



THE  
**AQUACULTURE**  
ROUNDTABLESERIES® 2015  
A shared vision for aquaculture in Asia

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**AQUA FEEDS 2.0:**  
**FROM FARM**  
**TO PLATE**



**TARS 2015**  
**Meeting Report**

TARS 2015 looked at the aqua feed sector in its supporting role for aquaculture in Asia. There were five sessions covering the contribution of aqua feeds along the supply chain, namely, state of industry and science, broodstock and early stage feeding, targeted grow-out feeds, sustainability and health interactions, and innovation and branding to plate. Plenary sessions were followed by the breakout session where participants deliberated on redesigning feeds for the future.

Dr Phan Anh Tuan, Deputy Director, Directorate of Fisheries (D-Fish), Ministry of Agriculture and Rural Development (MARD), Vietnam presented the welcome address where he highlighted Vietnam's development plans in aquaculture and the role of an expanding aqua feed sector. There were three breakout groups; feeding today's shrimp, freshwater and marine fish feeds and aqua feed industry.

TARS 2015 organised by Aqua Culture Asia Pacific and Corporate Media Services, Singapore was attended by 198 participants from 26 countries. The Industry sponsors were Inve Aquaculture, BioMar, Biomin, Nutriad, Jefe, DSM, Aquativ and Alltech.

## State of industry

To start off the plenary session, **John Diener**, Aqua Division, Gold Coin Group, Singapore gave the state of industry address, a signature presentation of this conference series. The title of his presentation was 'State of the aqua feed industry in Asia: trends, challenges and opportunities'.

"Farming and market conditions bring challenges for the aqua feed industry. We have low prices for fish and shrimp, higher costs of major raw materials and new and old diseases continue to challenge production. On top of this, the recent devaluation of many of the Asian currencies against currencies like the USD and Euro affects those with businesses in Malaysia and Indonesia in particular."

Diener used prices of tilapia and shrimp in the US as an example of challenging trends in 2015. "There is a long term upward trend in prices and we can expect this to continue as supply will tend to be short versus steadily growing demand. However, short term we are seeing recent drops in prices. The implication for the feed industry is that many farmers respond to low prices by delaying, reducing or skipping stocking altogether."

## Fish meal price volatility

"Price of fish meal increases every year, and recently varies as much as USD 188/year. For feed companies, it is difficult to establish dynamic feed pricing to respond to cost increases



“ There is a lot of upside in taking feed to the next level of development. Is the industry in Asia up to the task? ”  
- John Diener



Dr Phan Anh Tuan (centre) with Dr Nguyen Huu Dung, Inve Aquaculture, Vietnam (right) and Dr Le Thanh Hung.

because fish and shrimp farming grow-out cycles are much longer than poultry for example. Therefore, feed companies absorb a lot of this increase which hurts the margins, but this practice will continue."

According to Diener, in the future, supply of marine fish meals will continue to be constrained by declines in alternative sources such as from fish trimmings as wild catch yields continue to decline. Prices of Thai fish meal usually parallel changes in Peruvian fish meal but in 2015, lower production raised Thai fish meal prices because of the enforcement on some illegal fisheries and vessels, divorcing Thai fish meal prices from global trends.

"Can the industry find an economically and environmentally viable alternative to reduce or replace fish meal? Substitutes such as insect meal lack consumer acceptance, whereas algae and marine microbials offer promising solutions for lipid and protein substitutes for fish oil and meal. The goal should first ensure sufficient supply, followed by cost."

## Threats

Aside from rising ingredient costs, feed producers also face increasing manufacturing costs. In comparing costs in 2014 versus 2015, Diener quoted the example in Indonesia where minimum wages rose by 22%, electricity, 13% and fuel, 6%. These were compounded by the depreciation of the Indonesian rupiah by 10% against the USD and 23% increase in prices of local fish meal. With regard to 'environmental' pathogens, the impact of early mortality syndrome (EMS) on the shrimp feed industry has been drastic, bringing down demand in several countries. The shrimp feed estimates showed declines in shrimp feed markets in China, Thailand and Malaysia.

"Thailand has the most comprehensive and competitive shrimp industry cluster, with everything from breeding programs, disease research, hatcheries, farms and multiple stages of processing and marketing. Despite this, no recovery is evident in the Thai shrimp farming industry and the new normal is probably around 200,000 tonnes of shrimp production per year. That means at least 50% of Thai shrimp feed capacity is redundant."

## Growing markets

These are in the shrimp feed market in Vietnam with the conversion of fish ponds to shrimp ponds, India with conversion of monodon farming to vannamei shrimp and Indonesia with increased stocking densities. Estimates presented also showed increases in the marine fish, tilapia and pangasius feed markets in China, Vietnam, Indonesia, Thailand and Malaysia. In Vietnam, some 30% growth is estimated for tilapia feed and 12% for seabass feed. In Thailand, 14% growth in tilapia feed is expected as some shrimp ponds are converted to farm tilapia.

## The industry should evolve

"The state of the industry is not all doom and gloom. Issues like disease, prices and costs are always present in any agriculture industry, and we should consider times without these challenges as unusual. Instead, we should accept these challenges as opportunities and the industry should respond accordingly.



Plenary sessions were followed by the breakout session where participants deliberated on redesigning feeds for the future.

As a whole, we can take a lesson from biological systems where host and disease tend to evolve together and how both mutually survive together. The implication for this industry is that if we not evolving, we will fall behind and succumb to all these challenges. Instead, we can get ahead of these challenges through better management practice in general, more efficient feeding strategies, matching nutrition with genetic development and implementing more sustainable practices.

Diener's message, "Industry needs to work together to overcome these challenges and become robust enough to remain profitable despite inevitable adversity. There is a lot of upside in taking feed to the next level of development. Is the industry in Asia up to the task?"

## State of science

In presenting, 'Finfish Nutrition: A Gap Analysis and Potential R&D Partnership between Academics and Industry Stakeholders in Asia', **Dr Dominique Bureau**, Fish Nutrition Research Laboratory, University of Guelph, Canada looked at the state of science on nutrient requirements at different life stages and potential R&D partnerships between academics and aqua feed industry stakeholders.

"Companies doing or funding research are also generating lots of information. We are now interacting with industry to see what information is available and how can we use these to generate information needed by the industry. In addition, the information is not often valorised to its full potential."

## Gap analysis

There are still gaps in our knowledge on nutrient requirements. "We are clear on 'what fish and shrimp require' which is similar for all species such as the 10 essential amino acids, fat and water soluble minerals, vitamin like compounds and minerals. But are we clear on how short chain fatty acids (which is species and life stage specific) elongate?"

Bureau added, "For juvenile fish and shrimp, we have a good handle on nutrient requirements at the juvenile stages but less is known on nutrients for which essentiality is species and stage-specific. These are taurine, types of phospholipids, cholesterol, nucleotides and other compounds. Some may not be essential but bring benefits."

"There is significant nutritional information coming from Japan which deals with species that may not be farmed in most of Asia. Information from China is increasing. Furthermore, with the large number of species and feed ingredients in Asia, there is a dilution of research efforts. In fact, there are only 9-10 species in Asia accounting for 80% of aquaculture production, but even if there are lots of data on one species, the picture is still not clear,"



Peter Coutteau managed a table discussion on the Aqua Feed Industry (AFI). On the left is Palanisamy Ravi, Waterbase, India. Among the strategies suggested by the AFI group is collaboration among stakeholders with centralised R&D on aqua nutrition by a private research centre funded by industry.



The team from PT Matahari Sakti (MS), Indonesia, was led by Dewi Prijadi, President Director (centre)





Brett Glencross



Shunsuke Koshio



Le Thanh Hung



Eddy Naessens

“The next step is to better understand the interactive effects of some nutrients, role of advanced shrimp genotypes and improving our capability in modelling nutrient demand.”

“Coated microdiets can minimise the use of live feeds such as rotifers, brine shrimp, copepods etc during seed production.”

“There is a large gap between nutrient requirement for the pangasius and the feed specifications by feed millers.”

“The advantage of formulated diets is the possible inclusion of active substances such as immunostimulants, antistressors, hormonal substances, as well as ease of storage and use.”

said Bureau. “In addition, dealing with the life cycle is difficult. For example, we use 32% crude protein feeds for the tilapia weighing from 10 g to 1.5 kg!

“We have reasonably good estimates for many species but still with major gaps. In the NRC, we have information on the essential amino acid requirements of different fish species at the juvenile stage which shows little difference in requirement for lysine, histamine and tryptophan among species. But we do not know whether the difference arose from nutrient density of diets, experimental errors, variability etc. It is also worrying that there are missing information for several species, even that for the Atlantic salmon.”

Large feed companies are now using nutrient based or factorial models. These look at nutrient deposition, metabolic intake, digestibility and bioavailability of nutrients etc to calculate requirements which are matched with expected feed intake.

“These are not perfect approaches but provide rational basis for estimating the requirements of the animal. The advantage is that these are dynamic and can be used for a range of species and feed composition. These models show that requirements are changing rapidly in small animals. Usually nutritionist underestimate these changes when formulating feed.”

### Stakeholder participation

The industry now produces too many different types of feed. There is no perfect method to adjust feed specifications to feed composition, and particularly in Asia, feed millers have to serve markets with different grades of feed such as 5 for the carp and 7 for the tilapia, as well as producing extruded or pelleted feeds.

In this presentation, Bureau stressed that animals utilise nutrients and not proximate components of ingredients. Nutritionists need to go beyond proximate analysis into ingredient characterisation.

“More efforts now need to be invested in developing accessible and user friendly interfaces for nutritional models so that researchers, feed manufacturers and aquaculture producers can easily access these tools and work together to generate knowledge required to meet future challenges. One example is the Feed Ingredient Composition Database (FICD) compiled by the Asian Aquaculture

Feed Formulation Database (AAFFD) group which is supported by the US Soybean Export Council (USSEC).”

### Nutrient requirements for shrimp across the cycle

**Dr Brett Glencross**, Technical Manager, Ridley Aqua-Feed, Australia gave a review on nutrient requirements for different life stages of shrimp. He started by emphasising the need to understand nutrient requirements versus diet specifications. Specifications are what the feed manufacturer determines for the diet as % diet whereas nutrient requirements are usually described in RDI (recommended daily intake) or g/MJ.

“Feeding a diet that is below requirements in critical nutrients will result in slower growth, and a poorer feed conversion but such diets can usually be made at much lower costs. Conversely a higher specification feed, with a more nutrient dense specification, will be more expensive, but usually deliver faster growth and a better feed conversion.”

There are more than 40 essential nutrients required for shrimp. Since his last presentation at TARS 2014, Glencross said that more



Allen Wu, Nutriad (right) with Anwar Hasan, Biomin (middle) and D. Chandrasekaran Professor of Animal Nutrition (Retired), India.

is now known on requirements for the vannamei shrimp (23 out of 45 essential nutrients) but this is much less than what is known for the monodon shrimp (38 out of 45). On nutrient requirements across growth cycle and whether size matters, Glencross showed that recent data and reanalysis of old data suggest that there are subtle changes with size.

“Size is marginally important as protein synthesis is highly active when animals are very young. Size effects on body lipid density and energy demands change minimally with size, and largely during the very early planktonic stages (mysis, zoea and postlarvae). Despite the absence of size-specific data on shrimp nutritional requirements, there is a tendency to use higher protein diets with small animals (<0.1 g) and as they grow to reduce the diet protein content. During the early stages from zoea to 1 g shrimp, the demands for protein, expressed as DP:DE (Digestible Protein:Digestible Energy) vary the most. Above this size (>1 g) there is minimal variation in protein demands.”

The next step, according to Glencross is to better understand the interactive effects of some nutrients, role of advanced shrimp genotypes and improving our capability in modelling nutrient demand.

### Feeding the pangasius

Within 10 years, farming of the pangasius in Vietnam has escalated to an annual production of more than 1 million tonnes in intensive systems (200-300 tonnes/ha) using 1.5 to 1.8 million tonnes of feeds produced by 60-70 feed mills. There are some studies on pangasius requirements for protein, energy, lysine, methionine, phosphorus, etc but in general, feed formulations for the pangasius catfish are largely based on requirement data for the channel catfish, despite of the differences in culture methods and fish physiology.

In his presentation on ‘Present Status and Future Perspectives on Pangasius Catfish Feed Nutrition and Feeding in Vietnam’ **Dr Le Thanh Hung**, Nong Lam University showed that new information on nutrient requirements are being generated within Vietnam and elsewhere in Asia.

“There is a large gap between nutrient requirement for the pangasius and the feed specifications by feed millers. This is because of stiff competition among feed millers and the push for reduced feed cost. Commercial feeds have four levels of crude protein; 32% for 5-50 g fish, 30% for 50-100 g fish, 28% for 100-500 g fish and 26% for fish more than 500 g. Studies by Glencross showed that at low density energy (2,400 kcal of DE), DP required varies from 30% (10 g fish) to 19% (500 g fish). The estimated FCR varies from 1.25 to 2.20. At high density energy (3,350 kcal of DE), DP required varies from 42% (10 g fish) to 27.5% (500 g fish) and the FCR from 0.90 to 1.2. However, in commercial feeds, DP/DE ratios are similar in low or high energy diets which rightfully should be different according to the size of fish,” said Hung.

“In the case of lipids, the general diet specification is 5-6% lipid with gross energy values ranging from 3,800-4,200 kcal/kg feed. This is despite our work showing that a protein-sparing effect of



*Dominique Bureau (left) with Ingrid Lupatsch, Aqua Nutrition Manager, AB Agri Ltd, UK*

lipid and optimal lipid levels can be 8% lipid in 32% crude protein diets and 30% protein with 12% lipid diet.

Hung listed gaps in nutrient requirement information including that of essential amino acids (with the exception of lysine and methionine), omega 3 and 6 fatty acids, phosphorus and major minerals. Work is required to determine digestibility values of these nutrients in ingredients and in the case of fatty acids, their effects on fillet quality.

With regard to ingredients, Hung said that fish meal inclusion has been reduced to 3-5% in commercial diets and zero fish meal diets have not yet been commonly used even though some studies confirmed that complete replacement is possible but with supplementation of feed additives, attractants, feed enzymes and trace minerals. There is a need to overcome the habit of using fish meal in diets; instead we should consider the use of vegetarian diets for the pangasius. Main ingredients are now rice bran, wheat bran, cassava and soybean meal. Some 80% of feed mills already incorporate phytase in feeds.

Hung’s take away message was “For the future sustainable development of pangasius farming, the feed sector needs to reduce feed cost and environmental effects of feeds and incorporate feed enzymes to produce more digestible feeds. The addition of functional additives into fingerling feeds will improve health status and reduce fish mortality during the early stages.”

### Broodstock and early feeding

Three presenters showed different approaches on broodstock and larval nutrition. Success in finfish broodstock management comes through both good nutrition and holistic management of the broodstock, said **Alessandro Moretti**, Product Manager-Fish Hatchery, Inve Aquaculture, based in Italy. In the case of the marine shrimp, **Eddy Naessens**, Product Manager, Inve Aquaculture, Belgium, said that biosecurity is the main criterion when developing diets, e.g. whether fresh/frozen or formulated feed for shrimp broodstock. According to **Dr Shunsuke Koshio**, Faculty of Fisheries, Kagoshima University, Japan, it is important to keep fish and shrimp healthy until the completion of early and nursery stages before reaching the grow-out stage. However, rising costs of critical ingredients such as fish meal makes it difficult to formulate suitable cost-effective aqua feeds for these early stages.

### Holistic approach for success with finfish

According to Moretti, for intensive aquaculture, successfully building up a pool of broodstock is now beyond the unpredictable and risky model of using broodstock sourced from cages, ponds or from the wild. Maintaining and controlling a large stock is more expensive, but the effort is paid off by better predictability and good quality eggs.

“Broodstock quality influences egg quality, which in turn has a direct impact on fry quality and disease resistance and gives a good start for the grow-out phase. This is applicable to any fish and is a safety margin for any culture activity. Finally, broodstock quality affects the economical value of the grow-out,” said Moretti, who also gave this advice, “The choice is a good start with quality of eggs or not to start at all.”

Moretti described the state-of-the-art in advanced broodstock management techniques with examples from Europe and Asia,



*Alessandro Moretti (left) with Dr M A Kabir Chowdhury, (middle) and Supornchai Sri-Nhonghang Territory Manager, Jefe Nutrition Inc.*





Chen Ming-Dang, Charoen Pokphand  
Foods Public, Thailand

Kenneth Chin

including management criteria, engineering and design of facilities and economics. However, in broodstock nutrition, the beneficial effects of a balanced diet on egg production and larval quality, the specific nutritional requirements of broodstock fish are still under investigation. "This is the reason, why sometimes broodstock is still fed with a substantial amounts of trash fish, a highly risky practice in terms of biosecurity. Conditioning of the broodstock to artificial diet is fundamental to manage a balanced nutritional program and prevent diseases," said Moretti.

"A correct feed should be formulated using high quality marine proteins, hydrolysed proteins and a well-balanced mixture of various indispensable free amino acids. The quality of dietary lipid and essential fatty acids has a major impact on the spawning quality. Lipids are the major source of metabolic energy from egg to adult stage and directly influence gamete and larvae quality because of selective retention during embryogenesis."

"Feeding is for three stages, maintenance, spawning and recovery. We do not want to grow the fish, but just keep them very well-conditioned since broodstock animals are our champions," concluded Moretti.

### Biosecure shrimp broodstock diets

In the drive for sufficient specific pathogen free (SPF) or high health post larvae, Naessens proposed that biosecurity is a concept not to be forgotten at each step in broodstock management and nutrition, from growth and general condition and from shrimp maturation to nauplii production. Each step has its own operational procedures and feeding conditions. Maintaining the broodstock in good condition for maturation and reproduction (accelerated by eyestalk ablation) prepares for rapid sequences in the spawning and non-feeding stages.

"However, our knowledge of broodstock nutrition is still incomplete and this affects the performance of the animal. Two types of broodstock diets are used for shrimp: fresh/frozen feeds and formulated diets. The biosecurity issue is with the former which can be contaminated with pathogens. There is a need for SPF type of polychaetes, the main fresh/frozen feed used in Asia. The advantage of formulated diets is the possible inclusion of active substances such as immunostimulants, antistressors, hormonal substances, as well as ease of storage and use. The disadvantage is the issue of reduced uptake (attractability, palatability) in some cases. With limited knowledge of nutritional requirements, only partial replacement is possible without affecting reproductive performance.

"Meanwhile a combination of various fresh-frozen marine organisms (squid, bivalves, clam, oysters, krill, artemia and polychaetes) and formulated feeds contributes to the overall nutritional package, providing carotenoids, highly unsaturated fatty acids (HUFAs), cholesterol, amino acids and various proteins. Dry pellets can replace up to 50% of the fresh food ration but at higher feeding rates, dry pellets are not readily ingested," said Naessens.

"The elimination and complete replacement of such diets with formulated diets would be ideal from a biosecurity perspective; but these diets are not well accepted at present. There is a new generation of soft formulated feeds (semi-moist pellets) with

state-of-the art formulation which have a higher acceptability and ingestion comparable to fresh feeds. Research shows that it can replace up to 70% or more of fresh feeds in vannamei shrimp and 60% in the case of the monodon shrimp. In some instances, they perform as well as fresh products," said Naessens. "These represent multiple benefits compared to fresh food such as accelerated ovary maturation, increased spawn frequency and size and improved egg and nauplii quality. Most important is the ability to have consistent composition of controlled quality of post larvae.

Naessens' take away message was, "The development of cost-effective formulated diets fulfils a dual role of eliminating biosecurity issues associated with feeding fresh/frozen feeds and ensuring high, consistent and prolonged reproductive performance."

### Creating robustness

According to Koshio in his presentation on recent progress of larval and early juvenile stages nutrition and feeds, coated microdiets can minimise the use of live feeds such as rotifers, brine shrimp, copepods etc during seed production. He discussed how supplements have been tested in microdiets for larval nutrition. These include peptides, carotenoids, and fucoidan from brown seaweeds.

The studies showed that peptides are efficient supplements in fish feeds and hydrolysing the protein ingredients help improve nutritional quality by way of increased protein content, functional properties and digestibility. However, the performance was only moderately enhanced during a supplementation of hydrolysates.

"With the shrimp *Marsupenaeus japonicus*, carotenoid levels up to 100 ppm showed higher body weight and total body length with metamorphosed post larvae (PL1). Rate of metamorphosis is higher with increasing dietary carotenoid levels at 200 and 400 ppm levels compared to the control group," said Koshio.

"*Undaria pinatifitida* fucoidan has functional properties and with *M. japonicus* larvae, survival improved during metamorphosis from zoea1 to mysis1 and from mysis1 to PL1. The trend shows higher growth rates with higher levels of fucoidans. On exposure to *Vibrio harveyi* at  $1 \times 10^7$  CFU/ml, survival increased as the level of fucoidan in the feed increased. Effects differed slightly with *Penaeus monodon* postlarvae where 500 mg/kg of dietary fucoidan improved growth and resistance against vibriosis.

In seabream juveniles Koshio discussed the interactive effects of probiotic bacteria (heat killed *Lactobacillus*) and beta glucan added to feed. He concluded that supplementation improved growth, feed utilisation, immune responses and reduced oxidative stress conditions. There is a synergistic effect of both additives in enhancing blood chemistry and improving immunological parameters.

### Targeted grow-out feeds

As a nutritionist covering the needs of industry in India and Indonesia, **Kenneth Chin**, PT Intraco Agroindustry, has the unenviable task of balancing the expectation of the farmer with



Dean Akiyama (right) with the Waterbase team, Palanisamy Ravi, Vice President (middle) and Ramakanth Akula, CEO



Clockwise, Vincent Percier and George Marco, Aquativ, Poh Yong Tong and Dr Daranee Sookying Gold Coin Specialties and Dr Thomas Gitterle, SyAqua Group.



Dr Fuci Guo, DSM, Singapore, (left) with June R Sayo, Novus International, Philippines and Ma. Patricia Rico, Santeh Feeds Corporation Philippines (right).

the profitability of the feed producer. The farmer is constantly under pressure from the increase in operational cost of producing fish or shrimp whilst facing rising or unstable costs of feed ingredients such as fish meal, soybean and corn meal. In his industry perspective on the needs of a commercial nutritionist, Chin said, "Often we have feed ingredients which were suddenly priced beyond our reach. We run back to reprogram and too often, quality is affected and the farmer is unhappy."

### What the nutritionist needs

Chin outlined challenges facing the nutritionist as he or she tries to formulate optimum feeds. He called on researchers to help industry provide some answers. The challenges included the lack of basic knowhow such as with the replacement of fish meal without sacrificing growth performance, effects of processing on quality of ingredients, and in shrimp, uncertainty on the specific requirements of most amino acids and fatty acids.

"Feed may come out of the extruder or pelletizer well but we need to know their effects on the fish. Thus we need to have knowledge on the physiology of the fish being fed, how fast the feed passes through the gut, the microbes in the gut and the negative effects of certain ingredients. Not all fish are created equal."

"Most nutritionists are aware of the potential of functional additives but we see so many products in the market and need to find methodologies to measure the effectiveness of these products such as the prebiotics and probiotics. We need to be open to substitutes. Seaweeds which also provide organic minerals is a potential ingredient today, but the price was prohibitive several years ago," said Chin.

"Whether for fish or shrimp feeds, nutritionists concur that we can no longer afford to use fish meal or need to limit its inclusion. In Norway, formulators overcome this problem by using soy protein concentrate (SPC) but for us there is the cost factor as well as palatability. We are running a trial using plant meals only in vannamei feeds in India, which could be promising as stocking density is low in India.

### Economy and farmer

"The nutritionist has to do a balancing act. To formulate a feed for optimal growth, FCR will not be sufficient under today's scenario. We need to focus on cost to produce a kilo of fish. We need to match technology to the needs of the farmer, produce a feed and show the farmer how to use the feed. The fish produced should be what customers want. The goal is for the farmer to remain competitive," said Chin.

"Today, the nutritionist not only provides a good feed but has the additional role of being an economist, as well as a healthcare provider in order to serve the industry effectively."

### Feeds for a better tomorrow

In his introduction to 'Feeds for a better economy and environment', **Dr M A Kabir Chowdhury**, Product Manager-Aquaculture Jefe Nutrition Inc, Canada said industry is facing consumer demand on environmental sustainability, traceability, management practices for the food they eat. How can the feed industry innovate to address these issues?

The demand for better growth performance, lower feed cost and environmentally sustainable production could be met by improving culture conditions and by increasing digestible nutrient contents in the feed. However, one major challenge is the variability in the quality of ingredients.

"There is a severe lack of industry standards such as with rendered meals. Then there is DDGS from several sources with a wide range of crude protein (CP, 24-33%), apparent digestibility coefficient (ADC) of 64-84% (CP) and 44-71% (for lysine). Algal meals have 19-40% CP and a range of ADC from 19-80% (CP). Associated with these are high levels of mycotoxin in DDGS," said Chowdhury.

"Conversely, ingredients that are highly digestible are usually expensive and often in limited supply. This is creating a major bottleneck in improving the availability and supply of quality raw materials. The solution is looking at additives to increase utilization of nutrients by fish and shrimp. Although utilisation can be enhanced by changing animal genetics, health and culture conditions as well."

Chowdhury said that recently, the industry is moving towards developing and producing 'functional' feeds to achieve desirable efficiency of metabolic transformation, growth performance, health and compositional traits of cultured animals at various developmental stages.

### Economic and environmental benefits

Chowdhury focused on various enzymes, which target specific nutritional components of an ingredient or a compound feed and improve digestibility. Among enzymes, there is carbohydrase to breakdown large carbohydrate molecules (soluble and insoluble) to small molecules and provide more energy. Phytase and phosphatase release phosphorus, some bivalent cations and amino acids. Each protease have specific substrates.

"Why use them? There are various reasons such as compensating endogenous enzymes, better digestibility of target nutrients, reduced effects of anti-nutritional factors, better growth and lastly, economic and environmental benefits. As in the case of phytase in rice bran, the benefit is 90% release of total phosphorus. Phytase in rice bran binds with minerals and amino acids such as lysine and histidine.



Henrik Aarestrup (left), BioMar A/S and D. Chandrasekaran, Professor of Animal Nutrition (Retired), India.





Le Thanh Hung and Kenneth Chin leading a freshwater fish feeds group



Thomas Wilson and Dr Rutchanee Chotikachinda, Feed Formulator, Thai Luxe, Thailand

“Benefits are species specific. In feed, multi enzymes optimise release of phosphorus with phytase, energy with NSPase and proteins and amino acids with protease.”

On the economic benefits, Chowdhury described the cost savings with reformulation of feeds for the pangasius, shrimp and snakehead with less fish meal and substitution with plant meals using protease.

Chowdhury’s message, “The industry must overcome its reluctance to change and throw its weight behind innovative technologies and new practices. A higher utilisation of ingredients means low nutrient discharge, reduced eutrophication, healthy animals and better welfare.

## Shrimp feed considerations

**Dr Dean Akiyama**, aqua feed consultant, Indonesia reviewed past development and suggests future steps for the industry. The shrimp feed industry has moved on from the early 1980s when fixed formulations were proprietary. Exotic ingredients and those containing unknown growth factors (UGFs) were the norm and key to successful feeds. The 1990s to 2005 saw the transition to least cost formulations. There was also the change in species, from the monodon to vannamei. Feed demand rose with the rise in targeted yields and faster turnaround in production where culture cycle was shortened to 90-110 days for the vannamei shrimp as compared to 140 days for monodon shrimp.

“The big change was feed protein levels, which went from 38-45% for the monodon to 28-35% for the vannamei shrimp. Growth rates increased from 5 to 10% with genetically improved and virus-free broodstock. Protein content was artificially constrained by market demanding certain feed and national specifications, such as the 35% specification in Thailand.”

Akiyama pointed out some limitations with extruded feeds, which include palatability and digestibility leading to slow growth. “There are excellent extruded japonicus shrimp feeds produced since the 1970s with low temperature extrusion and long low temperature drying time. Extrusion has the potential to produce higher energy nutrient dense pellets of uniform one mm diameter. A major constraint is the cost of production which is 20% to 25% higher. An advantage of extrusion is waste reduction.”

## State of current shrimp feeds

Akiyama said, “Current feed quality standards exceed the production facilities (outdoor ponds) and farmer capability (farm management). We have no major innovations for shrimp feed and industry focused on disease issues and genetic improvements. In fact, we have many biological and farm technology constraints that greatly affect nutrient requirements in shrimp feeds.

“Shrimp are osmotically balanced at 25 ppt, yet we put them into a wide range of salinity from 2 to 35 ppt. Digestibility of nutrients will be reduced when salinity is above or below 25 ppt. A lower digestibility means higher daily nutrient intake. Shrimp metabolism and growth are regulated by water temperature. Every 1°C change translates to 8-10% difference in growth; 30°C will have 15% faster growth than 28 °C. Shrimp growing 15% faster requires higher daily nutrient intake. Water quality parameters should be stable for the animal to use less energy

for maintenance. Dissolved oxygen is critical with the high performance genetically improved animals.

“In controlled systems, we have shown that PL10 stocked in raceways with minimum 6 ppm dissolved oxygen, stable temperature and pH, will reach 35 g in 100 days.”

Akiyama’s message was, “We have feeds which are better than what the farmer needs. Now we have to take a lesson from the chicken industry and work towards more controlled production systems.”

## Sustainability & health interactions

**Dr Pedro Encarnação**, director, Business Development, Biomin Singapore Pte Ltd focussed on feeds and feeding management to reduce impact on the environment. “Our industry has a list of sustainability challenges which are biological, environmental and occupational; added to this, we have challenges that are related to consumer perception. Specifically, the aquafeed sector’s contribution is with feed formulation and feed management to reduce waste outputs from feed. However, this also comes at an economic cost and may affect profitability of aquaculture operations.

“Minimising the impact on the environment by reducing waste is a responsibility of everyone along the supply chain. Feed is a main source of waste in aquaculture. Feed formulations should be dynamic, adapting to fish size, temperature and salinity. Feed millers should use a combination of feed ingredients and additives that best enhance the animal’s health and performance but with minimum impact on the environment.

“We can select the proper ingredients to develop a feed that can deliver maximum growth and survival of fish and shrimp, while minimising waste. However, with replacements of fishmeal with animal proteins, we may have adverse effects on the immune systems, such as with the seabream in Europe. Therefore, sometimes we need to look beyond replacements.



Herve Lucien Brun, Consultant, France (middle) with Jamon Jimenez, Jefe Mexico (left) and Rafael Pena Ruelas, Nutrimar (Nutrición Marina S.A. de C.V.), Mexico



“We can use additives to improve sustainability. In a field trial with pangasius production, phytogenics have an effect on the endogenous enzyme production. This improved feed efficiency resulting in increased profitability, by reducing feeding costs (\$/kg fish produced).

Encarnação concluded, “Our role is to optimise feed formulation, focus on feed performance and seek innovative feed strategies. Together with this, we also need to improve profit margins and reduce cost per kg of fish produced. Sustainability and ecologically sound fish farming is paramount to secure the future of the industry.”

### The next step in sustainable aqua feeds

In his presentation on the above topic, **Henrik Aarestrup**, Global Marketing Director, Biomar Group, Denmark recounted, “Until recently, fish was considered healthy natural products. As a ‘natural’ product, few people would question what the fish feeds on or how it was produced. When they now start to realise that the fish being consumed are farmed, perceptions change. As authorities spent millions to promote ‘fish as healthy’, we saw an explosion in farmed fish production and consumption in particular for salmon but also for seabass and bream in the Mediterranean, where almost 95% of seabream is now farmed.”

### Fish is an industrial product

“Now we see a new paradigm arising, where fish from aquaculture is being perceived by consumers as an industrialised food product. This in turn put demands on the aquaculture industry to act in a responsible and sustainable manner. These sustainable practices, however, need to be communicated to the consumers. While a lot of attention has, in the past decade, been focussed on the substitution of scarce marine resources, the new reality requires that aquaculture producers document the traceability and sustainability of every single ingredient utilised in the feed and that every single process in the value chain is performed in a responsible manner.”

Aarestrup said concepts such as fish-in-fish-out gained importance in the last decade. Ethics on using fish to feed fish arose. Industry’s immediate answer was to research into alternative diets. The next step is when feed producers document the traceability and sustainability of every single ingredient utilised in the feed and that every single process in the value chain is performed in a responsible manner.

“BioMar has been one of the feed producers driving changes in the salmon feed. Fish meal and fish oil content has been lowered by more than 50% in the last decade. Increasingly, mainly vegetable ingredients, but also processed land animal by products have been introduced. However, this change could have happened even faster, if it was not for certain conservatism among some farmers. We are now using 12-18 different ingredients in a typical diet versus the 5-7 different ingredients used a decade ago and optimisation of diets is now done daily.” Change is so rapid in the recipes that feed millers now print the labels at production instead of preparing standard labels.



From left, Thapanee Temrangsri, Progressus Asia, Thailand, Balaji Nakula, Nagahanuman Feeds, India, Ho Gim Chong, Nutriad, Malaysia, K. Venkata Raju, Avanti Feeds, India, Partha Bandyopadhyay, Biostadt India, Vilas Chandrakant Autade, DSM, India, Dhanunjaya Goud, Lallemand, India and Anuj Tyagi, Avanti Feeds India. Bandyopadhyay led a breakout table on Feeding Today’s Shrimp (FTS).

Aarestrup provided details on how sustainability is being integrated into feed formulation by the company. “With BASF, we evaluated all the ecological impacts of all of our feed ingredients and transformed these impacts into index figures, which can be used in our recipe formulation software just like the nutritional demands of the fish and the nutritional profiles of each feed ingredient. This way we can make it possible for our customers to make informed choices. We can help them to achieve the optimal balance between feed performance, production economy, and sustainability. We can also help them to perform life cycle assessments on their products and calculate the environmental footprints throughout the whole supply chain.

“Ours and the industry’s focus must move from looking at the sustainability of individual ingredients in the feed to a more complex calculation which involves evaluating the sustainability and health consequences of all ingredients used in the feed and all production processes in the value chain. It is today fully possible to design fish feed according to nutritional needs, production economy, and sustainability at the same time.

“This is a challenging task which will ultimately change the structure of the whole aquaculture industry,” said Aarestrup.

### Paradigm shift in feed specifications

The aqua feed sector is dynamic and has many innovations to address industry challenges. However, in some major aquaculture countries in Asia, feed specifications are regulated. Such specifications may have delayed or limited the application of new knowledge on nutrition and functional feed additives which can improve nutrient utilisation efficiency, said **Dr Peter Coutteau**, Manager of Nutriad’s Business Unit Aquaculture.

“The traditional concept of feed specifications based on absolute nutrient levels are no longer adequate to evaluate and regulate a feed industry aiming at optimal feed performance in an increasingly competitive market situation. Regulations on feed specifications are aimed at protecting farmers, and this is rightly so. Many focus on physical parameters, nutritional specifications (usually proximate composition), ingredient quality and feed/food safety issues. Feed specifications are not universally suitable for all production conditions and need to be tailored and updated in function of production requirements.

“The use of additives and their mode of action must be better understood. Natural emulsifiers are efficient in improving lipid digestion and absorption in carnivorous fish and shrimp and offer ways to compensate depressed fat utilisation in high plant formulations and reduce dietary fat levels without impacting performance. Enzymes can enhance the availability of phytate phosphate and protein in plant ingredients. More recent



Breakout session: the group discussing challenges and strategies for marine finfish feed sector.



Thomas Wilson



Ei-Lin Ooi



Diep Thanh Hai, Nutriad, Vietnam



Ramesh Gangatharan, Wenger India who led a roundtable on the aquafeed industry

**“ We do not have much choice except to do what our markets demand of us. If the market wants us to reduce fish meal to be ‘sustainable’, then that is what we have to do. The question is how are we going to do that? ” - Wilson**

**“ When you complete a successful nutritional study on replacement of fish meal you may not be aware of the alternative ingredient’s impact on the animal’s health.. ” - Ooi**

research shows how functional feed additives with combined anti-bacterial/quorum sensing inhibition action improved the survival of vannamei shrimp challenged by EMS. Protein sparing effects in tilapia were also demonstrated with the use of a metabolic/digestive enhancer.”

Coutteau added, “However, the industry could benefit from a regulating framework setting rules for a competitive and consumer-safe animal feed market, including the authorisation and labelling of ingredients and feed additives, implementing feed hygiene and traceability, and measures to control medicated feeds and contaminants.”

## Challenges with replacing fish meal

**Dr Thomas Wilson**, Aquaculture Nutrition Consultant, Thailand, focused on the formulation strategies to re-balance nutrients, maintain growth and health.

“For more than 30 years, researchers have worked to replace fish meal with alternative ingredients, sometimes with significantly poorer performance and sometimes with complete failure. Useful alternative ingredients to replace fish meal are animal proteins, by products from meat and seafood processing, plant proteins from the edible oil industry, and others such as single cell protein and seaweed. Nevertheless, the feed industry in Asia needs to carry out more work on fish meal replacement for our farmed species,” said Wilson. “We do not have much choice except to do what our markets demand of us. If the market wants us to reduce fish meal to be ‘sustainable’, then that is what we have to do. The question is how are we going to do that?”

The industry in Europe has moved on to reducing fish meal with plant proteins in salmon whilst here in Asia, nutritionists are still looking for answers.

## Know the ingredients well

“Here in Asia, many alternative ingredients that have been researched on are not available locally but we assume what we buy is the same thing, and we use the NRC book values instead of doing actual ingredient analysis.

“To replace fish meal successfully, study the specifications of alternative ingredients and determine their origin, characteristics, anti-nutritional factors, and industrial methods used in their

production. For example, cooking and drying temperatures affect nutrient digestibility and available lysine may be reduced.”

Using an example of three 58% protein meat meals and one 48% protein meat and bone meal, Wilson demonstrated the effect of processing on the apparent *in vivo* amino acid digestibility for tilapia.

His advice is that whenever possible, the nutritionist should have data from actual ingredient analysis and only in its absence, use book values. “It is essential that industry shares information about ingredients, and it does not matter if the data are old or whether ingredients are still in use. Formulators everywhere will benefit from having such information.”

“Failure of an alternative ingredient in replacing fish meal may have little to do with the raw material itself, but arises because removing fish meal and using an alternative ingredient leads to several problems. Firstly, this reduces supply of essential nutrients or adds anti-nutrients that have negative effects on the digestive system, hormones, metabolism, physiological or biochemical processes, and health. Secondly, it creates nutrient imbalances and nutrient antagonisms, and lastly, it reduces feed palatability and feed intake. Thus, the feed formulator has to make the adjustments or add feed ingredients/additives to restore nutrient balance, growth, or health,” said Wilson.

## Challenges with plant meals

Wilson elaborated with an example on tilapia feed formula. He reduced fish meal from 32% to 20%, 10%, 5%, and 0% and substituted protein from soybean meal, canola meal and corn gluten meal, and showed how essential nutrients decrease and anti-nutrients increase.

“Replacing fish protein with plant protein decreased lysine marginally from 6.11% to 5.08% but reduced methionine from 2.31% to 1.36%. At the same time, cysteine increased, but cysteine cannot replace all of the functions of methionine. Adding synthetic methionine (DL-Met) might be best, but today, there are supply issues with methionine, making it an expensive ingredient (around USD 5/kg) . We could also blend complimentary ingredients such as soybean meal (low in methionine) with sesame meal (high in methionine) to raise methionine levels. This is the preferred method for shrimp feeds, where leaching of water-soluble amino acids is a concern.”

## Sustainable alternative ingredients

Wilson then discussed the pros and cons of fish acid silage, fish solubles and marine protein hydrolysates (MPHs). Research on fish silage showed that different acids such as formic, hydrochloric, sulfuric, propionic produce different qualities and taste of silage, and that excessive hydrolysis would result in high concentrations of free amino acids, which may degrade to ammonia. Fish solubles from seafood processing or fish meal manufacturing are good sources of peptides, free amino acids and nucleotides. Total replacement of fish meal by silage or solubles is not recommended because they are not complete proteins and quality is highly variable.

The advantage of MPH is that they are made from enzyme-digested by-products of seafood (tuna, tilapia, squid and krill) by





Orapint Jintasataporn, Faculty of Fisheries, Kasetsart University, Thailand (left) with Nuttapong Muangsuwan, Charoen Pokphand Foods Public, Thailand



Henrik Aarestrup



Chandrasekar Sankaranarayanan, INVE Aquaculture, India.

controlled batch hydrolysis, which gives a uniform and consistent batch-by-batch product. The choice of the right enzymes allows fine-tuning of the peptide profile and creates MPH with a high percentage of di- and tri-peptides.

“As MPHs are made from intact proteins, they have nearly the same amino acid balance as fish meal and can be recommended to replace fish meal at high replacement rates. Furthermore, in addition to improving feed palatability, enzyme digested MPHs from crustacean and fish by-products have been shown to have other important functional benefits, including functional binding properties that improve physical quality of feeds. They also provide free amino acids, low molecular weight peptides and nucleotides to improve growth of larval fish with non-mature digestive systems.

“Aquativ (SPF-Diana Group) was able to obtain a European patent (WO2014114767) for its crustacean protein hydrolysate for maintaining and/or promoting gut health of cultured fish based on research with European seabass, red seabream and olive flounder.

The take home message is for nutritionists/formulators not to be afraid to try substitutes that are of plant or marine origin. “It is important that industry in Asia replaces fish meal. The industry in Europe has demonstrated that this can be done with success. Nutritional imbalances of ingredients can be counteracted by supplementation of feeds with functional feed ingredients and functional feed additives.”

## Nutrition and health balance

With changing ingredients, diet formulations and genetic stocks, understanding the building blocks of nutrition and health is important to ensure health of the animal,” said **Dr Ei-Lin Ooi**, regional technical and research manager at the Aquaculture Centre Asia Pacific, DSM, Thailand.

“The need to balance nutrition and health was clearly observed in a study with Senegalese sole. At first glance, the replacement of dietary fish meal protein by a mixture of plant protein sources did not adversely affect feed intake, growth or protein utilisation. However, increased vacuolisation and necrosis were observed in the hepatocytes,” added Ooi.



Philippe Tacon, Phileo-Lesaffre Animal Care, France (left) and Ma. Patricia Rico, Sante Feeds Corporation.

“Fortunately today, the industry has more tools to delve deeper into the effects of ingredients and diets. In a nutrigenomics analysis on the partial substitution of fish meal in diets for the Atlantic halibut, no significant difference in feed conversion ratio (FCR) and weight gain was shown. However, there were indications of down regulation of genes for muscle structure, physiology, lipid transport and metabolism and up regulation of immune related genes and detoxification genes.

“All these underlined the need for nutritionists/formulators to make the link between different components of diets and how they impact health. We need to understand the immune response and survival when animals are exposed to various stressors,” said Ooi.

As basic building blocks for DNA and RNA, nucleotides are essential for cell growth and physiological function. Their inclusion can also up-regulate leukocytes cell count and increase the survival of tilapia challenged with *Streptococcus iniae*. Dose response studies show that nucleotides improve general shrimp immune response by up-regulating of haemocytes, semi- and granular cells and prophenoloxidase of haemocytes. Nucleotides can also improve the vaccination response.

“Arginine (4%) and glutamine (2%) and their combination have been shown to improve antibody response in channel catfish fed for two weeks prior to vaccination against *Edwardsiella ictaluri*. Glutamine is important for the production of cytokines and phagocytosis while arginine is an important precursor for nitric oxide, phagocytosis and cell cytotoxicity,” said Ooi.

“In replacing fish oils with vegetable oils (linseed, soybean oil and a 50:50 blend of these oils) in the gilthead bream, the soy oil group exhibited markedly higher Mx expression (Mx genes are involved in antiviral defences) with poly I:C (synthetic dsRNA) simulation which mimicked a virus infection. In addition, fish fed a vegetable oil blend exhibited a higher prevalence and intensity of parasites when challenged.”

Aside from the nutritional effects of vitamin deficiency, the interactions between vitamins are also important. A study showed that high dosages of vitamin C (3 g/kg diet) and vitamin E (1.2 g/kg diet) act synergistically enhancing respiratory burst of seabream phagocytes.



Dang Thi Thuong, Vinh Hoan Corp, Vietnam (right) and Bui Van Canh, Vietnam



From left, Dr Wee Kok Leong, Gold Coin Aqua, Malaysia, Ramakanta Nayak, Nutreco Asia and Chawalit Orachunwong, Charoen Pokphand Foods Public, Thailand.



Marc Campet (centre), led a roundtable for freshwater feeds with David Serene, EWOS Vietnam (right) and Indra Febrianthoro, PT Matahari Sakti, Indonesia (left).

Trace minerals have multiple roles, from immune response development (zinc, copper, selenium) to structural integrity of tissue through collagen synthesis (zinc and copper) and gene expression (zinc). Ooi discussed a study which showed how rainbow trout fed zinc and manganese deficient diets had NK cells with reduced cytotoxic activity, but recovered when fed trace mineral sufficient diets.

## Health assessment

There are different approaches to assess immune responses, ranging from cell characterisation and function, production of antiviral and antibacterial peptides, as well as cytokines and gene expression. Flow cytometry assesses cells by sorting them by size and complexity. Fortunately, current genomic databases have been expanding and available online. Microarrays can be used for differential gene expression analysis whilst the enzyme-linked immunosorbent assay (ELISA) is for immunoassays.

"However, disease challenge is one of the best measures of a total response of the animal's immune system. Although animal challenge models are useful, it may not be easy to achieve the targeted results. There are factors to consider such as genetic strains of the animal and their resistance level and culture conditions. With regard to the pathogens, we need to know how to culture and maintain virulence and ascertain the dosage. The experimental design is also important to provide valid results, such as the number of animals per replicate and the number of replicates per treatment."

Ooi's message is that "a better understanding of the impact of nutritional status on health will help the industry meet the challenges of maximising productivity for the next generation of performance feeds."

## Innovation to plate

Moving away from mainstream aqua feed production, two presentations looked at the aqua feed industry from two different perspectives. How can aqua feed be used to innovate farmed fish to play a larger role in human health. In his presentation, **Dr Serge Corneillie**, Alltech, Japan described the DHA story: Aquaculture's contribution to human health (for details, see article DHA in seafood for human health, in issue September/October 2015, pp31-35). This was followed by a need for the aqua feed industry

to be proactive and communicate to buyers and markets the challenges and efforts of the feed industry to support sustainable aquaculture in Asia.

Corneillie said, "FAO recommends a daily intake of 250 mg docosahexaenoic acid or DHA and as such we can position farmed fish vis-à-vis human health aspects at the consumer level. As the aquaculture industry has been attacked with its farming practices, this is our big chance to show how we can impact human health in a good and sustainable way with using alternatives to fish oil. At the same time, we can add value to farmed fish and brand products."

## Algae and DHA enriched tilapia

On the source of DHA, Corneillie described some recent developments with using algae in yellowtail and tilapia. The trials indicated that total replacement of fish oil with DHA from algae meal is possible without adverse effects on growth. Tilapia can be enriched with DHA which can be appealing as a premium product.

"Our future is with algae, a sustainable product which will not limit growth of the fish business. However, algae is expensive but the required levels are lower for the same benefits when compared to fish oil. In the case of the yellowtail, diets with 1% algae meal gave the same growth performance in terms of weight gain and feed conversion ratio as fish fed diets with 5% fish oil.

"With the production of tilapia enriched with DHA, trials showed that four diets with varying levels of algae meal (0, 0.2, 0.4 and 0.8%) with DHA levels up to 2.93 mg/g in diets increase weight gain and DHA in fillet. In terms of costs, adding 0.8% algae will increase feed costs from USD 650/kg to USD 770/kg. With a feed conversion ratio of 1.6, the feed cost/kg fillet increases to USD 3/kg fillet from USD 2.44/kg fillet."

"In the near future, we are likely to be looking at cost/kg fish to cost/g DHA, branding and labeling DHA content in fish products and the production of high DHA fish sticks" said Corneillie.

## Communicating what we do

Perspectives on the aqua feed sector through the eyes of the consumer and on what the market expects from the industry was



Mai Anh Tuan (left) and Nguyen Quoc Viet, Behn Meyer Vietnam Co Ltd



Watcharapong Poomongkutchai (right) with Chantana Thuwadaratrakool, Cargill Thailand





Serge Corneillie

Piyapa Erber (right) with Saisampan Tanmanee, Biomim

Pedro Encarnação

provided by **Marc Campet**, Virbac Vietnam. Campet presented “Growing the aqua feed industry- getting communication right,” on behalf of the author **Anne Laurence Huillery**, Production Coordinator and Sustainability Officer for the leading tilapia producer, Regal Springs.

## A perspective from the feed consumer

Regal Springs is a vertically integrated company with an annual production of 100,000 tonnes of tilapia in cage farms in Mexico, Honduras and Indonesia. Production in open water bodies requires the company to be cognisant with environmental impacts of its farming. In the last 5-6 years, Regal Springs has taken a proactive role in the development of sustainable aquaculture.

In Honduras, nearly all its requirements is supplied by a joint venture feed mill and a small feed mill which supplies starter feeds in Indonesia. More than 70% is supplied by toll manufacturing or third party suppliers. As the largest consumer of tilapia feeds in the world, Regal Springs is in a position to guide its feed suppliers to meet the demands of consumer and markets for tilapia fish. The questions from European buyers are no longer limited to farming and processing, and there is a growing interest in the US on issues related to feed. Markets are increasingly aware of the impact of feed on the final finished products in terms of food safety, organoleptic characteristics and social and environmental sustainability.

The issues raised are categorised as:

- Safety of the finished products (contaminants in feed which remain in fish products such as melamine, pesticides, PCBs, dioxin, prions such as the BSE prion, use of terrestrial animal proteins and GMO ingredients)
- Sustainability and impact on environment. Several life cycle analysis or LCA show that most of the impacts of farmed fish are related with the production of the feed.
- Social responsibility (production of ingredients often involves workers in developing countries, and since this is one segment of the supply chain, little control applies here).
- Transparency in general

## Safety and sustainability of ingredients

“With rising prices of raw materials, the possibility of intentional contamination is increasing. Feed mills confront contamination

issues daily and need to conduct their own checks on raw materials. On the contrary, although terrestrial animal protein sources are allowed in feed, its use poses an image issue and some markets do not accept its use in fish aquaculture.

“The issue of GMO ingredients could have political or ecological implications. For some ingredients such as soybean meal, it is impossible to avoid using GMO ingredients. Furthermore, we see that markets have negative perception on standard feeds with GMO ingredients,” added Campet. In terms of sustainability of fish meal used, Regal Springs has a strong position with its suppliers. It identifies origin of the fish meal.

## Transparency

Campet said that generally in Asia, feed formulation is not open information. “However in Europe, with regulations on labelling, we can almost decipher the formulation. Can we start to see this in Asia? The message is that feed formulation should be shared with customers, and feed millers should communicate with their customers to provide information on their products.

“The market will always seek more traceability and the feed industry should be prepared. It should be ready with accurate information in a timely manner. With the exception of major feed millers, feed suppliers are not well prepared to answer due to the lack of understanding since the issues are new to them or the information is not available. For ingredients where information is public and there are standards, feed suppliers should be ready to answer queries.”

To move forward, the take home message is that “the aqua feed industry should have better control of the supply chain and have a better understanding of feed issues. The industry must be able to anticipate demands for information and be ready to communicate well. This is the right direction for it to reach the same level of maturity as older feed industries such as for the salmon.”

**TARS 2016, to be held August 17-18 2016 at the JW Marriott Phuket Resort & Spa, Thailand will focus on Shrimp Aquaculture & The New Normal.**



From left, Teddy Njoto, PT Matahari Sakti, Indonesia, Dr Daranee Sookying, Gold Coin Specialities Thailand, Mathieu Laissus, InVivo Vietnam and Christopher G. Co, Oversea Feed Corporation, Philippines.

# TARS 2015 INTERACTIVE BREAKOUT GROUP DISCUSSIONS

## Redesigning Feeds for the Future

### Aqua Feed Industry

Farm performance and management was identified as a key challenge. Educating the farmer on better and more efficient management practice is a priority as farmer capability came through as a constraint for the industry. Some strategies include common technical support, establishing farmer institutes and seminars to educate on topics such as feed additive usage, probiotics and farm management. The need for collaboration among stakeholders, especially on nutritional R&D and disease management was highlighted.

One key recommendation was the formation of a centralized, coordinated research body to study nutrient requirements and feed ingredients, with strong emphasis on data sharing. Farmers should also form co-operatives/associations where unbiased advice to farmers can be provided. A private research centre funded by industry was suggested.

Fishmeal replacement is a key challenge where farmer education is essential to increase acceptance of replacements in feeds. The industry can help with support for the development of novel ingredients, like insect meals. Matching genetics and feed is aimed at maximising the benefits of feed and genetics. The group called for better cooperation and collaboration between feed and breeding companies to work out the right feeding schedules.

On raw material quality, safety and consistency, the discussion was on the difficulty to procure non-GMO soybean meal. Concern was expressed on traceability of products and quality and consistency of locally available fishmeal. The group called for the establishment of regulations on material quality, which could be imposed by the governments around the region, and the sharing of information among feedmillers on ingredient issues.

### Feeding Today's Shrimp

The concern with using live feeds for broodstock is biosecurity and disease transmission. A key challenge with 100% artificial feeds is achieving the same spawning performance as with live feeds. There is also a lack of information on nutritional requirements for maturation diets. The strategy proposed is more targeted and reliable R&D. The short-term solution for live feeds is to ensure that the feeds are virus and bacteria free and there is minimum transfer of diseases. In the long term, there should be 100% replacement with formulated feeds.

On functional feeds for disease prevention and therapy, reliability and proven third party claims of benefits of all these additives were raised. There should be targeted and reliable R&D by a third party. Better government regulations on information on additives are required.

In terms of feed development to meet customer demands, the issues raised were lack of clarity on consumer demands such as organic, pigmentation to quantity, quality, type of product and volume. There should be more transparency between producers and customers.

The major concern with shrimp feed ingredients is supply, in particular fishmeal, squid meal and other marine meals. There is a need to develop local and novel raw materials. The group discussed the need for market transparency on GMO feed ingredients. Restrictions on the use of GMO ingredients reduce options with raw materials such as cereals, grains and plants.

### Freshwater and Marine Fish Feeds

With freshwater fish, the issue of low image, negative publicity and industry's lack of ability to promote a more positive image is complicated with product diversity, competition and undercutting of prices. Image building will require adhering to standards and better culture practices. The group called for more cooperation between different industry stakeholders, namely fish producers and marketers. A marketing agency or board at an ASEAN level was suggested as well as industry benchmarks to raise the bar and focus on transparency.

The challenges with product and flesh quality; taste, appearance, smell, etc., is related to feed formulation, choice of ingredients, water quality, production practices, feed storage, feed and product handling practice. The strategy suggested was through better feed manufacturing techniques, selection of ingredients and ingredient quality. Culture conditions also play a role. Education and healthy dialogue between fish producers, feed manufacturers and processors is needed so that each understands the challenges of one another and can work together.

With regard to industry regulations and role of government, sometimes feed regulations are too restrictive and are not constructive in promoting innovation. Today, with new additives and information, they may stifle changes in feed formulation. The feed industry is more advanced than what many of the regulators think and should be responsible for their own products. The removal of such regulations was proposed but governments need to continue to have oversight and auditing of practices.

However, to communicate this to authorities, there should be a united voice and solid association of feedmillers. An alliance between fish producers and feedmillers would increase the responsibility of stakeholders, instill transparency of practices, abiding by certain standards and benchmarking to promote the use of smarter approaches.

Sustainability of raw materials (also covered by the other breakout groups) concerns the cost of ingredients such as that for soybean meal, a staple in freshwater feed formulation. Feed millers cannot rely too much on local ingredients because of the generally low nutritive value. With the use of GMO soy, European supermarkets are putting pressure on buyers who passed on unrealistic demands on fish producers in Asia. Food distributors push the sustainability issue. Certification bodies demand the use of certified fishmeal.

Feed should optimise production without degrading the environment. The unsustainable practice of feeding trash fish for marine fish should be discouraged through better dialogue and education. Feed companies should demonstrate the benefits of using pellets such as reduced infections and less damage to fish gut. They should also share the information on trials conducted at selected farms with others who need to be convinced on the merits of using pelleted feeds. The industry will not move if farmers continue to believe that pellets are expensive. Functional feeds promote stress and disease resistance but can also be cost effective.

To promote research, the group suggested R&D under the administration of a board appointed by industry representatives with government and academia participation. Funding can be in the form of a levy similar to that of the check-off program of the US Soybean Board. On the challenge on fry quality, the group suggested more work on broodstock management, quality and nutrition and when this is done, to focus on genetics. Nutrition is fundamental to improving larval breeding.







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