Where do we want Asian shrimp aquaculture to be tomorrow?

TARS 2012
The Aquaculture Roundtable Series
15-16 August 2012

In August, stakeholders in the shrimp sector held roundtable discussions to brainstorm on how to drive shrimp aquaculture forward.

From left, Arman Zakaria Diah, PT Central Proteinaprima, Indonesia, Kittipon Krittiyarat, DuPont, Thailand, Anutara Boonnat, Charoen Pokphand (CPF), Thailand, Saenphon Chandaeng, Wahyuni Mandira Farm, PT. Central Proteinaprima, Indonesia, Suphol Phantuma-o-phas, CPF, Thailand, Kalayanee Poon-Asawasombat, DuPont, Thailand and Sujit Kaewchum, CPF, Thailand (extreme right).

The second in the Aquaculture Roundtable Series (TARS) 2012 was held in Phuket, Thailand from 15-16 August focusing on the shrimp aquaculture value chain. There were 190 participants from 18 countries comprising the public and private sector, NGOs and academia. This event was successful in presenting a neutral forum for multiple stakeholders to share new knowledge and expertise, and provide substantial input to improve the sustainability and profitability of shrimp production in Asia.

As shrimp aquaculture crosses the threshold to become an industrial supply chain it faces numerous challenges within each of its segments as well as in the integration of all these segments. Asian producers contribute 91% of the annual global production of 3.5 million tonnes and need to be leaders shaping the future of the industry.

The objective of the first day was to determine 'where we are today'. At the plenary session, participants benefitted from updated overviews from leaders in their respective fields. Highlights from the 16 presentations from experts in Asia, Europe and the USA which addressed current challenges and emerging trends in shrimp aquaculture are given below. This formed the starting point for the break-out sessions. Led by team leaders, participants were then divided into four main groups within the shrimp aquaculture value chain segments (breeding and hatchery; culture and health management; feeds and feeding strategies and marketing, branding and certification) to discuss key challenges and formulate recommended strategies to drive the industry forward during the breakout sessions on Day 2. The responses from each group were then consolidated and deliberated in a panel discussion open to all participants to encourage cross fertilisation.

From left,Hidajat Handaja Dantjaputrat, PT Suri Tani Pemuka, Indonesia, Peter Couteau, Allen Wu, Nutriad, Taiwan, Ravi Pelluru, The Waterbase Limited, India, Srinivas Rayaprolu, Novus Animal Nutrition, India and Manoj Sharma, Mayank Aquaculture, India

Breeding and Hatchery

Traits of commercial importance

Genetics research and the development of genetically improved shrimp stocks have moved further ahead for *Litopenaeus vannamei*, which accounts for 82% of global shrimp aquaculture production. However, there are significant knowledge gaps with regard to understanding the genetics of commercially important traits in vannamei shrimp. Currently, most selective breeding efforts focus on improving growth, grow-out survival and disease resistance. However, there are other traits of commercial importance, such as reproduction and carcass traits, and little is known on the genetics of these traits, said **Dr Shaun Moss**, from the Oceanic Institute (OI), Waimanalo, Hawaii, USA.

OI is credited with developing the first Specific Pathogen Free (SPF) populations of vannamei shrimp. These populations have been very important to the global shrimp aquaculture industry, particularly in Asia, where most of the farmed stocks are descendants of OI shrimp. Currently, OI supplies a limited number of brood stock to the industry each year, conducts research related to shrimp genetics and advanced production technologies, and works with industry partners to develop new lines of selectively bred vannamei shrimp.

"We have seen the rapid expansion in vannamei shrimp since 2000. Up to 2011, production has increased 1700% to 2.7 million tonnes and in comparison, the production increase was only 24% for the monodon shrimp. This is because of the lack of healthy monodon shrimp brood stock from captive or wild stocks and their poor reproductive performance. The commercial availability of SPF vannamei shrimp since 1991 and later the availability of genetically improved strains catalysed this expansion in Asia," said Moss.

Understanding the relationships between traits is very important

Dr Mahmudul Karim, Bangladesh Shrimp and Fish Foundation

Dr Surapol Pratuangtum, CEO, Bang Go Farm, Thailand

Dr Le Thanh Hung, Dean Faculty Fisheries, Nong Lam University, Vietnam

Dr Manoj Sharma, Director, Mayank Aquaculture, India

when defining goals for a selective breeding program. In other words, geneticist/breeders need to know how selecting for one trait will affect shrimp performance for another trait. This has been a major research focus at OI and the OI Shrimp Research Program has been able to estimate the phenotypic and genotypic correlations among several commercially important traits for vannamei shrimp. For example, Moss reported that there is no significant phenotypic correlation between Taura Syndrome Virus (TSV) survival and grow-out performance (growth or survival). He also reported that the genetic correlations for shrimp survival to multiple isolates of TSV are positive and of moderate magnitude. Importantly, this suggests that selection for improved survival to one TSV isolate will result in improvements (though smaller) in survival to other TSV isolates.

"An unanticipated consequence of breeding is the size of the brood stock and reproductive performance. As the shrimp is selected for growth, the 10th generation brood stock sizes have increased by 43% for the female and 33% for the male" added Moss.

Moss further stressed the importance of understanding the relationship among traits targeted for selection and how selection decisions should be focused on improving the net merit (or economic value) of a target population. He also discussed the need to not only determine whether a trait is amenable to selection (sufficient heritability and variation), but also whether it is worthy of selection (i.e. is it of economic importance).

"We should assign relative economic values of traits and understand them. However, as the industry is fragmented, we see that each stakeholder is interested in traits which will impact their particular sector. For example, a processor may want a firmer gut to facilitate ease of removal. Selective breeding targeted at the selection process cannot make all stakeholders equally happy. Along the supply chain, there will be specific traits for selection. For maturation, these are increased spawning frequency, spawn size and hatching rate, and the hatchery, nursery and grow out will want good growth and survival, while the processor will be interested in better size distribution and finally the market will want better colour, texture, taste, etc. But using the example from the poultry industry, vertically integrated companies can examine 'trade-offs' among traits that increase overall profitability."

The Ferrari analogy

This was how Moss described why farmers have yet to fully exploit the genetic potential of selectively bred shrimp stocks. To reach its maximum performance it should not be limited by poor culture conditions. A Ferrari capable of 250 kph in an autobahn can only achieve a speed of only 25kph when forced to travel on a dirt road. "The future is selective breeding with biotechnology and controlled production environments."

Taming the tigers: the need of the hour

Ravi Kumar Yellanki, Vaisakhi Bio-Marine (P) Ltd, India is sure that the niche segment of bigger size shrimp could be achieved with monodon shrimp which grows quickly to 50-60 g. But the ultimate weapon for its farming is large scale domestication. This is the need of the hour: domesticated stocks with a reliable history of being free of pathogens of concern which can help mitigate risks from persistent outbreaks of diseases.

"India's national production of the monodon shrimp for 2011-2012 is estimated at 135,778 tonnes. This is the highest ever monodon shrimp production to meet market demand despite the introduction of the vannamei shrimp. In Bangladesh, monodon shrimp is farmed using the traditional method. Despite recurring disease out breaks, the annual production is above 60,000 tonnes but it has the potential to produce 150,000 tonnes annually. In India, about 30,000 tonnes are produced annually through traditional culture whereas the potential is almost 100,000 tonnes. The introduction of vannamei shrimp is ruled out in both countries as the tide-dependent traditional farms are closely connected with the natural environment. There is a chance for the vannamei shrimp to escape into the wild and affect the biodiversity".

Ravi showed that it is still possible to have good production from wild brood stock. He compared the higher productivity of 2.47 tonnes/ha/yr in Gujarat with the rest of India, where average production was only 1.15 tonnes/ha/year. Here all the farmers stock post larvae from a few selected hatcheries which screen the brood stock for pathogens of concern before and after spawning.

Dan Fegan

Leading Culture and Health Management groups, Francisco Gomes and Pornlerd Chanratchakool (right).

Hervé Lucien-Brun (left) and Panisuan Jamnarnwej at the panel discussion on Marketing, Branding and Certification

From left, Tim Flegel, Pornlerd Chanratchakool and Pedro Encarnação

Nyan Taw (left) and Soe Tun, chairman, Myanmar Shrimp Association

Ravi Kumar Yellanki (left) with Carlos Massad, Groupe Grimaud, Vietnam

There are already several companies involved in the domestication and breeding of monodon shrimp: Moana Technologies in Hawaii, Aqualma in Madagascar, Charoen Pokphand in Thailand, CSIRO in Australia and the Marine Products Export and Development Authority (MPEDA) in India. However, Ravi said, "These breeding programs need to get a grip on commercial mass scale reproduction. They need to scale up to cater to the critical mass of the farming community and I believe that successful breeding programs need to set up multiplication centers in shrimp growing countries.

"Monodon shrimp is more suitable for traditional farms. The farming of the vannamei shrimp which requires new infrastructure and high operational costs is not an option for small farmers. In view of the large groups of small, marginal and traditional farmers facing increasing incidences of WSSV infections in the wild brood stock, it is up to the governments of shrimp growing countries with a large base of small, marginal and traditional farmers to work on breeding programs for the monodon shrimp as soon as possible."

"However, looking at the success in Gujarat, in the meantime, there are alternatives to domestication such as the consortium nauplii centers with stand-alone quarantines, maturation and improved egg/nauplii washing protocols, better diagnostic tools and sampling procedures for testing brood stock subjected to unfavourable conditions such as reduced water temperature or any other stress conditions," said Ravi.

New trends in hatchery protocols

According to **Dr Olivier Decamp**, INVE aquaculture, these tend to be in four areas; upgrading of biosecurity in the hatchery, some replacement of live food, feed and health boosters and improved water management by the application of probiotics.

"It has been shown that most bacteria live in colonies, i.e. in aggregates in the water or in biofilms on surface. The persistence and survival of *V. harveyi* in shrimp hatcheries is attributed to its ability to form biofilms with resistance to disinfectants and antibiotics. Thus, the recommended protocol is to use new types of biocide with increased activity against bacterial biofilms," said Decamp.

Shrimp brood stock is usually fed with fresh feeds such as polychaetes, oysters and mussels. The drawback is the biosecurity issue in addition to supply and nutritional quality. Decamp suggests the increased use of performing formulated feeds. With conventional dry diets no more than 50% of the fresh food can be replaced in brood stock rations. New generation, semi-moist pellets replace up to 70% without affecting reproduction performance and nauplius quality.

"The uncertain availability and pricing of *Artemia* cysts from the Great Salt Lake are triggering the industry towards the development of *Artemia* replacement protocols. Different commercial feeds are now being positioned as total *Artemia* replacement diets. However, reported results appear still variable and there is room for improvement. Best results occur with partial *Artemia* substitution using a balanced combination of live food and formulated larval diets. Work in Brazil, Ecuador and Mexico demonstrates that production cost reductions of 25-30% are obtained when increasing the *Artemia* replacement from 65 to 85%.

Decamp added that in a monitoring of the nursery grow-out performance of 60 million post larvae (PL) it was shown that survival increased by 30% when quality hatchery feeds were used to feed the PL.

In Brazil, the application of probiotics in zero exchange aerobic heterotrophic culture system led to improved survival and growth rate. In Mexico, a combination of live food, selected water and feed probiotics, health booster and feed resulted in a minimum harvest weight of 200mg after a 30-day nursery cycle at a stocking density of 15 PL15/L.

"The current challenge in Asian shrimp farming is early mortality syndrome and this is an opportunity to reconsider biosecurity measures, culture system management and the relationship between hatchery and on-growing stages."

Culture and Health Management

Progress on managing EMS

In his presentation on the current diseases in shrimp, **Dr Tim Flegel**, Shrimp Biotechnology Business Unit, Centex Shrimp, Thailand said that the two top threats to the industry are White Spot Syndrome Virus (WSSV) and followed by Early Mortality Syndrome (EMS). There is no doubt that shrimp farmers have been facing challenging times with diseases and in particular, EMS or Acute Hepatopancreatic Necrosis Syndrome (AHPNS) which remains a threat in China since 2009 and Vietnam, Malaysia and Thailand since 2011.

"EMS is the name used for the unusually heavy shrimp mortality approximately within the first 35 days of culture. This very imprecise case definition has led to confusion in diagnosis. This has become clearer with a case definition presented by Dr Donald Lightner, University of Arizona, at a meeting on the EMS in NACA from 8-9 August, 2012. The case definition is a major breakthrough for groups seeking answers on EMS and is a very important progress as we can now look at the same type of specimens.

"EMS, in short is the acute progressive degeneration of the hepatopancreas which is dedicated for various functions and its degeneration will stop all the functions. E-cells no longer divide and cells in the centre of the organ no longer work. At the terminal stage, there will be secondary bacteria but when diagnosis is done at this stage, there could be several causes."

With a series of slides, Flegel showed that these can only be seen through histopathology. He added," I propose that, although there may some disagreement, that EMS is the sloughing of hepatopancreatic cells and this situation might end up with septicaemia. Lightner confirms that the problem is not caused by IMNV or a microsporidian. The new and presumptive field diagnosis is given in in the NACA website and diagnosis should be confirmed by histological examination."

There are ways to assess the causes for AHPNS. It could be biotic and abiotic toxins in pond water and water supply, soils and sediments, feed and feed ingredients, probiotics, and in old and recently used agricultural pesticides, etc. Nobody has isolated the bacteria. Flegel cautioned that, "it is important that the dissection for sampling is done well to avoid stomach and midgut bacteria contamination."

From left, Li Huitao, Shandong Liuhe, Mingyan Huai, Alltech China, Hu Liang, Novus International, Peng Zhi Dong, Guangzhou Hinter Biotechnology, Yan Yuan, Ningbo Tech-bank and Dong Qiufen, Guangzhou Hinter Biotechnology.

Olivier Decamp (centre) leading the Breeding and Hatchery Management Roundtable, together with Jeff Prochaska, Global Gen, Indonesia (right) and Christopher Co, Oversea Feeds Corporation, Philippines

Flegel's message is that we need to look at this in totality.

"At Centex Shrimp, we have started to investigate a possible new bacteria and checking for the possible phage-bacterium partnership which could result in a toxic bacteria. We have identified bacteria present at a high level in the affected ponds. We are now working on a probe for this."

Key points to avoid mortality and disease

Dr Pornlerd Chanratchakool, Novozymes Biologicals, Aquaculture explained how the balance between basic pond management and biosecurity set up can reduce losses in a shrimp farm. In any farm, the bottom line is to reduce diseases and this is achieved with a clean environment, healthy stock and less pathogens. Recent research in Thailand pointed to effects of temperature and dissolved oxygen on feed consumption causing poor water and soil conditions which in turn trigger disease outbreaks and also affect growth and survival.

"Some important measures include adjustments to feed amounts as per the recommendation of Dr Chalor Limsuwan. When temperatures go down to 24-26°C, the feed amount should be reduced by 40-60%. Feeding behaviour is an important indicator of the health of shrimp. In a poor pond environment, feeding will start to either slow down or stagnate after 60-80 days. This is a sign that the shrimp is under stress, which affects the feeding behaviour and thereby the weight gain. In a good pond environment, no external factors stress the shrimp, and it continues to feed and grow until harvest."

Some management guidelines presented include the following;

- Based on a stocking density of <120 post larvae/m^2 of the vannamei shrimp, the biomass is < 1.3-1.5 kg/m^2 in a standard pond without partial harvest and < 0.6-0.8 kg/m^2 for monodon shrimp.
- The feed tray should be checked earlier at 20-25 days (instead of 30-35 days) after stocking to determine growth. Feeds should be adjusted based on actual growth in each pond. The daily feed increment should be monitored and adjusted accordingly (for example; not more than 500g/100,000 shrimp per day) and no feeding should take place if weather fluctuates or if there is leftover feed on the tray.
- Dissolved oxygen levels should be maintained at > 3 ppm near the edge of sludge.
- Partially harvest/ or direct harvest if production close to maximum capacity.

His message was that although there are basic pond and feed management and biosecurity practices to achieve optimal soil and water conditions, there will be a need to consider individual pond management and appropriate decisions based on specific pond data and shrimp. In the future, farmers will need to include in their operational procedures, the unpredictable weather conditions.

Probiotics- why are there still doubts?

Probiotics have been used in shrimp farming for decades and yet the question 'does it work' persists. According to **Dr Pedro Encarnação**, Biomin, Singapore, the doubts are on their efficacy and strains. Then there are also questions on their application in terms of dosage and when to apply. Most importantly, the economic return and cost effectiveness must be demonstrated.

"In the case of aquaculture, we need to specify the different applications. There are feed probiotics which improve the intestinal microbial balance in the gut and those for water application. The latter are for bioremediation which is to change the microbial community in the rearing environment, to degrade organic waste products and to eliminate toxic substances and organic odours. There should be different strains for different applications since they have different modes of action (competitive inhibition, nitrification, denitrification, enzyme production), different requirements (pH, O_2, nutrients) and occupy different niches in the ecosystem (shrimp gut, water column, soil).

"A healthy gut is important and is the major vehicle for entry of pathogenic bacteria. The gut is rich in nutrients which supports pathogenic bacteria. In the gut it is essential to minimise negative or potential pathogenic bacterial strains. Gut probiotics work by competing with pathogenic bacteria for space and nutrients and they lower pH through an increased production of volatile fatty acids (VFA) and lactic acid. Gut probiotics produce antimicrobial substances (lactoferrin, lysozyme, bacteriocins deemed as natural antibiotics) and can also stimulate intestinal immune responce."

"There are proven benefits in the use of probiotics in shrimp culture but we can understand the doubts because sometimes the effects are not significant and not clearly identified. Usually the benefits do not compensate for the increase in investment and there is confusion with the number of strains. Some probiotics work well in some conditions, for example *Lactobacillus* can work well in the gut but not for bioremediation. Some have poor bacterial stability or the concentration is too low at less than 10^8 CFU/g. A study in Thailand showed that several probiotics in the market do not live up to the claims on the label. Unfortunately, there are claims that artisanal probiotics work against viral diseases such as WSSV.

"Generally, probiotics work in aquaculture operations but need to be managed. Given the concerns in the industry, there is a need to regulate probiotics in the market. We also need to learn to evaluate the potential probiotics well."

Culture models

Biofloc technology

With emerging viral problems and rising costs for energy, biofloc technology appears to be the answer for sustainable production not only

in Asia but throughout the world, said **Dr Nyan Taw**, Blue Archipelago, Malaysia.

Biofloc technology is a system that has a self-nitrification process within the culture pond water with zero water exchange. The technology has now been applied widely, from shrimp brood-stock production, hatcheries and farms including super-intensive raceway systems. Commercial interest in biofloc technology is threefold, for it provides high productivity, low FCR and a stable culture environment, which lead to better economic viability.

"There are some basic requirements for a successful application of biofloc in vannamei shrimp farming such as high aeration (28 to 32 HP/ha of paddlewheel aerators) and the positioning of the aerators is critical. The floc density is controlled at <15 ml/L and the accumulated sludge requires siphoning. Ideally ponds should be HDPE or concrete lined. For sustainable commercial production, with a stocking density of 130-150 PL10/m^2, a production of 20–25 tonnes/ha/crop with 18-20 g shrimp can be expected. At the R&D level, we have used biofloc technology for stocking density of 250-300 PL/m^2 either direct or partial harvest to produce up to 50 tonnes/ha/crop. Feed costs can be reduced with supplements of grain pellets and molasses are required to maintain the C:N ratio. With the focus on sustainable production methods, this is surely one of them."

Nyan detailed the technology in his presentation and compared this with a conventional culture system. "The economics of biofloc can be explained in terms of higher daily growth rates; 0.16-0.21 g and better FCR at 1.1-1.2 as compared to 0.13- 0.16 g and 1.5 - 1.7 with the conventional systems. This translates to 3-4% savings in feed costs for every 0.1 change in FCR. Other savings are in days of culture and energy costs with zero exchange of water."

A glimpse of the future

The vision of **Dr Addison Lawrence**, Texas A& M is shrimp production in raceways inside buildings or greenhouses with complete biosecurity with increased predictability and the potential for the production of 'organic shrimp'.

"Our vannamei shrimp are already selected for higher growth at 4-6 g per week and can show linear growth to large sizes of 35-40 g. The future will need more predictability requiring complete biosecurity. Recently a completely new innovative technology has been developed using stacked raceways with a unique bottom design using average water depths of 15 to 20 cm with production levels between 600 and 1,200 tonnes/ha of footprint water per year and growth rates between 2.5 and 3.2 g/week."

Lawrence outlined the features of the shallow water stacked raceway technology (SST) which requires a small footprint. It can be used for the nursery phase to produce 19 to 33 day old post larvae from PL5. The SST technology is a cost effective way with complete biosecurity to increase production and crop predictability. It can act as a nursery system adjacent to existing traditional ponds or deep water raceways. In hatcheries, it is value adding as it can produce PL19-33 from PL5.

"What are the advantages? The management quality is better, there is a quarantine phase and stocking of larger PL with no expression of WSSV in ponds. Furthermore, there will be an accurate account of PLs stocked and a shorter time to commercial size in the grow-out system."

Production planning

Dr Francisco Saraiva Gomes, Novus International, Inc said, "More often than not, success in large aquaculture operations leads managers and owners to develop integration plans across the supply chain. The most common example is when grow-out operations integrate with hatcheries and nurseries. Successful farms may integrate further and bring to their operations either upstream feed mills, either downstream processing plants, or both."

The two typical drivers for integration are short term and long-term profitability. He added that in the first, there is a need to bring in-house gross margins that are otherwise paid to a supplier (upward integration of farms with feed mills) and/or captured by a customer (downward integration of farms with processing plants). The perception is that by integrating the adjacent segment in the supply chain there is an immediate increase in margins due to either cost reduction either to higher net selling price. Long-term profitability pertains to control of the supply chain within a certain defined context of anticipated market trends. Control-led integrations tend to be longer term strategic decisions. They imply that in the near-future, the lack of control of a new part of the supply chain, will result in increase of costs and or in loss of production capacity and or in decrease of sales price.

Joe Kearns

Dr Addison Lawrence

Marketing, branding and certification

Shrimp from Thailand

With more than 30 year's history, Thailand has been successful not only in farming up to 550,000 tonnes but also in exporting almost 380,000 tonnes annually. "These numbers easily place Thailand as the world's number one in farmed shrimp aquaculture production", said **Dr Panisuan Jamnarnwej** from the Thai Frozen Foods Association. TFFA is a private non-profit organization with 210 members, 98 of them in the shrimp business. The distinctive elements of the Thai shrimp industry are farms operations, the supply chain structure and business practices coupled with government support.

"Shrimp is now the leading product, with two third of our members' income from marketing shrimp. Thailand's shrimp exports have seen a steady growth up to 2011. In 2012, there has been a decline in tonnage by 3% but prices were relatively higher. But generally, shrimp prices have been steady all these years, at USD 6.50 to 7.00/kg. In 2010, there was a big swing up to more than USD 9.00/kg which made it difficult for us to cope. The US is our largest market and here our shrimp prices are high but this is because there is more value adding. The highest share of this market that we have achieved was 45%, but it now hovers around 32 to 35%.

"Although our shrimp trade centre is still the Mahachai market, many processors now buy direct from farms and the Movement Documents for both fry and harvested shrimp assure traceability. Control on food safety assures quality. Today, some companies are using the radio frequency identification (RFID) technology to facilitate an accurate tracing system.

"For exporters, the transition to the vannamei shrimp has greatly facilitated the traceability requirements. Imagine when we were marketing the monodon shrimp, for one 17-tonne container we would need shrimp from more than 130 ponds to get the acceptable size uniformity. With the vannamei shrimp, we can do the same with only 24-30 ponds. Our shrimp production will continue and growth in terms of volumes for 2012 is estimated at 3%. The industry is not worried on 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."

Shaun Moss

Jorge Arias

Shrimp for the EU market

The European Union (EU) is the largest shrimp market in the world and imported 610,300 tonnes in 2011. A 1.2% slight decline of imports in 2011 reflected a marginal impact of the actual crisis in the shrimp market, said **Hervé Lucien-Brun**, consultant, France in his presentation. "Although it is a large market for seafood, it is a very diverse one with consumption as high as 56kg/capita in Portugal to less than 4kg/capita. Spain and France are the largest markets at 12 and 7% of the world market, respectively."

"We can see some historical links on where shrimp is imported from but quality and prices also play an important role. India is the main supplier to the UK market, displacing Thailand in 2011 and is getting stronger as quality is improving. It is now the second largest supplier to France after Ecuador. Bangladesh is a major supplier to Germany but only provides large black tiger shrimp. In Germany, price overrides quality as discount outlets are becoming more important than supermarkets in the distribution of frozen shrimp.

"The impacts of the economic crisis differ in each market. The shrimp market in France fell from 114,600 tonnes in 2010 to about 109,800 tonnes in 2011. Madagascar is losing its market, falling from 9,600 tonnes in 2006 to 7,600 tonnes in 2011, due to the very high prices for its large black tiger shrimp and to the improvements of the Indian competition. After 4 years of strong growth the German imports have slightly decreased. In all the European countries, the market for certified shrimp is growing." (For more details, see article on the European shrimp market, Volume 8 Issue 4, July/August 2012, pp 46-47).

Shrimp farm certification

"There are many reasons for certification. We have environmental issues around shrimp farming and NGO pressure on importers and retailers. Through certification, major retail chains use their Corporate Social Responsibility (CSR) and reputation to reassure consumers that the shrimp they supply are safe and farmed in a responsible and/or sustainable manner.The differentiation of products comes with better prices and economic incentives. There is increasing attention on traceability in the supply chain," said **Dan Fegan**, Cargill Siam Ltd in his presentation on 'Where are we now and where do we go from here?

Fegan discussed the role of national certification schemes such as ThaiGAP, VietGAP and IndoGAP which is to raise standards across the board and promote local standards internationally to maintain competitiveness. The credibility of these programs depends on capacity although governments say that they have the sovereign rights to have them. There are many third party certification schemes such as GlobalGAP, Aquaculture Stewardship Council Shrimp Standards (ASC) and Aquaculture Certification Council BAP program.

"These aimed at differentiating and rewarding best performers. It is also to raise the bar such as with the objective with the ASC shrimp standards to get others to replicate the best 20% in industry. Instead, the question is whether the top 20% will leave the rest behind. In Asia, we need to be aware of the importance of certification or else we spend our time trying to play catch-up when inputs come from industry in other regions and used for a competitive advantage against shrimp from Asia."

Fegan also raised some issues when such farm certification schemes include elements outside of the direct control of the farmer such as brood stock/fry source and treatment, feed formulation and ingredient sourcing and requirements to source from certified suppliers.

"BAP's Star system of certification is aimed to benefit the end user. However, the difficulty is that certification is dependent on supplier being certified too. The BAP and ASC farm certification is dependent on the feed supplier being certified and which in turn requires certification of its respective suppliers. For GlobalGAP certification, the feedmill should be GlobalGAP certified too."

Other issues with certification is the complexity in dealing with non-integrated operations such as farmer groups and contract farming systems who do not keep records, confusion over the role of third party and government certification schemes, multiple certifications for different customers and the heavy burden of documentation and effectiveness of the audit process. A bone of contention among governments in Asia is the lack of recognition of their certification programs by international retailers. A major issue is also the costs of certification.

"The burden of costs is not only the registration and audit costs but the difficulty and costs of compliance by the farmer. The costs of improvements and requirements such as that for an environmental impact assessment (EIA) or social impact assessment (SIA) can be quite high. Some producers question the benefits of certification to their business. We need to see impacts at various levels within the industry, and provide some suggestions on where certification may lead in future," said Fegan.

The take home message is "Asian producers should be more engaged and involved to have a larger influence in standard setting. As these dialogues include retailers and NGOs and with an active participation, we hope that they will be able to understand better the challenges of the producers".

Feeds and Feeding

Where are we today

The gap analysis by Dr Jacques Gabaudan, DSM Aquaculture Center Asia Pacific, Bangkok, Thailand explained how much we do know on shrimp nutrition and what should be the target for improvements in productivity. The best information available for the public is contained in the NRC 2011. The model to explain targeted nutrition is the change in productivity for the salmon where since 2007, it takes only 14 months to achieve marketable size fish as opposed to 18 months in 1980. The shorter production cycle reduced costs of production from USD11 to USD 2.97 and the relative feed cost to produce a kg of salmon went down from USD 3.59/kg to only USD 1.48/kg. In Thailand, the work by McIntosh showed that productivity increased when time to harvest of 25g vannamei shrimp changed from 128 days in 2004 to only 72 days in 2010 and FCR and survival was better.

The presentation also covered the numerous technical advances required to lower feed costs for shrimp. These include information on nutrient requirements for all life stages, different temperatures, salinities, stocking densities, for optimum water quality and resistance to adverse conditions, alternative ingredients, formulations based on nutrient digestibility, functional feed additives enhancing survival/growth and feed management. Available information for the two species of shrimp, *Penaeus monodon* and *P. vannamei* is still not comprehensive. When these are available, comparison between species is difficult because of the different methods used.

The future will require specialised formulations which give benefits beyond classical nutrition to help shrimp exposed to adverse conditions from temperature change, water quality to bacterial, viral and parasitic infections. Learning from the salmon feed industry where there are functional feeds to meet the needs of the various stages of culture,

Group on Culture and Health management.

the shrimp industry can look at single or multi components to develop functional feeds enhancing resistance to diseases. At the same time, there a push towards less use of fish meal and replacing with alternative shrimp feeds containing poultry meal, distillers' grains or pea meal.

Rising ingredient costs

Dr Jorge Arias, Alltech USA Inc, in presenting 'feeding shrimp for health, performance and profit', agreed that nutrition has not kept pace with advances in productivity. He added that the constraints nowadays are that when we try to use alternative raw materials, cost is also a factor. However, cheaper raw materials will inevitably increase the risk of mycotoxins leading to hepatopancreatic damage.

"Alternatives to fish meal are functional nutrients from yeast which contain 45% crude protein and 5-7% nucleotides to improve immunity and are rich in glutamic acid, amino acids and inositol. There is also a field of enzymes in the market which industry can use in feeds. A study by Cruz Suarez uses an enzyme to improve digestibility of plant meals but the logistics of inclusion is an issue. Dietary selenium, nucleotides and antioxidants showed improvement in shrimp immunity and disease resistance in a recent trial in Malaysia. The way ahead may be through algae which contains high levels of docosahexaenoic acid and is a non GMO (genetically modified organism). The ingredient can match required functions such as pigmentation, attractability and immune modulation," said Arias

"Perhaps the main challenge is to make sure that nutrition concepts and technology are applied to shrimp nutrition. Raw material supply is almost reaching crisis levels, and certainly prices; but there are opportunities to replace fish fishmeal and fish oil with sustainable protein sources. There are technologies available to improve utilisation of plant proteins and to use low cost ingredients without losing shrimp performance."

Beyond nutrition

"There is a need to think out of the box when we look at aquafeed formulation. So far shrimp nutritionists are mostly focused on obtaining acceptable levels of 40+ essential nutrients for maximising shrimp growth and survival. Under pressure of increasing ingredient prices, the formulator is focusing on standard ingredients providing the known essential nutrients. However, there are extra-nutritional or functional feed additives that have benefits beyond their nutritional role and which can affect drastically cost-efficiency at the farm and the feed qualities. The inclusion of functional feed additives can promote nutrient utilisation and thus improve FCR, growth, reduction in visceral waste, improvement in fillet yield, and reduction in environmental impact through less pond waste. They also promote health by reducing impact of bacterial/viral diseases and parasitic infestations on farm productivity," said **Dr Peter Coutteau**, Nutriad International, Belgium.

Although it is widely accepted that supra-nutritional levels of certain nutrients such as vitamin E, vitamin C, carotenoids, nucleotides, essential fatty acids, are important for disease prevention in fish and shrimp, the role of extra-nutritional or functional feed additives is far less documented. In shrimp, disease prevention measures can include the application of specific additives to boost energy reserves in the hepatopancreas via the enhancement of lipid vacuolisation. Promising results in disease prevention are obtained with phytogenic feed additives, used as alternatives to antibiotic growth promoters and capable of modulating gut health in fish and shrimp. A wide range of functional feed additives are being explored in aqua feeds such as enzymes, herbal extracts and phytobotanical compounds, organic acids and feed emulsifiers.

Extruded shrimp feeds

The progress on extrusion technology for shrimp feed production was discussed by **Joe Kearns**, Wenger, USA. There are advantages of extrusion such as flexibility in formulation of recipes, higher starch gelatinization, less fines in feed and increased water stability. Extruded product sizes down to 0.8 mm or less lends well to the current situation where automatic feeders are used in shrimp farming in many parts of Asia. "If we study the salmon industry and how it evolved over the years, their industry went from hand feeding to automatic feeders. Besides lowering manpower costs of feeding this change also had an effect on extrusion machinery manufacturers. Why? We did not design the auto feeders but we were expected to make feeds which survived the feeders without pellet destruction or fines development. Studies of pellet hardness and how to achieve the required pellet specifications resulted in equipment design changes and operation changes in order to achieve the cell structure required. Salmon feed formulations are not as ever changing as seen in shrimp feeds so this will be a special challenge for this industry.

"Feed processing costs for extrusion are higher, typically USD 20-25/ton higher than for pelleting. But increased extrusion rates with smaller extruders can reduce costs. Under development is the technology to produce shrimp feeds and sinking products less than 3mm at high capacity with 3x open area and 5 times the capacity. Research may show the capacity can be doubled to 6-10 tons per hour. Increasing extrusion rates with smaller extruder size can greatly reduce operating costs.

"We know that feed management can be improved with extrusion technology as there are potential costs savings in the recipe costs. There are better effects on feed performance. The final product density correlated with float/sink properties show that for fast sinking pellets in 3 ppt salinity have 640g/l bulk density," said Kearns.

TARS 2013 will focus on Finfish Aquaculture- Industrialisation and Sustainability. It will be held from 21-22 August in Singapore.