markets | Market trends, product development and promotions at local and regional trade shows | | | | | |
| ***Deadlines for articles in 2014*** | **November 11 2013** | **February 3** | **April 2** | **June 2** | **August 1** | **October 1** |
| ***Show Issue & Distribution at these events as well as local and regional meetings*** <br> ****Show preview*** | **Aqua India 2014** 24-25 January Vijayawada, India <br> **Aquaculture America 2014** February 9-12 Seattle, USA | ***FIAAP/VICTAM Asia 2014** April 8-10 Bangkok, Thailand <br> **Global Seafood Expo 2014** May 6-8 Brussels, Belgium | ***World Aquaculture 2014** June 7-11 Adelaide, Australia | **The Aquaculture RoundTable Series (TARS 2014)**- (TBA) <br> **Vietfish 2014** August 6-8 Ho Chi Minh City, Vietnam | **19th China Seafood & Fisheries Exposition 2014** November China (TBA) | |
| ***Deadlines Advert bookings in 2014*** | **December 3, 2013** | **February 7** | **April 8** | **June 9** | **August 7** | **October 8** |

# Indian International Seafood Show 2014 (IISS)

**January 10-12, 2014**
**Chennai, India**

The Marine Product Export Development Authority (MPEDA) and Seafood Exporters Association of India (SEAI) will be organising the 19th edition of the Indian International Seafood Show 2014 (IISS) from 10-12 January 2014 at the Chennai trade Centre, India. IISS-2014 promises to be even bigger and better than the previous editions. This year the focus is on "Quality and Production Infrastructure" of Indian seafood to the global seafood industry.

In its press release on the show and India's seafood industry, MPEDA's chairman Leela Nair said that during the 2012-13 financial year, exports of marine products reached an all-time high of INR 18,856 crores or USD 3.5 billion and crossing all previous records in quantity, rupee value and USD terms. Exports aggregated to 928,215 tonnes. Compared to the previous year, seafood exports recorded a growth of 7.68% in quantity, 13.61% in rupee and 0.1% growth in USD earnings respectively. The largest export commodity was frozen shrimp at 52%. Higher volumes and value were attributed to the increased production of vannamei shrimp.

The Indian seafood industry has now come a long way with a major position in the global seafood mark, added Nair. Exports markets for its seafood are led by South East Asia (37%), EU (17%), USA (10%) and China (9%). It is the third and fourth largest exporter of shrimp to Europe, Japan and US. MPEDA envisages an ambitious target of USD 4.3 billion for the year 2013-14 which will come with increased production of vannamei shrimp. Quality control measures and increase in infrastructure facilities for production and value added items are expected to help in achieving this target.

IISS-2014 will present tremendous scope for tapping new markets and introducing various technology and products to the global market. The show will be a great opportunity to forge new partnership and strengthen the existing relationship for all sectors associated with seafood industry.

More information: www.indianseafoodexpo.com. Last date for early bird discount is 30 September 2013.

# 2013-2014

**Details on the events below are available online at http://www.aquaasiapac.com/news.php To have your event included in this section, email details to zuridah@aquaasiapac.com**

## August 9-12
**Aquaculture Europe 2013**
Trondheim, Norway
*Web: www.easonline.org*

## August 21-22
**The Aquaculture Roundtable Series (TARs 2013) –Finfish Aquaculture**
Singapore
*Web: www.tarsaquaculture.com*
*Email: conference@tarsaquaculture.com*

## September 2-5
**Larvi 2013 - 6th Fish & Shellfish Larviculture Symposium**
Ghent, Belgium
*Web: www.aquaculture.ugent.be/larvi/index.htm*

## September 3-5
**Asian Seafood Expo**
Hong Kong
*Web: www.asianseafoodexpo.com*

## September 4-6
**Genomics in Aquaculture Symposium (GIA 2013)**
Bodø, Norway
*Web: www.gia2013.org*
*Email: secretariat@gia2013.org*

## September 22-27
**13th Annual Practical Course and Aquaculture Feed Extrusion, Nutrition and Feed Management**
Texas A&M, USA
*Web:www.tamu.edu/extrusion*
*Email:mnriaz@tamu.edu*

## October 7-10
**GOAL 2013**
Paris, France
*Email: homeoffice@gaalliance.org*
*Web: www.gaalliance.org/GOAL2013/index.php*

## October 6-10
**10th International Symposium on Tilapia in Aquaculture (ISTA10)**
Jerusalem, Israel
*Web: www.ista10.com*
*Email: kevfitz@ag.arizona.edu/ vlaqua@volcani.agri.gov.il*

## October 10-12
**Shanghai International Fisheries & Seafood Expo (SIFSE)**
Shanghai, China
*Web: www.sifse.com/en*

## November 5-7
**China Fisheries and Seafood Expo 2013**
Dalian, China
*Web: seafoodchina@seafare.com*
*Email: jennie8888@seafare.com (Jennie Fu)*

## November 7-9
**Expo Pesca & AcuiPeru**
Lima, Peru
*Web: www.thaiscorp.com*
*Email: thais@amauta.rcp.net.pe*

## December 10-13
**Asian Pacific Aquaculture 2013**
Ho Chi Minh City, Vietnam
*Web: www.was.org*
*Email: worldaqua@aol.com*

# 2014

## January 10-12
**Indian International Seafood Show 2014 (IISS)**
Chennai, India
*Web: www.indianseafoodexpo.com*

## January 24 -25
**Aqua India 2014**
Vijayawada, Andhra Pradesh, India
*Web: www.aquaprofessional.org*
*Email: aquaindia2014@gmail.com/ aquaprofessionals@gmail.com*

## February 9-12
**Aquaculture America 2014**
Seattle, USA
*Email: worldaqua@aol.com*
*Web:www.was.org*

## April 8-10
**FIAAP Asia 2014/Victam Asia 2014**
Bangkok, Thailand
*Web : www.fiaap.com/www.victam.com*

## May 25-30
**16th International Symposium of Fish Nutrition and Feeding**
Cairns, Australia
*Web:www.isfnf2014.org*

## June 7- 11
**World Aquaculture 2014**
Adelaide, Australia
*Web:www.was.org/ www.aquaculture.org.au*

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*We probably wrote about $5 million worth of business at the show and we would expect that to convert, on an annual basis, to around $10 to $12 million.*

Eric Barratt
Sanford Fisheries Ltd.

**November 5-7, 2013**

**ASIA'S LARGEST SEAFOOD SHOW**
**www.chinaseafoodexpo.com**

**Dalian World Expo Center, Dalian, China**

For more information contact Jennie Fu
jennie8888@seafare.com

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21-22 August 2013, Holiday Inn Atrium, Singapore

## TARS 2013: The Industry's Foremost Opinion-leading Aquaculture Event in Asia for the Third Successive Year!

**Finfish aquaculture**, especially from the Asia Pacific region is expected to contribute to the future global demand for food fish. While production systems in both freshwater and marine environments may vary geographically as well as the market focus, be it for the high value niche market or as a commodity, the potential is disadvantaged by the malaise in production from backyard operations, multispecies, lack of controlled systems, poor marketing, and the negative image of Asian finfish. Production has become more of an art than science. Asian producers continue to grapple with challenges such as increasing cost of production and cyclic demands.

The global white fish trade also requires that the complex intersection of changing market conditions with production methods address issues such as food safety and quality standards, as well as the ecological and genetic risks to the environment. There is growing momentum to educate and influence market demand to play a more responsible role in shaping future finfish production systems - industrialisation and integrating production, from breeding to farming to market distribution may just be the solution.

This is the premise behind the third Aquaculture Roundtable Series (TARS 2013). To be held in Singapore from August 21-22, 2013, the theme for **TARS 2013 is Finfish Aquaculture: Industrialisation and Sustainability** with specific emphasis on controlled production and science, rather than empirical production methods.

Following two successful meetings held in Singapore (2011) and Thailand (2012), the annual TARS roundtable format has become one of the industry's foremost opinion-leading aquaculture events in Asia. TARS provides a neutral platform for multiple stakeholders to come together to share knowledge and expertise in the different aspects pertaining to the aquaculture industry in Asia, prioritise areas for research and development and formulate strategies in light of current and emerging challenges facing the industry. TARS 2013 benefits multiple stakeholders from the academia, policymakers, NGOs, integrators, investors, farmers and technical staff, feed suppliers, ingredient and equipment specialists.

TARS 2013 is organized by **Aquaculture Asia Pacific** and **Corporate Media**, and supported by the **Agri-food and Veterinary Authority of Singapore (AVA).**

## Network with Stakeholders and Dialogue with Experts in the Field

Hallmarks of the Roundtable in Aquaculture Series (TARS) is a ***Plenary Session*** with a host of international experts from Asia, Europe, and Australia to present overviews as the starting point for the breakout session. In the ***Breakout Session*** participants will get to brainstorm and propose new directions to take the industry forward. It is likely that many groups will work on similar topics, giving a wider approach to industry challenges. Group come together for a ***Panel discussion*** on proposals for future direction.

Organisers:

Supported by:

Sponsors:

Media Partner:

**REGISTRATION**
The number of participants is limited to 200. Pre-registration is required and walk-ins are not encouraged. Register online or complete the registration form to reserve your space. You will be asked to specific your preferred area of interest for the breakout session.

**More Information**
Program and Speakers, click on: www.tarsaquaculture.com
Registration, click on: http://www.tarsaquaculture.com/registration.html
Email: conference@tarsaquaculture.com

REGISTRATION FEE SGD 800

**Fee includes opening day cocktail reception, tea breaks, lunch and conference materials.*

THE
# AQUACULTURE ROUNDTABLESERIES® 2013
A shared vision for aquaculture in Asia

## FINFISH AQUACULTURE: INDUSTRIALISATION AND SUSTAINABILITY
21-22 August 2013, Holiday Inn Atrium, Singapore

# PROGRAM HIGHLIGHTS

## DAY 1 - WEDNESDAY, 21 AUGUST 2013

**0730 - 0830 hrs**
**Registration**

**PLENARY SESSION:**
**International experts will present an overview of the state of each sector in the supply chain; from breeding, production management to image building, sustainability of the sector and marketing products.**

**0830 - 1000 hrs**
**Session 1: Breeding and Hatchery Management**

**Domestication and Selective Breeding in Asia: The Tilapia Model and Implications for the Marine Fish**
- **Morten Rye**, *Scientific Director, Akvaforsk Genetics Center, Norway*

**Industrial Finfish Hatchery in Asia: Towards Quality Barramundi Fry Production**
- **Frank Tan**, *Founder and Chief Operating Officer* / **Tan Kay Heok**, *Chief Scientific Officer, Marine Life Aquaculture, Singapore*

**Intensive Hatchery Management: Monoculture Production and Learning from Experiences in the Meditteranean**
- **Alessandro Moretti**, *Product Manager, Fish Hatchery Nutrition and Health, INVE Aquaculture, Belgium*

**1020 - 1040 hrs**
**Tea Break**

**1040 - 1230 hrs**
**Session 2: Production, Health and Environment**

*Part 1: Industry Reviews*

**Production Systems: Business Models, Efficiencies and Investor Outlook**
- **Bjørn Myrseth**, *CEO of Vitamar and Chairman of Morpol, Norway*

**Industrialisation and Sustainability in Tilapia Production – From Small Business to Market Leader: An Industry Perspective**
- **Freek Huskens**, *President Director, PT Aquafarm Nusantara, Indonesia*

**Industrialisation and Sustainability in Marine Fish Production in Asia**
- **Misai Tsai**, *Managing Director, PT Lucky Samudra Pratama, Indonesia*

**1230 - 1400 hrs**
**Lunch**

**1400 - 1520 hrs**
**Session 2: Production, Health and Environment (cont)**

*Part 2: Fish Health*

**Managing Fish Health in Tropical 'Open-Water' Systems – The Way Forward**
- **Norman Lim**, *Regional Technical Manager, Merck Animal Health, Singapore*

**Overcoming Bacterial Virulence Using Quorum Sensing – Hitting Below the MIC Belt**
- **Tim Goossens**, *R&D Engineer, Nutriad International NV, Dendermonde, Belgium*

**1520 - 1540 hrs**
**Tea Break**

**1540 - 1730 hrs**
**Session 3: Feeds and Feeding**

**Beyond a Vision of 2020: The Future of the Ideal Aquaculture Feeds in Asia**
- **Brett D. Glencross**, *Principal Research Scientist and Stream Leader for Aquaculture Feed Technologies Research, CSIRO, Australia*

**Evolution of Performance Feeds - From the Marine Fish to the Tilapia**
- **Michel Autin**, *Technical Director, BioMar West Med, Norway*

**Functional Nutrition to Sustain High Feed and Fish Performances**
- **Philippe Sourd**, *Fish Health Specialist (DVM), SPF-Diana, Aquativ, France*

**Question & Answer Session**

**1830 hrs**
**Cocktail Reception & End of Day 1**

## DAY 2 - THURSDAY, 22 AUGUST 2013

**0815 - 1045 hrs**
**Session 4: Marketing and Sustainability**

**Asian Finfish Aquaculture: Building a Positive Image**
- **Anton Rizki**, *Director and Principal Consultant Kiroyan Partners, Indonesia*

**White Fish Markets- Trends and Requirements**
- **Christelle Vigot**, *Food Business Developer, Bayong Ltd, Hong Kong*

**The Sustainability Challenges of Fish Meal and Fish Oil Crisis in the Finfish Aquaculture**
- **Ioannis Nengas**, *Aquaculture Nutrition Expert, Alltech, Europe*

**Mitigating Environmental Risks: Lesson Learnt and Zonal Management for Sustainability**
- **Han Han**, *China Program Manager, SustainableFisheries Partnership Foundation (SFPF), China*

**1045 - 1100 hrs**
**Break**

**1100 - 1300 hrs**
**BREAK OUT SESSION:**
**Moving The Industry Forward**

Participants will break into groups of 10 to discuss challenges facing the industry. (Participants will be required to select their area of interest in the registration form prior to the meeting and will be allocated to the specific groups). Led by team leaders, there will be multiple groups discussing three or more industry topics related to finfish aquaculture. The expected output would be a list of key challenges, priority areas for improvement and recommended strategies to take the industry forward. Leaders from each group will present a summary of the output from the breakout sessions. This will be an interactive session.

The choice for industry groups are:
- **Breeding and Hatchery Management**
- **Production, Health and Environment**
- **Feeds and Feeding**
- **Marketing and Sustainability**

**1300 - 1415 hrs**
**Lunch**

**1415 - 1800 hrs**
**REPORT SESSION:**
**A total of 4-5 facilitators representing 20 groups will present a summary of the output from the breakout sessions. This is an interactive session.**

**1800 hrs**
**Closing & End of TARS 2013**