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AQUA CULTURE Asia Pacific

Barramundi in Thailand

Farming shrimp with probiotics in India

Squeezed from both sides for aqua feeds in Asia

Marine shrimp in Asia in 2012

Sustainable tilapia in Hainan Island

Shrimp in Ecuador

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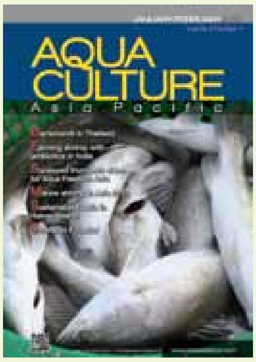

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Editor/Publisher
Zuridah Merican, PhD
Tel: +603 2096 2275 Fax: +603 2096 2276
Email: zuridah@aquaasiapac.com

Editorial Coordination
Corporate Media Services P L
Tel: +65 6327 8825/6327 8824
Fax: +65 6223 7314
Email: irene@corpmediapl.com
Web: www.corpmediapl.com

Design and Layout
Words Worth Media Management Pte Ltd
Email: sales@wordsworth.com.sg
Web: www.wordsworth.com.sg

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Aqua Research

3 Pickering Street, #02-36 Nankin Row,
China Square Central, Singapore 048660
Web: www.aquaasiapac.com
Tel: +65 9151 2420 Fax: +65 6223 7314

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Overseas Supplies Pte Ltd
6 Jalan Lembah Kallang, Singapore 339562

Editorial and advertising enquiries
Email: zuridah@aquaasiapac.com
Tel: +603 2096 2275 Fax: +603 2096 2276

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From the editor

Staying optimistic in 2013

Reflecting on all the adversities faced in 2012, we know that 2013 will be just as challenging. How do we approach the new year? Pessimists will be disillusioned with the industry as they face continuing challenges, from marketing uncertainties to rising costs of production. Optimists, on the other hand, will find the means to move forward and that is how we need to approach 2013.

Firstly, the past year has shown that the US is still a major market for both shrimp and tilapia. In 2013, the petition by a US coalition in December 2012 will make it harder for producers from China, Ecuador, India, Indonesia, Malaysia, Thailand and Vietnam accused of subsidising their shrimp industries. The Japanese yen is weakening, making shrimp imports automatically more expensive. China has become an international market for shrimp, evidenced by interest from Latin American producers.

Asian shrimp needs more markets and the potential comes from local markets such as Indonesia and India as they gear up production. Large shrimp integrators in China will focus on the local market. The supply of shrimp is expected to be low as early mortality syndrome takes its toll on Thailand even as the industry gears up to nip production woes early. The shrimp industry is now monopolised by the vannamei shrimp but 2013 could see the revival of the black tiger shrimp with the supply of SPF post larvae.

Asian producers will continue to work hard to please consumers and demands of retailers. Vietnam's pangasius producers expect to do better in its current markets as several large integrators have been working with the Aquaculture Stewardship Council (ASC) to certify pangasius under the WWF Pangasius Aquaculture Dialogues. In the case of the tilapia, there was overproduction in 2012 in China with conversion of shrimp farms. This is an annual dilemma but in Asia, for any aquaculture product with an export potential, we see rising costs of production and low offer prices forcing some to abandon farming only to witness later, new investors believing they can do better. This is a classic tale among small scale farmers.

The uncertainties with costs of feed ingredients will continue. The most affected will be freshwater fish feed producers, working on low margins. Our review on the aquaculture feeds in Asia in 2012 showed that the usual fall back on local feedstuffs is no longer applicable. Whether it is extrusion or pelleting technology, economies of scale is crucial and will we see smaller feed mills closing down and more likely, the consolidation of others. In the case of the export focussed pangasius catfish in Vietnam, the upstream integration of large processors is expected to increase as small farmers feel the effect of lower profit margins with higher feed costs. Downstream integration is happening with the pangasius catfish in India where feed producers expand into farming to secure markets.

Where will we see technology advances? In shrimp farming, biofloc technology will gain momentum in Vietnam and China but even if semi biofloc produces consistent harvest in Indonesia, it is still more of an art rather than science. We expect the use of auto feeders in feeding shrimp and fish will rise as its efficacy is proven, no doubt helped by rising labour costs and its shortage. This requires feeds with less fines.

Asia is no longer a low cost producer. Labour costs are rising from China to India and since January, Thailand and Malaysia have implemented minimum wages. The aquaculture model in Asia has been a backyard model that has grown in size incurring higher labour cost per kg of output. There is a need to transform to an industrialised model where capital investments are higher but operating costs are lowered with economies of scale.

From 2013 onwards, where can we expect growth? We have identified the area of growth in the marine finfish sector, where the limits to growth have been its dependence on live fish and chilled whole fish markets. The elasticity in prices in these markets is not sustainable. A recent example is the oversupply of barramundi in the local market in Malaysia as shrimp ponds have been converted to farm the fish. In the absence of a processing industry for the fish, the market is determined by the time taken in logistics hence limiting the market and consumers for the fish. We expect the industrialisation of the sector to continue with the global demand for white fish. Country-wise, Myanmar should be the future for aquaculture in Asia, in particular for shrimp and marine fish.

We wish all readers a HAPPY AND PROSPEROUS 2013

Zuridah Merican

OUR MISSION

- We strive to be the beacon for the regional aquaculture industry.
- We will be the window to the world for Asia-Pacific aquaculture producers and a door to the market for international suppliers.
- We strive to be the forum for the development of self-regulation in the Industry.

The Aquaculture Roundtable Series
21-22 August 2013

TARS 2013

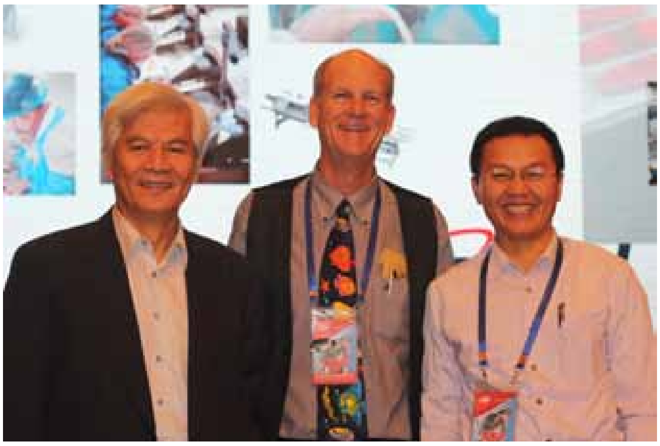
The third of the Aquaculture Roundtable Series (TARS2013) will be held in Singapore from 21-22 August. TARS 2013 will focus on **Finfish Aquaculture-Industrialisation and Sustainability**. For more information and updates on this all important meeting, visit www.tarsaquaculture.com

Tilapia connection in Hainan

Industry forum reviews issues of production and marketing, and focus on sustainability of production and certification as the next step.

The International Tilapia Industry Development Forum was initiated in a small way in 2001 during the China Fisheries and Seafood Exposition in Qingdao. Subsequently, it became a more formal international forum with the participation of buyers, scientists, importers and exporters in 2002. Participation at subsequent forums in Hainan, Fujian, Guangdong and Guangxi increased as the industry consolidated and more vertical integrators were created. Producers (grow-out and hatchery production) and processors used the forums to discuss important issues affecting the industry.

The Ninth International Tilapia Industry Development Forum (ITIDF9) was held from 12-14 November, 2012 in Haikou, Hainan. It was preceded by a roundtable discussion on where and how the industry should go. It was organised by China Aquatic Products Processing and Marketing Alliance (CAPPMA) and the National Tilapia Industry Technology System Research and Development Centre (NTITSRDC). Aside from discussions on production and market challenges along the supply chain, this year's forum also focussed on certification.



Kevin Fitzsimmons (middle) and Cui He (right) with Der Ming Chiang, Taiwan Tilapia Alliance

Domestic market

Dr Kevin Fitzsimmons, University of Arizona, USA was one of the founders of the forum. "Industry used the forum to connect and discuss current issues. In the first few forums, the issue of off-flavour was often discussed. For many years, China has been concentrating on exporting more tilapia and domestic sales is only of live fish. Value added tilapia for international markets is doing well and so we would like to do the same for the domestic market. In the past 4 years, China's demographics have changed. The Government also recognises that it needs to have more domestic consumption and the industry is now convinced of value adding for the local markets."

Fitzsimmons added, "In China, no tilapia is imported and the fish remains a low end product. But we expect this to change soon. Some restaurants are already serving tilapia. To gain some leverage, we need to worry about the off-flavour issue with techniques to remove blue green algae through depuration. A simple and cheap test is the microwave test with brown paper bag. Domestic consumption is estimated to rise by 55% in 2012."

Export markets

An analysis on tilapia production and trade situation in 2012 by **Dr Cui He**, vice executive president and secretary general, CAPPMA gave a conservative estimate for exports in 2012 of more than 350,000 tonnes with a value of USD 1.2 billion. Tilapia exports from China have been on the rise for the past ten years. In 2012, exports to the US and Russia increased by 26% and 8% respectively but Mexico and the European Union imported less tilapia by 13% and 14%, respectively. Export volumes came mainly from Guangdong (35%), followed by Hainan (33%), Guangxi (22%), and Fujian (9%). During the January to September period in 2012, exports from Hainan and Guangxi increased by 10%and 35%, respectively in comparison to a smaller increase of 6% for Guangdong. Export volumes from Fujian dropped by 13%. The US is still the largest market for tilapia (frozen whole and fillet).

US market expanding

According to **John Connelly**, president of the National Fisheries Institute (NFI), the US will remain a huge and growing market and the tilapia is already one of the top five seafoods with a per capita consumption

At the dinner function, representatives of companies planning for ASC certification of tilapia of 1.28 lbs (0.58 kg). Americans seek new products to meet health, wellness and nutritional expectations and with a changing profile of the population to those more accustomed to eating fish, there are opportunities for increased sales. However, the barriers to future growth lie with the perception of Chinese seafood. Connelly quoted the import alert on seafood from China in 2007. Other problems are short weighing and carbon monoxide use. In the former, NFI is seeking CAPPMA's assistance to track abuse. Nevertheless, the future is bright for Chinese tilapia in the US if producers address problems in the supply chain.

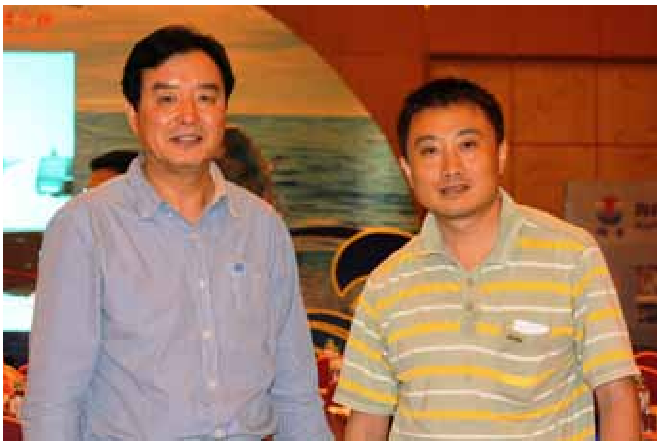
Losing out with off-flavour and low prices

In his presentation on the position of the farmed tilapia , Fitzsimmons said that the tilapia is unique and someday he expects it to surpass the carp in global demand. The tilapia already enjoys a good reputation as one of the greenest forms of aquaculture.

"China is the world largest producer of the tilapia, estimated at 1.3 to 1.4 million tonnes in 2012 which is almost 37% of world production of tilapia in 2012, estimated to be 3.78 million tonnes. However, we do need to improve on genetics and seed production. The main complaints are market prices of the fish and that of feeds. We need to reduce fish meal and fish oil usage to as low as possible, and in general nutrition, we should be able to match that of the salmon which has shown a 1:1 feed conversion ratio. There are also off-flavours and environmental issues."

In his short presentation, **Liping Liu,** professor at Shanghai Ocean University, gave an overview of the issues facing the tilapia supply chain. He said that China may be the leading producer and exporter but there have been considerable losses over the years in the tilapia export industry. "Prices for frozen tilapia fillet from China are considerably lower at USD 1-2/lb than its competitors. The major problem is that Chinese tilapia does not have a reputation for high quality and this is largely due to off-flavour. Although large producers with branded products have managed to overcome this in their production, there are still a large number of small and medium size producers who do not pay attention to off-flavour in their product, presumably because there is no incentive to produce quality fish. We need to stop this vicious cycle of lower quality>lower price>off-flavour>lower price. Furthermore, off-flavour can be easily overcome with testing and depuration but with added costs"

Another issue raised by industry is the low prices in October and November which have been fluctuating between RMB 8-9/kg. Prior to this, prices hovered at RMB10/kg. At the farm, cost of production has been rising and exacerbated by the higher exchange rate of the RMB to the USD which is now RMB 6.2. In general, profit margins are still small in the supply chain when cost of fillet production is around USD 600-800/tonne (RMB 3.7-5/kg) and average offer prices are at USD 3.2 (RMB 20).



William Su, deputy chairman, Tilapia chapter, CAPPMA (right) and Sun Zhong Yi, Chairman-President Baiyang Aquatic Group, one of the companies planning for ASC certification

From right. Wang Yu Xiang, Hainan Progift Aquatech Co, San Guibao and Liu Zhong Qiang, professor of genetics.

Sustainability and certification

Moving forward, Cui He said that CAPPMA is leading the industry towards sustainability and certification. There are already several inspection schemes in China such as the Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) for registering farms, random checks by the Ministry of Agriculture and other provincial agencies, third party testing and China Inspection and Quarantine Bureau (CIQ). The country has closed farms with poor hygiene. In the last Olympics, only certified seafood was allowed. He added that the industry cannot waste time and should start quickly and be ready for the next Olympics with Aquaculture Stewardship Council (ASC) certified products.

Chris Ninnes, CEO, said that the role of ASC is to 'transform aquaculture towards environmental sustainability and social responsibility using efficient market mechanisms to create value across the chain'. He explained how the ASC will add value in the supply chain. It recognises and rewards responsible fish farming and improved transparency for seafood, from farm to fork. The ASC logo also links consumer to production. For the investor, ASC acts as a screening tool to aid decisions and can be used as a requirement for investment. The tilapia standards are now ready for certification and certified products are already in the market. At the dinner function, ASC also announced the start of ASC certification of farms and processing factories for the tilapia. Jose Villalon, WWF-Aquaculture Program followed with an introduction on the aquaculture dialogues and tilapia standards. Anton Immink from the Sustainable Fisheries Partnership explained the role of the NGO and its current program in Hainan (see page 51).

News in Brief

More brood stock for India

The Rajiv Gandhi Centre for Aquaculture Centre (RGCA) has added an additional wing to the Aquatic Quarantine Facility in Chennai. It will be able to quarantine more vannamei shrimp brood stock. The construction was funded by the National Fisheries Development Board (NFDB), Ministry of Agriculture. The third and the final phase of the facility are also underway which will boost the total quarantine capacity of the facility to 20 cubicles to quarantine around 237,600 brood stock/year). According to business-standard.com, this will allow for a five- fold increase in vannamei shrimp production, from around 80,717 tonnes in financial year 2011-2012.

All male freshwater prawn venture

The Tiran Group of Israel signed an agreement with Green Advances of Vietnam in November 2012, to advance aquaculture in Vietnam using innovative BGU biotechnology to change the sex of the freshwater prawn *Macrobrachium rosenbergii* and yield fast growing all-male populations. The process was developed in Professor Amir Sagi's laboratory at Ben-Gurion University of the Negev (BGU). It is patented and licensed through BGN Technologies, BGU's technology transfer company, to the Tiran Group, an Israeli shipping company with aquaculture farms in China. Tiran group has already started to implement this patent in China where they have a farm and a hatchery in Yang Jiang city, Guangdong. The group is also involved in hatching and raising red tilapia fish (ND56 strain which was developed by Nir David hatchery in Israel) in China and Vietnam (see story on page 57).

Vietnam's pioneers for ASC certification for the pangasius

Five Vietnamese pangasius producers have been given the Aquaculture Stewardship Council (ASC) certification for responsible aquaculture. These were Vinh Hoan Corporation, Vinh Quang Fisheries Corporation, NTACO Corporation, Hung Vuong Corporation and Hoang Long Seafood Processing Company. This also means that the Vietnamese pangasius sector has reached its target to certify 10% of the country's pangasius production for export under the ASC farmed responsibly programme by the end of 2012. Chris Ninnes, CEO, ASC said, "ASC certification recognises and rewards farms that are following responsible practices that include conservation of water resources, no misuse of antibiotics, responsible use of feed, and behaving in a socially responsible manner."

Locally farmed Pacific salmon

AgriMarine's China subsidiary introduced its locally farmed Pacific salmon to China's retail market in December. In Seafoodsource.com, Richard Buchanan, company managing director said that the firm sees Chinese consumer demand for smaller 2.5kg Pacific salmon for home consumption. The fish is sold in stores of Japan based convenience store, Ito Yokado, in Beijing. The firm will also supply BHG, a Beijing-based high end supermarket chain. He added that the 25% mark-up sought by BHG and Ito Yokado retailers is cost efficient for AgriMarine. The company will avoid duties of 13% paid by salmon importers and the product can be delivered from the firm's northern China production bases directly to the retailers' distribution.

AgriMarine has not determined what the price tolerance of Chinese consumers will be but the product will be two-thirds lower than the price of Atlantic salmon, said Buchanan. AgriMarine's first Chinese farm, located near the northerly city of Benxi, is designed to produce 500 tonnes/year but the company plans to increase production. It is seeking investors in Chinese private equity circles to expand its operations and looks to an eventual IPO in Hong Kong in 2013. The firm last month signed an agreement with Akvatech AS, a Norwegian private equity group, to advance the adoption of the company's closed containment farming technology.

Petitions for relief from subsidised shrimp imports to the US

On December 28, 2012, the Coalition of Gulf Shrimp Industries, a new organisation, filed petitions with the US government seeking relief from subsidised shrimp imports from seven countries: China, Ecuador, India, Indonesia, Malaysia, Thailand and Vietnam. The petitions seek the imposition of countervailing duties on their shrimp exports. The Coalition of Gulf Shrimp Industries says US producers struggle daily to compete with artificially low-priced imported shrimp that is heavily subsidised by foreign governments. Since 2009, shrimp producers in the seven countries have gained US market share by aggressively undercutting domestic prices through the use of billions of dollars in assistance from their respective governments. Subsidised imports have suppressed and depressed domestic prices, eroded domestic sales, destroyed USA jobs and eliminated the operating margins of domestic producers.

The Coalition of Gulf Shrimp Industries says shrimp is a major export commodity in each of the seven countries and their governments have set specific growth and export targets for their domestic shrimp industries as part of their national economic development plans. To meet these targets, these foreign governments are spending billions of dollars on subsidies for their shrimp industries, including grants, investments, low interest loans, tax breaks, the provision of land, feed and export credits and guarantees. The petitions document over one hundred programs benefitting shrimp producers in these seven countries, including numerous export subsidies.

The Coalition of Gulf Shrimp Industries says in 2011 the seven countries exported over 984 million pounds (447,000 tonnes) of shrimp to the United States, worth nearly USD4.3 billion and accounting for 85% of US imports and over 75% of domestic consumption. The petitions document more than USD13.5 billion in government subsidies to the aquaculture and seafood processing industries in these countries, with the shrimp industry as the primary recipient. If they accept the case, the US International Trade Commission (ITC) and the Department of Commerce (DOC) will investigate the petitions, with final determinations expected in the second half of 2013.

Specifically, the petition states that

- The Government of Thailand intervenes in the market to buy shrimp from farmers and provide that shrimp to processors at artificially low prices.
- The Indian government provides subsidies to reduce shrimp processors' ocean freight costs, with an added subsidy specifically for exports to the USA.
- In China, the government is providing financing to build what it hopes will be the world's largest shrimp processing and export platform.
- The Malaysian government is investing tens of millions of dollars to build vertically integrated shrimp farms and processing facilities to target world export markets.

For more information and related news: http://www.shrimpnews.com/FreeReportsFolder/NewsReportsFolder/USAshrimpIndustriesSeeksRelief.html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A farmer's perspective on probiotics in shrimp culture

By Manoj M. Sharma

The application and dosage of probiotics should be culture specific with more clarity and understanding provided to the farmers.

For many years, the major focus of the shrimp industry in India was on the farming of the black tiger shrimp, *Penaeus monodon*. The economic benefits led to high stocking densities and use of spurious post larvae which in turn led to a constant threat of diseases. Shrimp farmers began to use antibiotics and water sanitizers routinely. This indiscriminate use of antibiotics brought a negative impact on the environment and food safety as well as introduced a trade barrier for our final products in international markets.

The government reacted with strict food safety protocols in all the shrimp farming areas to disallow the use of banned chemicals. Culture techniques following Good Management Practices (GMP), Best Management Practices (BMP), organic farming, and zero water exchange systems were examined. However, probiotics claim to have a major role towards a more sustainable industry. In India, there are more than 100 companies producing probiotics targetted for the aquaculture industry. However, farmers usually do not have sufficient knowledge on microbiology and they are unsure on the benefits of probiotics.

A vannamei shrimp harvest. Mayank Aquaculture's farm covers 55 ha in Surat, Gujarat, India. The 45 grow-out ponds produce 80 to 100 tonnes/year of monodon shrimp and 200 to 250 tonnes/year of vannamei shrimp

The science behind probiotics in shrimp culture

The historic definition for probiotic as per Fuller (1989) is 'a live microbial feed supplement which beneficially affects the host animal by improving its intestinal balance' However, in aquaculture recently, the scientific definition of probiotic was given by Merrifield et al. (2010). According to this group, probiotics are defined as 'microbial cells that are administrated via the diet or rearing water, with the aim of improving health and disease resistance, growth performance and feed utilisation, stress response, general vigour, carcass and flesh quality and reduced malformations.'

They classified probiotics into three groups; gut probiotics, water probiotics (as in bioremediation) and soil probiotics (as in detritus management system). Probiotic inoculates are either in the form of spores or as resting bodies of one or more species in a medium design to prevent germination or to retard growth. All these available probiotics are either in liquid or granular form coated with bacterial propagules.

Mode of action

Probiotics containing multiple strains of bacteria spores or resting bodies produce extracellular enzymes to degrade large molecules into smaller particles that can be absorbed for further degradation by enzyme-catalysed reactions within their cells. It should be obvious that enzyme additions cannot speed up degradation of organic matter or toxic substances unless bacteria are present. Probiotics within shrimp or in their environment adhere to host surfaces and have the ability to colonise and to prevent the establishment of potentially pathogenic bacteria.

A farmer's view:

The farmer's understanding and definition for probiotics is simply; 'single or multi-brand microbial products when used singly or mixed should benefit shrimp and culture ponds'. In their view, the probiotics are only of two types; feed and pond probiotics. The possible benefits of probiotics are;

- Improve health when probiotics competitively exclude the pathogenic bacteria or produce substances that inhibit the growth of the pathogenic bacteria.
- Provide essential nutrients to enhance the nutrition of the cultured shrimp.
- Improve growth and feed conversion when probiotics provide digestive enzymes to enhance the digestion of the shrimp.
- Lower environmental impact when probiotics directly uptake or decompose the organic matters or toxic materials (metabolites such as NH_3, NO_{2-}, H_2S, PO_4, CH_4 etc.) in the water, thus improving the quality of the culture water.

In addition, under investigation are other claims such as improvement of the immune response of the shrimp against pathogenic microorganisms by activating both cellular and humoural defenses (non-specific immune system) and having anti-viral effects.

However, farmers consider probiotics as miracle products, giving them quick and positive results after application. Probiotics become a curative tool rather than prophylactic. On the other hand too, farmers are often discouraged by the increased cost of operations. Probiotics are still accepted or adopted in the primary culture protocols.

Applications

This can be divided into the following phases

- Phase-1: Pre-culture application.
- Phase-2: In-culture application.
- Phase-3: Post-culture application.

Phase1 Pre-culture application

The pre-culture application probiotic has to be catalysed by proper BMP protocols. This mainly involves the proper design and construction of all the culture ponds followed by proper pond preparation. The main catalytic steps to improve the probiotic effects after pre-culture application include proper drying and ploughing before starting the crop, followed by compact and levelling after ploughing. Incoming water should be well filtered and pond preparation follows the steps shown in Chart 1.

The probiotic works effectively when we apply a good prebiotic carbohydrate source. The water colour after application of the prebiotic

Chart 1. Steps in pond water preparation.

	Pond water preparation
Day 1	Fill water to 1.2m (average depth)
⇩	*Leave for 2 days to settle*
Day 4	Chlorination @10pp, bleaching powder
⇩	*Dechlorination for 5 days*
Day 9	Application of prebiotic media after fermentation (jaggery +rice bran + yeast) - dose 1
⇩	*Leave for 1 day*
Day 10	Application of probiotics for water – Dose 1
⇩	*Leave for 5 days*
Day 15	Application of prebiotics media after fermentation probiotics for water (jaggery +rice bran + yeast) - Dose 2
⇩	*Leave for 1 day*
Day 16	Application of probiotics for water – Dose 2
⇩	*Leave for 2 days, check water parameters*
Day 19	Stocking of good quality tested PL 15
	Note: Jaggery is a brown coloured semisolid sugar.

Figure 1. Water colour after application of prebiotic as well as probiotic.

and probiotic after pond preparation before stocking of post larvae is given in Figure 1. This colour shows the efficacy of probiotics with good pond preparation.

Phase-2: In-culture application

As per the guidelines from most probiotic companies, the recommended concentration of probiotics during in-culture application is given below.

Table 1. In culture application of probiotics.

Water probiotics	Feed probiotics
Initial start-up dose followed by weekly doses up to end of the culture recommended by company to company basis and also as per the product specification. Dose @ 0.5–1.0 kg/ha/week (powder) @ 5 -10 litres/ha/week (liquid)	Administrated through feed on a daily basis from day 1 of culture till harvest. Mostly once a day (peak meal) Dose@ 5-10 g/kg feed with a suitable binder.

The in-culture application of probiotic is mostly catalysed by proper water quality management, optimum aeration facility, good quality and correct feeding schedule, proper check tray management and strong biosecurity. The main catalytic steps to improve the probiotic effects

Table 2. Optimum water quality parameters.

Dissolved oxygen	>5ppm (morning)
pH	7.8 to 8.5
Transparency	35-45 cm
Alkalinity	>100 ppm bicarbonate
Salinity	15-25 ppt
Temperature	28-32°C
Water depth	Average. 1.8 m
Ca : Mg ratio	1:3 especially for *Litopenaeus vannamei*

after in-culture application include optimum water quality parameters for better probiotic efficiency (Table 2); effective aeration for optimum in-culture probiotic effects; competent feeding program and check tray management for optimum in-culture probiotic effects.

The impact of in-culture probiotic to maintain the healthy water colour is shown in Figure 2.

Figure 2. Impact of probiotic application in shrimp culture pond.

Phase-3: Post culture application

Post culture application of probiotics in shrimp pond is one of the most important management practices, which is usually overlooked by the farmers. This practice should be done to remove excess amounts of organic load during post culture pond preparation. The post culture application of probiotics followed in our farm (MAPL) is given in Chart 2.

A healthy bottom condition is a result of the application of post culture probiotics. The stocking of good quality shrimp will also help to sustain a good pond bottom condition.

Chart 2. The post culture application of probiotics at MAPL.

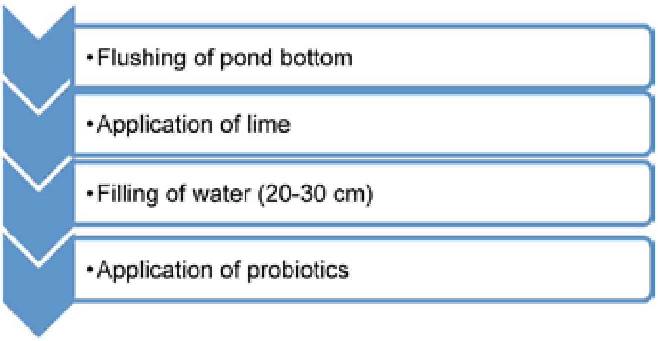


Table 3. Some observations and findings with probiotic applications.

Days of culture	Observations	Findings
Water probiotics		
01-50	Good initial water quality, stable bloom with good transparency.	Visible and significant change in water condition.
51-100	Stable water colour with reduced transparency.	Stable water parameters, but ammonia start accumulating (>80 DOC)
101- till harvest	Thick bloom with abrupt colour change.	pH and DO diurnal fluctuation. Stressed shrimp.
Feed probiotics		
Days of culture	**Observations**	**Findings**
01-50	Good initial growth with proper moulting.	Increased shrimp survival > 90% of stocking.
51-100	Good shrimp colour with uniform size.	Better Average daily growth (ADG) with improved healthy shrimp (gut).
101- till harvest	Good growth, but < 5% shrimp with poor growth and discolouration.	May be due to water quality in later stage causing stress. Improper moulting.

Some observations and findings

The following observations and findings have been recorded during several years of culture while applying probiotics (Table 3)

In addition, the best water probiotic effects and performance was observed in salinity close to 20 ppt. Gut probiotic efficacy was the best at the above salinity range. The result of probiotics is purely pond specific and varies from season to season. The age of pond is also a determining factor. The cyclic nature/ cropping pattern of shrimp farming also affects the permanent establishment of microbial communities. In spite of various claims, it is very difficult to eliminate blue green algae in shrimp culture ponds through water probiotics. Compared to *P. monodon* culture, it is easy to control water colour in *L. vannamei* culture pond which could be due to its feeding behaviour.

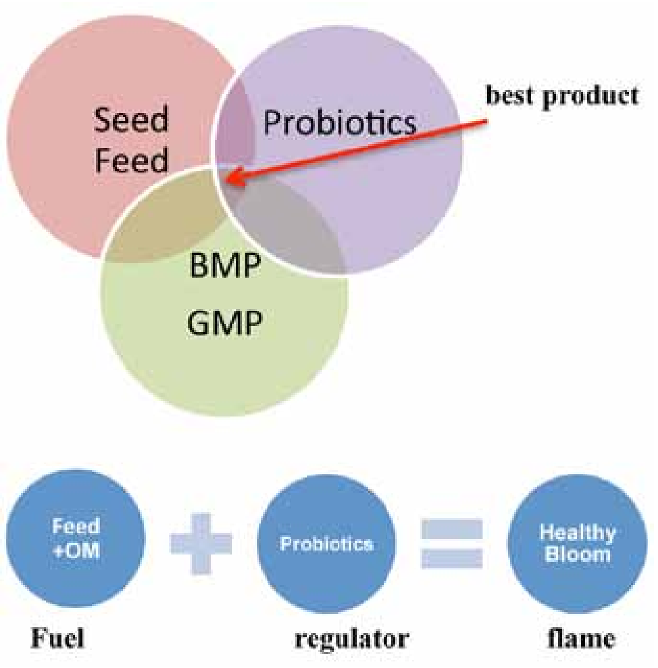
Main constraints of nitrifiers in ponds

Nitrifiers are fragile microorganisms, which are sensitive to acids despite the fact that they produce acid during oxidation of NH_3 and NO_{2-}. Therefore, if large amounts of nitrogen are available in the water, these organisms can potentially kill themselves by metabolising nitrogen to nitric acid unless pH is buffered. Nitrifiers are autotrophs and they need oxygen during the degradation of NH_3.

The reactions of *Nitrobacter* spp are inhibited by small quantities of ammonia gas, which can lead to toxic build up of NO_{2-}, since *Nitrosomonas* spp. is not inhibited from NH_3 to NO_{2-} in the presence of ammonia gas. Both *Nitrobacter* spp. and *Nitrosomonas* spp work in culture pond within pH ranges of 6.8-8.5 with the optimum at pH 8.2 to 8.3.

Symbiotic and regulatory effects of probiotics:

We have observed that the symbiotic effect of probiotics in aquaculture ponds as below:



Recommendations

As per our own pond trials and experiences we have found that the application of water probiotics gives excellent results when applied twice or three times in a week instead of weekly or fortnightly doses. The quantities of water probiotics should be directly proportional to feed input rather than stocking densities. This has given us sustained result than the conventional method. In the case of feed probiotics, instead of one or two meals per day we strongly recommend to apply feed probiotics in all meals. This means that instead of 5-7 g/kg/meal, we use 1-2 g/kg for all meals/day.

Conclusions

Probiotics definitely improve results significantly in shrimp farming. The efficacy of feed probiotic is more noticeable than water probiotics. However, the probiotic will only render excellent and desirable results under good farm management and has insignificant effect under improper farm management.

We do wish to remind users that probiotics should not be used for curative or therapeutic purposes. Rather they should be used as an insurance for long term sustainability and profitability of shrimp farming. We would recommend that probiotics be included in the primary culture protocol and a main component of standard shrimp farming operations.

Our message to all producers and distributors is that they should realise that the application and dosage of probiotics should be culture specific, and more clarity and understanding of their use should be provided to farmers. Probiotic is an all natural effective biological tool for long term sustainability of shrimp farmers to meet the 'Food and Profit' ambition of all farmers.

Dr Manoj M. Sharma is director, Mayank Aquaculture Pvt. Ltd in Surat, Gujarat State, India. E-mail: mapl.shrimp@gmail.com

Update on top disease threats for shrimp cultured in Asia

While investigations to find the causes behind EMS/AHPNS continue, Dr Tim Flegel has several messages for producers.

Several research groups are working on the etiology of early mortality syndrome/acute hepatopancreatic necrosis syndrome (EMS/AHPNS), including those from Centex Shrimp, Mahidol University, Thailand and Thailand's Department of Fisheries (DOF), Aquaculture Pathology Laboratory, University of Arizona led by Dr Don Lightner, USA, and a national taskforce under Vietnam's Ministry of Agriculture assisted by a FAO team led by Dr Melba Reantaso. Outbreaks of EMS/AHPNS first occurred in China in late 2009, subsequently in Vietnam since 2010, Malaysia since 2011 and in Thailand since 2012. Possible causes by both infectious and non-infectious agents are under investigation.

At the DSM Aquaculture Conference Asia Pacific in Bangkok on November 22, 2012 (see pages 36-40 for the conference report), Dr Tim Flegel from Centex Shrimp updated participants on EMS/AHPNS. Most farms in affected countries experienced massive mortalities from EMS/AHPNS but Flegel asked that the industry consult and apply the case definitions for presumptive field diagnosis (before sending samples) and confirmatory histology before attributing the deaths to EMS/AHPNS. Lightner provides these definitions, available at the NACA website (http://www.enaca.org). Flegel reminds everyone that analysis should be on identical cases for researchers to make rational progress.

Care with sampling

To date there has been no successful model on infectious agents. EMS/AHPNS is characterised by massive sloughing of cells of the hepatopancreas (HP) followed by severe bacterial infections resulting in high and rapid mortality. Sloughing of cells is preceded by loss of function of all major cell types of the HP. Flegel asked industry and researchers "to work on the standard that has been agreed on at the NACA meeting and for confirmation to look at the histology of samples. There is no escape from this requirement; however if you see it, you will know it."

Flegel discussed Lightner's breakthrough case definition at the histological level. He added, "In fixation of samples for analysis, everyone must be aware of the need to use live shrimp and to inject the formalin fixative (Davidson's fixative) first into the HP directly before injecting other tissues. If the samples are left for even one to two minutes, disintegration from digestive enzymes will result in post mortem changes, making diagnosis difficult or impossible. Nothing can be deduced from samples with bad fixation."

Is mortality due to EMS/AHPNS?

"Shrimp dying within approximately 35 days of stocking can be due to many causes, including white spot syndrome virus (WSSV). In Thailand, the DOF with Dr Chalor Limsuwan and Dr Niti Chuchird have found that many cases of early mortality (up to 50%) can be attributed to WSSV rather than EMS/AHPNS.

We estimate that only 6-10% of Thai early mortality cases can be attributed to EMS/AHPNS and that these have been limited to the eastern Gulf of Thailand. Other possible causes include yellow head virus (YHV), *Vibrio harveyi* and *V. parahaemolyticus*. We know that *Penaeus vannamei* and *P. monodon* can be affected by EMS/AHPNS and also *P. chinensis* in China. The spreading suggests that it is caused by yet unidentified infectious agents."

He continues, "EMS is NOT caused by infectious myonecrosis virus (IMNV) and this virus is still limited to Indonesia in Asia. But it only takes one irresponsible person to bring in unchecked shrimp from Brazil or Indonesia to start a disaster. We can stop its spread if all stakeholders believe that it is morally wrong to bring in unchecked shrimp."

Caused by microsporidian, gregarine, parasite?

"We know that EMS is definitely NOT caused by the microsporidian parasite *Enterocytozoon hepatopenaei* discovered in *P. monodon* and now common in *P. vannamei*. However, our tests showed that infected shrimp show only slower growth and the histopathology of infected shrimp is totally different from AHPNS."

"Also it is definitely NOT caused by a newly discovered 'gregarine-like' parasite that is a totally new type of shrimp parasite. Its histopathology is different from EMS/AHPNS. It does not appear to kill shrimp but heavy infestations may cause them to grow slowly."

Flegel added that these two parasites were reported in shrimp dying from EMS/AHPNS in Vietnam; but, "the histopathology is different from AHPNS and it should be relatively easy to identify the reservoirs for these pathogens and eliminate them from the culture system."

Are toxins involved?

In Vietnam, Lightner's team has conducted toxin bioassays on several possible abiotic toxin sources. Tests on feed and feed ingredients, soil and sediments have so far been negative. The insecticide cypermethrin (previously recommended by the Vietnamese government to kill WSSV carriers) caused mortality but not AHPNS pathology. Flegel commented, "Even if this is not a cause, this pesticide should not be used at all. In Thailand, we recommend instead very short-lived organophosphate pesticides that are safer."

Investigations on biotic toxins such as those from blue-green algae isolated from EMS/AHPNS ponds have also shown no AHPNS pathology. Researchers in Malaysia have identified low levels of a dinoflagellate toxin in shrimp from AHPNS ponds but since these are neurotoxins at low levels it is unlikely that they would damage the shrimp HP. Laboratory tests are needed to determine whether these or other phytoplankton toxins can cause EMS/AHPNS.

What about bacteria?

Flegel emphasised that dissection for sampling should be done properly to avoid contamination by bacteria from the stomach and midgut since portions of these organs lie within the HP. Otherwise one might conclude erroneously that every shrimp HP is heavily contaminated with bacteria. "Fortunately, there is now a cheap way to do sequencing. Sample sets from China, Thailand and Vietnam were analysed. However, we have not found bacteria that are unique to AHPNS shrimp and causal species that are dominant in shrimp from affected ponds. Our analysis showed that bacteria had nothing to do with the problem, but this type of analysis could not reveal phage-bacterium interactions."

Flegel explained that bacteriophages can transfer lethal toxin genes to bacteria. It is known that *V. harveyi*-phage interaction can result in the production of lethal shrimp toxins. Such a partnership might be involved in EMS/AHPNS.

"In samples from Vietnam, we saw phage bacterium pairs but we do not know whether they cause AHPNS. Two labs from Thailand and one from Vietnam currently have samples of phages and their bacterial partners isolated from EMS/AHPNS shrimp. Preliminary results showed low mortality with the bacteria or the phage alone but 100% mortality within 24 hours upon injection of bacterium plus the phage. However, these tests need to be repeated, and it also must be shown that the mortality is accompanied by typical EMS/AHPNS histopathology (i.e., massive sloughing of HP cells)."

What about viral etiology?

"Preliminary tests have so far failed to cause mortality or reproduce the histopathology of EMS/AHPNS by injection of bacterial-free solutions from EMS/AHPNS shrimp, suggesting the cause is not a new or existing viral pathogen. However, current technology enabling quick and low cost sequencing opens up the possibility of a broad search for new viruses by direct sequencing and comparison between affected and unaffected shrimp. Presently we can say that viral etiology is unlikely but it cannot be 100% excluded."

Other disease problems in Asia

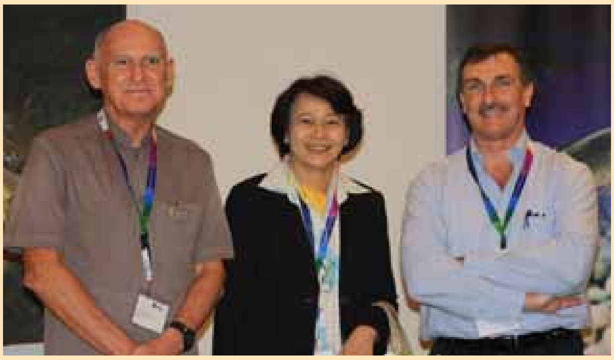
Flegel said that the hepatopancreatic microsporidian parasite sometimes seen in EMS/AHPNS specimens (as mentioned above) was initially discovered by his group in *P. monodon* when they were looking at monodon slow growth syndrome. Later it was reported in Vietnam and Thailand from shrimp with white faeces syndrome. High levels of infection retard growth. "We infected healthy shrimp by feeding but they did not show white faeces and mortality, and the histopathology is unlike AHPNS. We can identify this parasite by PCR and ensure that it does not enter the culture system."

As stated earlier, there is also a new 'gregarine-like' parasite in *P. vannamei* and *P. monodon* that has not been previously recognised. These are inside the HP tubules and not in the midgut only. It is an unsegmented organism and can be seen in squash mounts. It is sometimes seen in shrimp with white faeces syndrome and EMS/AHPNS. Heavy infections do not show white faeces or mortality. The histopathology confirms that it is not the cause of EMS/AHPNS.

At Centex Shrimp, the gregarine-like organism was collected using a stereo microscope. The DNA has been extracted and sent for sequencing in the hope of developing a probe for PCR detection. Using PCR, it will be possible to identify reservoir species and eliminate them from the culture system. Another relatively minor problem is abdominal segment deformity disease which distorts the shrimp tail muscle in *P. vannamei*. It does not affect growth or survival but can reduce the value of the crop by 10%. Flegel notes that it is caused by a retrovirus-like element present in the shrimp genome and is probably a genetic disease. He suggested that the best long-term strategy would be to eliminate it from specific pathogen free (SPF) stocks.

"Taura syndrome virus is no longer a threat. SPF stocks do get infected but the disease does not harm them. By chance too, SPF shrimp are not affected by infectious hypodermal and hematopoietic necrosis virus. The bad news is that we still do not know the cause of EMS/AHPNS."

Flegel recommends a broad research approach involving groups in Asia and elsewhere investigating alternative possible causes of EMS/AHPNS and reminds everyone that it is vital to include epidemiologists in this work.



Tim Flegel (left) with Dr Juadee Pongmaneerat, Department of Fisheries, Thailand (middle) and Dan Fegan, Cargill Animal Nutrition, Thailand at the DSM conference.

Driving barramundi in Thailand

By Zuridah Merican

A revival of barramundi farming but now in freshwater ponds.

Thailand's hatcheries produce fry and fingerlings to feed the demand for Asia's grow-out of the Asian sea bass *Lates calcarifer* or barramundi. Recently, demand for this seed stock has been increasing with the reported change from marine shrimp to barramundi farming in brackish water ponds in Malaysia, Vietnam and Thailand. At home, demand is also increasing with the relatively recent interest in farming the fish in freshwater ponds, in particular in Chachoengsao province in Eastern Thailand. In 2012, the estimated production will be 20,000 tonnes, with almost 15,000 tonnes production from this province and the rest, barramundi farmed in brackish water and marine cages in South Thailand.

Cage to pond culture

Some 30 years ago, barramundi farming centred in the brackishwater cage farms in the estuary of the Bang Pakong River. As recent as 2009, the small group here produced almost 4,000 tonnes annually. But as water quality declined with pollution from agricultural and industrial effluents, so did the number of cages. Today only 20% of the original number of cages has remained. Most of the grow-out activity has moved to inland freshwater ponds.

Live fish are sold to restaurants around Pattaya in the north and Bangkok to the east. These are held in containers on trucks. Some two hours before, salt is added to the water and aerated to increase dissolve oxygen in the water.

According to Khun Sutin Wuthisin, who started farming the barramundi 32 years ago, "Usually stocking will begin early in the rainy season, but nowadays, the weather is too unpredictable. We stop our hatchery production using brood stock kept in the cages in winter from October to February and will resume in summer again."

Harvesting and sorting is by a specialised contract team. Sorting by size at the pond side.

TFM's team, from left Dr Suttisak Boonyoung, Manager Product R&D, Supis Thongrod, Preecha Bangnokkhwaek, formulation manager and Chin Boripon, with Khun Toy (centre left) and Suthi Mahalao (centre right).

Sutin Wuthisin

Pond showing feeding enclosure

7.5 cm fingerlings at Khun Chan's nursery

In this province, the R&D team from Thai Union Feedmill (TFM) is leading this recent development in the farming of this fish. The feed mill in Samutsakorn began production of extruded floating feeds for the barramundi and the grouper in 2007. The initial introduction of the feeds to cage farms did not work well because of the change in season, strong currents and infections with parasites, all of which resulted in high feed conversion ratios (FCR). The 4mX4m and 2.5 m deep cages stocked 50 fingerlings/m^2 whereas in ponds, the density is lower at 2 fingerlings /m^2.

"Our first success came later with the same group of farmers who had moved to farm the fish in freshwater ponds in 2009. The better feed performance and FCR at 1.4 instilled famer's confidence in using extruded feeds, especially when they are well versed in farm management," said Dr Supis Thongrod, manager R&D Department, TFM.

"This collaborative work with the farms also gave us the opportunity to make improvements to the feed. Initially we received complaints on fatty fish with soft flesh and scale damage during harvest. Our feed is now well accepted by farms in this region, even though we have the highest price at an average of THB 47/kg for the large size pellets. The protein composition is more than 38%, fat>10 % and fibre below 4% for feeds for the later stages of culture.

Today almost 40% of the national production of the barramundi is based on extruded feeds, manufactured by three other local feed companies in addition to TFM. In Chachoengsao and the eastern provinces, some 50% of production is with extruded feeds whilst only 20% production is with extruded feeds in the south.

Grow-out in freshwater ponds

In Pimpha district, Amphur Bang Pakong in Chachoengsao, Khun Toy is achieving success in the farming of the barramundi in ten ponds, each of one rai (1600 m^2). Culture starts with stocking of 3,000 fingerlings/rai of 18 g or 10 cm (4 inches). Within 135 days, fish is harvested at 500-700 g. During the nursery stage of 25 days, stocking occurs in half to a third of the pond, depending on the size of the pond, which has been sectioned off with a net. A 1 HP long arm aerator is used in the pond.

The common practice is feeding in a floating net enclosure of 10 m^2 where only 45 cm of the 90 cm deep net is under water. Feeding is twice a day in the early morning and early evening at 4- 5 pm. The feeding rate is 3-5% of body weight per day. Throughout the culture period, fish uses 7 feed sizes, starting with pellets of 2 mm with 42% crude protein and ending with those of 10.5 mm with 38% crude protein as finisher feeds for fish of 500-700 g.

An extension of the grow-out is the production of jumbo size fish of more than 3 kg each which takes a year from an initial size of 1 kg. Larger size feeds such as 18–22.5 mm are used with 36% crude protein content. "In general, Khun Toy is managing very well in this current crop, as survival is 80% and FCR is 1.3. Her production is 1.7 tonnes/pond/crop and she manages two crops per year. One issue is the limited availability of fry, especially in December. The current ex-farm price for live fish is THB110/kg for fish of 500-800 g range. Outside of this range or for dead fish, fish prices come down by THB 5/kg. Jumbo fish of 3 kg are sold at THB 160/kg," said Chin Boripon, assistant sales manager, TFM.

Most of the barramundi farmers depend on private hatcheries or nurseries to supply weaned fry such as that run by Suthi Mahalao, who also exports barramundi fry to Vietnam, Malaysia, Singapore, Taiwan, Australia and Israel. In addition, Suthi runs his own farm and is a feed distributor to farms in the province. In his nursery comprising earthen ponds, he nurses 1 cm fry to 10 cm (4 inches). He bundles fingerlings with feed and his customers such as Khun Toy, get a reduced price of THB 1.5/2.5cm (1.5/inch) of fingerling. The 10 cm fingerlings will cost THB 6 each. In contrast in the free market, fingerlings are sold at THB 2 for each inch (2.5cm). According to Suthi, the farming of the fish and hatchery production have not been easy. Apparently, he has been in the fish farming and hatchery business for the past 17 years and has only achieved success in the past 5 years.

Khun Chan (left) and Suthi. In the background are the 5-tonne rearing tanks

From shrimp to fish

After 12 years of running a black tiger shrimp and freshwater prawn hatchery, Khun Chan has given up because of persistent low prices arising from low demand. She now uses the 5-tonne tanks to nurse barramundi from 1 cm fry to 7.5cm (3 inch fingerlings). This is the first cycle and the learning curve is difficult as the first crop gave a survival of only 30% instead of the average 60-80% in the more established nurseries. This increased her cost of production to THB 7.5/fingerling. In comparison, the cost should be only THB 4.5/fingerling of 7.5cm with 80% survival.

"Nonetheless, this is only her first crop and she is learning how to manage a fish nursery. Soon she will be able to produce 100,000 fingerlings (10cm) per month. The stocking is 14,000 fry/tank," said Suthi.

Khun Chan's feeding protocols include the use of artemia and various sizes of microencapsulated feeds. She also uses the starter feeds produced by TFM which are 1 mm to 2 mm. The general FCR range for these feeds is from 1.17 to 1.25.

Exporting and flesh quality

"Previously, some farms have sent their harvests to a major fish processing plant, and with Good Aquaculture Practise (GAP) and movement documents (MD), it was possible to export frozen products. In the culture of the barramundi in the region, a contentious issue is the taste and flesh quality of fish farmed in freshwater versus that in seawater cages. We do not have any report of any sensory evaluations but we know that fish farmed in freshwater have firm flesh. We have reports that some farmed large size fish of 3 kg have ended up in markets at the jetty in Surat Thani posing as wild caught fish. I would assume that this is an attestation of the similarity in taste to fish farmed in marine ponds or cages," said Supis.

"The potential for expansion of barramundi farming is not only here in Thailand especially in the north east, but also in neighbouring Laos and Myanmar, where the barramundi can replace the Indian carp such as the rohu."

Note: In the sales of fingerlings, hatchery and grow-out farmers quote in inches. Conversion: one USD=THB30.4.

Finisher feeds for 500-700 g fish

Squeezed from both sides in 2012

By Zuridah Merican

Higher volumes of fish feeds and a second difficult year running for some shrimp feed producers.

During the year, most aqua feed producers in Asia were squeezed from both sides. All faced rising production costs driven by high raw material costs. Many saw decreasing volumes in shrimp feed sales because of diseases and culture problems. Fish feed volumes were on the upward trend but despite the already low profit margins, the pressure was to supply cheap feeds in particular for freshwater fish species with low farm gate prices. Although demand is increasing for marine fish feeds, it is not fast enough and often inhibited by a downward trend in fish prices when production volumes increase. Leading feed producers continue to use their technical resources to work closely with governments and farmers to move the industry forward.

Higher costs and prices

The current situation with prices of major materials rising to unprecedented levels results in tremendous challenges for the industry. Since June 2012, prices rose by about 20% for all three commodities, soybean meal (SBM), corn and wheat because of drought fears. Fish meal prices rose to USD 1,850/tonne in October following reduced fishing quotas in South America, low inventories, higher demand in China and the likelihood of another *El Niño* (Globefish, October 2012).

The challenges faced by feed producers were described by Thomas Wilson, Thai Luxe Feeds in Thailand. "The raw materials situation extends beyond SBM. The rapid rise of SBM prices by 46% was accompanied by even steeper cost of imported corn gluten meal (CGM) at THB 32/kg. Companies wanted to buy more animal by-products, the cheapest protein source but suppliers were giving us short orders as the European economic situation was reducing raw materials for renderers, because of reduced meat consumption in countries with high unemployment and because importers in China, were aggressively buying frozen by-products and shipping them to China".

Thomas Wilson

"At the same time, with the high price of SBM, feed companies outside the EU, wanted to buy animal by-products, which they could get by offering higher prices than Thailand. The lifting of the EU ban on the use of animal by-products in aqua feeds expected in mid-2013 may see supplies tightening, and make it difficult for us to get this ingredient from Europe, but the effect should be gradual over a year or two. We know we have to rely more on plant proteins, so we need more R&D to improve performance of plant protein-based feeds. Some shrimp feed companies also faced high prices for wheat flour this year. We bought wheat flour by contract 5-6 months ahead, so were not affected by high wheat flour prices."

According to Narasimha Rao, Uno Feeds, the situation in India is aggravated by the 20% depreciation of the currency from INR 45 to INR 54 to the USD. Feed millers saw increases of almost 100% of most protein, 30% in oil and 50% in carbohydrate sources. Unfortunately local SBM, being non GMO commanded premium prices (Fishing

Chimes, August 2012). In the case of local fish meal and fish oil as alternatives to imports, prices are at the international level because of demand for vannamei shrimp feeds. It has been impossible to use fish meal for fish feeds. Fish feed producers work on narrow margins at 3% or lower and cannot absorb such wide fluctuations in ingredient prices for a long time. Ultimately, the full impact will be increases in feed prices or a combination of increase in prices with better feed conversion ratio (FCR).

Rising selling prices

During the year, shrimp feed producers did not increase prices in Vietnam. In China, shrimp feed prices were decreased by RMB 300/ tonne in January and then increased back again in July by the same amount. In Malaysia, there was a one-time increase by 3.5% and in India, 3 times to 15% for the year. In Indonesia, shrimp prices increased 1-2 times, depending on producer and fish feed prices were raised 4 times since July to 15% higher than in 2011. Tilapia and snakehead feed prices increased 4 times during the year in China. Marine fish feed prices increased twice in Indonesia and only once in Malaysia. In Thailand, the Ministry of Commerce controls the retail price of feeds and the Thai Feedmill Association had to ask for price increases for all feeds at least once this year.

In India, fish feed millers operating at low profit margins, changed their feed prices often. Rao said that prices of fish feed have gone up by 30 to 50%. He has calculated that the increase in SBM from INR 20 to INR 44/kg, corn prices from INR 11 to INR 15/kg and deoiled rice bran (DORB) from INR 6 to INR 10/kg will bring up the feed cost by INR12.80 for the pangasius catfish and INR 6/kg for carp mash. To maintain margins, prices have to be increased by INR 17-18/kg. He added that there is no magic wand and farmers need to understand that high crude protein is not the answer but digestible protein is, and that some protein can be used with synthetic amino acids (Fishing Chimes, August 2012).

Shrimp feeds

Feed volumes have remained relatively firm in Vietnam despite widespread reports on EMS in the country. Industry attributed this to a lower production of monodon shrimp and higher vannamei shrimp production (see pages 28-32). In Indonesia, feed sales were stable, characterised by higher consumption in the open market and lower consumption by integrated farms in Lampung operated by CP Prima, the leading shrimp feed supplier. Haris Muhtadi, PT CJ Feed Jombang said that they are producing at capacity to meet demand.

India's feed consumption reflected the expansion of culture of the vannamei shrimp. Estimates on total feed produced in 2012 ranged from 350,000 to 383,000 tonnes and Dr Manoj Sharma, Mayank Aquaculture reckoned that 83% was actually converted into shrimp production and 17% was wasted due to crop failures. Market players are Avanti Feeds, Waterbase, CP India and Godrej. Around 10,000 tonnes of feeds are imported from Uni President Vietnam.

In EMS affected countries, feed sales in 2012 were seen as a zero sum game, where some feed millers maintained sales volumes while some gained feed volumes lost by others. The change in ranking of market share in Vietnam reflected this. In Malaysia, the large drop in feed sales occurred in 2011 and the prolonged EMS continued to affect sales which were down by a further 10-15%. Industry reported that during the year, small feed sizes 1-3 dominated sales at 50-60% in Vietnam.

For several years, feeds have been bundled with post larvae (PL) supply. Farmers closely associate mortality from EMS with poor PL condition. Thomas said, "With mortalities reported in eastern Thailand, in affected areas, farming seasons were completely disrupted this year. Before feed companies had a chance to sell feed, mass mortality occurred and farmers had to restart operations. First, they have to queue for PL and sometimes, there would be considerable delay in supply, maybe as long as 2 months. On the back of poor performance of PL bundled with feed sales, customers looked for alternative source of PL. Our gain was when PL from Thai Luxe were available."

According to data from the Thai Shrimp Association, the countrywide drop in feed sales went down by 16 to 25%. However, both Thai Luxe and Thai Union Feed Mill (TFM) reported slight improvements in shrimp feed sales. In the case of Thai Luxe, the increase was because the major market is in the south where EMS has not been reported. In 2011, the shrimp feed volume was 1,020,000 tonnes which was calculated based on a FCR of 1.7 on a shrimp production of 600,000 tonnes. However, Dr Supis Thongrod, TFM said that estimation of feed production by FCR is not reliable now, as many sizes of shrimp are being produced with FCRs from 1.2. FCR also depends on the size of harvest, although in Thailand a considerable volume of shrimp production was size 70/kg, produced with a FCR of 1.3.

In 2012, Japan imposed limits on residues of the antioxidant ethoxyquin (EQ) on shrimp imports at 10 ppb from India and Vietnam. In India, feed millers reduced the inclusion rate and are working on alternatives to EQ. Although the regulation only applied to these two, it created awareness in other countries which started to implement measures to monitor EQ levels during production and in end products.

Freshwater fish feeds

Feed producers in most countries reported increasing volumes of feeds for freshwater fish in 2012 and expect this trend to continue into 2013. Recent 2012 estimates on the production of feeds for freshwater fish in China indicated 3% increase from 10 million tonnes in 2011. Industry reported that volumes of tilapia feeds went down. In addition, 0.3 million tonnes of feeds for the eel were produced. In Thailand, the production of feeds for various freshwater fish increased 56% from 511,100 tonnes in 2011 (Department of Fisheries, Thailand; Thongrod, 2012). The Thai Feedmill Association expects fish feed demand to grow at 9.4% per year. Volumes increased in Malaysia for the major producers like Dindings Soya and Multifeeds, Cargill and Star Feed Mills (part of Charoen Pokphand, Thailand). The demand is expected to increase in particular for tilapia feeds.

In Indonesia, the increase is 10.5% from the estimate of 905,000 tonnes in 2011 for feeds for the catfish, common carp and tilapia. Industry in Indonesia has also predicted a growth of 7.5% to 15% in 2013. The leading producer PT Sinta Prima says that its strength is the good distribution channel, good services and consistent feed quality.

In the freshwater fish feed segment in Indonesia, farmers have asked for cheap feeds especially when farm gate prices of fish do not move up with increasing feed costs. Pangasius catfish farmers usually use 29% protein floating feeds costing IDR 6,700/kg (USD 0.68/kg). They complained that at a FCR of 1.4, final production cost will be up to IDR12,500 (USD 1.3/kg). But when they use cheaper feeds costing IDR 4,000/kg, the FCR rises to 2 (Trobos, 2012).

G.Ramesh (right) with Martin Guerin, Gold Coin Malaysia (middle) and Mathieu Castex, Lallemand, France at Aqua India 2012, Chennai.

Denny Indradjaja, chairman of Indonesian Feed Mills Association, Aquaculture Division said "The government has asked the association to develop cheap feeds for catfish and milkfish. The feed developed was for the catfish priced at IDR 5,000/kg (USD 0.5/kg). It has also asked feed millers to use locally available raw materials. The problem is that even copra meal has risen in price. Using local soybean meal is in competition with its direct use as food for human consumption and fish meal needs to be from a sustainable source before large retailers will buy our fish or shrimp."

In the case of Thailand, Thomas says, "Fish feed continues to be focused on the largest segment, which is tilapia. The fish feed market seems to have two segments now, half the market wants quality feeds (mainly for catfish), and this segment is served by Thai Luxe, Charoen Pokphand Foods (CPF), Betagro and Krungthai Feedmill. The other half of the market wants cheap feeds with little interest on quality. This segment is also crowded with lots of small players. In 2013, we expect our fish feed sales to increase, but we have to have low cost products to do that."

Production capacity of extruded fish feeds is expanding in India (see box). "Besides rising SBM prices, the other main challenge is the erratic power cuts particularly in Andhra Pradesh where most of the feed mills are located," said G. Ramesh. However, high SBM prices have forced feed millers to utilise other protein sources such as cotton seed cake, rapeseed meal and meat and bone meal to bring down costs. Until 2011, 28% protein and 4% fat were the standard feed contents for all fish species. "Falling farm gate prices and increasing feed cost have changed the protein content to range from 20 to 28%," added Ramesh.

A challenging extruded fish feed market in 2012

In early 2012, four new extruders for fish feed production were added by poultry and livestock feed millers, namely Indian Broiler (IB), Growel Feed, Nexus Feeds and Mulpuri Foods and Feeds. These are high capacity extruders purchased for the production of fish feed and pet foods. The fish feed capacity rose to an estimated 1,698,000 tonnes per year (tpy) in 2012. G. Ramesh, manager, South Asia, Wenger, USA in a presentation at Aqua India in March 2012, said, "It was only 1 million tpy in 2011 and 468,000 tpy in 2010. In theory, the capacity is far below that required for the large production of freshwater fish of 3.8 million tonnes, mainly comprising more than 2 million tonnes of the Indian major carps and 0.5 million tonnes of the catfish pangasius. Most feed millers initially target feed production for the pangasius catfish which at a FCR of 1.2-1.5 would require 600-750,000 tpy.

"However, feed sales in 2011 reached 365,000 tonnes comprising 325,000 tonnes of extruded feeds and 40,000 tonnes of pelleted feeds in 2011. The expansion in production areas did occur and quickly to 180,000 acres (72,843 ha), especially in Andhra Pradesh with easy access to markets. Unfortunately, this added interest in pangasius farming increased cost of pond rentals by more than 30% while the large volumes of production brought down fish prices. This affected mainly the extruded feed market as farmers reverted to using farm made feeds. The cash and carry of feed sales changed to sales with credit."

Ramesh added that farm gate price went down to a low of INR 42/kg for the pangasius which reduced the profit margins. The cost of production is INR 38/kg. Feed sales were unstable as farmers shifted from extruded or pelleted feeds to farm made feeds depending on the price of fish. In contrast, carp prices were higher at INR 58-60/kg which is encouraging the development of extruded feeds. "Nevertheless, some feed producers have gone downstream to farming. There are also plans to develop extruded shrimp feed. The industry should also look at the production of quality fish fillet produced with formulated feed as there are price differences based on fillet quality. In 2012, Mulpuri Foods and Feeds became the largest producer of pangasius catfish and has started processing the fish in a pilot plant.

"With the availability of extruded feeds at prices comparable to sinking pelleted feed, many farmers moved away from pelleted feeds. The consumption of pelleted fish feeds, usually for the carps, went down to 25,000 tonnes in 2012 while extruded feed production grew 20% to 395,000 tonnes," said Ramesh.

Marine fish feeds

Throughout the region, growth is with feeds for various marine fish species. China still remains the leader with 500,000 tonnes in 2012 and feed volumes for the barramundi and pompano increased. Indonesian feed millers say that only 1-2% of total fish feed production in 2012 was for the marine fish segment, mainly for the barramundi. PT Sinta Prima, PT Matahari Sakti, PT Suri Tani Pemuka, and PT Grobest Indomakmur are the leading producers.

In Thailand, TFM is making inroads with their barramundi feeds (see page 15). Other producers of marine fish feed are CPF, Lee Pattana and Platong. In Malaysia, the market is expanding with three local companies producing marine fish feeds. The market leader is Star Feedmills producing feeds mainly for the barramundi. The company also supplies feeds to shrimp farmers who have switched to farming of barramundi in ponds in the southern part of the peninsula. A significant amount of feeds are imported from Uni President Vietnam (UPV), PT Matahari Sakti (Indonesia), Otohime (Japan) and Grobest (Taiwan). UPV markets the slow sinking pellets with 40% protein for groupers, snappers and pompano in cages and barramundi in ponds.

Ku Azahari, Lantas Resources Sdn Bhd imports and markets the Megami range of feeds for the grouper, barramundi and pompano produced by PT Matahari Sakti. His success is with the 45-46% protein feeds for the grouper which is well accepted by producers in the northern region of Peninsular Malaysia.

"Our feed prices are high relative to locally produced feeds, but they give high growth performance. Most of the feed is used for early stages, from size 10 cm and then the farmer will move to other brands. I expect that 2013 will be the year for marine fish production. We bundle feeds with fish fry from Bali to the producers here, in particular the Cantang hybrid which is popular because of its fast growth rate at 6 months for a marketable size," said Ku Azahari. The Cantang is a hybrid of the giant and tiger grouper.

Multidimensional expansion

In shrimp production, the use of automatic feeders is expanding. However, Thomas said that autofeeders create demand for size 3, 3P and 4S feeds. Pellets need to be durable and Joe Kearns, Wenger, USA said in a presentation at TARS 2012 that industry is expected to make feeds suitable for use in autofeeders without pellet destruction or fines. Uni President Taiwan produces extruded shrimp feeds to be used with autofeeders. Rudra Techno Feeds test-marketed extruded shrimp feed in 2012 while Godrej Agrovet Ltd which is one of the leading producers of pelleted shrimp feeds is expected to launch extruded shrimp feeds together with Growel Feeds, Indian Broiler and Shree Vijay Aqua Feeds in 2013.

Uni President Taiwan also introduced feeds with probiotics to the industry in 2012. As a major feed producer, Uni President has its own bacteria bank used for the production of probiotics, and selected *Bacillus* spp and *Lactobacillus* have been chosen for inclusion in new feed formulations. Dave Robb, EWOS Vietnam also sees the opportunity for functional feeds in Vietnam as effective control of disease and stress (see box).

Industry also indicated that feed millers have been producing bespoke fish and shrimp feeds, such as containing immunostimulants. Feed is tailored to the requirements of large clients willing to pay more for these feeds. However, feed millers also guard their reputation and ensure that clients understand the product function and overall strategy for farm operation. In the case of shrimp, careful scrutiny of biosecurity sometimes precedes selling of functional feeds against stress and disease resistance.

There are industry expectations, especially in the shrimp industry, where feed companies are expected to supply quality specific pathogen free (SPF) fry to farmers. Uni President Vietnam has added a new hatchery in Quang Tri to supply PL. It already has a hatchery in Ninh Thuan. A new hatchery of Sheng Long Bio-Tech International functional in 2013 will have adequate biosecurity and preventive measures to

R&D for success in Vietnam

EWOS Vietnam is a joint venture between ANOVA Aquafeed, Vietnam and the salmon feed company EWOS AS, Norway. The company started operations in March 2011, just as the economic crunch started to impact globally.

Dave Robb

"The force of this was felt more in 2012, as fish sales from Vietnam dropped, reducing demand for feed. In a difficult market, the EWOS strategy was clear, we had to distinguish ourselves from our competitors, who are providing nearly identical feeds to their customers," said Dave Robb, deputy general director.

"R&D underpins the activities of our salmon feed activities. This has given us the market leading position in Europe. EWOS is the company many turn to in difficult times. Our feeds are truly differentiated from the competition and the customers see the difference. Quality and R&D are going to be the tools for the company to break into the Vietnamese market."

The company prides itself on quality. Within less than a year of operations, it had made great changes in the factory, allowing it to achieve Global GAP certification in March 2012.

Dave said, "Having full control of what is happening in the factory is the first step to differentiate us from the competition. Within the first 6 months of operations, we have established two trial units in Vietnam. Over 200 small hapas or net cages (1.5 mx1.5 m) allow the company to run trials to develop feeds for customers. In 2012, 18 trials were conducted in 4 major areas: basic nutrition, additives, functional feeds and benchmarking."

In basic fish nutrition, information specific to the Pangasius catfish is sparse. By understanding it better, it can target accurately the requirements of the fish and to formulate smarter. Additives have an important part in Pangasius feeds, particularly as the feeds have to be very cheap. However, the effect of many additives is not documented and there is a risk of financial losses by using ineffective ones.

"By testing the additives ourselves, we will only use those that have a documented, economically viable impact," said Dave. "Functional feeds have been the corner stone of our success in salmon feeds, the provision of these feeds at specific times in the life cycle of the fish, for example to combat disease or stress. There is a clear opportunity for such feeds in Vietnam as effective control of disease and stress is required to improve the industry. This is a major research area for us."

Benchmarking allows the company to see the performance of its feeds under controlled conditions compared to competitors' feeds and its earlier feeds. It shows feed improvements and the benefits that customers can see. This will help demonstrate the increased profitability farmers will have when using the new, improved feeds.

"Our earlier results with R&D have helped us to show gains in growth rate and feed conversion ratios in the Pangasius. Some customers have found FCR as low as 1.39, but the variation among customers is high, showing that while the feed may be good, there is a lot to work on with respect to other farming issues. We have also developed a market leading snakehead feed, an important fish for the domestic market in Vietnam. With a FCR below 1.10, farmers are very happy with this feed, especially coupled with the low spinal deformities seen in many production units," said Dave.

"These two prongs of quality and R&D are going to be the tools for our success in Vietnam. It is a difficult market, given the current export situation for Pangasius. But, we have invested for the long term and are making big developments ready for the improved market which will come in the future."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Some examples of prices (local currency) at range of crude protein levels (%CP) for shrimp and fish feeds in 2012 in selected countries.				
Prices/kg	Shrimp feeds		Freshwater fish feeds	Marine fish feeds
	Vannamei	Monodon		
China, RMB [a]	7.7 (39%) - 8 (41%)	7.9 (40-42%) - 8.9 (42%)	Tilapia 4.0(28%)- 4.6 (33%)	7.8 (38%) - 8.8 (42%)
Thailand THB	37-39 (35%)	43-45 (≥38%)	Tilapia, catfish, 30-35 (25-32%) Tilapia, pelleted, 25-30 (18-25%)	seabass 45-50 (36-42%) grouper 45-50 (40%) 50-55 (40-45%)
Vietnam VND	28,000 (38%)	35,000 (40%)	Catfish 11,600 (28-30%)	26,450 (≥ 43-46%)
Indonesia IDR [b]	10000 -12000 (30-36%)	12,400 (40-42%)	freshwater fish, 6,150 – 6,650 (≥18%), milkfish 5,300 (≥18%), catfish, tilapia, 7,750 (≥ 28%)	sea bass 13,000 –18,000 (44-46%)
India INR	48-51 (32-36%)	58-62 (≥ 38%)	pangasius 20 (20%), 24 (24%), 27 (28%)	na
Malaysia MYR	3.20-3.30 (36%)	3.60 (40%)	tilapia 2.45 (≥ 28%)	sea bass/ grouper, local 3.80 (≥ 42 %); imported 4.50 (≥ 42-46%)
Conversion to USD on 8 Jan 2013; RMB 6.2; THB 30.4; VND 20818; IDR 9660; INR 54.9; MYR 3.0				

[a] *Price range by feed companies in Zhanjiang, China*
[b] *Range of prices for floating and sinking feed for freshwater fish, milkfish in extensive culture and catfish and tilapia in intensive culture*

Some estimates by industry on aqua feed consumption (tonnes) in 2012 in selected countries.			
	Shrimp feeds	Freshwater fish feeds	Marine fish feeds
China	1,500,000	13,000,000	500,000
Thailand	765-850,000 [b]	800,000 [b]	20,000
Vietnam	503,000	1,500,000 -1,600,000 [c]	na
Indonesia	300,000 [d]	1,000,000[d]	
India	350,000 -383,000	420,000	-
Malaysia	90,000	72,000	36,000
Taiwan [e]	24,785	121,281	208,000

a *Estimates by industry stakeholders and feed producers including from India- Manoj Sharma, Mayank Aquaculture, G. Ramesh, Indonesian Feed Mills Association, Aquaculture Division*
b *Thai Shrimp Association (Thongrod, 2012)*
c *Mainly feeds for the pangasius catfish; estimate >620,000 tonnes in integrator market*
d *Indonesia - shrimp, open market and integrator market, includes marine fish*
e *Published data in 2011- marine fish include milkfish, grouper and barramundi*

produce Vibrio free SPF post larvae which it hopes will minimise the occurrence of EMS. It also wants to promote polyculture models by combining shrimp and fish farming during the grow out period. Jie Cheng Chuang, general manager said that shrimp can be cultured with pompano, mullet and milkfish in sea water; and with tilapia and milkfish in fresh water at a total stocking density of 1,000 pcs/ha. The Gold Coin group will focus on shrimp genetics in its hatchery operations for PL supply and export of commercial brood stock to the region (see pages 26-27).

In the region, expansion is highest in India arising from demand for both pangasius and vannamei shrimp production. Feed producers look forward to a future demand for tilapia and marine fish feeds, as and when approval is given by the government for tilapia farming and when farmers take up the culture of cobia and grouper. A new entrant, Shree Vijay Aqua Feeds came on line, integrating feed mills with its other aquaculture activities (see box). Shrimp feed producer, Godrej Agrovet has diversified into fish feed production.

In Vietnam, the top pangasius catfish integrator Hung Vuong (HV) is expanding its feed business to secure feed supply for its farms. Recently, it has increased its share in the largest fish feed producer Viet Thang which already supplies 60% of its production to HV. In addition to its own feed mill Hung Vuong Tay Nam, HV also acquired Viet Dang in Dong Thap, which has a 100,000 tpy capacity. Thailand has a new feed company Thai Royal Feed Mill which is building an aqua feed mill with a capacity of 3,000 tonnes per month (tpm) catfish feeds and 5,000 tpm of shrimp feed. Asian Feed went into downstream integration with STC, which it bought a few years ago and will now build up the feed production facilities. In Indonesia, Malindo Feeds will be a new player in the fish feeds business, while Suri Tani Pemuka will be setting up a new factory in Lampung. PT Sinta Prima will expand to increase production in early 2013.

References are available on request.

Integration in India

In February 2012, Shree Vijay Aqua Feeds Pvt Ltd acquired extruders and pellet mills for its fish and shrimp feed mill, located in West Godavari, Andhra Pradesh on the east coast.

This venture is part of the upstream integration of the Group. With partner companies, it has a *Penaeus vannamei* hatchery which produces 100 million post larvae, more than 120 ha semi-intensive shrimp and satellite farms with an annual production of 1,900 tonnes of fish and shrimp and processing capacity of 40 tonnes/day. It exports 75,000 tonnes of fish and shrimp to major markets worldwide, including the US.

B.K. Murthy

Shree Vijay Aqua Feed managing director B.K. Murthy said, "We have been in the import and distribution business for aqua feeds from Vietnam and Taiwan since 2004. The feed mill completes the connectivity with our farmers. The additional extruder will raise production to 180,000 tonnes per year (tpy) of both pelleted shrimp and extruded fish feeds. The plan is also to produce extruded shrimp feed in the near future. We will also begin to export feeds and have a license from the Indian government to provide fish food for tropical fishes"

"We started production of extruded feeds for the pangasius catfish, Indian major carp and tilapia using two single screw extruders from Wenger USA and Muyang, China. These have a capacity of 10 tonnes/hour (tph) each. Our single screw extruders can produce 8.5 to 10 tph of extruded shrimp feed. In addition, shrimp feed is produced using a pellet mill from Muyang. The technical evaluation of our feed mill is by Graintech, Denmark."

"Our shrimp farm has a capacity to produce 500 tonnes/year. The stocking density is low at 40 PL/m^2. In the future, Group Chairman N.V.R. Mohan Rao said that the company will be looking at contract farming in India. It will supply seed and feed support with prices for the products. This will help farmers overcome the problems in farming, especially fluctuating ex-farm prices.

"The future market will demand certified products and this is where we can help the farmer. Our group processing plants in Andhra Pradesh, Srikanth International and Blue Park Sea Foods Pvt Ltd are accredited for export with EU, BRC, USFDA and ISO certifications.

"The company has set an ambitious target of doubling its revenue to INR 200 crores (USD 36.7 million) by 2015."

Value adding in marketing feed

The new aqua business team will shift from generic feed marketing to value added services.

Tycho Vos joined Gold Coin in 2011 as managing director of SyAqua and is responsible for the new aqua business group since June 2012.

Whilst several aqua feed producers have vertically integrated with hatchery operations and farming, Gold Coin is reformulating its business strategy. Gold Coin was one of the pioneers in shrimp feed production that helped drive the commercialisation of Asia's shrimp farming industry and it continues today to rely on historical relationships with customers to maintain market share.

Tycho Vos, director of Aqua Business Group sees that generic feed marketing is no longer sustainable today where the expectations of industry from a shrimp producer goes beyond feed production to farm and disease management to marketing of the final products.

"We will now focus on value-added services, and move away from the traditional way of just selling feeds. The goal will be to be a credible partner to the farmer and not just focus on sales. Margins are getting smaller all along the supply chain and integration is getting stronger.

"Since June 2012, we have been changing the organisation of the Aqua Business Group to reflect this and will offer more than feed and husbandry advice to farmers. In April 2011, we acquired the shrimp genetic company SyAqua which gave us a foothold into shrimp genetics for our hatchery operations for post larvae supply and export of commercial brood stock to the region."

Animal nutrition and feed milling company, Gold Coin Group has its headquarters in Malaysia. It specialises in livestock and aqua feeds and is a market leader with a presence in eight Asian countries. It started shrimp feed production in 1984 in Singapore. Since then, the company has remained a dedicated producer of feeds for marine shrimp species, and has recently diversified into production of freshwater fish feeds.

In Malaysia, production of pelleted feeds for marine shrimp is at the new feed mill in West Port, following the closure of the shrimp feed mill in Johor Baru. It also has a specialty factory producing encapsulated and micro particulate hatchery feeds for marine shrimp. In addition, the plant in Sarawak produces extruded feeds for freshwater fish.

In China, the feed mill in Zhuhai, Guangdong province produces extruded freshwater fish feeds. In Bekasi, Indonesia and Songkhla, Thailand only shrimp feeds are produced. All these mills have a combined annual production of more than 150,000 tonnes per year. In India, it now markets only hatchery feeds for marine shrimp after leaving the market for grow-out shrimp feeds two years ago.

Shrimp genetics program

The headquarters of the aqua business unit is located in Bangkok, Thailand.

"With SyAqua part of Gold Coin, we are now one of the three Asian based companies with specific pathogen free (SPF) shrimp genetic programs. The selection work is done in our centre in Phang Nga, Thailand. Biosecurity is ensured as it is 5 km inland and we have a comprehensive intensive treatment and recirculation system for the water," said Tycho.

"We are very serious in developing our family based genetic program and have invested a lot of resources, manpower and finances in this. On taking over SyAqua, we have revamped the facilities and are now building a new state of the art facility. We have implemented a new strategy of selection and are using modern technology tools to increase the pressure of selection. The program is led by Dr Thomas Gitterle who previously head the Genetic and Breeding Department at CENIACUA, Colombia and was scientific advisor to AKVAFORSK Genetic Center in Norway.

"I would like to say that we do have a world class genetic program. The pressure is on us to meet the demands of industry for fast growth, robustness and disease resistance. In any genetic program, how to marry these is the challenge. We have emphasised on growth but do not overlook robustness and resistance. We have upgraded our facility's infrastructure to minimise the effects of the environment such that the progress is only from genetic contribution. We test all cohorts under commercial conditions and use the data to make the best choices. We have an agreement with a third party outside expert to advise us on what are the new technology trends in this field and also to benchmark us."

SyAqua brood stock

Upstream and supporting role

At the moment, post larvae supply is only available for farms in Thailand where Gold Coin has two hatcheries in the south. In Indonesia, it has two hatcheries, in Lampung, Sumatra and Anyer, West Java. It is also registered with the Coastal Aquaculture Authority of India to supply hatcheries with its SyAqua brood stock.

"In Indonesia, we are a minor player and have been focussing on the industry in South Sumatra. We have also streamlined our activities here and expect to move to other parts of the country. The new SyAqua brand of post larvae is entirely different from those that we marketed in Indonesia some 1.5 years ago".

In Thailand, there is already a newly furbished laboratory which carries out bacteriological, virological and PCR analyses on a daily basis. In the different countries, Gold Coin currently has collaborative R&D programs, in particular on disease management. It is working with universities in Thailand to better help industry understand the situation with early mortality syndrome (EMS). A program is currently in the discussion stage to collaborate on research into infectious myonecrosis virus (IMNV) with the government in Indonesia. In both cases, Gold Coin believes that it has a responsibility to provide solutions and finance R&D for the betterment of the industry when required.

Outlook on industry

Dutchman Tycho is a biochemist and animal husbandry engineer who started his working career in the genetic selection of niche poultry species at the French genetics company Grimaud Frères. He is very familiar with Asia as he spent several years developing the Asian business for Ceva. With a background in animal production, Tycho has this to say on the aquaculture industry in Asia.

"Coming from the poultry sector, I can see a lot of inefficiencies in survival rates in the hatchery and commercial production of aqua products. However, we understand this as fish and shrimp farming are relatively young in comparison to that of livestock. I see that more focus is placed on feeds which contribute to more than 50% of cost of production but we need to have an economical approach and look at output based on per m^2 as is practised in the livestock sector.

"The middleclass in Asia will continue to grow and as seafood consumption is directly correlated with income, we can expect demand for aquaculture products to grow in the next 15 years. Therefore, it will be an opportunity for the industry but I believe that demand will be on quality products. Our challenge is that this comes with prerequisites that the production is certified and has the least impact on the environment. Industry must be prepared to have more dialogues with buyers and work together on this."

The Thai sales team

Shrimp production in Asia in 2012

Low supplies continued in 2012 with fluctuating prices. New protocols introduced to improve production but there is a grim outlook on rising costs of production. AAP reports.

In 2012, the total production of *Penaeus vannamei* and *P. monodon* in Asia as estimated by industry in the respective countries declined by 11% as compared to estimates in 2011. Lower production was attributed to diseases, mainly early mortality syndrome (EMS) or acute hepatopancreatic necrosis syndrome (AHPNS) which was officially reported in China and Vietnam in 2010 and Malaysia in mid-2011 and recently in Thailand in mid 2012 (Flegel, 2012). However, losses could also be due to white spot syndrome virus (WSSV), white faeces disease, yellow head virus and in Indonesia, infectious myonecrosis (IMNV). Monodon shrimp production continued to decline in the top producing countries.

The cause of EMS is still unknown and investigations are ongoing (see page 13). A regional consultation organised by the Network of Aquaculture Centre in Asia Pacific (NACA) in August 2012 called for more coordination in investigations and sharing of resources to achieve progress in seeking the causes of EMS. In order to reduce the severity from crop losses, farmers have been advised to adopt a multifactorial approach to improve culture conditions for post larvae (PL) to pond water quality. Culture and disease experts have asked farmers to pay attention, not just on PL quality but also seek ways to use older PL which may adapt better to changing pond conditions. Dr Chen Ming Dang, Charoen Pokphand Foods (CPF) says that at PL40, shrimp are stronger to resist infections. Adequate and the right type and volume of aeration for oxygen dispersion is important.

Chen Ming Dang at TARS 2012

Feed producers, health and nutrition companies have been at the forefront of efforts to help farmers overcome the problems. In Vietnam, Sheng Long Bio-Tech is working with China's Hinter Guangdong Biotechnology group in introducing a new culture model whilst CJ Feeds in corporation with Shrimp Club Indonesia (SCI) encouraged Vietnamese farmers to implement a protocol using various pond and feed additives which was successful in farms in Lampung, Indonesia.

Post larvae supply and quality

In most countries, supply of specific pathogen free (SPF) vannamei PL is generally adequate despite the higher and sometimes erratic demand with shrimp dying within 30-40 days of culture (DOC). However, PL quality is a concern with growing use of progeny from pond reared brood stocks. China's PL annual production capacity is 700 billion and demand is only 500 billion but the worry is that only 10% of PL production is from imported brood stock from the US, 20% from F2 generation of imported brood stock and 70% from pond reared brood stock. Since 2007, the demand for imported brood stock has increased to 33% to 100,000 pieces in 2010 but prices have increased by 48% (Dong, 2012).

In Indonesia, vannamei PL from imported brood stock are sold at IDR 27-35/PL (USD 2.8-3.6 /1000 PL) whereas PL from local brood stock are sold at IDR 7-13/PL (USD 0.72-1.34/1000 PL). The wide price range is due to differences in season and location. The current demand is 500 million/month which is within the current capacity of 2.8 billion/month of existing hatcheries. "However, the planned revitalisation program involving 82,870 ha in Java, (see below) will demand more

Marketing shrimp from Indonesia at ESE 2012

brood stock and capacity to produce 8-13 billion PL/month," said Agus Somamihardja, head of the Hatchery and Nursery Association in Agrina News (2012). The association is suggesting a nucleus centre to produce SPF brood stock.

In the Philippines, the demand is around 100 million per month and about half is non SPF PL costing 0.9-1.2 centavos (USD 2.2-2.9/1000 PL). In contrast, PL from SPF brood stock costs 2.3-2.5 centavos (USD 5.6-6.1/1000PL). "In general, prices have remained the same as last year and are high, relative to other countries because of air freight costs. PL quality is improving and the production capacity is already saturated in the Philippines," said Ryan Michael Alegre, Dobe International.

"In India, the lower supply of SPF vannamei PL has led to more spurious seed in the market," said Dr Manoj Sharma, Mayank Aquaculture. Vietnam produces 50.5 billion vannamei PL but there is an alarming decline in quality from small and scattered hatcheries which lack good brood stock. The prices as reported in Bac Lieu news was VND 30-35 each for PL before testing (USD1.4-1.7/1000PL) and VND 50-60 each of PL after testing (USD 2.4 to 2.9/1000PL). The role in the supply of quality SPF PL has been taken over by feed companies and large integrators.

Biofloc technology

Biofloc technology (BFT) is seen as the way to reduce water exchange, alleviate diseases, increase yields and reduce production costs. BFT is common in Indonesian shrimp farms to counter IMNV. In India, Anil Ghanekar, Biosecure systems said that a few farms are trying to use BFT or semi BFT and many farmers are keen to know more about this. A two-day workshop was organised by the Society of Aquaculture Professionals (SAP) and World Aquaculture Society (WAS) in July 2012.

"However at the moment not many farmers are ready to spend on infrastructure changes, such as pond liners. They prefer to wait for more success stories. In the Hitide farms in Tamil Nadu, lined ponds using BFT gave excellent production of 5.5 tonnes in a 1,200 m^2 pond with partial harvests resulting in large size shrimp. This was done with the guidance of BFT expert Dr Yoram Avnimelech.

"I have developed a biofloc nursery near Chennai where we rear a million PL to juveniles for 21 days in circular 100-tonne tanks. These juveniles which have a stunted weight of 0.25 to 0.4g show excellent compensatory growth in the ponds with high survival rates," added Anil.

In Vietnam and China, farmers are attracted to BFT because of higher survival rates and are keen to learn more. Major feed producers are encouraging farmers to adopt BFT. CP Vietnam has conducted some successful trials in farms in Ben Tre. In China, the Hisenor company, part of the Haid group and a large producer of shrimp and fish seed stock is using BFT in Zhanjiang. In Vietnam, Sheng Long Bio-Tech will follow suit in 2013. An industry source said that 'although 2013 is the key year of biofloc promotion in China and Vietnam, there is still a need to understand that BFT will require not only change in infrastructure but also the understanding of the science of BFT by farmers.'

The new i-Sharp farm on the East Coast of Peninsular Malaysia is demonstrating the use of semi biofloc technology for high production yields. The farm has been designed with BFT in mind. It has biosecurity to prevent outbreaks of WSSV and to date; no diseases have been reported despite adverse weather conditions in late October 2012. In one cycle in 2012, yields at fully lined 0.5 ha ponds ranged from 15-17 tonnes/ha. FCR ranged from 1.26-1.39. The energy efficiency was 643-715 kh/hp (Nyan Taw, 2012).

Markets

The two years of high prices in the international market since January 2010 were disrupted by a drop in mid 2012 but prices recovered by December 2012. Urner Barry reported the highest prices for head on shell on (HOSO) shrimp in Europe in April (USD 5.95/kg size 50/60) which then dropped in August to USD 5.54/kg and picked up back in November to USD 5.66/kg. Shrimp exports from Asia were affected by a depressed demand in the US and Europe but producers and exporters then directed their focus to China, where demand is increasing.

Japan imposed new regulations on the residue level of ethoxyquin at 10 ppb for shrimp from Vietnam and India. In Vietnam, producers were already upset by 100% checks for residues of enrofloxacin. Imports from India for the period January to November 2012 declined by 15% to 24,103 tonnes from 28,103 tonnes for the same period in 2011. Vietnam registered a small 4% growth of imports to Japan. The competitor to shrimp from Asia was Argentinian shrimp which saw imports to Japan rise by 53.9%.

Volatility in local prices

Although supply was generally short in all countries, volatile ex-farm prices were related to availability of stocks in India, Thailand and Indonesia. In November, farm gate prices in Malaysia remained high at MYR16.50/kg (USD 5.4/kg) for size 70 because it has a good local (25,000 tonnes/year) and Singapore market (20,000 tonnes/year) for live and chilled shrimp. Vietnam shrimp prices were also high in mid-November, at VND 103,000-105,000/kg (USD 4.9-5.0/kg) for size 70/kg vannamei shrimp and from VND 120,000 to 180,000/kg (USD 5.8-8.6/kg) for size 40/kg monodon shrimp, depending on location. In Malaysia and Vietnam, with high raw material prices, it was not profitable to process shrimp based on the fixed international prices. High prices and a shortage resulted in imports of Thai shrimp into Vietnam and Malaysia. In comparison, prices were lower in Thailand at THB 140/kg (USD 4.6/kg) for size 70/kg in October.

Producers in Indonesia faced lower prices in May (IDR 35,000/kg or USD 3.6/kg for size 60-65/kg) which picked up in July to IDR 42,000 (USD 4.3/kg). The domestic market is very small relative to its production. Thomas Darmawan, chairman of the Indonesian Fishery Products Processing and Marketing Association said this reflected the availability and situation in other countries (www.indonesiafinancetoday.com). Lower prices in Indonesia were attributed to the crisis in Europe, market preference for shrimp from Thailand, India and Vietnam (which are priced competitively lower than that from Indonesia), early harvest in Thailand and the weak position of packers in Indonesia in terms of volumes and prices.

Rising costs of production

In intensive shrimp farming, cost of production (COP) is rising, mainly because of the higher feed prices which may account for 54 to 63% of the total COP. In Vietnam, in 2012, COP increased 5-8% because of increases in feed and PL prices at 5-6%, electricity at 5% and labour at 10%. Current costs of production range from RMB 16/kg (USD 2.56/kg) for size 80/kg and stocking at 100 PL/m^2 in China to INR180-200/

Table 1. Marine shrimp production (tonnes) in 2010 to 2012.

	Production in 2010 [a]		Estimates of production in 2011 [b]		Estimates of production in 2012 [b]	
Country	***P. vannamei***	***P. monodon***	***P. vannamei***	***P. monodon***	***P. vannamei***	***P. monodon***
China	1,223,277	60,210	1,092,000	54,600	1,050,000	52,500
Thailand	561,075	3,500	550,000	5,000	450,000	6,000
Viet Nam	136,700	333,000	172,000 [c]	318,000 [c]	177,817 [c]	298,607 [c]
Indonesia	206,578	125,519	246,420 [d]	126,157 [d]	183,000	35,000
Malaysia	68,084	18,118	60,322	7,150	55,000	7,000
India	10,400	96,500	70,000	111,700	120,000	60,000
Philippines	4,971	48,162	9,000	40,000	18,000	40,000
Bangladesh	2,125	43,154		56,569[e]		50,000
Others	9,563					
Total Asia	2,222,773	728,163	2,199,742	726,670	2,053,817	548,107
Latin America						
Ecuador	223,313					
Brazil	69,422					
Mexico	104,612					
Others	77,891					
Total Latin America	475,238		452,000 [f]		527,000 [f]	
Total	2,698,011	728,163	2,651,742	722,520	2,580,817	544,107
Total Asia and Latin America	3,079,655		3,378,412		3,128,924	

[a] *Published production figures in 2010 (Fishstat Plus, 2012).*
[b] *Estimates from industry. China-data from China Aquatic Products Processing and Marketing Alliance (CAPPMA); P.monodon-previous year's data; India- Chandrasekar (2012); Manoj Sharma (2012); Thailand & Malaysia-various sources, Philippines - Estimates provided by Chen Ming Dang, CPF;*
[c] *Ministry of Agriculture and Rural Development, Vietnam (2011 and 2012)*
[d] *Ministry of Marine Affairs and Fisheries, Indonesia (2011).*
[e] *Bangladesh Water Development Board*
[f] *Total for Latin America, estimates from industry*

kg (USD 3.3-3.7/kg) in India where stocking density is 60 PL/m^2 and production size is 30-40/kg. In Indonesia, COP is now IDR27,000/kg for size 100/kg (USD 2.8/kg) to IDR 35,000/kg for the production of size 60-65/kg (USD 3.6/kg,) and in Malaysia, the average is MYR 11/kg (USD 3.6/kg) for a production size of 70/kg stocked at 100 PL/m^2. After feed, the largest cost component is energy for producers in Indonesia, China, Malaysia and India. Land rentals are increasing, with a 50% increase in India since 2009 and 10% increase since 2007 in China. In all these countries, labour costs are rising, now estimated at 5-9% of COP. In the last 5 years, labour costs have increased 100% in China and in India, cost of labour including food and lodging has increased 5.5 times since 1993 but shrimp prices have remained the same, according to Ali Hussain, Bismi Farms.

Vannamei shrimp ponds in North Vietnam

Production trends

China

China Aquatic Products Processing and Marketing Alliance (CAPPMA) estimates showed vannamei and monodon shrimp production in freshwater and marine environments was 1.5 million tonnes in 2012. Vannamei shrimp comprised 70% of the annual production at 1.09 million tonnes. In 2010, Wang (2012) reported that China harvested 833,000 tonnes of shrimp from marine ponds comprising 73% of vannamei shrimp, at 608,267 tonnes. The rest were *Penaeus chinensis* (45,313 tonnes, 5.4%, *P. monodon* (56,634 tonnes, 6.8%) and *P. japonicus* (54,792 tonnes, 6.6%).The farming of *P. vannamei* in inland fresh water ponds also reached a record level of 615,000 tonnes in 2010. Estimates from industry for 2012 production in marine ponds ranged from 550,000 to 650,000 tonnes.

Despite challenges with disease, in particular that of EMS, it is unlikely that Chinese farmers will reduce stocking density, as is the proposed practice for Thai farmers to alleviate stress in open systems or during adverse weather conditions. The common practice in soil bottom ponds is stocking at 105-120 PL/m^2 and rearing for 100 days to harvest 80 kg size with a survival rate of 40%. It is also likely for a small farmer to stop operations after two crop losses and lease out the ponds to a new investor who in turn will go through the learning curve in shrimp farming.

Some of the latest innovations are high density stocking in lined ponds and raceway culture. The indoor industrialised farming models with indoor tanks of 50-200 m^2 and stocking 200-300 PL/m^2 to as high as 400 PL/m^2 provide harvests from 4-4.5 kg/m^2 (Wang, 2012). The advantage is that these can be located near to markets such as Macau. In ponds with concrete dykes and sandy bottom or HDPE lining, the stocking density is from 180-210 PL/m^2, culture period is 90-110 days for shrimp of 60-65/kg size and survival is 50-60%. In Guangdong, the trend is moving towards the small and deep pond (more than 2.5 m) farming model with stocking density of 450 PL/m^2. Yields are 36 tonnes/ha (Dong Quifen, 2012). In 2013, it is expected that production will remain stable or decline due to the lower survivals and increasing costs of production.

Thailand

With EMS reported in the shrimp farms in the eastern provinces from mid-year, Chen projected that the vannamei shrimp production in 2012 would decline to an estimated 450,000 tonnes from the 540,000-550,000 tonnes production estimated by industry for 2011. During the last two months of the year, Soraphat Panakorn, Novozymes, Thailand said that in anticipation of a difficult 2013, shrimp associations have been conducting seminars with shrimp experts such as Dr Chalor Limsuwan, Kasetsart University to notify farmers on ways to prevent EMS outbreaks within the first 30-50 days of culture.

"Most farms practise testing of PL quality using the formalin tests. The weak shrimp are destroyed. Each time there are problems, farmers clean up and disinfect ponds. In using HDPE liners, the advice is that it should be supported with adequate water exchange for optimal mineral levels in the water," said Soraphat. "Some farms have a separate nursery system with 3 tonne tanks placed on the dykes. The nursing of PL for up to 20 days will weed out the weak shrimp. The tank water is treated with probiotics and shrimp are fed high nutrient diets. Shrimp are easily transferred to grow out ponds by releasing a valve."

A major challenge for Thailand's industry will be the high production costs. During the TARS conference on shrimp aquaculture in August 2012, Dr Panisuan Jamnarnwej from the Thai Frozen Foods Association said, "The industry is not worried about sales since the production is stable while demand continues to grow. However, a general concern is the rising costs of labour, expected to be over 10% of total cost within a year or so." According to Chen, in 2013, industry is confident that it can overcome EMS and that production will resume to the 540,000-560,000 tonnes levels.

Indonesia

In 2011, official data from the Ministry of Fisheries and Marine Affairs showed a production of 381,288 tonnes, comprising 246,420 tonnes of vannamei shrimp and 126,127 tonnes of monodon shrimp.

Iwan Sutanto, head of Shrimp Club Indonesia (SCI) expected production to increase in 2012 to 420,000 tonnes comprising 85% vannamei and 15% monodon shrimp. However, the feed industry estimates 218,000 tonnes, comprising 183,000 tonnes of vannamei shrimp and 35,000 tonnes of monodon shrimp. This includes 38,000 tonnes produced in CP Prima's integrated farms in Lampung.

The Indonesian shrimp industry is still recovering from IMNV which occurred in 2009. In Lampung, SCI is active with revised protocols on farming such as reduction of density from 100 to 80 PL/m^2 , reduction of water exchange, use of partial biofloc systems, partial harvesting and increasing biosecurity. Technicians conduct seminars on these protocols and a recent inclusion are precautions to be taken to avoid EMS.

Dr Bambang Widigdo Indonesian Shrimp Commission said that it will not be possible to eradicate IMNV totally from the system. New production parameters include reduction of stocking density to 60-100 PL/m^2, feeding from 30-50 days onwards and partial harvesting from 70 days for size 100/kg shrimp, followed by 90-100 days for size 70/kg and final harvest of size 50/kg at 110-115 days. The total production can be 15 tonnes/ha and the carrying capacity is maintained at 10 tonnes/ha. An option in low saline areas of 10-15 ppt is traditional culture of tilapia and shrimp at stocking density of 5 pcs/m^2 each. Production can be 17-20g shrimp in 120 days at survival rates of 50-70%. In highly saline ponds (20-25 ppt), polyculture of shrimp and saline strain of GIFT tilapia is practised. The stocking density of fish is only 0.2-0.5 fry/m^2 and shrimp 55-60 PL/m^2 and production is 60-10 tonnes/ha of 18g shrimp at 70-80% survival.

Throughout the archipelago, there are 34,000 ha of idle ponds, previously used for intensive culture. The government's revitalisation program which is a partnership between farmer, consultants, banks and government is an important strategy to increase production. The government supports with infrastructure improvements and pond liners whilst the private sector provides fry, feed, other production facilities and buy the harvested shrimp. The program also aims to change some areas from traditional culture systems to semi intensive systems. The initial focus of the government's program is 82,870 ha of idle ponds in the north coast of Java. There are 310,000 ha of ponds under traditional farming systems, mainly monodon shrimp. Bambang said in 2012, CP Prima's Vannamei Village (Kave) program has revitalised up to 1,000 ha in East Java and Madura. Stocking is at 50-60 PL/m^2, with two partial harvest at DOC 70 and 100, at a biomass of 2-2.5 tonnes/ha and 6-7.2 tonnes/ha, respectively. The total yield was 8-9.2 tonnes/ha at survival rates of 80-95%.

There is a general optimism for higher shrimp production in 2013 coming from this revitalisation program.

India

"In 2012, vannamei shrimp production rose to 120,000 tonnes but that of the monodon shrimp went down to only 60,000 tonnes," said Manoj Sharma. "Aside from the threat of WSSV and vibrosis in the farming of both species, farmers faced higher costs of production but lower farm gate prices. The monodon shrimp had the lowest farm gate price in 5 years at INR 180-220/kg (USD 3.3-4.0/kg) for size 30/kg during the peak harvest season of July/ September which usually sees a big drop in prices coupled with insufficient processing capacities."

"In 2013, the diminishing trend toward monodon shrimp production will continue with a likely ratio of 20:80 ratio of monodon: vannamei production. Vannamei production should rise to 150,000-200,000 and monodon production to drop to only 20,000-30,000 tonnes. Prices will be stable at INR 240-280/kg (USD 4.4-5.1/kg) for size 30/kg vannamei shrimp if other countries continue to face production problems. In the case of the monodon shrimp, a higher price range is expected for size 40-50/kg with lower production. As there is still insufficient processing capacity, farmers will need to spread harvesting away from the current peak period in July/ September to avoid prices dropping due to excess supply."

Biofloc farming at i-Sharp farm in Malaysia

Vietnam

In 2012, more areas were affected by EMS as compared to 2011 with losses of USD 285 million, according to the Ministry of Agriculture and Rural Development (MARD). In a meeting in February 2012, Dr Pham Anh Tuan, Directorate of Fisheries said that the area damaged by diseases amounted to over 97,000 ha and mostly were in Soc Trang with 25,000 ha. He attributed early mortality to poor quality PL and degradation of pond conditions. WSSV was also a cause of mortality.

Farmers have begun to use BFT for the whole crop which makes it difficult to control water volumes, said Jie Cheng Chuang, Sheng Long Bio-Tech. Some farms in the Mekong Delta are lining ponds and using a close water system. For the successful farms, yields are high from 8-15 tonnes/ha/crop of size 80/kg of vannamei shrimp stocked at 80-150 PL/m^2. The yield is 7-11 tonnes/ha/crop of size 30-40/kg stocked at 30-50 PL/m^2 for monodon shrimp. Survival for both species was 80%. The cost of production is VND 59,000/kg (USD 2.8/kg) for size 50/kg vannamei shrimp stocked at 100 PL/m^2, DOC 85 and survival at 80%. In 2013, MARD has planned for a production of 340,000 tonnes of monodon shrimp and 190,000 tonnes of vannamei shrimp.

Malaysia

Industry estimates indicated a further decline in production of the vannamei shrimp in 2012 to 55,000 tonnes. Several ponds in large farms succumbed to EMS and WSSV in 2011 and crop losses continued into 2012. In addition, several farms in East Malaysia (Sabah and Sarawak) have reported cases of EMS since mid-2012. As EMS is also suspected to come with PL consignments from West Malaysia, the Sabah Fisheries Department has banned the importation of PL from West Malaysia. The decline in production is also because some shrimp farms such as in the southern part of Peninsular Malaysia shifted to the production of the Asian seabass or barramundi.

Stakeholders are working together to find solutions and share information. Agrobest, one of the largest integrated farms in West Malaysia reported that it is slowly managing to resume production after reporting losses since mid- 2011. In the farms managed by Star Feed Mills, part of Charoen Pokphand Thailand, the strategy is to line ponds for better management. In 2013, industry expects a small increase in production from new ponds such as the phase one ponds of the i-Sharp farm which will be fully operational.

Philippines

Production estimates by industry in 2012 varies from 13,000- 18,000 tonnes of vannamei shrimp compared to an estimate of 20,000 tonnes in 2011. Official data and industry information do not correlate. The official statistics recorded a production of 47,494 tonnes of monodon shrimp and 1,974 tonnes of vannamei shrimp in 2011.

Production of vannamei shrimp is for the local market while large monodon shrimp is exported mainly to Japan. Local demand is for small shrimp from 10g and the cost of producing 10g shrimp is PHP 120 to PHP150/kg (USD 2.9-3.6/kg) and the farm gate prices are around PHP 160-185 (USD 3.9-4.5/kg) in the Visayas and Mindanao areas. There is an additional cost of PHP 25-35/kg (USD 0.6-0.8/kg) for air freight. Thus, producers in Luzon benefit as they are closer to large markets in Metro Manila where the retail prices are PHP 220-250/kg (USD 5.4-6.1/kg). "The main challenge for producers is WSSV, common during the colder months and bringing down survival rates to 20-50%," said Ryan. There are sporadic reports of WSSV within the General Santos area in Mindanao in the south in December but this was also attributed to poor biosecurity.

As vannamei production is for the fresh chilled local market which is already saturated, any additional production will create a glut. Stakeholders at the 8th Philippines Shrimp Congress discussed an expansion of the local market with frozen shrimp to supply fast food outlets, currently dependent on imports. For this to happen, processing companies will need to upgrade facilities. In 2013, some 8-10% increases in production are expected with the set-up of a shrimp feed mill by CPF. The slow demand for monodon shrimp by exporters will force the conversion of extensive monodon shrimp farms to produce vannamei shrimp.

Monodon shrimp

Twenty five % less monodon shrimp was produced in Asia compared to 2011. It remains the major species in Vietnam and Australia and the only species cultured in Bangladesh and Myanmar. In Indonesia, there is a national nostalgia to remain with the monodon shrimp or 'udang windu' which is a domain of traditional farms. A resurgence is expected with the faster growing and disease resistant strain being developed in a government hatchery in Bali. PL10 is produced from the 5th generation brood stock with founder stocks from various locations in Indonesia. The SPF PL is free from WSSV. Next, there are plans to develop WSSV resistant brood stock. The hatchery produces 6-7 million PL/cycle. To date, the performance of the PL is unconfirmed as farmers mix these PL with that from other hatcheries. There is a niche market for this shrimp and with a shortage, prices are at IDR100,000/kg (USD 10.4/kg) for size 18/kg. Profit margins are high in traditional farming at 20 PL/m^2 stocking without feeding or small volumes of supplementary feeds, even though PL prices are high at IDR 30/PL (USD 3.1/1000PL).

In Malaysia, the Manjungjv group is producing SPF PL from SPF broodstock imported from Madagascar. The hatchery which was recently completed has a production capacity of 10 million PL/month. Yong Kui Thing, managing director said that the first batch of PL was stocked in its 60 ponds in Selangor and Perak with good results. Yields were 6.2 tonnes/ha from a stocking density of 25 PL/m^2) at DOC 120. The average weekly growth was 0.25 g. Survival rate was 82%. Size 33/kg were sold at MYR 24.00/kg (USD 7.9/kg). In this first cycle of PL production, excess shrimp were supplied to its contract farmers.

"Manjungjv plans to market the PL to other farms in year 2013. As our industry is facing production losses due to EMS outbreaks particularly with the vannamei shrimp, Manjungjv has developed SPF PL of the monodon shrimp as a premium strain. This is also to create new opportunities for the farmers to farm the shrimp and fulfil market demand," said Yong.

Australia's monodon shrimp farming received a boost in 2012 when a new strain developed after eight generations at a farm resulted in a more productive and profitable business. This breed was developed through a 10-year program. The improved growth rates increase yields by 50% from 5 tonnes/ha to 17.5 tonnes/ha. One farm recorded 24.2 tonnes/ha (CSIRO, 2012). This means that the country's annual production can increase from 5,000 tonnes to 12,500 tonnes.

Outlook 2013

In general, industry is not expecting significant changes in production volumes but rising costs of production are expected to continue. Aquaculture experts have also indicated that 2013 will be a tougher year with the adverse effects of *El Nino* resulting in dry weather and drought.

There is also a new challenge in marketing shrimp. The US department of commerce (DOC) initiated antidumping duties in 2004 for US imports from China, India, Thailand and Vietnam, and since then, yearly reviews have reduced the duties. Vietnam and Thailand successfully filed complaints with the World Trade Organisation (WTO) on the illegality of the 'zeroing' method to impose anti-dumping tariffs. However a new threat is imminent since late December 2012. A coalition of processors has petitioned the DOC to impose duties on shrimp from China, Vietnam, India, Indonesia, Malaysia, Thailand and Ecuador to offset what they say are unfair foreign government subsidies.

References are available on request.

AAP would like to thank industry quoted in the article, as well as those who have so kindly provided information but chose to remain anonymous.

Improving growth performances of tra catfish cultured in earthen ponds

By Nguyen Nhu Tri and Le Thanh Hung

The inclusion of an all-natural feed additive in feeds for juvenile fish showed better growth and health of fish.

Tra catfish, *Pangasius hypophthalmus*, is a dominant cultured species in Vietnam in terms of production. Its aquaculture production in 2011 was approximate 1.2 million tonnes. The main culture system for tra catfish is the intensive model in earthen ponds with very high densities and yields. In this model, feed is the main contributor to the production cost. As the cost of feeding is increasing, this leads to a reduction in profit margins for farmers. In order to improve the profit of tra catfish farming, one of the measures to reduce feeding costs is through feed additives which improve nutrient absorption and utilisation.

SANGROVIT® is an all-natural feed additive that has been utilised in many animal species. The main active ingredients include bitter constituents, which help to enhance the absorption of feed and promote digestion. The special active substances belonging to the group of benzophenanthridine and protopine alkaloids, have the additional effects of improving hormonal and chemostatic regulating mechanisms in feed uptake, nutrient absorption and availability. Therefore, it is feasible to utilise its characteristics in tra catfish intensive culture system in Viet Nam.

The purpose of this study was to evaluate the effects of Sangrovit® on the final mean weight, feed conversion ratio (FCR),survival rate and non-specific immunity parameters of tra catfish fingerlings cultured in hapa installed in an earthen pond. The present study consisted of two experiments conducted at Experimental Station, Nong Lam University, Ho Chi Minh City, Viet Nam.

As a feed additive

Tra catfish fingerlings (9.8 ± 0.1g) were randomly stocked into 15 one m^3 cages (1x1x1.3m) installed in a 600 m^2 earthen pond at an initial density of 40 fish per hapa. Treatments diets contained 4 different levels of Sangrovit® supplementation (Table 1). There were 3 replicates per treatment to determine the optimal dose in the feed.

Table 1. Treatment diets for determination of optimal dose.

Treatments	Control	1	2	3	4
Inclusion level g/tonne of feed [1]	0	25	50	75	100

[1] Sangrovit® Phytobiotics Feed Additives, Germany)

The utilised feed was 2mm extruded floating feed with the following specifications: 30% crude protein, 5% crude fat, metabolisable energy (ME) min 2,800 Kcal and 6% maximum of crude fiber. Fish were fed to satiation twice a day.

This experiment was conducted for 16 weeks. Fish were weighed every 4 weeks to monitor growth and survival rates. At the end of the first experiment, fish were harvested, counted and group weighed to determine final mean weight, feed conversion ratio (FCR) and survival rate.

Water quality variables were measured as follows: dissolved oxygen, temperature and pH were measured twice a day (7am and 4 pm) using YSI-550 digital oxygen/temperature meter and Fisher-Scientific portable pH meter. Total ammonia nitrogen and nitrite were measured 3 times a week by spectrometric method. Water in the pond was exchanged regularly to maintain good quality for the entire experimental period. The parameters for water quality were maintained at the levels shown in the Table 2.

Table 2. Water quality variables.

	Temperature	Dissolved Oxygen	pH
Maximum	31.2°C	8.2 ppm	6.79
Average	29.3°C	4.9 ppm	6.78
Minimum	27.1°C	1.6 ppm	6.71

Analyses

Initially, fish was weighed and randomly distributed into hapa. To minimize stress of fish during weighing, MS222 was used to anaesthetise the fish. At the end of the trial, fish in each hapa were weighed. Growth performances were monitored using specific growth rates (SGR).

In the study, feed efficiency was monitored using the feed conversion ratio (FCR) and protein efficiency ratio (PER).

Statistical analyses were performed using Minitab software version 16.0. Data collected from the experiment were analysed using one-way analysis of variance to determine significant differences ($P<0.05$) in final mean weight, FCR, survival rate and non-specific immunity parameters between treatments. Tukey multiple comparison test was utilized to determine differences among treatment means.

Enhancing growth

Data presented in Table 3 showed that final mean weight of the first 3 treatments was not significantly different ($P>0.05$). However, final mean weight of treatments 3 and 4 was significantly higher than that of the control. The survival rate of all treatments was not significantly different. The highest SGR was obtained in treatment 3, followed by treatments 4 and 2. These were significantly different from the control. It means that the supplementation to the feed at levels from 50-100 g/tonne of feed enhanced growth rate of tra catfish (Figure 1).

Table 3. Final mean weight, SGR, FCR and survival rate of experimental fish.

Parameter	Control	1	2	3	4
Initial wt (g)	9.77 ± 0.10^{a}	9.78 ± 0.02^{a}	9.72 ± 0.01^{a}	9.74 ± 0.01^{a}	9.82 ± 0.01^{a}
Final wt (g)	75.86 ± 3.45^{a}	84.25 ± 9.15^{ab}	87.19 ± 3.23^{ab}	92.96 ± 3.97^{b}	89.29 ± 3.45^{b}
SGR (%/day)	2.31 ± 0.04^{a}	2.41 ± 0.11^{ab}	2.46 ± 0.04^{b}	2.51 ± 0.04^{b}	2.47 ± 0.11^{b}
FCR	1.70 ± 0.02^{a}	1.57 ± 0.08^{b}	1.60 ± 0.01^{ab}	1.51 ± 0.05b	1.49 ± 0.11^{b}
Survival rate (%)	93.33 ± 5.20^{a}	92.50 ± 2.50^{a}	90.83 ± 2.88^{a}	94.17 ± 5.20^{a}	90.83 ± 1.44^{a}

Data are expressed as mean ± SD. Data with the same superscript in the same row are not significantly different ($P>0.05$)

$$\text{Specific Growth Rate} \quad SGR(\%/day) = \frac{(LnW2 - LnW1)}{T2 - T1} \text{ X } 100$$

W2 : Mean weight at the end of the experiment; W1 : Mean weight at the beginning of the experiment; T2- T1 : Duration of the experiment 112 days (16 weeks)

FCR = Total feed intake/ Total weight gain (W2-W1);

One of the most important parameters to consider in tra catfish farming is FCR. Data from Table 3 showed that FCR of the control treatment was significantly higher as compared to treatments 1, 3 and 4. Supplementation to the feed at levels of 75 and 100g/tonne helped

Figure 1. Impact of supplementation of on specific growth rate.

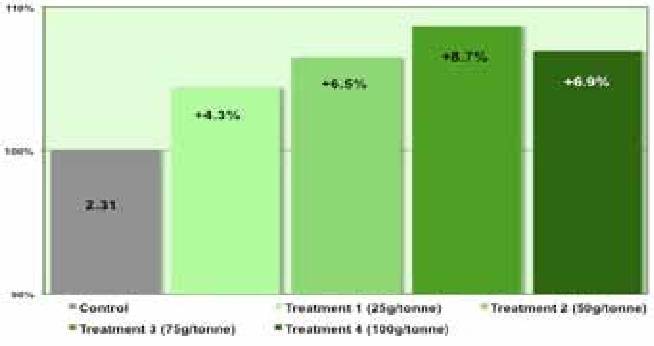
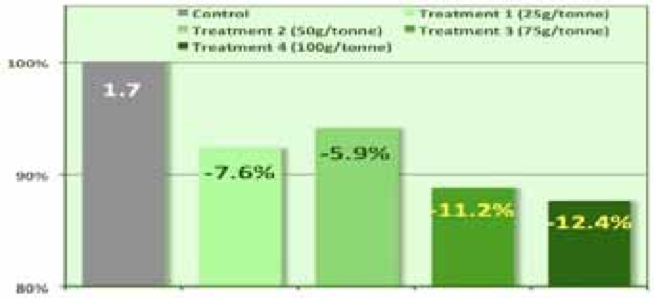


Figure 2. Impact of supplementation on the FCR.



to remarkably reduce FCR (Figure 2). That means the supplementation in the tra catfish feed improved feed utilisation by enhancing the secretion of internal enzymes in digestive tract.

Health improvement

After the first experiment was completed, 15 fish from each hapa were randomly assigned to a 100-L fibreglass tank in a wet laboratory for a challenge test with *E. ictaluri* to evaluate the effects of the additive on health status of experimented fish.

Lysozyme activity

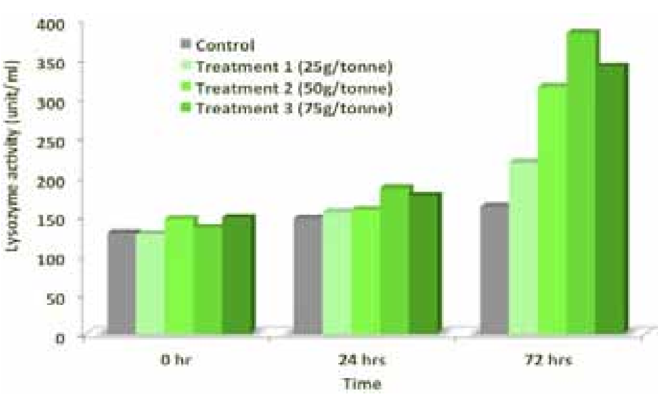
When the first experiment was completed, 5 fish from each hapa were challenged by dipping in a low-density *E. ictaluri* solution (1.28 x 10^5 CFU/mL) for 1 hour in order to stimulate the activity of immune system. Blood samples were taken right before challenging and 24 and 72 hours, respectively, after challenging to measure lysozyme activity. Lysozyme activity of all 5 treatments is presented in Table 4, Table 5 and Figure 3.

Table 4. Lysozyme activity of experimental fish.

Time (hours)	Control	1	2	3	4
0	128.3 ± 35.3^a	126.7 ± 30.6^a	145.8 ± 36.4^a	135.0 ± 32.5^a	147.5 ± 24.6^a
24	146.7 ± 38.8^a	154.2 ± 47.9^a	157.5 ± 18.0^a	185.0 ± 2.50^a	175.0 ± 55.2^a
72	161.7 ± 34.0^a	217.5 ± 23.8^{ab}	313.3 ± 52.8^{ab}	381.7 ± 25.7^b	339.2 ± 121.6^b

Data are expressed as Mean ± SD. Data with the same superscript in the same row are not significantly different (P>0.05)

Figure 3. Lysozyme activity of experimental fish.



Data in Table 4 and Figure 3 showed that serum lysozyme activity of all treatments was not significantly different at 0 hour and 24 hours post challenge with *E. ictaluri*. However, this parameter was significantly higher in treatments 3 and 4 as compared to the control at 72 hours post challenge. The supplementation at levels of 75 and 100g/tonne of feed helped to boost immune system of tra catfish through increasing lysozyme activity to a level that significantly different from the control.

Density of white blood cells

The density of white blood cells was determined at the same time frame as lysozyme activity measurement and presented in Table 5.

Table 5. Density of white blood cell (x10^3 cell/mm^3) of experimented fish.

Time (hours)	Control	1	2	3	4
0	83.83 ± 3.05^a	97.02 ± 20.44^a	95.78 ± 3.89^a	105.58 ± 11.88^a	98.34 ± 32.44^a
24	93.61 ± 30.18^a	102.57 ± 27.39^a	118.70 ± 35.35^a	125.75 ± 23.06^a	116.17 ± 30.99^a
72	9.96 ± 4.77^a	15.20 ± 3.56^a	12.80 ± 1.92^a	13.10 ± 4.35^a	14.93 ± 2.29^a

Data are expressed as Mean ± SD. Data with the same superscript in the same row are not significantly different (P>0.05)

Data in table 5 showed that the density of white blood cells was not significantly different among treatments at 0, 24 and 72 hours post challenge. However, this parameter tended to be higher in supplemented treatments as compared to the control at 24 and 72 hours post challenge. This indicated that Sangrovit® might enhance the production of white blood cells to fight against infected bacteria.

Survival

Experimental fish were dipped in an *E. ictaluri* solution (3.39 x 10^5 CFU/ml) for 1 hour and then returned to the tank. Mortalities were monitored for 14 days. During this period, water temperature was maintained at 26°C, an optimal temperature for bacteria growth. Dead or moribund fish were retrieved from the tanks. They were necropsied, and bacterial laboratory diagnosis was made from the moribund and freshly dead fish. Bacteria from moribund and freshly dead fish were isolated and classified by IDS 14 GNR test kit of Nam Khoa company. The results of the second experiment presented in Table 6 showed that the mortality of tra catfish started from day 4 and stopped at day 11 post challenge.

Table 6. Survival rate of tra catfish at 14 days post challenge.

Treatment	Survival rate (%)
Control	11.11 ± 3.85^a
1	17.78 ± 3.85^{ab}
2	13.33 ± 6.67^{ab}
3	22.22 ± 3.85^b
4	20.00 ± 6.67^{ab}

The survival rate of tra catfish in treatment 3 was significantly higher than that of the control. The supplementation at a level of 75 g/tonne of feed could enhance survival rate of tra catfish when challenged by *E. ictaluri*.

Conclusion

Notably the inclusion of the additive into commercial feed at levels of 75g/tonne enhanced growth rate, SGR and lysozyme activity of tra catfish and it also reduced FCR significantly. Furthermore, a positive effect on the test fish challenged with *E. ictaluri* was detected. The measured influence can be attributed to the known effect on nutrient absorption and on the anti-inflammatory mode of action of Sangrovit®, which is particularly focused on the intestinal tract. Thus feed conversion and digestibility and the health status of fish was improved. Therefore, we recommend this additive to be added into feed at this level to increase return on investment of tra catfish farming.


Dr Nguyen Nhu Tri


Dr Le Thanh Hung

Dr Nguyen Nhu Tri and **Dr Le Thanh Hung** are with Nong Lam University, Ho Chi Minh City, Viet Nam. Email: lthungts@yahoo.com.vn (Le Thanh Hung)

New diets counter high temperatures

Trials with the Atlantic salmon in Australia show management of fish performance through warm summers.

Fish species have an optimum temperature range, losing appetite and growing more slowly when water temperatures go much above that range. Scientists at Skretting Aquaculture Research Centre (ARC) identified the changes caused by the high temperatures and developed a way of counteracting the effect with a blend of feed micro-ingredients. Tassal, Australia's leading salmon farmer, conducted trials on the new Optiline HT (high temperature) grower feed from Skretting over the 2011–2012 summer and gave enthusiastic approval.

David Kiemele, head of farming at Tassal, was encouraged to use the HT diets, based on the ARC knowledge of improved fish performance and the potential benefits of reduced nitrogen outputs. "We had a very challenging 2011–2012 summer, water temperatures reached as high as 19–20°C in most of our production areas. Optiline HT helped us maintain performance during this difficult period."

The HT diet was fed in commercial cages as water temperatures climbed above 15°C and from then on all the way through the summer months. "Compared to the conventional summer diet, fish fed the diets showed 8% improvement in growth as well as reduced feed conversion ratio (FCR) and increased feed intake. We are very pleased with the results of the commercial trials this past summer, and plan to incorporate the HT option into how we manage fish performance through warm summers in the future.

"Optiline HT gave us an opportunity to challenge the high protein formulations conventionally used over summer in the Australian salmon industry," says Rhys Hauler, marketing manager in Skretting Australia. "These conventional summer feeds lead to a high excretion of nitrogen. Optiline HT has less protein, subsequently nitrogen outputs are less and therefore the diet delivers sustainability benefits as well."

Optimum temperature range

It is widely understood that each fish species has an optimum temperature range and will lose appetite and grow more slowly when water temperatures go much above that range. Until recently the physical effects on the fish leading to these symptoms were not fully understood. Scientists at ARC identified the changes caused by high temperatures and developed a feed solution to the problem that can be applied across species. Following validation trials showing benefits in growth and feed conversion ratios, high temperature (HT) grower diets have been developed for various species, including Atlantic salmon, sea bass and rainbow trout.

David Kiemele

The research journey began in 2010, in a joint research project funded by the Research Council of Norway. The project was in anticipation of potential problems from climate change bringing warmer waters to the coast, especially in the south of Norway, but was also developed keeping in mind the annual challenges faced by Tasmanian salmonid farmers during summer. Skretting joined Marine Harvest, the Norwegian Institute of Nutrition and Seafood Research (NIFES) and the Institute of Marine Research (NOFIMA) to investigate.

Ingunn Stubhaug, who led the research project at ARC said, "Using knowledge gained in that project, we ran high temperature trials with several micro-ingredient blends at our Lerang Fish Trials Station. By January 2011 one combination really stood out. The fish were healthier, ate more, grew better and had a lower feed conversion ratio." That blend forms the basis for the growing Skretting range of HT feeds.

Drivers for production gains: Better nutrition and health

Experts looked at the knowledge gap on nutrient requirements for the vannamei shrimp, lipids in fish nutrition and health, macro and micronutrients for health and growth of the grouper and reducing production losses with control on infectious diseases and culture management.

"The role played in global aquaculture production by Asian countries is significant, with China being the leading player producing 36.7 million tonnes annually. While the global aquaculture growth rate is now averaging 2.8% demonstrating that the industry is mature, we cannot expect the earlier 10% growth rates," said **Dr Jacques Gabaudan**, DSM Aquaculture Centre Asia, Bangkok, Thailand during his welcome address to participants at the annual DSM Aquaculture Conference Asia Pacific held in Bangkok on 22 November 2012. The 300 invited participants from the region, comprise professionals from the industry and academicians. This year, the conference achieved a milestone as the 18th conference without a break and with growing interest from industry.

"The changes in production volumes during 2000 to 2010 are interesting. We have a 71% increase in China, small in terms of percentage but large in volumes. The increase was 138% in production in Southeast Asian countries. However, the production increase of 222% in Africa to 1.3 million tonnes showed that Africa, led by Egypt and Nigeria is becoming a region to watch."

By 2020, aquaculture production is estimated by the Food and Agriculture Organisation (FAO) to be 79 million tonnes and the average global consumption of fish is expected to reach more than 5.3 kg/capita by 2020, indicating a future supply problem. Gabaudan added that the demand will rise from population growth and urbanisation, retailing and call for healthy foods.

"This is also driven by technological advances and productivity gains. The FAO State of the World Fisheries and Aquaculture report 2012 showed that from 2000 to 2010, aquaculture productivity increased globally from 3.1 to 3.6 tonnes/person. However, we see a large difference, 187 tonnes/person in Norway to 1 tonne/person in Indonesia. In general, we have restraints to aquaculture growth which include increasing price of fish meal and oil and of other protein sources, disease impact on productivity, and production capacity affected by water resources and the effects of climate change", added Gabaudan.

The conference focused on the latest information on the use of feed ingredients to improve the efficacy of feeds and the reduction of mortality due to infectious diseases. Dr Vibe Glitsø touched on the use of enzymes and their application in aqua feeds, Dr Marisol Izquierdo discussed the role of fish and plant oils in aquaculture nutrition whilst Dr Sadasivam J Kaushik looked at the transfer of knowledge from the laboratory to commercial production of shrimp feeds. In production, Dr Pablo Intriago reviewed shrimp farming in Ecuador (see pages 39-40), a leading producer of vannamei shrimp and Dr Yu-Hung Lin looked at requirements of macro and micro nutrients, mainly for the grouper. On the effects of disease, Dr Tim Flegel gave an update on current disease threats in Asia (see pages 13).

Feed enzymes in aquaculture

The discovery, development process and use of enzymes in aquaculture were presented by **Vibe Glitsø**, Department of Feed Applications, Novozymes R&D. The company is the world leader in industrial enzymes and microorganisms. As a research based company, 14% of its revenue is spent on R&D. It has been working on enzyme development for several years and believes that enzymes have widespread applications in animal production today, although their use is more recent in aquaculture. Novozymes has an alliance with DSM, the former develops and produces the enzymes and the latter does the marketing.

"The role of feed enzymes is to degrade feed inside farm animals to improve feed utilisation, profitability and environmental impact. Enzymes are a solution to a problem. There is a relationship between enzymes and substrates, and the prerequisites are fixed pH and temperature. Often, the feed composition needs to be changed to benefit from the enzyme," said Glitsø

Examples of enzymes in aqua feeds are phytase which liberates the phosphorus and increases utilisation and reduces the anti-nutritional effects. Protease improves protein utilisation and NSP- degrading enzymes (xylanase) degrade cell walls to improve energy and nutrient utilisation due to their release from the 'cage effect'. Amylase improves starch utilisation. Enzymes are long chain amino acids and are easily denatured with high temperature or low pH, leading to the loss of 3D-structure and thus functionality. Some are reversible, others are not. The function of the different enzymes is given in Table 1.

The activity of an enzyme is determined by enzyme assays. The enzyme activity unit (U) is the amount of enzyme that catalyses the conversion of a given amount of substrate in a given time interval under specified conditions (e.g umol phosphate released/min). Once conditions are altered, the results will be different.

Table 1. Enzymes degrade specific well-defined substrates.

Enzyme	Substrate	Reaction products
Protease	Protein	Peptides and amino acids
Amylase	Starch	Glucose and oligomers
Xylanase, Glucanase	Fibre (NSP)	Monomers and oligomers of different sugars
Phytase	Phytate	Phosphate and inositol phosphates

Glitsø emphasised that enzyme assays are essential for product development, quality control and the determination of optimal dosage for use. They however, cannot be used to quantify enzymes, compare products and predict performance in final applications such as in animals.

The road to development of an enzyme product is complex and time-consuming. The selection process requires the screening and *in vitro* testing to rank and select the best candidates which are then tested *in vivo*. In the case of the feeding trial with phytase in tilapia, the best parameter to measure is apparent digestibility of the phosphorus and with NSP degrading enzymes, it is the final body weight and feed conversion ratio (FCR). This is followed by product development to commercial products which the customer wants and in which form (liquid or solid forms). Registration of the product requires elaborate safety testing.

Finally Glitsø explained that although the development process uses genetic engineering, the protein (enzyme) itself is not a genetically modified organism (GMO).

Vibe Glitsø (middle) with from right, Dr Chen Ming Dang, Charoen Pokphand Foods, Supamat Tantipaswasin, Rovithai Limited, Dr Supis Thongrod, Thai Union Feedmill and Bandhit Komolprasert, Rovithai Limited.

S. J. Kaushik (right) with participants from India, from left, Vilas Autade and Dr Ravindra Vyawahare, DSM Nutritional Products India and K. Ventaka Raju and Anuj Tyagi, Avanti Feeds

Revisiting nutrient requirements for vannamei shrimp

Globally, vannamei shrimp production is on the rise while production of the monodon shrimp is decreasing. However, our knowledge on its nutrient requirements does not follow this trend, remarked **Dr Sadasivam J. Kaushik** from the Nutrition, Metabolism and Aquaculture group at INRA, France. In his presentation 'Shrimp nutrition: from requirements to development of practical feeds', he said, "it is rather surprising that despite the growth of shrimp farming around the world, precise quantitative data on the nutrient requirements of the two major species *Penaeus vannamei* and *P. monodon* is far from complete.

"Fish and shrimp feeds have high digestible protein: digestible energy (DP:DE) ratio such as 24 for the shrimp. At least in the case of the salmonids, we have developed highly efficient diets relying on reducing the reliance on protein ie the protein sparing effect and DE:DP ratio is down to 17-18. This is not the case with shrimp feeds."

Kaushik discussed some methodological issues in studies to derive nutrient requirements. "When we talk about nutrient requirements, we use standard purified diets in closed conditions with graded levels of nutrients to get objective data on the amount of a given nutrients to be supplied in the feed leading to maximising one or more response criteria. Results should be repeatable by others. The form of supply of nutrients and their bioavailability is important but some researchers still continue to use Vitamin C as ascorbic acid instead of the more stable forms."

Which growth models

Most often the response criteria is maximum growth in a given period of time. Most studies undertaken relate to juvenile shrimp growth over a short period of time (6 weeks).

"Unfortunately in trials with the shrimp, we still do not take into account the consequences of a moult cycle and other biological factors. How to control feed intake is a major issue as well."

A normal dose-response curve should provide data on adequate nutrient levels for maintenance of body weight as well as for growth. The broken line and logistic (log) models are choices to derive at the requirement for maximal growth. Kaushik cautioned that, "It is important to use different models to evaluate which fits the data. When using the purified diet it should be providing the same kind of response as a practical diet. In *P. monodon*, Richard et al. (2011) checked that the growth performance of purified diet at high protein and medium protein levels is close to that of a practical diet. This will prevent overestimating or underestimating requirements."

Quantitative requirements of the shrimp

In the most recent publication by the National Research Council (NRC 2011), it is clear that information is lacking on nutrient requirements of *P. vannamei*. No quantitative data on essential amino acids (EAA) requirements for *P. vannamei* whereas there are some data for the kuruma shrimp *P. japonicus* and *P. monodon*.

Moises John Reyes, DSM, Philippines (left) with Angelita Vicente and Gemma Ramos, Feedmix Specialist II and Jose Hubert Malinao, Marcela Farms, Philippines

From left, Pablo Intriago, S. J. Kaushik and Jacques Gabaudan

From left, Sandy Eka Prawiranegara, PT Suri Tani Pemuka, Teddy Njoto , PT Matahari Sakti, Candra Yanuartin and Stefani, PT Sinta Prima Feedmill, Indonesia

Karim Kumaly, DSM, Singapore (left) and Dan Fegan, Cargill Animal Nutrition, Thailand

"This is strange as we may be possibly overlooking something that we can optimise in feeds. This happens to be the same situation with the Atlantic salmon when we did not have the information but was producing large volumes of fish. How did industry formulate feeds? The good correlation between whole body composition profile and the requirement pattern was used. Fish meal became the most ideal protein source.

In the case of the shrimp, there could be difference in EAA profile of whole body and exuvia, inducing possible differences in requirements of shrimp during moulting. This basic investigation can be carried out in the laboratory and will possibly indicate how much nitrogen goes into the pond for recycling."

Essential fatty acids and cholesterol

Requirement data of linolenic (18:3n-3) and linoleic (18:2n-6) acid for *P. vannamei* is not available. The much debated issue is the requirement for cholesterol; estimated at 0 to 2g/kg feed but a subsequent investigation indicated that under pond conditions, supplementation is not required as cholesterol is available from fishmeal and fish oils. The inclusion of synthetic cholesterol could add 10% to feed cost. A major issue is also the seasonal variability of cholesterol levels in fish meals and oils. Major feed companies should take heed of this and explore the potential also of phytosterols.

Vitamins and minerals

Data on requirements for fat soluble vitamins A and E are 1.4mg/kg and 100mg/kg, respectively. Information is complete for the monodon shrimp at 2.5, 100, 90 and 35 mg/kg for A,D, E and K respectively. In the case of water soluble vitamins, complete data is available for the monodon shrimp but only for Vitamin B6 and C at 80-100 and 50-100 mg/kg, respectively. Dietary needs for most water soluble vitamins do not differ even between phylogenetically far distinct species. We find that estimates on vitamin requirements (IU or mg/kg diet) of fish and chicken have been applied to the shrimp.

In *P. vannamei*, the reported phosphorus requirement is 0.3 to 0.7 mg/kg. Kaushik said that in the coming years, supply will be an issue especially when non marine meals feature more in feeds. Plant phytic acid also reduced the availability of zinc and selenium.

The available data on micro mineral requirements of *P. vannamei* shrimp show that copper is required at 16-32mg/kg, selenium at 0.2-0.4mg/kg and zinc at 15 mg/kg. Apparently Iodine and manganese is not required under practical conditions.

"Again the question is whether what we are supplying is required for growth, health and disease resistance. Most research data provide information on the animal's physiological needs and are easily applicable to intensively reared species where the nutrient supply from the farm environment is limited. Under semi-intensive conditions, we should also take into account the potential of natural productivity," said Kaushik.

"In the pond, nitrogen excretion differs with the moult cycle, after meals and dietary protein levels. Penaeids are the most sensitive to ammonia. Ideally, we should have solid figures on how much a certain level of production release nitrogen and phosphorus into the pond."

Replacement of fish meal

Some 28% of global fishmeal production is used in shrimp feeds. The possibility of replacing 60-70% of fish meals with single types of plant and animal meals in *P. vannamei* feeds has been shown. However, based on the EAA patterns of different plant protein sources, no single ingredient can replace fish meal. It is biologically possible to replace fish meal but it is up to industry to evaluate the economic feasibility. Solid information on ingredients is required and this is available from sources such as the Feedipedia (www.feedipedia.org). This is an open access information system on animal feed resources.

Refinement of feeding strategies

In how much to feed, Kaushik discussed the bioenergetic principles encompassing the measurement of dietary digestible energy, energy needs for maintenance and prediction of growth. The feed supply should compensate for these losses and provide for growth. The growth prediction based on water temperature and body size uses the Thermal Unit Growth Coefficient and prediction of weight gain depends on the genotype, husbandry practices and feed quality. How variable is the growth of *P. vannamei* versus *P. monodon*? This can be measured using specific growth rate and daily growth coefficient.

Kaushik concluded that "Efficiency is the only way we can compete with other animal production systems."

Optimal levels for growth and health of the grouper and shrimp

Dr Yu-Hung Lin

Infectious disease is the major cause of economic loss in intensive aquaculture and what is the role of nutrition? **Dr Yu-Hung Lin**, Department of Aquaculture, National Pingtung University of Science and Technology, Taiwan discusses the interactions between environment, pathogen, and host which can result in diseases.

"One preventive measure is to use various nutritional strategies to enhance immunity and resistance to diseases. Usually the definition of nutrient requirements has been limited to normal development and neglects the increased nutrient needs arising from stress and the increased demands of a stimulated immune response. Our group has been conducting dose response experiments to investigate the relationships between nutrition and health. This is to help us understand better the differences between optimal levels for growth and immune responses," said Lin.

For example, some vitamins are required at higher levels to maintain immunity as compared to just growth. Nutritional factors affecting the immune system include: macronutrients, in particular lipid and fatty acids; micronutrients (vitamins and minerals); and non-essential nutrients (nucleotides).

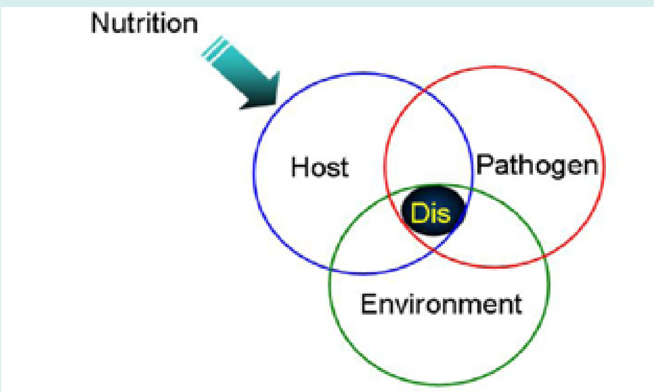
Lipid levels

In our experiment, grouper, *Epinephelus malabaricus* were fed lipid levels of 0, 4, 8, 12 and 16%; the optimal lipid level for maximum growth of juvenile grouper is 8.71%. However, when the lysozyme and other health response parameters were monitored, it showed that dietary lipid deficient diets depressed non-specific immune responses of grouper. When the lipid comprised DHA and EPA purified from algae sources, enhanced growth was observed when the dietary DHA/EPA ratio was greater than 1. This indicated that DHA is important for growth as compared to EPA and affects the cellular defence of the fish.

"What about n-6 fatty acids? When the lipid source was a mixture of corn oil (CO) and fish oil (FO), weight gain was highest in the groups which were fed 100% fish oil, 3:1 (FO:CO) and 2:2 (FO:CO). However, when challenged with *Vibrio*, the group fed 100% FO had the lowest survival rates, indicating that the grouper needs both n-3 and n-6 fatty acids to maintain their immunity. Immune responses to cold stress were depressed in fish fed diets containing fish oil and either palm or tallow oil, as compared with those fed diets with fish oil and soybean or corn oil mixtures. Thus, replacement of fish oil with palm oil and tallow must be limited in winter."

Vitamins and minerals

The dietary L-ascorbic acid requirement of grouper is 45 mg/kg diet; but 288 mg/kg of L-ascorbic acid supplemented in diets can enhance non-specific immune responses and resistance to *Vibrio carchariae* infection. In the case of vitamin E, the requirement for growth is 61-68 mg vitamin E/kg (4% lipid) and 104-115 mg vitamin E/kg (9% lipid). But non-specific immune responses were the best in grouper fed diets with 200-400 mg vitamin E/kg.



In the case of selenium, the optimal level is 0.7 mg/kg diet for growth but 0.77 to 2.02 mg/kg diet may be required to improve immune responses. When fish are fed higher amounts of fish oil, their oxidative response is higher too. High copper ingestion induced an oxidative stress in grouper and depressed their immune response. However, selenium can inhibit copper in the tissue and high dietary selenium supplementation (2× adequate) reduced this oxidative stress and improved the immune response of the fish.

Lin added that the adequate dietary copper concentration for growth for *Penaeus monodon* is about 15-21 mg Cu/kg diet, but levels of 10-30 mg Cu/kg diet enhanced the immune responses of the shrimp. In the case of dietary zinc, the level is 32-34 mg Zn/kg diet but rises to 35-48mg Zn/kg diet for non-specific immune responses.

Nucleotides and other extracts

In the grouper, growth and immune responses were enhanced in juvenile grouper fed with a diet supplemented with 1.5 g nucleotide/kg diet. The nucleotide is a 1:1:1:1:1 pure mixture of the following: adenosine monophosphate (AMP), cytidine monophosphate (CMP), uridine monophosphate (UMP), guanine monophosphate (GMP) and inosine monophosphate (IMP). When the single nucleotide was tested, the result was that 1.5 g/kg diet of AMP seemed to be more beneficial on the immune responses in fish as compared to the other nucleotides.

These requirements are summarised here.

Vitamin C	Levels (mg/kg)		
Response	Growth	Immunity	Immunity/growth
Grouper	45	288	6.4
Channel catfish	50	150	3
		1000	20
Rainbow trout	20	500	25
		320	16
Turbot	20	1000-2000	50-100
Atlantic salmon	50	2750	55
		4000	80
		1000	20
Japanese sea bass	53	489	9.2
Yellow croaker	28	489	17.5
Japanese eel	32	762	23.8
Indian major carp	53	200	3.8
Tiger shrimp	40	200	5
Vitamin E			
Grouper	100	200-400	
Atlantic salmon	60	326	5.4
Rainbow trout	50	450	9
Indian major carp	130	1000	7.7
Gilthead sea bream	60	1200	20
Tiger shrimp	85	89	1
Other vitamins and minerals (mg/kg)			
Vitamin B1	Jian carp	0.8-1.1	1.02
Vitamin B6	Atlantic salmon	10	10
Folic acid	Grouper	0.8	0.8
Pantothenic acid	Jian carp	23	42-47
Inositol	Jian carp	518	232-687
Cu	Tiger shrimp	15-21	10-30
Fe	Channel catfish	30	30
Se	Grouper	0.7	1.38-2.02
Zn	Tiger shrimp	32	35-48

Lipids for performance, health and product quality

Dr Marisol Izquierdo, Aquaculture Group, GIA, Canary islands, Spain discussed the importance of dietary lipid sources in feeds for shrimp and fish and the effects of alternative oils on growth performance, health and flesh quality.

The most tested vegetable oil is soybean oil which is high in linoleic acid. It has been tested on 30 species of fish and crustaceans but only 9 species showed marked growth reductions. The partial replacement (60%) has been successful in many species. The side effects are increase in n-6 fatty acids in the fillet and alterations in gut morphology and immune system. Linseed oil has 50% n-3 fatty acids and therefore needs protection from oxidation. High substitution levels (75-100%) gave good growth in salmonids and tilapia but poor growth in *Penaeus monodon*, *P. vannamei* and *P. chinensis* at 100% substitution.

The novel lipids are single cell oils from these algae; *Schyzochytrium, Cryptechodinum*, *Euglena, Phaeodactylum*, *Nannochloropsis* and *Nitzschia*. These are a result of a patented chemostat process. In weaning diets in the sea bream, these oils perform well. Other novel lipids are krill oils with high levels of carotenoids and phospholipids, fungi oils and salmon oil which is the by product from salmon processing. Salmon oil production is around 20,000 tonnes, each from Chile and Norway. In Europe and US, the oil is only allowed in feeds for species other than the salmonids.

Oils and health

How would the substitution of fish oils with vegetable oils effect responses to stress? Izquierdo said that "we know that in the presence of stressors, both the hypothalamus and pituitary will be affected. This will create a series of metabolic actions in the fish which will include immune suppression in the long term.

"We tested these effects by replacing fish oils with rapeseed oil or linseed oils at 60% and 80%, mixed blends of different oils at 60% and analysed the cortisol levels. What we saw was that generally the cortisol levels increased when vegetable oils are used, in particular with linseed oils. When we submitted fish to stress through confinement, two hours later, linseed oil fed fish increase cortisol levels. When linseed oil is replaced 100%, there is an increased in cortisol and a marked increase in expression of stress related genes."

However, is the response pathological and a problem for the fish? Izquierdo said that that they did not see any mortality or pathological effects, just increase in the reaction to stress. In the larvae of fish, with the complete substitution they did not see any difference in survival with larvae fed fish oil.

However, substitution of dietary n-3 long chain PUFAs rich fish oils by n-3 PUFAs rich vegetable oils alters the fatty acid composition of cells, including those involved in immune system regulation. The substitution of fish oil with vegetable oils in effect reduces the levels of the fatty acids, eicosapentaenoic acid (EPA) and arachidonic acid (AA) which are important for the synthesis of special molecules that have strong metabolic activity. Docosahexaenoic acid (DHA) and AA are important substrates for two enzymes for the production of eicosanoids which play a role in immune regulation.

"However, these effects can be minimised by using blends where the n-3/n-6 ratio is balanced and adapted to each species. Even if immune parameters changed we see that there are few studies which have been able to demonstrate a reduction in disease resistance in fish fed high inclusions of vegetable oils, since infection depends on the complex interaction of environment, pathogen and fish. Vegetable oils in diets seem to also affect the gut morphology and deposition of lipid in the liver. However, this is a completely reversible process."

Effects on fillet quality

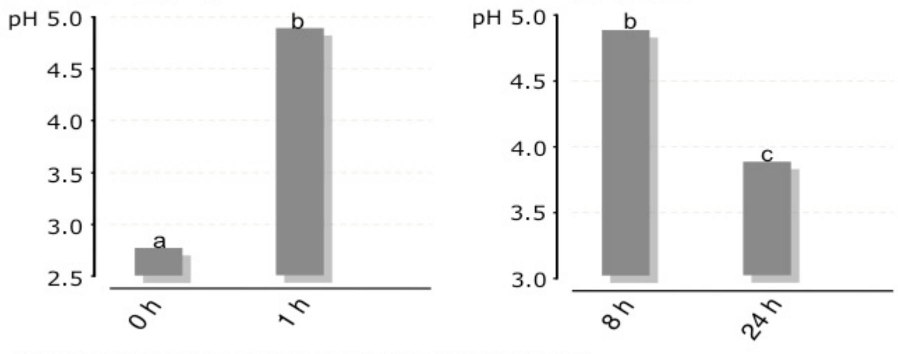
According to Izquierdo, the substitution of vegetable oils will certainly effect the composition of the fatty acids in the flesh. Tissue fatty acid will mirror that of the oils. In one study, fish were fed fish oil or soybean oil or linseed oil at 60% or 80% substitution levels and at the texture level, there was no significant difference. There was slight effect on colour. High levels of substitution (60 to 80%) of rapeseed oil or soybean oil reduced colour in the salmon but this can be overcome by blend of vegetable oils or linseed oil. On consumer preferences, it was found that sea bream fed rapeseed or soybean oil diets was preferred but fish fed a blend of vegetable oils was acceptable. Blind tests showed that fish fed linseed oil or a vegetable oil blend is preferred as they do not have the 'fishy' smell.

Corrections

In the article 'Acidification in monogastric fish: Limits and potentials' (pages 38-39 Issue November/December 2012), we printed the same figures as figure 1a and b. Please see below for the corrected figures. We apologise for this mistake.

Figure 1a: Stomach pH in trout before and after feeding

Figure 1b: Stomach pH in trout during digestion



Figures are adapted from Bucking and Wood (2009)

Key factors in shrimp production in Ecuador

By Pablo Intriago

Ecuador is a major producer of farmed vannamei shrimp in Latin America and the production has been increasing at an annual rate of more than 10% since 2003.

In 2012, production was estimated at 200,000 tonnes valued at USD1 billion. Success can be attributed to good quality water as Ecuador is not a heavily industrialised country; biosecurity and the accommodation of the animal to several diseases. Farmers also look at returns instead of achieving record production and with a strong emphasis on post larvae (PL) and brood stock as the most important asset of the hatchery.

The history of Ecuador's shrimp industry is similar to that in many countries in Asia. It has taken 7 years for it to reach high production levels again after the outbreak of the white spot syndrome virus (WSSV) in 1998-1999. Ecuador is located between Colombia and Peru and has about 190,000ha of shrimp farms of which 170,000ha are in production. Shrimp production is the second most important non-oil export after bananas. Production of vannamei shrimp was on the rise from about 70,000 tonnes in 1994 to almost 120,000 tonnes in 1998 until WSSV brought production down to 40,000 tonnes. Since 2000, the recovery has steady to about 200,000 tonnes in 2012. In the 1980s to 1990, production also included *Penaeus stylostris* which was decimated with its high sensitivity to WSSV and infectious hypodermal and hematopoietic necrosis virus (IHHNV). Nowadays, only *P. vannamei* is produced.

The majority of farms are in the Guayas and El Oro provinces which have the advantage of oceanographic currents of the Gulf of Guayaquil. Exports are mainly to the US as peeled shrimp and unfortunately prices are dropping to around USD 5.5/kg. Temperatures are low in May to December.

Hatcheries with domesticated stock

There are 140 hatcheries all using 100% domesticated brood stocks from shrimp farms. Many are part of large integrated companies and may carry out maturation work in-house to ensure traceability. These hatcheries meet the monthly demand of 4-5 billion nauplii. Natural insemination is commonly used in the reproduction process with male: female ratios of 1:1 using 18-25g brood stock. In general, maturation rate is 16 to 18% and fecundity is from 140,000 to 170,000 nauplii/female.

To prevent spread of disease, Ecuador does not allow any imports of live shrimp from other shrimp growing countries nor from other growing areas within the Americas. In general everybody uses chlorine to disinfect tanks and equipment. Some treat incoming water at 5-10ppm and free chlorine is neutralised with sodium thiosulphate. The use of antibiotics is restricted or not allowed by the regulating authority, the National Fisheries Institute. Any use has to be registered. Thus hatcheries used different blend of probiotics, and unfortunately there is more folklore than scientific facts in its use.

Harvest size range between PL9 and 12 but some transfer to nursery raceways at PL2-3. PL selling price is from USD 1.50 to USD2.50 per 1000PL. The aim of nursery rearing is to have more cycles rather than higher survival in the pond. Usually farms benefit by 30 days.

An important quality control protocol is the PCR monitoring of disease in PL and brood stock. PCR screening since 2007, showed the presence of IHHNV in brood stock has been reducing from 55% in 2008 to 23% in 2011 and IHHNV in PL9 from 72% in 2008 to 37% in 2011. Outbreaks of WSSV in hatcheries and brood stock is now rare and screening usually show low level presence of WSSV, taura syndrome (TSV) and yellow head (YHV) virus.

Pond returns important

The average productivity is 2 tonnes/ha/year and usually well managed farms can double or triple this. The average stocking density of 5-15 PL/m^2 and some farms are raising this to 25 PL/m^2. Stocking sizes are PL9-10 can be stocked directly or those of PL25-40. Harvest size is variable depending on farm targets but usually range from 11 to 27g. Farmers themselves do not look at record productions but at the returns. Faster growth also comes with diseases in association with moulting. To deal with WSSV, Ecuador introduced in 2001 a greenhouse system with plastic covers, to raise temperature to higher than 30°C, thus preventing the WSSV expression. The system worked well to prevent the disease but it became too expensive and farms reverted to extensive farming.

Feeds and feeding

There are 12 feed mills producing low protein of 18, 22 and 24%, medium, 28-32% and high protein 35-45% feeds. The general practice is to feed once a day but farms with higher yield feed 2-3 times/day. The challenge for feed producers is not only high cost of fish meal which escalated to higher than USD1900/tonne (December 2012), but more so the fluctuations in composition of amino acids (see table). Looking at values, we can see the drop in quality of fishmeal. In real terms, price of shrimp have dropped 42% from 1988 to 2011 but ingredient prices have increased almost 100%.

Diseases

Outbreaks of WSSV in ponds are common especially during changes in season or when there is sharp drop in temperature. Acute mortality is not uncommon and survival can drop to 15-20%. Chronic mortality results in survival rates of 40-70%. *Vibrio* infections are common in farms which result in bacteraemia, septicaemia and depending on pond factors, in haemocyctic enteritis. Vibriosis might be also associated with WSSV as a secondary infection. Vibriosis associated to

Shrimp production in Ecuador

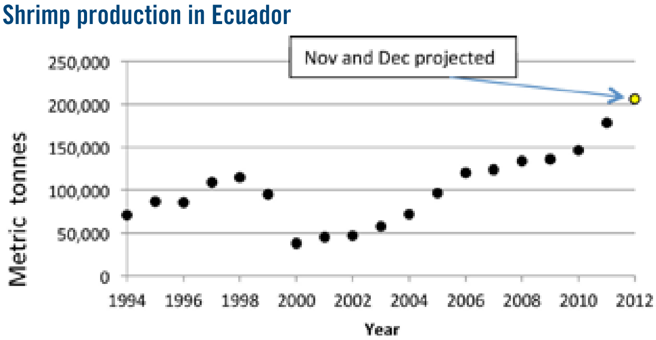


Table 1. Shrimp feeds: Feed quality- protein sources (% of amino acids per % protein).

	Soybean meal		Fish meal A		Fish meal B		Fish meal C		Squid meal A		Shrimp head meal		Krill meal		Poultry meal FG	
		+/- sd		+/- sd		+/- sd		+/- sd		+/- sd		+/- sd		+/- sd		+/- sd
Tryp	1.49	0.03	1.36	0.01	1.22	0.03	1.00	0.07	1.74	0.48	1.16	0.02	1.23	0.03	0.97	0.04
Cys	1.39	0.10	0.84	0.01	0.82	0.05	0.73	0.22	1.63	0.51	0.88	0.04	0.50	0.02	1.06	0.36
Met	1.41	0.06	3.03	0.04	2.73	0.23	2.16	0.31	4.43	1.28	2.06	0.04	2.04	0.06	1.65	0.20
Thre	3.91	0.11	4.61	0.04	4.19	0.10	3.67	0.16	6.57	1.82	3.64	0.08	4.29	0.10	3.63	0.13
Leu	7.75	0.13	7.90	0.07	7.49	0.22	6.34	0.27	11.26	3.05	6.12	0.12	7.83	0.22	6.85	0.30
Lys	6.55	0.12	8.30	0.07	7.80	0.19	6.45	0.40	10.16	2.83	5.46	0.14	7.65	0.16	5.60	0.30
Arg	7.18	0.07	6.21	0.05	5.83	0.23	5.57	0.34	10.68	2.96	5.74	0.20	5.98	0.12	6.55	0.16
Protein	46.90	0.27	68.70	0.28	66.89	1.24	59.64	2.18	82.13	1.57	48.57	1.17	60.36	0.62	58.94	1.12
Fat	1.50	0.34	8.03	0.27	10.40	1.62	10.31	3.10	4.30	0.12	8.23	0.39	16.01	0.33	13.19	1.21
Fiber	4.03	0.70	0.28	0.10	0.50	0.31	0.66	0.67	2.43	0.42	14.97	0.77	3.82	0.26	1.20	0.37
Ash	6.31	0.23	15.34	0.73	15.59	1.67	21.92	2.07	4.06	0.64	23.87	0.41	9.18	0.09	17.87	0.96
Dry Weight	88.59	0.41	92.02	0.32	91.76	1.00	92.05	1.14	90.77	0.85	91.02	0.23	90.79	0.05	93.80	0.69

hatcheries can drop survival to lower than 30% and the recommended is to discharge this larvae.

Gregarine infections are wide spread, regardless of geography and salinity. The infection affects growth, feed conversion ratio but not survival. The NHP intracellular bacteria are endemic in the south in Provincia de El Oro and north of Peru. This is associated with high temperatures and salinity. Mortality is linked with poor condition and is chronic. Sporadic outbreaks of Penaeus vannamei nodavirus (PvNv) occur. The disease was first identified in Belize in 2005. This cause muscle necrosis and infected shrimp have white, opaque lesions in the tail muscle similar to IMNV but with much less mortality.

Dr Pablo Intriago is with Empagran, S.A. División Balanceados, Guayaquil-Ecuador and South Florida Farming Corp, Miami, Florida, USA. Empagran has more than 3,500 ha of shrimp culture area, hatchery, feed mill and processing plant. Email: sffarming@yahoo.com

Caulerpa culture in South Sulawesi – an alternative for brackishwater pond culture

By Nana S.S.U. Putra, Imran Lapong, Michael A. Rimmer and Sugeng Raharjo

This is not only a profitable diversification from shrimp farming but restores shrimp ponds.

Since the 1990's, shrimp production in Asian countries, including Indonesia, has fluctuated substantially, mainly due to emerging shrimp diseases such as white spot syndrome (WSSV), Infectious Hypodermal and Hematopoietic Necrosis Virus (IHHNV), Taura Syndrome Virus (TSV) and Infectious Myonecrosis Virus (IMNV). Overall, these disease outbreaks have caused widespread economic losses amongst shrimp farmers in the region.

In Indonesia, it is estimated that more than 95% of coastal pond ('tambak') farmers are small-scale and disease-related crop failures greatly impact the incomes of these vulnerable farmers. Because of the ongoing production constraints associated with disease-related production losses in shrimp aquaculture, there is increasing interest in alternative production options for coastal pond farming. The requirements for alternative commodities are that they are economically profitableand easy for small-scale farmers to culture.

Since 2010, the Brackishwater Aquaculture Development Centre (BADC) Takalar has cooperated with several Australian and Indonesian institutes to implement an Australian Centre for International Agricultural Research (ACIAR) project titled 'Diversification of Smallholder Coastal Aquaculture in Indonesia'. This project is trialling and evaluating various commodities that can be cultured in disused shrimp ponds.

Our initial trials included an evaluation of swimming crab *Portunus pelagicus*, which were polycultured with milkfish *Chanos chanos* and seaweed *Caulerpa* spp. to provide additional production in the event that the crabs did not survive. The trials were undertaken in brackishwater ponds,formerly used for shrimp culture, in Laikang Bay, Takalar district, South Sulawesi (5° 35' 18" S, 119° 28' 2" E). Our initial trials indicated that *Caulerpa* could produce a good income for pond farmers, so we have continued to investigate this commodity as an option for brackishwater pond production in South Sulawesi.

Caulerpa as a promising alternative commodity

Seaweed production for carrageenan extraction (*Kappaphycus alvarezii* and *Eucheuma denticulatum*) is widespread in Indonesia amongst coastal communities, and Indonesia is currently the world's largest producer of carrageenan-producing seaweeds. However, these seaweeds are usually cultured on lines in the sea (mariculture).

Ratte Daeng Bella, a local farmer, shows off the source of his new business.

Another group of seaweeds that have not received much attention in Indonesia is the 'sea grapes' belonging to the genus *Caulerpa*. *Caulerpa* species are widespread globally in warm (25–30°C) coastal waters throughout Southeast Asia and the Pacific Islands, as well as in Africa. *Caulerpa* usually grows in shallow and open lagoons, on reefs and on a variety of substrates including sand and mud. Throughout their range, edible *Caulerpa* species are commonly consumed throughout their range, mainly from 'gleaning' or collecting from the wild.

Lawi-lawi (C. lentillifera) from brackishwater ponds in Laikang, South Sulawesi. This variety is known locally as 'bulaeng'.

In Indonesia *Caulerpa* is known as 'lawi-lawi in Sulawesi and 'latoh' in Java. Although *Caulerpa* is used directly as a fresh vegetable in some parts of Indonesia, its culture has not been commercialised as is reportedly the case in the Philippines and Vietnam. However, *Caulerpa* is traditionally consumed in South Sulawesi as a fresh and cooked vegetable, and there is a strong local market in South Sulawesi.

Two species of *Caulerpa* are cultivated in ponds in South Sulawesi: *C. lentillifera* (known locally as 'bulaeng') and *C. racemosa* (known locally as 'bu'ne').

Pond site selection

The following recommended conditions for *Caulerpa* ponds are based on observation of successful *Caulerpa* production in ponds at Laikang, South Sulawesi. Ponds used for *Caulerpa* production should be close to the sea to maintain high salinity, have a mud substrate and be away from pollution sources and freshwater influence. The preferred salinity range is 25–30 ppt and *Caulerpa* will not grow at salinities below about 20 ppt. Like most macroalgae, *Caulerpa* is very good at bioconcentrating metals and contaminants, hence the need for culture ponds to be located away from pollution sources. Pond depth should be in the range 50–120 cm, to allow light penetration but also to prevent dramatic fluctuations in water temperature.

Caulerpa culture

Our first trials with *Caulerpa* culture in 2011, involved 4 ponds each around 0.5 ha. These trials demonstrated that *Caulerpa* biomass could increase by a factor of 10-13 times over a 3-month culture period, and the 4 ponds produced a total of 1.6 tonnes (wet weight) with a value of IDR 6 million (USD 625). This revenue (around IDR 3 million per ha for a 3-month crop cycle) compares favourably with our reference revenue for 'traditional' shrimp culture, which is IDR 1–5 million per ha per crop cycle of around 100 days.

Based on these promising early results, the project supported the expansion of *Caulerpa* culture in Laikang. This expansion was supported by development of a local farmer group facilitated by Dr Mardiana E. Fachri of the Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar. Technical support to the group was provided by BADC Takalar through the ACIAR project. The second phase trials included 7 farmers, and the results are summarised in Table 1.

Table 1. Monthly production of *Caulerpa* in ponds at Laikangin January-June 2012. All ponds were initially stocked with 160 kg of *Caulerpa*.

Farmer	Stocking time	Monthly production (kg)						Total (kg)
		Jan	Feb	Mar	Apr	May	Jun	
1	Jan-12	-	560	640	2,240	2,280	3,400	**9,120**
2	Mar-12	-	-	-	600	800	1,200	**2,600**
3	Mar-12	-	-	-	-	560	1,160	**1,720**
4	Mar-12	-	-	-	600	1040	1,200	**2,840**
5	Mar-12	-	-	-	400	440	1,280	**2,120**
6	Mar-12	-	-	-	400	520	600	**1,520**
7	Apr-12	-	-	-	-	160	160	**320**
Total (kg)			560	640	4,240	5,800	9,000	**20,240**

These trials have shown that there are many advantages in culturing *Caulerpa*.

Low investment
This is particularly important to poor coastal farmers who have little capital and usually limited access to finance. Planting a crop of *Caulerpa* requires only IDR 600,000 (USD 65). No additional inputs are required during the crop cycle.

Simple culture techniques
Provided the pond site is suitable for *Caulerpa* culture, there is little management required to produce a crop. The main requirement is to have regular water exchange to maintain good water quality and renew nutrients for the plant growth.

Regular income
As Table 1 shows, *Caulerpa* provides a regular monthly source of income to farmers, rather than a single high income at harvest time which is typically the case with shrimp farming. This supports better spending patterns by the farmer household. *Caulerpa* culture also generates income amongst other members of the local community, such as people involved in harvesting the seaweed and transporting it to market. Consequently, there are indirect benefits throughout the community.

High profitability
On a per hectare basis, the production from the trial outlined in Table 1 represents revenue ranging from IDR 2.15 million to IDR 16.5 million per ha over the six-month period. This compares favourably with 'traditional' shrimp culture, which generally brings revenue in the range IDR 1–5 million per ha per crop with 2 crops per year.

Restored pond use
Prior to the adoption of *Caulerpa* culture, these ponds were either not in use or were used for very limited grow-out of, for example, undersized swimming crabs caught from the wild. Now these ponds are providing a useful contribution to the village.

Environmental benefits
Caulerpa culture has no deleterious environmental impacts, and the plants absorb nutrients from local waters, contributing to better water quality.

Market
One potential disadvantage to *Caulerpa* culture is that the market is local and in probably limited in volume. To check this we are planning to conduct market studies in collaboration with Hasanuddin University. Although there is good demand for edible seaweed in countries such as Japan and Korea, it remains to be seen whether South Sulawesi farmers can access these markets.

Further R&D
To support the Laikang *Caulerpa* farmers, BADC Takalar and project partners, particularly the University of Sydney and Hasanuddin University, are continuing to undertake specific research activities into

Bags of lawi-lawi ready to be transported to local markets around Makassar, South Sulawesi.

The house that lawi-lawi built. Parigi Daeng Bella made enough profit in his first year of farming Caulerpa to buy a new motorcycle and build a new house for his family.

aspects of *Caulerpa* culture. Hasanuddin University is undertaking a study of market capacity, to evaluate to what extent market is likely to limit production of *Caulerpa*.

Caulerpa, like other macroalgae, concentrates metals in the plant tissue. Together with researchers from the State University of Makassar we are currently evaluating the metal content of *Caulerpa* sampled from the ponds to see whether this is likely to produce any significant food safety issues.

Acknowledgments
We thank Dr Mardiana E. Fachri, Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar, for her assistance with development of the farmer group at Laikang, and Prof. Alan Millar, principal research scientist, Royal Botanic Gardens Sydney, for *Caulerpa* identification. We thank ACIAR for funding this research. This article is an output of ACIAR project FIS/2007/124 'Diversification of smallholder coastal aquaculture in Indonesia'.

Nana S.S.U. Putra

Imran Lapong

Nana S.S.U. Putra is with the Ministry of Marine Affairs and Fisheries, Directorate General of Aquaculture, South Jakarta. Email : nana_ssup@yahoo.com.

Imran Lapong and **Mike Rimmer** are with the Australian Centre for International Agricultural Research Field Support Office, Makassar, South Sulawesi. Rimmer is also with the Faculty of Veterinary Science, University of Sydney, Australia.

Sugeng Raharjo is with the Brackishwater Aquaculture Development Centre, Takalar, South Sulawesi.

The impact of the EU crisis on South East Asian seafood trade

By José Fernández-Polanco

The European Union is one of the most relevant destinations, in terms of quantities and value, for seafood products from all over the world. The volumes of imports of fish and shellfish products in the first decade of the new century increased 22.8% in quantity, and 43.7% in value. Despite the crisis, total seafood imports in 2011 reached a peak of euro 18 billion. The EU continues to be a very attractive market for seafood exporters in general, and for producers from developing countries in particular.

However, the economic crisis in the European Union is a matter of concern for many producers in the world exporting to the continent. Evidence that the restrictions imposed by certain governments in order to reduce the public financial deficit are also hurting food demand warn for turbulences in the near future. Asian seafood exporters are not an exception, since many of them have seen their volumes of trade with the EU declining in the last few years.

Economic constraints of seafood consumption

In economic terms, consumption is a function of disposable income. Research in food consumption suggests that as income increases, not only do consumers eat more food, but also the diet becomes more diversified. Under those circumstances, adequate promotional effort has raised seafood consumption in countries where the rates used to be low. Prices also play an important role, the absolute prices of seafood products and their relative prices compared with other sources of food and protein. A recent Globefish report on the Spanish seafood market (Fernandez-Polanco et al, 2012) illustrates how both variables follow unfavourable trends for consumers, with continuous reductions in the citizens' incomes due to increased taxes and cuts in public salaries and subsidies, while seafood prices have dramatically risen since the beginning of the crisis.

The dominant rising trend in European seafood imports flattened in 2008. The rate of change in traded quantities went down from 30.6% before the crisis started, to 1.2% in the period between 2008 and 2011. In contrary, value per kilo decreased at 6.1%, but increased 11.2% from 2008. Although the increase in seafood prices in the EU market started four years before the beginning of the financial crisis, this resulted in an added inconvenience to sustain the levels of consumption when consumers' disposable income started declining.

The current situation of declining imports and increasing prices slowed the expected growth of seafood consumption in Central and Eastern Europe, and resulted in a step backward in the traditionally fish eating Southern countries. The crisis is hitting the domestic economies of the countries in the Mediterranean area, which, by the way, are also some of the countries with the largest rates of seafood consumption in the continent. Portugal, Spain, Italy and Greece comprise 36.8% of total EU seafood imports in 2007, but declined to 33.8% in 2011. Seafood imports in these four countries where growing at a rate of 18% before 2008, and changed to a 2% decrease after that year.

Asian commodities and trade

The trade volumes of seafood products from Asia have shown the same evolution described above. According to Eurostat external trade databases, imported quantities increased 174.2% from the beginning of the decade until 2008. This rate of growth changed after that year and slowed to 4.4%. However, the value per kilo, decreasing until 2008, shifted the trend to an increase of 18.7% until 2001. As a result, total value of seafood imports from Asia kept on rising at 23.8% despite of the decrease in the volumes of trade. Shocks in the prices of certain commodities and continued specialisation of the Asian seafood industry in value added products has contributed to sustain the growth in the value of exports even in this period of recession. The evolution of quantities and values differed according to the class of commodity (Table 1).

Table 1. Growth (%) of EU imports from South and East Asia by main commodities.

	1999 – 2008	2008 - 2011
0302 Fresh Fish	375.47%	-46.47%
0303 Frozen Fish	141.35%	-7.09%
0304 Fish Fillets & Meat	453.23%	2.71%
0306 Crustaceans	127.30%	4.28%
0307 Molluscs	84.31%	17.17%
1604 Prepared Fish	63.41%	0.57%
1605 Prepared Crustaceans & Molluscs	131.59%	11.34%

Source. Eurostat

Processed commodities, including fish fillets (0304), prepared fish (1604) and prepared crustaceans and molluscs (1605), accounted for 62.5% of total seafood commodities imported from Asia into the EU in 2011, but for a lower 55% of total value. This difference in the percentages of quantities and values is mainly due the low prices of prepared fish and fillets. Unprocessed fish, whether fresh (0302) or frozen (0303), only represented 7% of total seafood exports from Asia to Europe, and their volumes have entered in a negative trend since the crisis started.

Fish fillets (0304)

Exported quantities of fish fillets to the EU are dominated by China (60.7%) and Vietnam (35.5%). These two countries have been competing for the European market along the decade, with the rapid growth and penetration of Vietnamese pangasius fillets as the best known example. But while Chinese fillets still increased exports 12% in the crisis years, European imports of pangasius fillets decreased 7.9% in the same period. The evolution of the prices in both countries was completely different. The prices of Chinese imported fillets followed an increasing trend all along the decade, and started to stabilise after 2008. In the contrary, the price of pangasius fillets has been decreasing since the beginning of the new century, but started increasing from 2010, at the same time as the exported quantities started decline. The financial issues faced by the Vietnamese producers and processing industry may make it difficult to change the trend in prices. Thus, there is no margin to expect that the evolution of the market for fillets will change in the near future.

Prepared and processed fish (1604)

The supply of prepared and processed fish is somehow more diversified than with fish fillets. Some 82.7% of the total exports to the EU of this commodity are concentrated in three countries: Thailand (52.4%); Philippines (16.9%); and China (13.3%). Similar to fillets, Chinese exports still increased 18% from 2008, while Thailand reduced the previous growth rate of 51.5% to 8% during the crisis years. Part of these increases in Chinese and Thai exports is being done at the cost of the Philippine market share, which has fallen ten percentage points from 2008.

Crustaceans (0306)

Unprocessed shellfish are significant commodities exported from Asia to the EU. They comprise 29.5% of total quantities and 38.4% of total value. The increment in value in comparison to quantities is due to the higher value of crustaceans, mainly shrimp and prawn. India (26.8%), Bangladesh (18.1%), China (17.9%), Thailand (16.8%) and Vietnam (14.7%), are the important exporters to the EU in terms of quantities. The distribution in value shows significant differences with regard to quantities. While the percentages for India and Thailand remain in percentages close to their contribution to total exported quantities, Bangladesh increased the contribution of total value up to 21% and Vietnam to 16%. China, on the other hand, decreased their share of total value to 12.3% due to cheaper export prices per kilo. Crustaceans were the commodities with the greater rate of increase before 2008 (137%) and continued at a reasonable rate (42.8%). However, the slow down in exports strongly differed across countries. While exports from Thailand, Vietnam and Bangladesh still sustain rates of growth of about 30% to 40%, China and India entered into negative trends.

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Prof. José Fernández-Polanco is with the Faculty of Economics & Business University of Cantabria, Spain. Email: jm.fernandez@unican.es

China Fisheries and Seafood Expo 2012

In Dalian, an interactive platform for Asia's seafood business.

The 17th Annual China Fisheries & Seafood Expo held from 6-8 November 2012 in Dalian saw a record number of visitors at 17,385. There were more than 900 companies from 84 countries occupying the 2,300 booths at the Dalian World Expo Centre. It is apparent that the focal point of the global seafood business is now in the East.

Peter Redmayne, president of Sea Fare Expositions, Inc., the show's overseas organiser said, "This was a 20% increase over the space at the last show in Qingdao. This year we saw another sharp increase in the number of overseas companies exhibiting with new national groups from Argentina, Denmark, Morocco and New Zealand. Overall, the attendance at the show reflected China's voracious appetite for imported seafood."

In October, a Rabobank report said that China has the potential to become a USD 20 billion seafood import market within this decade, with rising incomes increasing domestic demand for seafood, particularly premium species. China's seafood consumption increased from 10kg/capita in 1990 to 30kg/capita in 2012. China's imports will play a key role in the future as China emerges as the leading consumer of high-end seafood in the world. Premium species will contribute to consumption growth in the future. China has a high demand for seafood, far higher than for meat, with consumption particularly sensitive to increasing incomes. Economic growth has led to more affluent consumers seeking to add novelty and prestige products to their diets.

This scenario on China was elaborated at the opening of China Fisheries and Seafood Expo on 6 November 2012 in Dalian. "The growing size of Asia's largest seafood show is a direct reflection of the amazing growth of China's huge seafood industry, the largest in the world. In 2011, the international trade was a record USD26 billion, a remarkable increase of 30% in one year. Soon China's may become the world's top seafood importer," said Redmayne.

Seafood to the world

Although China will remain the leading exporter for many years to come, Rabobank expects its seafood export growth to slow down in the near term, due to resource constraints and the unfavourable macroeconomic dynamics in Western markets. The EU, Japan and US are China's major markets. In the first three quarters of 2012, official statistics showed that exports declined by 4.1% to 2.7 million tonnes but the value increased by 8.1% to USD13.45 million. The major seafood exports are shrimp, tilapia, eel, shellfish, yellow croaker, crawfish and catfish. Export volumes of shrimp, eel and shellfish declined whilst that of the tilapia increased. Chinese exhibitors displayed products for export and local markets; from the frozen to value-added tilapia, high value fish such as the puffer fish, trout, salmon, turbot to the sea cucumber, marketed for its health and aphrodisiac attributes.

Jackson Su, United Fortune Seafood Corp, Taiwan (left), Gerry McGuire, Xyrex, UK (middle) and Jacqueline Obediente, Farallon Aquaculture, Panama

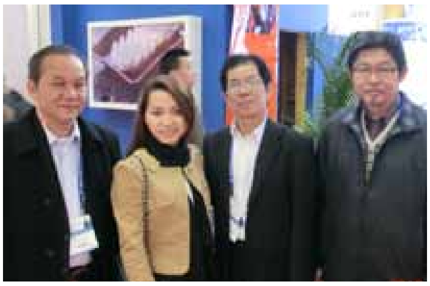
The tilapia is a leading export commodity for China. Xihe Food Co located in Beihai Industrial Zone, Guangxi Province comprise Xihe Aquaculture which uses reservoirs for the culture of tilapia and channel catfish in cages and Guangdong Shuanghu Feed Co Ltd which produces feeds for the tilapia, channel catfish and vannamei shrimp. Tilapia products are skin on fillet, skin-on tail fillet, shallow skinned fillet and super deep skinned fillet. Aside from Xihe, most of the top tilapia producers were present at the show, such as producers from Hainan Island; Hainan Sky Blue Ocean Foods, Baiyang Aquatic Group and Hainan Qinfu Foods Co Ltd. All have farming areas to monitor traceability from production to export. As part of the Grobest group, Hainan Sky Blue is fully integrated with genetic selection and supply of fry from the hatchery in Guangdong province on the mainland.

Joey Zhou (centre), Xihe Food Co Ltd

The Inve Team at the China Fisheries and Seafood Expo in November 2012. From left, Bergkamp Xu, Kath Li, Song Gao, Grace Gao, Pepino Candreva and Rudi Bijnens

Zheng Anli (left) and Monica Tao (middle) from Tianjin Fishery Products Chamber of Commerce and XinXinDu

Shawn Sun with Annie Kang (right) at the Beijing Bio-Tech booth



The Phu Cuong group at the show, from left, Nguyen Viet Cuong, chairman, Jessica Nguyen Thi Ngoc Mai, Ly Chi Minh and Francis Loew

At Alsons Aquaculture Corp, Jose Maria L Cabrera (right) and Mary Grace M Bingco

Leena Nair, chairman MPEDA (left) and Aditi Gupta, IFTRA.

Since 2006, Hongyuan Aquaculture in Chengdu, Sichuan Province has been producing the rainbow trout using eyed eggs imported from Troutlodge, USA. This is the largest trout farm in Sichuan and the only one that imports eggs and feed for its production. It also produces Siberian sturgeon from imported eggs. In the case of the trout, the company uses 5 million eggs annually and the survival rate is 80-90%. Troutlodge is the world's leading supplier of eyed salmonid eggs. It specializes in the production of all-female and triploid (sterile) eggs. In China, distribution is through Beijing Bio-Tech.

"Farmed trout is marketed fresh within China and processed into frozen steaks for export. Live fish are sold at CNY70/kg (USD 11.23/kg). The culture period is 11 months for 600g fish and for larger 3.5kg fish, the culture period is 2.5 years. Temperatures are ideal in Sichuan for trout culture. In Sichuan, there is a good local market for fish to prepare a hot pot dish and for sashimi," said Annie Kang, general manager.

Selling into China

The domestic consumption of shrimp in China has been rising and large shrimp producers such as Zhanjiang Guolian and Zhanjiang Evergreen are selling more into local markets where the preference is live fresh shrimp followed by frozen head on shell on (HOSO). During the show, it was obvious that local buyers were seeking suppliers. Shrimp producers from Asia and Latin America are targeting exports to China, as buyers in Europe and US slow down. Asia's large integrators marketing vannamei shrimp comprised Indonesia's CP Prima, Thailand's Thai Union and Charoen Pokphand Foods and Malaysia's Blue Archipelago. Black tiger shrimp supply came from Indian companies under the umbrella of the MPEDA (Marine Products Exports and Development Authority) booth. Madagascar's Unima has premium black tiger farmed at low stocking densities.

"In general, the sentiment is that China is growing in importance both as importer and exporter. All of us from Asia and Latin America are here, marketing farmed shrimp but there is also marketing of the wild caught Argentinian shrimp. There is lack of shrimp in the market and offer prices are higher than in Europe and the US for HOSO," said a shrimp supplier.

Ecuador's Omarsa began exporting shrimp into China 17 years ago but stopped when China itself started producing vannamei shrimp. Three years ago, the company resumed exports into China. The company is one of Ecuador's largest shrimp producers with 2 farms of more than 1500ha. Recently, it opened an office in Beijing to expand into the Chinese market. According to Infofish, frozen shrimp imports from Ecuador into China increased significantly to 5,574 tonnes from only 324 tonnes in 2009.

"We export head on shell on (HOSO) into China. Currently prices for shrimp are relatively high and this is to be expected," said Sandro Coglitore, general manager.

The team from Phu Cuong group in Vietnam saw the show as helpful in meeting buyers. Phu Cuong is one of the earliest seafood companies in Vietnam. It has 8-ha of pangasius farms, a feed mill in Kien Giang and a recent addition is a 1,000 ha shrimp farm in Soc Trang. They also carry out contract farming and raw materials for processing come from catfish, tilapia, white shrimp and black tiger shrimp farms in the Mekong Delta. According to Nguyen Viet Cuong, the revenue was USD200 million in 2012 and it expects to increase this in 2013.

Tianjin Fishery Products is already buying fish from India, Pakistan and Iraq at an average of 20 containers/year. It supplies to wholesalers and retailers and the food service sector (restaurants and hotels). In 2013, it wants to open up new areas of business such shrimp. The visit to the show was to see new suppliers such as those from South America.

The next China Fisheries & Seafood Expo will be held in Dalian, November 5-7 2013.

A zone management approach for sustainable aquaculture

While it carries out zonal AIPs with the pangasius sector in Vietnam, shrimp in Indonesia, SFP is using the AIP with the tilapia industry in Hainan Island, China for sustainability through zone management.

The Sustainable Fisheries Partnership (SFP) approach is to ensure that there is not only sustainability in seafood production but also in the supply of international traded seafood. This young and dynamic, business-focused NGO engages and catalyses global seafood supply chains in rebuilding depleted fish stocks and reducing the environmental impacts of fishing and fish farming. Sustainable seafood is currently certified to the Marine Stewardship Council (MSC) for a fishery product and to one of the aquaculture standards for an aquaculture product. However, if responsible retailers insist on certified seafood as part of their sustainable buying policies, this means that only a small percentage of seafood supply is available to them. SFP believes engagement in Aquaculture Improvement Projects (AIPs) or Fishery Improvement Projects (FIPs) helps enhance sustainability whilst ensuring greater availability of responsibly sourced seafood.

SFP operates through two main principles: information and improvement. FishSource™ provides major seafood buyers and the public with up-to date information on the sustainability of fisheries and the improvements they need to make to be sustainable. In both FIPs and AIPs stakeholders work together to improve a fishery or an aquaculture zone by pressing for better practices, policies and management. These projects are increasingly led by industry, with SFP providing technical support and expertise at a various levels.

Sustainability in aquaculture

Until recently SFPs main activities have been in capture fisheries, but in response to industry requests, it has created a parallel system for aquaculture that complements the wild fisheries program. It is also developing an aquaculture component for FishSource along with aquaculture metrics for seafood buyers and a number of Aquaculture Improvement Projects (AIPs) in China, Vietnam, and Indonesia. The idea behind SFP's three AIPs is to move the industry towards sustainability so that both the producers and the markets in the interim period can sustain supplies and state clearly and publicly that they are moving towards sustainability.

Prior to the current zonal AIPs, SFP carried out benchmarking of the various leading aquaculture certification standards to understand how they could affect farmer practices on the ground. In Vietnam, since 2010, SFP has been building on this work by monitoring water quality in the Mekong Delta, both of incoming water and farm effluents in relation to pangasius production, building a greater understanding of the likely impact of diseases and food safety. It will also highlight the potential impact on aquaculture of the Mekong river dam construction proposals. A summary report is planned for early 2013. SFP also has an AIP working with shrimp producers in East Java, Indonesia, but the Hainan tilapia AIP in China is the most advanced with the collaboration of several stakeholder groups including regulators.

Adding value to aquaculture

"In fisheries, SFP works towards certification on a fishery. However in aquaculture, certification is all at the farm level and individual certifying bodies are already there to help each individual farm. So how can SFP add value to the aquaculture industry?" said **Anton Immink**, the newly appointed director of Aquaculture who's role is to further expand the approach for aquaculture. In November, Immink announced the establishment of the Hainan Sustainable Tilapia Alliance during the Ninth International Tilapia Industry Development Forum held from 12 to 13 November in Haikou, Hainan.

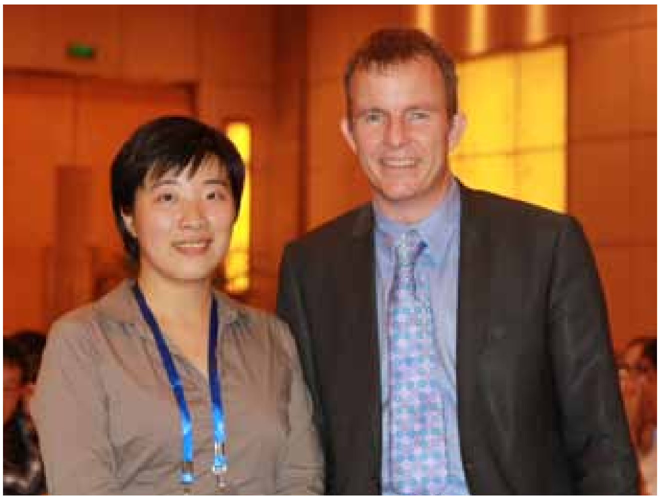
A tilapia farm in Hainan

"In aquaculture, we have benchmarked the three main aquaculture certification programs and what this means for aquaculture farms. We are also looking at issues around the harmonisation of standards. But over the last two years we have been moving towards a key improvement focus for managing the impact of aquaculture at a zonal level."

This means taking best practices at the farm to best practices to a zone level. Here, the farmers become responsible and consider their impact on the wider environment. According to Immink, buyers are interested in the zone or regional approach as improving water quality, maintaining water carrying capacity, disease risk management and putting best practices in place will reduce risks of food safety scares and increase production of quality products.

"The key message is that in such an approach, all stakeholders acknowledge that they are responsible for the long term sustainability of the shared resource; water or land. We see that zone management will go beyond international standards. Farms will have to be responsible for wider impacts of their production process. Governments will have a key role to regulate such as on carrying capacity to ensure no over-development and resource deterioration. SFP builds its reputation on honesty and integrity and a strong basis in science and will go on to build the same consciousness in our partners," said Immink

"Our framework is in contrast to the farm-level AIPs implemented by the ASC/IDH program. Certainly individual farms can be moved towards certification, but there is a bigger picture impact that needs to be dealt with. In Hainan the overall concept is to inform and educate producers and processors and others in the value chain, along with regulators and policy makers on the need for comprehensive planning and management".



Anton Immink (right) and Han Han

Participants at the Haikou roundtable included farmer association members, processors, feed producers and distributors as well as seafood buyers and retailers from North America

AIP in Chinese tilapia

China is the not only the biggest producer and exporter of tilapia, but also has seen significant growth in the past 10 years. Some 90% of tilapia production is from the southern provinces of Hainan, Guangdong, Guangxi and Fujian. Hainan is the second largest producer at 317,000 tonnes and exported 103,000 of processed products in 2011. Image issues such as food safety, environmental concerns and sustainability dominate arising from poor water and soil quality, overstocking and disease outbreaks. In 2012 over production and excessive competition has brought down ex-farm prices to as low as RMB 8/kg (USD 1.3/kg). Furthermore, farmers faced the issues of rejections of harvests by major processing plants, leading to a further lowering of offer prices by medium size plants.

Han Han, SFP's country manager for China is focusing on the AIP for tilapia in Hainan Island. "The industry is always challenged on food safety issues even though the Chinese government started its CIQ (China Inspection and Quarantine) process in 2006 and is closely monitoring farms and processing plants. There is also a considerable number of Best Aquaculture Practices (BAP) certified farms and processing plants. Nevertheless, in the past 3-5 years, we have issues such as overstocking, disease outbreaks and off-flavour. These have to do with the overall environment of the water resource. The current certification programs overlook the regional effects from the rapid growth of the tilapia industry. This is especially so when there are several farms concentrated in one small area."

"Such a task will not be easy at the national level and thus, we think it will be best to demonstrate at a provincial level. For the AIP in China, our focus is on the four provinces in the south where we observe as being most vulnerable to international market economy and weather, such as floods and droughts. In general, farmers are struggling as profit margins go down. In Hainan we have started to do industry mapping and try to understand the supply chain dynamics and relationship between stakeholders including the decision makers. Although at the farm level, the impact of adverse conditions is fully understood but at the regional scale the cumulative impact is unknown. We are collaborating with the Environmental Department and an aquaculture research institute to check water quality at farms to see the future risks of impacts on the surrounding natural waters".

Han explained that the work on disease management such as the impact of Streptococcus is being done with a local research institute. In Hainan, production is mainly in ponds and poor water quality trigger diseases. She will use these to develop some best practices at a zone level and present these at the aquaculture policy roundtable.

"In September, we had one in Haikou where we presented our findings to 60 participants from association members, feed producers and distributors. Feed producers play an important role in the industry. SFP also brought in buyers and retailers from North America and encouraged face to face communication with the producers," said Han.

"These aquaculture policy roundtables are core to our key role to strengthen the voice of individual actors into their stakeholder groups. They join up and voice their concerns and issues and also listen to others all along the production chain. Through this they may instill values; enhance their positive impacts and reduce the negative impacts of their production", added Immink.

Hainan Sustainable Tilapia Alliance

"We realise that we could leverage on this zonal management approach to help them build up their industry and enhance production quality with a regional brand. At the same, we will have trust in the SFP program. There is also an acceptance of an NGO, a rarity in China, what more one in the seafood business. The roundtable helped us to deliver our message and build the partnership with local stakeholders. Together we have agreed to establish the Hainan Sustainable Tilapia Alliance," said Han.

Hainan was chosen because it is China's only tropical island and is independent from other production areas. It has good environment given the low industry development. Within the tilapia industry in China, the quality of tilapia from Hainan is recognised as the best because of good quality water and soil. As such the industry here has a strong desire to build their own brand. The key motivation is sustainability as from the farmer's point of view, certification has not brought premium prices. The idea is to create a Hainan tilapia brand but this must come with responsible practices and consideration for the environment. The alliance is also supported by the local government.

"Ideally the alliance should be an industry led grouping but at the moment we will take a leading role. As the industry still lacks the capacity and knowledge. Eventually we will pass this to industry to manage."

In the meantime, Han will continue with the environmental studies and will engage relevant government agencies such as the Department of Commerce as the tilapia is a major export commodity. On the side lines of the tilapia industry forum, a discussion was held with international buyers to encourage their suppliers in Hainan to participate in the alliance.

"SFP would like to see change, where the influence from buyers and retailers down the value chain to producers will help to drive change. However, we do believe tha when the sector comes together, there will be a strong voice to be heard in the broader national planning," added Immink.

Business-to-business platform for aquaculture in Asia

This is the second edition of Aquatic Asia 2013, an independent trade show. As it is co-located with VIV ASIA 2013, buyers and suppliers in aquaculture in Asia-Pacific have the unique opportunity to meet not only key contacts active in aquaculture but also those with joint-interest in both aquaculture, poultry and livestock. In 2009, the organisers of VIV Asia saw the potential of aquaculture in Asia and decided on a dedicated show for the industry. This concept has been refined and developed into this event in 2011. Aquatic Asia 2013 will be held in the Bangkok International Trade and Exhibition Centre, Bangkok, Thailand and will be from March 13-15 2013.

At VIV Asia 2011, Aquatic Asia formed the first edition of a dedicated event for the production of fish, shrimp and other aquaculture products in Asia. Some 26 exhibitors presented their technologies to a total of more than 6,000 visitors. The organisers are aiming to exceed these numbers as the focus is on aquaculture to meet global demand for food fish.

At Aquatic Asia organisers have planned for around 30 companies to present the latest developments and products in feed additives, breeding, culture technologies and farming equipment. Next to it, some 80 major international players in feed milling technologies, feed additives and animal health will have joint livestock and aquaculture presentation at their respective booths in VIV Asia. A selection of companies exhibiting in Aquatic Asia and those with interest in aquaculture at VIV Asia 2013 is given below. There will also be conferences and technical seminars. For updates, please go to the show website.

More information: www.aquatic-asia.net. Email: Guus.van.Ham@vnuexhibitions.com (Ham, G. van – Guus, project manager, VNU Exhibitions Europe); pannada@vnuexhibitionsap.com (Pannada Kongma, communications manager, VNU Exhibitions Asia Pacific.)

Dates and times
Wednesday 13 March 10.00 - 18.00 hrs
Thursday 14 March 10.00 - 18.00 hrs
Friday 15 March 10.00 - 16.00 hrs

Aquatic Asia 2013 Conference Program as at press time

Room 224	**Wednesday March 13, 2013**
10.00 - 13.00	Bayer Aquaculture Conference in cooperation with IntraFish- TBA
14.00 – 18.00	The role of probiotics in aquaculture- Dr Farshad Shishehchian, Blue Aqua International & the Asian Aquaculture Network
Room 225	**Aquatic Asia Conference 2013**
10.00 - 13.00	Benefits for the Thai aquaculture industry from the forming of the Asian Economic Community -Department of Fisheries of Thailand
14.00-17.00	Future trends and developments in the Thai aquaculture industry- Department of Fisheries of Thailand
Room 224	**Thursday March 14, 2013**
10.00 - 13.00	Bayer Aquaculture Conference in co-operation with IntraFish-TBA
14.00 - 16.00	Aquaculture Certification - One standard inclusive of many species for the entire production chain, TBA
Room 225	**Thursday March 14, 2013**
10.30 - 11.30	Acute Hepatopancreatic Necrosis syndrome outbreak in Asia Pacific- Prof Timothy Flegel Centex Shrimp
12.00 - 13.00	Global trends in seafood 2013-Thai Frozen Food Association
13.30 - 14.30	Thai shrimp industry overview- Department of Fisheries
14.30 - 15.30	Aquaculture Standard of Thailand-Department of Fisheries
Room 224	**Friday March 15, 2013**
10.30 - 11.30	Global G.A.P. Certification - Good Aquaculture Practice- Mario Velasco

AL Asia Chemical Industry Sdn Bhd is a privately held, ISO 9001:2008 certified Malaysian company specialising in the production of pellet feed binder used in the animal feed industry. As "*A Trusted Quality Partner*" in aquaculture and agriculture, the products and services offered include the Feed Binder- AQUABOND 910P, an ideal solution for the improvement of superior pelleting and water stability as well as feed additives, feed processing, feed preservations, feed nutrition and water management programs.

Booth A018
Contact: Lisa Octafia, sales & marketing manager
(lisayu@alasiachemical.com; sales@alasiachemical.com)
Web: www.alasiachemical.com

Aliphos is the feed ingredients division of Tessenderlo Chemie NV/SA. It produces and commercialises a wide range of feed ingredients including specialised products for aquaculture and is one of the world's leading producers of inorganic feed phosphates. The Aliphos range is produced in modern, ISO 9001 and GMP-certified plants. Marketed under the Aliphos® and Windmill, brand names, these products guarantee optimal animal performance and welfare, with maximum respect for the environment. Our range of feed phosphates includes next to Aliphos® Monocal (monocalcium phosphate), Windmill Monamphos® a feed phosphate especially suitable for aqua feed production.

Aliphos Blue Line is a range of feed ingredients including inorganic feed phosphates, trace metals and microencapsulated products, specially developed for concentrated aquaculture feeds. Windmill Monamphos® is a highly digestible feed phosphate which provides high species productivity with low environmental impact. AliGlys® bis-glycinate, organically bound trace metals ensure full trace element supply for optimal performance. Aliphos ButyForm, a combination of micro-encapsulated formic and butyric acids, improves intestinal health and nutrient digestibility.

Booth A014
Contact: Sjo Zwart, technical manager Feed Ingredients (sjo.zwart@aliphos.com)
Juan Lorente, Sales manager Iberia, America and East Asia (juan.lorente@aliphos.com)
Web: www.aliphos.com

Aran Farm International has over 25 years of experience in the field of aquaculture. It is a leader in a modern design auto-feeder with a global presence. The Aran autofeeder is an energy saving, modern design feeder with a 98% accuracy rate and 30% reduction in feed waste. It has an intelligent control unit which is friendly to use, easy to install and maintain. It is supported by a solar power system. The Aran Aerator has an engine which uses 50% less electricity to run a total of 76 prop blades in 4 groups and increase contact surface between water and air for higher dissolved oxygen.

Booth Z011
Contact: Aran Jirawut Prasan (aran-sons@hotmail.com, ceo@shrimpautofeed.com)
Web: www.shrimpautofeed.com, www.aranautofeeder.com

Asian Aquaculture Network (AAN) was established in 2009 as a regional professional network of communication, knowledge and sharing practical technical information about aquaculture. The primary focus is on promoting sustainable development and profitable practices of aquaculture in Asia. The mission of Asian Aquaculture Network is to help aquaculturists and farmers operate a profitable and environmentally sound business in order to sustainably feed the world affordable products at high quality. Web: www.asianaquaculturenetwork.com

Blue Aqua International is a one stop solution provider for the livestock and aquaculture industry in Asia Pacific. We manufacture and distribute specialty products and services to our customers in four specific areas: nutrition and feed quality, environment, disease & health, system & equipment. Our goal is to help customers increase their profits and be able to operate their business sustainably and in an environmentally friendly way. Web: www.blueaquaint.com

Booth Z010
Contact: Amornrat Boonchuay, vice president (amornrat.boonchuay@blueaquaint.com)
Thaphatkorn Dulgaiphan, Media & Marketing Communications (thaphatkorn@blueaquaint.com)

AQ1 Systems is a global leader in sensor based feeding control and sizing systems for aquaculture. Incorporating the latest in acoustic and optical sensing technology, AQ1 offer a range of intelligent feeding control systems for shrimp and fish farmers and fish sizing systems. AQ1 has released the latest model of feeding technology to the shrimp farming sector. Using passive acoustics, the system measures feeding intensity and uses this information to match feed delivery with appetite precisely. It is also capable of environmental monitoring with all feeding and environmental data logged and available for management locally or over the internet. The system produces significant productivity gains in growth and feed conversion.

Booth Z029
Contact: Peter Blyth, director (pblyth@aq1systems.com)
Web: www.aq1systems.com

Axcentive is market leader in tosylamide chemistry and has a worldwide presence with a range of well-known branded products such as Halamid® and Ketjenflex®. Halamid is a unique broad spectrum powder disinfectant that eradicates all major problem causing pathogens. While inactivating bacteria and viruses irreversibly, it is also mild for men, animals and equipment. Halamid® is readily biodegradable. It is used in veterinary hygiene, aquaculture and many other applications.

Booth Z030
Contact: Paul Van Lenthe, director (p.vanlenthe@axcentive.com)
Barbara Jean, sales assistant – Customer Care Department (b.jean@axcentive.com / info@axcentive.com)
Web: www.axcentive.com

Biorigin specialises in the development of innovative solutions based on yeast and other products from biotechnological processes. Biorigin will be exhibiting at VIV Asia 2013. With a focus on innovative natural solutions that promote health and quality of life, all its products are GMO-free and allergen-free. Products for the aquafeed industry include MacroGard®, a pure and natural product derived from baker's yeast *Saccharomyces cerevisiae*; ActiveMOS, a prebiotic additive for animal feed, rich in mannanoligosaccharides (MOS); Selemax, an inactive dry yeast containing high levels of organic selenium; Biotide and HiCell, an autolysed dry yeast obtained from the fermentation of a strain of *Saccharomyces cerevisiae*, especially selected for use in the feed industry.

Booth - Hall 106, Booth B020
Contact: Goetz Gotterbarm(goetz.gotterbarm@biorigin.net)
Web: www.biorigin.net

Charoen Phatara Panich Co., Ltd is a manufacturer and exporter for O2bubbles aeration hose, Rainforest soaker hose, Thaitara dripping line, connectors, as well as other aquaculture and irrigation equipment in Thailand. It has a 50 year history in the production and export of plastic and rubber products. O2bubbles aeration hose is a porous pipe which enhances the aeration efficiency in aquaculture and waste water treatment. Rainforest soaker hose and Thaitara dripping line are irrigation equipment to save water, energy and labour for plantations and home gardens.

Booth Z017
Contact person: Orawan Jiravanstit, sales manager (thaicpphoses@gmail.com)
Web: www.o2bubbleshose.com, www.rainforesthose.com

The GLOBALG.A.P. Aquaculture Standard applies to a diversity of fish, crustaceans and molluscs and extends to all hatchery-based farmed species, as well as the passive collection of seedlings in the planktonic phase. The standard covers the entire production chain, from brood stock, seedlings and feed suppliers to farming, harvesting, processing and post-harvest handling operations. It serves as a practical manual for any aquaculture producer, ensuring food safety, minimal environmental impact and compliance with animal welfare and worker health and safety requirements. The Compound Feed Standard also helps aquaculture producers find GLOBALG.A.P. certified compound feed manufacturers. During the event there will be a 2-hour GLOBALG.A.P. workshop on updates on the new developments: "GLOBALG.A.P. Aquaculture Certification - One Standard Inclusive of Many Species for the Entire Production Chain." The program will be announced at VIV Asia 2013.

Prior to Aquatic Asia, there will also be a GLOBALG.A.P. Public Workshop: Aquaculture from 11 to 13 March at the Ramada Encore hotel in Bangkok. More details on this are available from Daniela Fabiszisky (fabiszisky@globalgap.org)

Booth No: Z021
Contact: Mario Velasco (velasco@globalgap.org)
Web: www.global.org

MSD Animal Health known as Merck Animal Health in the United States and Canada, is the global animal health business unit of Merck. MSD Animal Health offers veterinarians, farmers, pet owners and governments one of the widest ranges of veterinary pharmaceuticals, vaccines and health management solutions and services. MSD Animal Health is dedicated to preserving and improving the health, well-being and performance of animals. It invests extensively in dynamic and comprehensive R&D resources and a modern, global supply chain. It is present in more than 50 countries, while its products are available in some 150 markets.

Booth B048
Contact: Melissa Meurkens, (esther.willems@merck.com)
Esther Willems (melissa.meurkens@merck.com)
Web: www.msd-animal-health.com

Sonac is a leading supplier of reliable and high-quality animal-based proteins, fats and minerals. All raw materials originate from animals suitable for human consumption. The keywords for Sonac ingredients are: natural - digestible – sustainable. Because of further production process specialisation, an active R&D policy, the geographical spread of locations and tailor-made products for their customers, Sonac adapts perfectly to the market needs.

For the aqua feed market, Sonac produces valuable and essential ingredients, such as fat, proteins, minerals and specialty products. Animal fats are the most sustainable energy source available and an indispensable element in commercial aqua feed. The fatty acid profile of poultry fat is very interesting for application in aqua feed. Our blood products and blood meals are excellent and sustainable alternatives for fish meal. The proteins are processed to reach high digestibility levels. Sonac is a producer of specialised gelatin based pellet binders, Pro-Bind Plus. Our fully hydrolysed mucosa protein is an ideal attractant in juvenile fish feeds in general and specifically for shrimp feeds.

Booth Y21
Contact: Geert van der Velden (geertvandervelden@sonac.biz)
Web: www.sonac.biz

EU authorisation for probiotic as a feed additive for use in feed for all farmed fish species

In September, Lallemand Animal Nutrition announced that BACTOCELL® (*Pediococcus acidilactici* MA 18/5M), the first ever probiotic to be approved by the European Union for use in aquaculture (salmonids and shrimp), has now received another positive opinion from the EFSA's Panel on Additives and Products or Substances used in Animal Feed (FEEDAP) for its use in all fish species.

The positive opinion was accorded after scientific assessment of additional trial results demonstrating reduced deformities and improvement in mineralisation in fish as well as a review of the mode of action of Bactocell in aquaculture. The panel concluded that "Taking the data on seabass and salmonids together, Bactocell has the potential to reduce bone deformation in developing fish at the dose of 1 x 10^9 CFU/kg of complete feedingstuffs."

Fish bone deformation represents a major challenge for fish farmers (in particular marine fish hatcheries), with financial consequences estimated to be up to 20-25 million/year in the Mediterranean area only.

This is the third positive scientific opinion granted by EFSA for the use of Bactocell in complete feed for aquatic species, the first two having resulted in its authorisation for use in salmonids and shrimps.

Mathieu Castex, product manager for aquaculture said, "With this recent development, we are very pleased to be able to bring this innovative and sustainable solution to all fish farmers to help them address a major challenge in fish farming. A complete range of fish feed containing Bactocell will soon be available for fish farming in Europe".

More information: www.lallemandanimalnutrition.com; EFSA Panel on Additives and Products or Substances used in Animal Feed (FEEDAP); Scientific Opinion on the efficacy of Bactocell (*Pediococcus acidilactici*) when used as a feed additive for fish. EFSA Journal 2012;10(9):2886. [6 pp.] doi:10.2903/j. efsa.2012.2886. www.efsa.europa.eu/efsajournal

Monosex culture of prawns

Androgenic gene silencing and a fast growing all maleline

Work conducted by Dr Amir Sagi, professor in the Department of Life Sciences and the National Institute for Biotechnology in the Negev, Ben-Gurion University of the Negev, Israel is now available to *Macrobrachium rosenbergii* commercial farms in Asia. Below, Sagi discusses developments in the industry and the role of this novel technology.

Sexual bimodal growth

In many crustacean species, a sexual bimodal growth pattern is exhibited where females grow larger than males of the species or vice versa. In several cultured species such as the Australian red-claw crayfish *Cherax quadricarinatus* and the giant freshwater prawn *M. rosenbergii*, males grow faster and reach higher weights than females. Thus, an all-male monosex population culture of the species is desirable.

M. rosenbergii is native to the tropical Indo-Pacific region of the world and is an economically important crop in China, India, Vietnam and many other Asian countries. It has high demand as a food item and as an export product. The reduction of wild stocks has resulted in a gradual increase in the volume of traditional prawn culture production up to 2009. China, India and Vietnam together produced more than 200,000 tonnes annually valued at USD 2.4 billion (FAO 2009). Bangladesh, Thailand and other countries produced smaller amounts. However a decrease in culture during recent years calls for the introduction of advanced technologies to increase yields.

Monosex culture

Differences between males and females of the same cultured species, in growth rate, alimentary needs and behavioural patterns, dictate the need to establish management procedures specifically adjusted to one sex or the other. Moreover, since a monosex culture population is inherently non-breeding, energy is diverted to growth. Reproduction can be carried out in such systems under separate, controlled conditions. The monosex culture strategy has become a common practice in fish culture and attempts have been made to apply it to crustacean culture.

A small scale experiment conducted as early as 1986 in Israel in hapa nets by hand segregating *M. rosenbergii* monosex populations resulted with significantly higher yields when all-male populations were cultured. More recently (India, 2006), an economic analysis of all-male population culture showed income increase by ~60% over mixed and all-female populations, taking into account the expenses under Indian conditions, caused by labour-intensive hand segregation and related losses (Figure 1).

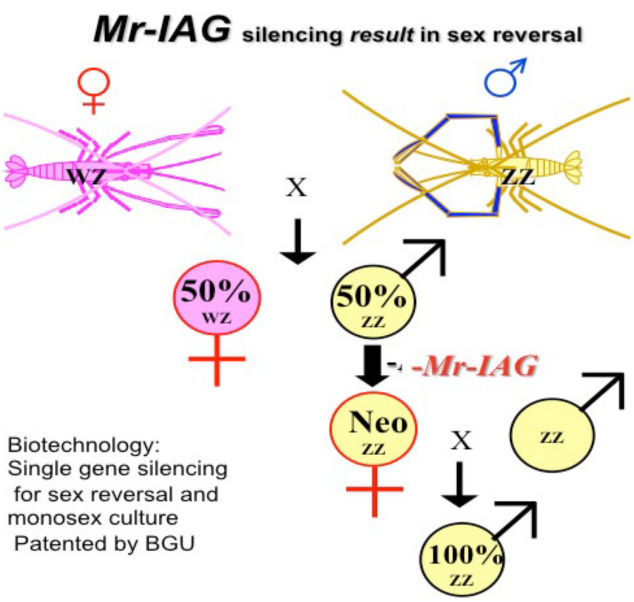
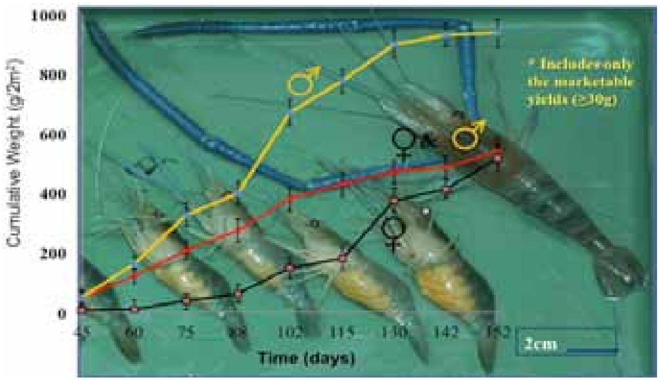


Figure 1. *M.rosenbergii* dimorphic growth in favour of all male culture and selective harvest* (modified from Sagi et al, 1986).



Sex reversal

In *M. rosenbergii* a fully functional sex reversal could be achieved by microsurgical manipulation of the androgenic gland (AG) in early post-larval males. Although AG manipulation dates back half a century, a biotechnological approach for the generation of all-male populations was only recently devised, and it involves the microsurgical removal of the AG from juvenile males. AG removal from immature males results in sex reversal. Since *M. rosenbergii* males are the homogametic sex, bearing two homologous sex chromosomes (ZZ) as in several other studied crayfish and shrimp species, sex-reversed males produce 100% male progeny. Indeed, we found that sex-reversed animals (neo-female) are capable of mating with normal males to produce an all-male offspring population. This population may result in an increase in yield since females at the end of a culture season may weigh 26-45 g, while males may reach up to 100-120 g. This biotechnology has been implemented in Vietnam, Thailand and India.

The novel technology: Gene silencing and the BGU line

The gene silencing technology was developed at the National Institute of Biotechnology at Ben Gurion University of the Negev (BGU). It is based on a recent finding of a new gene encoding an insulin-like androgenic gland hormone from *M. rosenbergii* (termed Mr-IAG and fully patented).

The patent is licensed to Tiran Shipping (1997) Ltd with exclusive, worldwide rights to utilise the IP and to commercialise the licensed products. Silencing of this gene could cause complete sex reversal of a male into a functional neo-female. The technology includes the application of gene silencing in males of the fast growing BGU line of *M. rosenbergii*. Via the use of specific molecular sex markers, the identified males are transformed through a temporal single gene silencing into neo-females.

The neo-females are grown and bred to produce all-male populations (see chart). The technology does not use hormones or chemicals and it is not producing genetically modified prawns. Thus this is a completely non-GMO technology. Because it does not involve genetic modification of the organism, thereby bypassing the regulatory pipeline required of genetically-modified crops, this is a boon for monosex biotechnology. As the intervention is temporal, it is not transmissible to next generations. Indeed, this approach may be of tremendous merit in the aquaculture industry. Moreover, it could also form part of a sustainable solution for the management of invasive and/or pest crustacean species, where the production of non-reproducing male or female populations is sought.

More information: web: www.tiran.co.il;Email: havioz@tiran.co.il (Haim Avioz, managing partner, Tiran Group);sagia@bgu.ac.il (Dr Amir Sagi)

TARS 2013: Finfish Aquaculture - Industrialisation and Sustainability

August 21-22 2013, Singapore

The third in this successful Aquaculture Roundtable Series (TARS 2013) focuses on Finfish Aquaculture.

Asia Pacific leads in the supply to global markets, contributing 89% by volume in 2010 with a production of 33.42 million tonnes, valued at USD53 billion (SOFIA 2012). While finfish production dominates Asian aquaculture at 64.6%, production styles and volumes vary among countries, including the focus of production, for the high value niche market or as a commodity. The sector also faces challenges such as rising costs of production, multispecies, lack of controlled systems, poor marketing, and the negative image of Asian finfish.

As Asian producers grapple with these constraints, industrialisation and integrating production (from breeding to farming to market distribution) may signal the way to the future to ensure the sustainable farming and profitability of finfish aquaculture in Asia. The global nature of the white fish trade also requires that the complex intersection of changing market conditions with production methods address issues such as food safety, quality standards and the environment.

The theme for **TARS 2013 is Finfish Aquaculture: Industrialisation and Sustainability** with specific emphasis on controlled production and science, rather than empirical production methods. Key topics will address monoculture, integration, standardisation of production methodologies, economies of scale and year round production of this aquaculture sector.

TARS 2013 is neutral platform for key stakeholders from the academia, policymakers, NGOs, and industry to share an open dialogue on current and emerging challenges, and the latest scientific, technological and market developments impacting the region.

TARS 2013 is organised by Aqua Culture Asia Pacific Magazine and Corporate Media Services, Singapore.

Preliminary **Program**

DAY 1

WEDNESDAY, AUGUST 21, 2013

Plenary Session

Session 1: Breeding and Hatchery Management

- Finfish hatchery development in Asia - Industrialisation is the future
- Intensive hatchery management: monoculture production and learning from the Mediterranean
- Domestication and selective breeding in Asia - the tilapia model and implications for the marine fish

Session 2: Production, Health and Environment

- Production systems: business models and efficiencies
- Industrialisation and sustainability in freshwater fish production - from small business to market leader: an industry perspective
- Industrialisation and sustainability in marine fish production: advances in Asia- an industry perspective
- Managing fish health in open and closed system - a gap analysis and the way forward
- Mitigating environmental risks - lessons learnt and zonal management for sustainability
- Investing in finfish aquaculture: an investor and private equity outlook

Session 3: Feeds and Feeding

- Developing the ideal feeds for finfish - gap analysis
- Evolution of performance feeds - from the marine fish to the tilapia

Session 4: Marketing and Certification

- Asian finfish aquaculture: building a positive image
- White fish markets in the US, EU and China
- The farmed fish complex - from food to industrial products

DAY 2

THURSDAY, AUGUST 22, 2013

Breakout Session

Moving the Industry Forward

Participants will break into groups of 10 to discuss challenges facing the segments of their choice. (Participants will be required to select their area of interest 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 move the industry forward.

The choice for industry groups are:

- Breeding and Hatchery Management
- Production, Health and Environment
- Feeds and Feeding
- Marketing and Certification

Panel Discussion:

Leaders from each group will present a summary of the output from the breakout sessions. This will be an interactive session.

More information: Email: conference@tarsaquaculture.com or visit www.tarsaquaculture.com

2013 Hinter Symposium 14-16 March, Zhanjiang, China

The annual Hinter Symposium on Nutrition & Feed Technology of Fish & Shellfish (Shrimp) will be held in Crowne Plaza hotel, Zhanjiang, China from 14-16 March 2013. The theme is 'encouraging communication and promoting progress of the feed industry'. The objective is to present different aspects in shrimp feed manufacturing, such as chain development, operating management, quality control, formula technology, production technology to marketing and shrimp culture technology.

The extensive program will have 8 presentations by regional experts, detailed below. In addition, the participants will visit Zhanjiang Guolian's feed factory, processing factory and market exchange centre.

- How to operate an efficient shrimp supply chain by Li Zhong, Chairman of the Board of Zhanjiang Guolian Aquatic Products Co., Ltd
- Development status and risk countermeasures in the shrimp feed industry in Southeast Asia by Chuang Jie Cheng, General Manager of Sheng Long Bio-Tech International Co., Ltd, Vietnam
- Recent research on amino acid nutrition of fish and shrimp by Dr. Gao Wen, Evonik Degussa (China) Co., Ltd
- The development situation and countermeasures of shrimp feed production in China by Dr. Liu Donghui, Guangdong Haid Group Co., Ltd
- The key points in shrimp feed processing by Han Junwei, Senior Engineer, Buhler (Changzhou) Machinery Co., Ltd
- The power of technology in the shrimp feed industry by Wang Rufeng, Technical Director, Guangdong Haid Group Co., Ltd
- Applied research of protein source replacement in *Penaeus vannamei* commercial formulations by Dr. Zhang Song, Vice-President, Guangzhou Hinter Biotechnology Co., Ltd
- Quality control of oils used in shrimp feed by He Fen, Technical Manager, Guangzhou Hinter Biotechnology Co., Ltd


Li Zhong


Chuang Jie Cheng


Gao Wen


Liu Donghui


Han Junwei


Wang Rufeng


Zhang Song


He Fen

This symposium is organised by Guangzhou Hinter Biotechnology Co., Ltd and Guangdong Haid Animal Husbandry and Fisheries Research Center. Co-organisers are Zhanjiang Guolian Group, Evonik Degussa (China) and Buhler (China). The symposium language will be Chinese.

More information: Web: www.hinter.com.cn Email: hintermeeting@gmail.com

What can you expect from AQUA Culture Asia Pacific in 2013

Volume 9 2013						
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	Food Safety & Traceability	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 Extrusion	Fish Meal /Oil Replacement Feed Management	Feed Enzymes Product Quality	Feed Probiotics Good Manufacturing Practices	Nutrition & Formulation
Production Technology *Technical information and ideas*	Culture Management & Biosecurity	Genetic Improvement	Recirculation Aquaculture Systems	Hatchery Technology	Certification and Regulations	Hygiene & Food Safety
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					
Show Issue *Distribution at these events as well as local and regional meetings* **Show preview*	**Aquaculture 2013** February 21-25 Nashville, Tennessee, USA **VIV-Aquatic Asia 2013** March 13-15, Bangkok, Thailand*	**ESE 2013** April 23-25, Brussels, Belgium **10th Asian Fisheries & Aquaculture Forum& Fourth International Symposium on Cage Aquaculture in Asia (CAA4)** April 30 - May 4 Yeosu, Korea	**Vietfish 2013** June 25-27 Ho Chi Minh City, Vietnam	**The Aquaculture RoundTable Series (TARS 2013)**-Finfish Aquaculture August 21-22, Singapore	**18th China Seafood & Fisheries Exposition 2013** November China*	**Asian Pacific Aquaculture 2013** December 10-13 Ho Chi Minh City, Vietnam*
Deadlines Articles	**November 14 2012**	**February 1**	**April 2**	**June 1**	**August 1**	**October 1**
Deadlines Advert bookings	**December 3 2012**	**February 8**	**April 9**	**June 7**	**August 7**	**October 8**

10AFAF and CAA4

30 April - 4 May 2013, Yeosu, Korea

The 10th Asia Fisheries and Aquaculture Forum (10AFAF) is the triennial forum for the Asian Fisheries Society (AFS). In 2013, the 4th International Symposium on the Cage Aquaculture in Asia (CAA4) will be held concurrently with 10AFAF. The theme is 'Blue Water and Green Fisheries'.

The event is jointly organised by AFS (www.asianfisheriessociety.org) and Korean Society of Fisheries and Aquatic sciences (KOSFAS). It will bring together scientists and industry from Asia and the world to share information on the status and recent advances in aquaculture and fisheries and provide research collaboration among them. In the long term, the aim is to ensure security and food safety through sustainable fisheries and aquaculture practices.

The local organising committee expects more than 1,000 participants. The joint event will have 12 technical sessions covering various fisheries and aquaculture related fields and 2 special sessions at 10AFAF, 4 sessions at CAA4 and a trade show. There will also be a farm tour. The special sessions will be on Higher Education of Fisheries Science and 4th Global Symposium on Gender in Aquaculture and Fisheries.

The venue is Ocean Resort, an integrated complex with restaurants, golf course, hotel, waterpark and condominiums located in Soho-dong. The resort has a panoramic view of the south of Korea.

The deadline for abstract submission is January 31st of 2013. Early bird rates for registration fees for both conferences will end on February 28 2013. More information:Email:10afaf@koference.org; Web: www.koference.org

Technical sessions at 10AFAF
Aquatic Animal Nutrition, Feed & Feeding
Aquaculture, Production Systems
Fisheries Processing
Fisheries & Asia Pacific Fish Watch
Fisheries Police, Social Science, Economics & Livelihood
Fish for Human Nutrition & Health
Environmental Impact, Pollution & Ecotoxicology
Biodiversity, Genetics, Biotechnology & Breeding, Conservation
Fishing Gear & Technology
Fisheries Assessment & Aquatic Resource Management
Aquatic Animal Health & Management
Shrimp & Other Crustacean Aquaculture
Technical sessions at CAA4
Marine and Freshwater Cage Culture
Environment, Pollution and Ecotoxicology
Disease Prevention and Health Management
Seed Production and Hatchery Management

2013

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

February 3-8
Practical Short Course On Feeds & Pet Food Extrusion
Texas A&M University, USA
Web: www.tamu.edu/extrusion
Email : mnriaz@tamu.edu

February 8-10
Aqua Aquaria India 2013
Vijayawada, Andhra Pradesh, India
Web: www.aquaaquaria.com
Email: pubmpeda@gmail.com

February 21-25
World Aquaculture 2013
Nashville, Tennessee, USA
Email: worldaqua@aol.com
Web : www.was.org

March 13-15
Aquatic Asia 2013/ VIV Asia 2013
Bangkok, Thailand
Email: : guus.van.ham@vnuexhibitions.com (Guus van Ham)
Web:www.aquatic-asia.net/www.viv.net

March 17-22
9th International Conference on Molluscan Shellfish Safety
Sydney, Australia
Web:www.icmss2013.com
Email: icmss2013@iceaustralia.com

April 23-25
European Seafood Exposition
Brussels, Belgium
Web : www.euroseafood.com

April 30-May 4
10th Asian Fisheries & Aquaculture Forum and Fourth International Symposium on Cage Aquaculture in Asia (CAA4)
Yeosu, Korea
Email:10afaf@koference.org
Web: www.koference.org

May 22-26
World of Seafood
Bangkok, Thailand
Web: www. worldofseafood.com
Email: s.teo@koelnmesse.com.sg (Sharon Teo)

May 30-June 2
Aquarama 2013
Singapore
Web: www.aquarama.com.sg
Email: squarama_2013@online.ubmasia.com.sg

June 25-27
Vietfish 2013
Ho Chi Minh City, Vietnam
Email: info@vietfish.com.vn
Web: www.vietfish.com.vn

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

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

10th AFAF 2013 Yeosu and CAA4

10th Asian Fisheries and Aquaculture Forum
4th International Symposium on Cage Aquaculture in Asia

April 30 (Tue) – May 4 (Sat) 2013
The Ocean Resort Hotel, Yeosu, Korea

[Theme]
Blue Waters and Green Fisheries

Sessions

10th AFAF

(1) Aquatic Animal Nutrition, Feed & Feeding
(2) Aquaculture, Producton System
(3) Fisheries Processing
(4) Fisheries & Asia Pacific Fish Watch
(5) Fisheries Policy, Economics, Marketing
(6) Fish for Human Nutrition & Health
(7) Environment Impact, Pollution & Ecotoxicology
(8) Biodiversity, Genetics, Biotechnology, Breeding & Conservation
(9) Fishing Gear & Technology
(10) Fisheries Assessment & Aquatic Resource Management
(11) Aquatic Animal Health & Management
(12) Shrimp & Other Crustacean Aquaculture
Special1 : Higher Education of Fisheries Science
Special2 : 4th Global Symposium on Gender in Aquaculture and Fisheries

CAA4

(1) Marine and Freshwater Cage Culture
(2) Environment, Pollution and Ecotoxicology
(3) Disease Prevention and Health Management
(4) Seed Production and Hatchery Management

The Korean Society of Fisheries and Aquatic Science
10AFAF /CAA4 Home Office
Tel : +82-70-8668-8734, e-mail : 10afaf@koference.org, www.koference.org