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AQUA CULTURE
Asia Pacific

Progress with case definition in EMS/AHPNS in Asia

Shrimp culture model in China

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Tilapia: getting more from feed formulations

Retail concentration in seafood marketing

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OUR MISSION

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

From the editor

Year 2012 – Two steps forward, one step back?

As we get ready for the final lap in 2012, shrimp stakeholders will sense a 'déjà vu' with early mortality syndrome (EMS) as they recall the hardship with white spot syndrome (WSSV) virus more than 5 years ago. In the freshwater fish sector, farmers faced the 'pig cycle' where farmers, initially lured by high prices, farm more, increasing supply followed by decreasing prices. Except this year, despite low prices, processing plants in Vietnam facing limited cash flow are not buying. Whether they are in freshwater or marine fish or shrimp, all producers shared the rising costs of feed, as the price for the main feed ingredients- soybean meal rose 60% and fish meal, 30% for the period January to September.

EMS was first reported in China in 2009, then in Vietnam in 2010, Malaysia in 2011 and most recently in Thailand. EMS has been declared a regional problem and NACA (see page 4) is calling for a concerted effort at a regional level. The threat continues with the fact that there has been little effort by most governments to fund more research in this syndrome and in general health management, despite the industry contributing significantly to their GDP. Is history repeating itself with the way Asian countries handle disease issues?

While shrimp production in China, Vietnam and Malaysia has been decreasing, India's shrimp production is expected to double in 2012. The change in supply has had differing effects on the markets. Ex-farm shrimp, a perishable product, could be sold chilled into the local market or to processors for freezing. The consequences are high local prices in Malaysia which has a significant market but yet low prices in India which has almost no local market and limited cold storage and processing capacity.

The zero and lower antidumping rates for the pangasius catfish in the eighth year review helped to open up the US market as exports to Europe fell. In 2012, this 'cinderella' from Vietnam achieved a milestone with 10 years of presence in the Netherlands and as the highest volume fish! Fears of a domino effect appeared after the collapse of Bianfishco, one of the largest producers and exporters of pangasius. In June, although ex-farm prices rose marginally, this was marred by rising costs and interest rates of 24-25% per annum. Surplus production in India brought down prices drastically in the absence of cold chain distribution for the larger urban markets.

In the marine fish sector, there are positive trends with emphasis on good fry quality in Malaysia, Singapore and Indonesia. Consequently, better survival rates have initiated more attention to better management practices to overcome infections and diseases. Monoculture of 1-2 species is becoming common. With EMS, many shrimp ponds have been converted to marine fish farming, in particular the barramundi. Barramundi from Indonesia has penetrated the US frozen fillet markets but live, fresh and chilled fish still dominate the local and regional markets.

In the first half of 2012, China, Indonesia and Thailand increased their tilapia exports of mainly frozen fillets to the US. However, prices fell to the lowest in two years. Production is also increasing in Bangladesh and Vietnam, where pangasius cages are now used to farm the tilapia while in Indonesia, managing streptococcosis becomes a reality with official approval of the vaccine.

European feed companies have been looking at expansion in Asia. After the acquisitions in China and Vietnam, Skretting is now set with a R&D centre in China, as part of the Aquaculture Research Centre (ARC). Ewos, through its joint venture in Vietnam launched functional feeds for the pangasius. We should expect more developments as Skretting and BioMar have entered into the tilapia feed market in Latin America.

From a food safety perspective, there are fewer reports of products with health hazards entering the European Union, as shown in the year's Rapid Alert System for Food and Feed (RASFF). China has also started to impose restrictions to its imports and requires countries to have the AQSIQ registration prior to exporting. However, Japan has fixed an arbitrary limit on ethoxyquin in shrimp imports which has hurt Vietnam and Indian exports.

There are positive technical developments. Progress was reported on the selective breeding of the monodon shrimp in India and Brunei. A new monodon shrimp developed in Australia produced record yields of 17.5 tonnes/ha compared to the industry average of 5 tonnes/ha. Two of India's aquaculture centres reported success with seed production of cobia from brood stock reared in recirculation systems and in ponds, respectively.

Overall, the year which began with anticipation of Asia becoming a major supplier but it seems to have hit a speed bump.

Zuridah Merican

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Emergency consultation on the EMS/AHPNS

A case definition to avoid confusion in diagnosis and setting direction to resolve the knowledge void on all possible causes.

The Network of Aquaculture Centres in Asia-Pacific (NACA) conducted an emergency consultation with representatives of member countries, as well as disease and shrimp culture experts to look at the status of early mortality syndrome (EMS)/acute hepatopancreatic necrosis syndrome (AHPNS) in Bangkok from 9-10 August 2012.

EMS affects both *Penaeus vannamei* and *P. monodon*. Significant losses in shrimp farms in China since 2009, followed by Vietnam in 2010, Malaysia in 2011 and Thailand in 2012 have been reported. Mass mortality occurs during the first 20-30 days of culture and in some cases, mortality was 100%. To date no potential causative pathogen (if the syndrome is infectious) has been identified, and possible etiologies include toxins (biotic or abiotic), bacteria and viruses. Irrespective of the cause, the devastating impacts of the syndrome require increased awareness as well as preparedness and contingency planning by countries in the region that are so far free of the syndrome but are potentially at risk.

The Australian Government Department of Agriculture, Fisheries and Forestry (DAFF, Australia) funded the emergency consultation whilst the OIE (World Organisation for Animal Health) supported the attendance of crustacean disease experts. NACA's Dr CV Mohan, said that outputs from this meeting included recommendations to promote increased awareness on the syndrome and the use of field level disease cards. Case definition and outbreak investigation template, collaborative research to identify the causative agents, improvements in surveillance and lessons in dealing with emergencies were also suggested.

Technical presentations provided latest updates on the syndrome while country presentations shared experiences from the affected countries. Four working groups had detailed discussions on different themes and reported back to the plenary session which developed recommendations and follow up actions.

Now AHPNS

The report said that the generic name EMS is commonly used to describe unusually high mortality within the first 30 days of shrimp grow-out due to a variety of pond management and pathogen related factors. In addition, various well studied pathogens (white spot syndrome virus -WSSV, yellow head virus-YHV and vibriosis) have been commonly linked to EMS. However, due to generic clustering of all potential causes of mortalities reported as EMS, this very broad and imprecise case definition provides little diagnostic value and has led to a lot of confusion.

The histology of hepatopancreas (HP) of the affected shrimp revealed massive necrosis and given these specific signs, the name 'acute hepatopancreatic necrosis syndrome', AHPNS was given based on the unique gross pathological lesions seen in the HP and to qualify it amongst other potential causes of early mortalities. For clarity and to avoid confusion, AHPNS was referred to throughout its report according to the detailed individual shrimp case definition described by Prof Don Lightner (see page 8).

Preparing for the future

As new diseases have emerged in aquaculture species with regularity, participants discussed arrangements to improve response mechanisms to future disease emergencies. One constraint identified is the lack of funding for a rapid response capability in the region. Requests for funding to investigate and contain an emergency disease often require lengthy approval processes that preclude funds being made available until the situation has become sufficiently 'hot' to persuade administrators to act. With the need to contain a disease during the early stages of its emergence, there is a need for a mechanism for very early investigation and identification. This could provide information to be used for any larger national or regional responses.

One additional possibility proposed was to establish a 'regional emergency aquatic animal disease fund' and pre-agreed procedures for activating an investigation or response coordinated regionally by an independent agency such as NACA. Likely contributors to such a fund would be government agencies. Industry representatives have indicated that they have also invested substantially to research the cause of AHPNS as well as other serious disease issues and they were open to the possibility of contributing to such a fund.

In harmonisation, the rigorous use of the animal-level and pond-level case definitions would enable direct comparison of data across AHPNS-affected countries. It will also help to better describe new suspect cases in AHPNS-affected countries and unaffected countries potentially at risk. AHPNS pathology is suggestive of a toxic etiology, while the nature of its spread is suggestive of infectious etiology. At this stage, the primary cause is unknown, and the possibility of an infectious agent and/or toxin cannot be discounted. In view of this, research efforts should focus on all possible causes of AHPNS and on confirmation through robust challenge studies.

Robust epidemiological studies have not been conducted so far in any country, even though a considerable amount of primary and secondary data have been gathered and preliminary epidemiological methods applied to identify potential risk factors. The consultation strongly recommended that a regionally-coordinated (e.g. by NACA, OIE Collaborating Centre ERAAD-Epidemiology and Risk Assessment of Aquatic Animal Diseases) epidemiological study be undertaken to better understand risk factors and disease spread so that predictive models can be developed.

In capacity building, the consultation recognised that the availability of competent expertise (e.g. Prof Don Lightner and Prof Tim Flegel) to deal with emerging disease situations in the region will decrease as senior people retire. The need for succession planning and development of necessary skill sets and expertise to respond to disease emergencies should be given high priority.

Knowledge sharing and communication was recognised as a very important prerequisite. The lack of it hinders effective responses in dealing with new/emerging diseases. It was suggested that NACA orchestrates a community dialogue hub for AHPNS for all researchers to share experiences (web-based, List-serve, Wiki, Facebook etc.)

References

Final Report Asia Pacific Emergency Regional Consultation on the emerging shrimp disease: Early Mortality Syndrome (EMS)/Acute Hepatopancreatic Necrosis Syndrome (AHPNS) http://www.enaca.org/modules/wfdownloads/singlefile.php?cid=11&lid=1059

More information: AHPNS news story and audio recordings of 19 technical presentations made at the regional consultation meeting are available on NACA website at the following links.

http://www.enaca.org/modules/news/article.php?article_id=1952
http://www.enaca.org/modules/podcast/programme.php?programme_id=9

Malaysian Shrimp Industry Forum

Report on the challenges to meet production targets and how to move forward with EMS in Malaysia.

There are two paradoxes in the shrimp farming industry in Malaysia. As large farms are being developed or proposed under the country's transformation program in agriculture, production from existing farms has been decreasing in the last two years. In the first half of 2012, only 25,000 tonnes of shrimp is expected. In 2009 and 2010, 69,227 and 62,202 tonnes were produced, respectively, according to the Department of Fisheries. However, industry said that production was higher at 90,000 tonnes in 2010. Most farms report inconsistent yields because of white spot syndrome virus (WSSV) but from 2011 to date, this and early mortality syndrome (EMS) continue to bring down production by 30-40%. In Malaysia, 20% of industry produces 80% of the volume with a significant impact on local shrimp prices.

Despite this, the industry seems vibrant with several new private public partnerships in the shrimp supply chain. Under the government's, National Key Economic Area (NKEA) program, there are 8 impending large shrimp farms, comprising new and existing players with a total of 4,100ha and MYR 1.8 billion (USD 590 million) in investments. The target production by 2020 is 214,913 tonnes.

In October, DOF organised a forum for shrimp industry stakeholders. The aim was to develop the shrimp aquaculture industry by integrating the goals of industry with that of government and determine the way forward. "Once or twice a year, we will need to look at our performance at the national level and at the problems facing industry. We want industry to work closer with us. In general the aquaculture industry has issues with land, diseases, financing, labour, rising production costs and for the shrimp, EMS, which we will need to solve together," said Ahamad Sabki bin Mahmood, director general, DOF.

"At the moment, we will need to focus on existing players and our main concern is how to overcome diseases in particular, EMS. The monetary impact has been drastic with losses at about MYR 3.5 billion (USD 1.14 billion) all along the supply chain. Processing plants not only face a shortage of raw material but high local prices which makes processing uneconomical at current international prices. We have 700 farms and already two large farms have stopped operations.

"With the low supply, the successful farms benefit from high prices, now at MYR 16/kg (USD 5.2/kg) for 70 pcs/kg but this also led to a flow of imports from Thailand where prices have been lower at MYR14/kg (USD4.6) for the same size, affecting small producers who target domestic markets. We need to keep the existing players in the industry and must find ways to be sustainable," said Tuan Syed Omar Jaafar, president, Malaysian Shrimp Industry Association."

The forum fulfilled its objectives of a better networking between stakeholders, academicians and government and that all in the value chain needs to be coordinated. Some of the solutions suggested include a training institute for locals to meet the demand for skilled labour in the industry and better coordination between several federal agencies (DOF and Department of the Environment) and state authorities on land issues. The processing industry is yet to recover from the self-imposed ban on exports to the European Union in 2008 and lifted in 2009. Raw material supply is limited from only 15 EU approved shrimp farms.

The most urgent issue is how to handle EMS in the country. The DOF has been working closely with some affected farms since September 2011 with bacteriology, virology and histological analysis of samples. However, the work has been largely constrained by a lack of funds and manpower. A closer interaction between producers should be encouraged to share new information and ways to overcome EMS. An operational task force was initiated and at the 'top of the list' will be to seek funding for local disease experts to work together to help industry move forward.

Customized inspection guideline

Thai aquaculture farms now have an easy-to understand and practical checklist to meet global consumer demand for safe and sustainable products.

This checklist was developed by an industry working group in Thailand to make the language and practices required by GlobalGAP easier to implement and understand.

"We are proud to have the commitment of industry and academia in Thailand serving the sector and aligning our global set of requirements to meet national legislation and accepted processes. All Thai farms can now begin to implement a global standard, that is already embedded in their culture and working practices," said Kristian Moeller, secretary GlobalGAP.

A National Interpretation Guideline (NIG) is a document, providing guidance on the implementation of GlobalGAP control points and compliance criteria at a national level. The NIG Aquaculture Thailand was developed by the National Technical Working Group (NTWG) Aquaculture Thailand and went through a transparent 5 step approval procedure including a 4-week peer review with relevant stakeholders. (http://www.globalgap.org/cms/front_content.php?idart=2238),

By December 5, 2012, within three months after approval, the National Interpretation Guideline Thailand becomes obligatory and a normative GlobalGAP document. All certification bodies that are working in Thailand have to include this guideline in their certification procedures.

Members of the NTWG Aquaculture Thailand

News in Brief

China demand for premium products

China has the potential to become a USD 20 billion seafood import market within this decade, with rising incomes and increasing domestic demand for seafood, particularly premium species, according to a Rabobank report. China has high income elasticity of demand for seafood, far higher than for meat, with consumption particularly sensitive to increasing incomes. Economic growth has led to more affluent consumers seeking novel and premium products. Premium species will be responsible for consumption growth in the future such as salmon, scallops and lobster. China will remain the leading exporter but its seafood export growth is expected to slow down in the near term, due to resource constraints and the unfavourable macroeconomic dynamics in Western markets. From a very strong compound annual growth rate (CAGR) of 15% over the last decade, Rabobank expects Chinese export CAGR to decline to low single digits in the next few years.

Call for ban on shrimp imports into Bangladesh

The illegal import of shrimp has two implications. The entry of disease infected shrimp and a possible loss of the EU-GSP (generalised system of preferences) facility. Shrimp is the third largest foreign currency earning sector and the Department of Fisheries said seafood exports for the 2011-2012 fiscal year was valued at BDT47 billion (USD 578.2 million) from 92,479 tonnes and shrimp contributed 77%. The EU is the largest market accounting for 50% of its shrimp exports. Media has reported that about 3.2 tonnes of virus affected shrimp were seized in the border areas of the country in September which were illegally imported from India. Exporters also demanded a ban on shrimp imports to save and boost the sector's growth which is already hit hard by global recession.

Expanding pangasius feed production

The Hung Vuong Group, Vietnam's leading pangasius fish exporter has acquired Viet Dan Seafood Feed Factory from Dong Thap Seafood Import Export and Processing JSC for VND74 billion (USD 3.56 million). The plant has a capacity of 100,000 tonnes per year. In September, it was reported that Hung Vuong Corporation's (HVG) put up a bid for an additional three million shares of Viet Thang Feed Company (VTF) to raise its stake in the feed producer to 28.54%. Viet Thang is the largest producer of pangasius feeds with 14% of market share. Hung Vuong Tay Nam, the feed production subsidiary of Hung Vuong currently has a total capacity of 150,000 tonnes/year. HVG currently has a total seafood farming area of 500 ha, including of its subsidiary An Giang Fisheries Import and Export and in farming cooperation with Ben Tre Forestry and Aquaproduct Import Export Company. Its daily fish processing capacity is 1,700 tonnes and the enterprise can meet 80% raw material demand. The acquisitions will help HVG speed up the process of developing a closed production process from feed production to farming, processing and export of fish fillets. As raw material costs for feed production have increased, acquiring a feed firm will help reduce impacts on prices of finished products and raise profitability, said Duong Ngoc Minh Minh, chairman cum founder.

More Thai shrimp to Japan

Due to increasing inspections of ethoxyquin residue levels in shrimp from Vietnam and China, Japan has reverted to Thailand to meet its shrimp supply. The report in The Nation quoted Somsak Praneetatyasai, president of the Thai Shrimp Association as saying that Thailand's total shrimp exports will reach 350,000-360,000 tonnes this year. Exports to Japan have risen by 23% in 2012, offsetting the loss in the US markets which slipped from 50% to 40% of exports volume. Both volume and value of exports are estimated to drop by 10% in 2012. In 2011, Thailand exported 390,000-450,000 tonnes worth THB 100 billion.

The weakness in exports will not hit Thailand much as shrimp production is also expected to decline because of climate change, according to Somsak. Shrimp prices are up as supply goes down). In October, prices were THB150/kg (USD 4.8/kg) for 70/kg, up from THB120-130/kg (USD 3.9/kg) previously. The higher price is forecast to remain through the rest of this year but Somsak said that the attractive price will entice farmers to farm more shrimp next year. He cautioned producers not to increase production, as this would increase the risk of disease. Producers have been asked to closely monitor weather forecasts before farming shrimp.

Milestone for Vietnam's pangasius in the Netherlands

Queens Products b.v. introduced the then unknown pangasius to the Netherlands in 2002. Now, 10 years later, it is the most commonly eaten fish in the country. In 2011, 5.5 million kg of the fish have been sold. Since September 2012, Queens pangasius have the Aquaculture Stewardship Council (ASC) label. In celebration, on October 15, families from Varsseveld were invited to pick up a free jubilee bag of pangasius. Harry Hoogendoorn, general manager, Queens Products, reflected, "This year we have a lot to celebrate: 10 years of pangasius in the Netherlands, pangasius is number 1 as the most popular and most purchased fish in the Netherlands, Queens panga is the largest fish product in the Netherlands, 10 years exclusive partnership with Vinh Hoan."

Vinh Hoan, in the Mekong Delta has more than 300 acres (121 ha) of private farms and hatcheries. It has its own factory for fish feed and manages the entire integrated production. Truong Thi Le Khanh, Vinh Hoan, said, "In a market with lots of competition, it is not easy to develop a sustainable production. Partly thanks to the support and efforts of Queens, we managed to be the first pangasius ASC certified producer."

Pond reared cobia brood stock

Chennai-based Central Institute of Brackishwater Aquaculture (CIBA) has reported success in the controlled breeding of cobia *Rachycentron canadum* from pond-reared brood stock at its experimental station at Muttukadu. A.R.Thirunavukarasu, principal investigator of the project said that in India, where the sea is always rough, setting up cages is a difficult task. The new technology has paved the way. "Since it is not easy for hatchery owners to set up cages in the sea, CIBA's technology will enable them to rear the fish in farms," he said. Farmers can harvest a tonne/year from 100 juveniles. The price is INR 300/kg (USD 5.6/kg). "We keep the female and male at the ratio of 1:2 and induce them to spawn with hormones. The hatching takes place after 20-22 hours and after 30 days of rearing, the juveniles reach a length of 10 cm and can be reared in nursery and grow-out systems in cages and ponds.

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EMS/AHPNS: On the same page on its diagnosis with a case definition

By Soraphat Panakorn, Karunanithi and Zuridah Merican

As disease experts investigate the cause or causes of early mortality syndrome (EMS), aquaculture experts have proposed going back to basics in shrimp farming.

In the first quarter of 2012, it was reported that the total area affected was 39,000 ha in Vietnam, according to the Directorate of Fisheries. In Malaysia, production is said to have declined by 20% in the first half of 2012. Malaysian farmers are now reporting shrimp mortality after 40 to 45 days of culture (DOC) and less at 30 DOC. The situation is much worse in China in 2012 with a diversity of symptoms of shrimp dying in the early stages of culture. Most of the mortalities do not fit into the case definition of EMS.

In Thailand, after scientific investigations on the actual cause of shrimp dying by Dr Chalor Limsuwan, Kasetsart University and Dr Tim Flegel, Centex Shrimp, the number of ponds affected by EMS/acute hepatopancreatic necrosis syndrome (AHPNS) dropped to 100 or so ponds. Investigations showed that farmers were quick to attribute unusual mortality as EMS, rather than analyse the actual causes, which in most cases are due to poor management of ponds. Today, the Thai industry estimates the level of severity of production losses to the following: monthly mortality syndrome (because of poor culture conditions due to hydrogen sulphide (H_2S) built up in ponds, poor post larvae quality, environmental pollution etc); yellow head virus (YHV); white spot syndrome virus (WSSV); and lastly EMS. As a comparison, some 3,000 ponds in eastern Thailand reported deaths due to YHV in 2012.

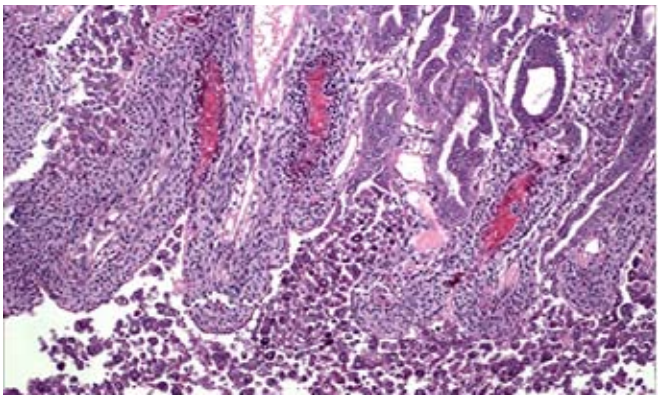
Case definition

At the recent NACA meeting in Bangkok (see page 4), a case definition was agreed. Dr Don Lightner, Aquaculture Pathology Laboratory at the University of Arizona (UAZAPL) said that the following symptoms can be used for presumptive (pond level) and confirmative (animal level) diagnosis. Diagnosis should always be confirmed by histological examination.

Disease signs at pond level

- Often pale to white hepatopancreas (HP) due to pigment loss in the connective tissue capsule.
- Significant atrophy (shrinkage) of HP.
- Often soft shells and guts with discontinuous contents or no content.
- Black spots or streaks sometimes visible within the HP.
- HP does not squash easily between thumb and finger.
- Onset of clinical signs and mortality starting as early as 10 days post stocking.
- Moribund shrimp sink to bottom.

Juvenile Penaeus vannamei from Vietnam, top with EMS, bottom appears normal. Courtesy of D. Lightner, University of Arizona, USA.



P. vannamei (10X) from Vietnam. HP tubule epithelium sloughing, significant inflammation and some tubules with putative vibriosis. Courtesy of D. Lightner, University of Arizona, USA

Disease signs at animal level by histopathology

- Acute progressive degeneration of the HP accompanied initially by a decrease of R, B and F-cells followed last by a marked reduction of mitotic activity in E-cells.
- Progress of lesion development is proximal to distal with dysfunction of R, B, F, and lastly E-cells, with affected HP tubule mucosal cells presenting prominent karyomegaly (enlarged nuclei), and rounding and sloughing into the HP tubule lumens.
  (Details and pictures available at http://library.enaca.org/Health/DiseaseLibrary/ahpns-disease-card.pdf)

Causative agents

Little has changed with information on the possible causes of EMS. Dr Chalor has identified three orders of bacteria which are not commonly found naturally in the pond environment. These were applied as part of the probiotic program so that the hatchery tanks can be maintained at low pH levels to reduce *Vibrio* infections (Tan, 2012). In a presentation at Aqua 2012 in Prague, Loc Tran, UAZAPL said that in Vietnam, some of the suspects include feed from affected farms and pesticide or insecticide used to kill wild shrimp or crabs in ponds. UAZAPL has tested commercial shrimp feeds and sediments collected at shrimp farms for EMS. Frozen samples of *Penaeus monodon* and *P. vannamei* with EMS from affected farms were used in infectivity studies and cypermethrin, commonly used in the region to kill vectors of WSSV prior to stocking have been tested. Experimentally induced lesions of the HP consistent with those observed in shrimp with EMS did not occur. Tran said that for now, the causative agent(s) of EMS remains idiopathic.

Back to basics in Thailand and Malaysia

In each affected country, investigations are on-going to find the causes of the mortalities. In Thailand and Malaysia, there are some observations on the possible culture management factors causing these mortalities. The general opinion is that in the last 2 years, farmers have been ignoring standard procedures on pond preparation. Most farmers rush to restock for the next crop so as to profit from the good shrimp prices.

PL quality

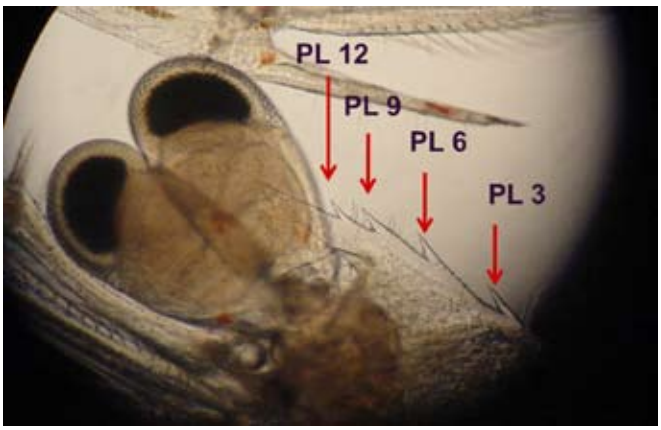
Thai experts suspect that little attention is being given to this as

demand outstrips supply. This sentiment was echoed in Malaysia, where most farmers now depend on hatcheries to do quality checks. In the days of monodon shrimp farming, farmers usually conduct a series of tests for PL quality and strength. Weak PL often succumb to WSSV or die quickly in adverse pond conditions. In the field, the advice is that in cases of EMS, shrimp die immediately within 2 days and with WSSV, shrimp start dying within 3-5 days.

In Thailand, hatcheries now report better survival rates from nauplii to PL10, from 20% a few years ago to the current 70%. Hatcheries may be achieving this because of better control of conditions with probiotics, stable pH, temperature, salinity and oxygen. The hypothesis is that weak PL stocked in open ponds easily die with the fluctuating temperatures and salinity. Climate change is a factor too such as in eastern Thailand; where EMS was confirmed, the highest rainfall in 50 years was registered.

As a safety measure, Thai farmers are now being asked to carry out an easy PL strength test to weed out weak PL. This was the formalin test used in the past. Prior to stocking, 100 PL are placed in freshwater for 30 minutes, followed by another 30 minutes in water of the same salinity as the hatchery water. If more than 10% PL dies, the whole stock of PL is rejected.

In Thailand, the stocking of PL10 instead of PL8 is now widely accepted. However, Dr Chalor pointed out that if the age is less than PL 10, the gill is not completely developed and on stocking, shrimp will die. He said that farmers should be aware of the actual PL age and their length, for example PL10 has an average length of 1 cm. They have been advised to count the spines on the rostrum, each spine equates to 3 days (see picture).



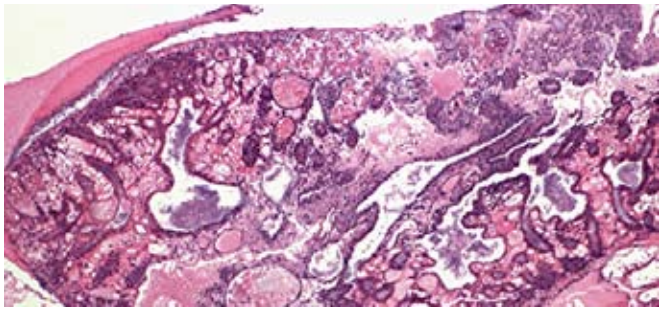
Determination of age of PL (P. vannamei). Courtesy of Chalor Limsuwan, Kasetsart University, Thailand.

Change in culture conditions

Another suspected factor is pond water pH. In Thailand and Malaysia, farms have been encouraged to lower pond water pH to 7.5 ±0.2 (in contrast to pH 8-8.5) to control *Vibrio* spp and hasten moulting and growth. This is carried out by the introduction of low pH photosynthetic bacteria of which there are over 20 strains and application of fermented rice bran and molasses to lower pH as fast as possible.

Proactive measures

Based on information from the field, some factors contributing or favourable to EMS occurring are low temperature and pH in soil and black soil. In such cases, farmers are advised to concentrate on basic pond preparations where lime is applied and the pond bottom is ploughed a few times to reduce the % of black soil (H_2S) prior to remediation with soil probiotics. In Malaysia, a solution being proposed is to use pond liners. In the case of existing ponds, prior to lining, pond bottom should be thoroughly cleaned up to prevent anaerobic conditions



P. monodon from Vietnam. Terminal phase of EMS. Most HP tubules are destroyed. Massive bacterial infection by a probable Vibrio sp. Courtesy of D. Lightner, University of Arizona, USA

building up beneath liners. There should be no holes in liners, as even few small ones will allow toxic gas to seep into the pond water. During the culture period, toxic plankton and blue green algae species should be eliminated. In addition to the above recommendations, to alleviate impact of EMS, a methodology to improve soil C:N ratio to increase biological activity in soil is being investigated.

To prevent EMS, perhaps industry should consider using feed additives to improve/increase the lipid droplets level in HP as well as increase mineral supplements to reduce soft shell syndrome or quickly promote shell recovery after moulting. Frequent checking or monitoring of lipid status in HP is a must. Another measure proposed is to reduce feeding from the 300kg per 100,000 shrimp to 150-200 kg per 100,000 shrimp in the pond for stocking density from 80 to 100 pcs/m² in 30 DOC.

Collaboration and networking

Thailand's shrimp industry has several experts (namely Dr Chalor, Dr Flegel, and Dr Chaiwud Sudthonkong, Department of Fisheries, Thailand) leading the industry and working closely with farmers, farmers' clubs and associations. As such the industry is confident that it will be able to overcome EMS soon. The industry has very regular seminars in the various shrimp producing provinces to convey the latest scientific and practical discoveries and to exchange problems and ideas. Enterprising farmers freely share successful ideas and experts analyse the reliability and suitability of these prior to dissemination to the rest of the industry.

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A new generation of sustainable shrimp

Henry Ahaen Wang is using his 37 years in shrimp aquaculture to embark on a new direction towards an energy efficient and economical green system in vannamei shrimp farming.

Henry Ahaen Wang, the managing director of Paiwan MASA Farms Co Ltd has this to say on the shrimp industry, "We have three major challenges in shrimp production, disease and viral problems in production, issues on food safety and environmental concerns. My take is that we need to work with natural solutions."

Henry Wang (left) and Paiwan Benjakul. The pilot farm has 5 workers.

This comes from his background in shrimp aquaculture. Henry began his career in 1976 as an assistant to Dr I.C Liao at the Tungkang Marine Laboratory in Taiwan. Later he worked in the Philippines, Indonesia and India and with Frippak Feeds in the 1980s and Super Shrimp in early 2000. Henry then started this hatchery in Phuket after a stint in China.

"I have a good blend of experiences from the eastern and western hemisphere in shrimp farming. It is very hard to draw a distinctive line between Asian and Western technological concepts; for instance Super Shrimp had offered a much more natural selective breeding approach. In the heydays of blue shrimp *Penaeus stylirostris* farming in Latin America, Super Shrimp developed specific pathogen resistance (SPR) shrimp against infectious hypodermal and hematopoietic necrosis virus (IHHNV).

Green technology

Henry says that there are two major areas which form the foundation of his concept on sustainable *P. vannamei* shrimp farming with green technology.

"There should be a more natural way of selecting and rearing post larvae. I have come to the conclusion that the existing ultra-hygienic protocol used today has somewhat plagued us with pitfalls which have consequently diminished the natural immunity programming within the shrimp itself."

His approach is to allow for natural immunity and both his selective breeding program and larval rearing protocol have been channelled into this area. According to Henry, the feasibility has been shown in Thailand in actual farming conditions. A theoretical interpretation could be via the latest concept in epigenetics which is the transgenerational transfer of phenotypic characters without modification of gene sequence.

"This is a new frontier of aquaculture research and shows that the new focus will be driven by a biological oriented reasoning instead of the existing industry concept which has been copied from terrestrial live-stock models and have shown flaws in many areas. In my view, the post larvae rearing and selection are the most needed areas for review and correction."

Ulva and Caulerpa seaweed for biological filtration. The clown fish is used as a water quality indicator.

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Secondly, he is advocating a more bio-diverse system of culture by coupling with water recycling. The existing land based shrimp ponds demand too much energy in generating 24-hour aeration and the effluent discharges have been harmful to the environment. His design incorporates biological filters with seaweed and the polyculture of sea fish, abalone and sea cucumbers. These stabilise productivity.

Pilot operations

In post larval production from the SPR stocks, the challenge was the selection of the 'best natural shrimp' to be the next generation of brood stocks. The initial founder stocks for the breeding work came from Hawaii in 2002 via Taiwan. In the early stages, the emphasis was on resistance to white spot syndrome virus (WSSV) and the criterion of growth was neglected. However, since 2006, the selection target has changed to that of growth and disease resistance.

"There is a consensus that selection based solely on maximal growth has resulted in weakened immune systems, resulting in a higher probability of WSSV outbreaks. Alternatively, there is a centric balanced strategy to achieve optimal growth without sacrificing the natural immune status. For the last five years, we have been able to overcome this dilemma by keeping the selection pressure in our selective protocol; and it has proven that the success rate in actual farming is higher than the maximal growth strategy due to fewer incidences of WSSV outbreaks

"Over the years, we have been working on the technology to develop resistant strains, which requires closed systems for the purpose of selective pressure. There is a regular screening of disease such as Taura syndrome virus (TSV), IHHNV and WSSV. Immunity is measured with a bioassay and challenge test for survival."

Nauplii production

Today, the company, Paiwan MASA Farms Co., Ltd formed in 2006, with a partner Paiwan Benzakul is producing nauplii from the 10th generation brood stocks. These are sold to hatcheries in Thailand which sell post larvae (PL12) at 10 santang/1000 PL (USD 3/1000 PL).

Henry pointed to some protocols at the hatchery which may deviate from those in other hatcheries. The survival rate is only 25% for these naturally immune stocks. Spawning ratio is 1:1 and an average of 100,000 eggs is produced per spawn. This is expected as the shrimp have not been selected for fecundity. However, this is not a concern as feeding with cold water polychaetes increases fecundity. He sees this as the process that each post larvae should have this 'early programming to be strong' and strongly believes that the early exposure to the challenges forms a training base for a stable immunity to future adversities in the pond.

Ecotopia shrimp farming

This is the name for the sustainable production platform to produce eco-shrimp using green technology. Ecological considerations of the environment ensure that only 1-2% of the water is released back into the environment and that the water quality follows specifications. In conventional systems, almost 5-10% is returned to the environment. There will be a balance with a diversity of species comprising seaweeds and sea cucumbers. Waste treatment will include seaweeds as the bio-filtration medium and the final waste from the operation can be converted to fertiliser for palm oil plantations.

"Currently, the prototype for this production platform is being tested. Only 25% of the area is used to hold the shrimp. The rest is used for water treatment using two species of seaweed, *Ulva* and *Caulerpa*, provided by the Phuket Fisheries Coastal Fisheries Research Centre. Interspersing clear roofing provides for light control for the seaweed culture. Electricity consumption is 30% of that in a conventional pond system. The next stage will include solar panels."

There is a three stage culture system starting with size 3-10 g shrimp stocked at 300 pcs/m² in recycled water ponds and followed by stocking 15 g shrimp at 100 pcs/m². The target is a higher turnover from 5 cycles/year production in the small footprint facility. When perfected, Wang expects the model to be scaled up 100 times for shrimp grow-out for international markets.

Branding and marketing

The importance of creating an eco-label brand is to convey to markets the endeavours of the shrimp industry, that seafood production is healthy both for the people eating them and for the environment. "Brand production is essential for win/win marketing and, as one of the pioneers, we ourselves want to overcome the challenge. Fortunately, we have a production model where the calculated profitability is 2.0-3.0 times of conventional systems. When we combine all aspects to develop an eco-label (reduction of fish meal in feeds, clean energy, water re-use and natural ingredients, etc.) and have a certification, all this fits in to the Ecotopia shrimp brand and matches the demands of the new generation of consumers."

This concept requires a management team with global expertise in seafood trading, breeding and systems design and most importantly leadership to bring forth this vision. A global company is being registered. Meanwhile, Henry says, "After 37 years in shrimp culture, I would like to leave a legacy and this is getting industry to see the merits of sustainable production platform with clean energy and ecological considerations."

Acknowledgements

Henry Wang would like to take this opportunity to thank the following: Dr. Diane Hatziioanou of Taiwan Academia Sinica and Dr. Eric Peatman of Auburn University for their guidance in work relating to epigenetics. Mr Tawat Sriveerachai, Phuket Coastal Fisheries Research Centre for the technical support on seaweed farming and for supply of *Ulva* and *Caulerpa* and to the family of the late Fang Yih-Chang, a Taiwanese technician with 32 years of experience who died in 2010. Fang did the original layout and design of the water recycling system.

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An improved culture model for vannamei shrimp in South China

By Peng Zhidong, Dong Qiufen, Zhang Song and Yang Yong

Smaller ponds for intensive culture are proposed but there are also reservations on the application of the new model.

China has a long history in marine shrimp culture spanning more than 50 years. Today, the Chinese shrimp industry has caught the world's eyes, for its large production volume. Shrimp is an important commodity for export, as well as for the emerging domestic market for the more than 1.34 billion population.

Guangdong, Hainan, Guangxi, Fujian, Zhejiang and Jiangsu are the main marine shrimp culture provinces, each with their own culture conditions. In 2011, China's production of both freshwater and marine shrimp reached 1.56 million tonnes, of which 895,000 tonnes were marine shrimp (China Aquatic Products Processing and Marketing Association). In turn, more than 70% comprised the white leg shrimp, *Penaeus vannamei*. There are various culture systems for vannamei shrimp ranging from high elevation culture ponds, where systems are intensive at 200 post larvae (PL)/m^2, semi intensive 70 PL/m^2, polyculture with ovate pompano, milkfish, tilapia, common mullet and in inland areas in low saline ponds with stocking density from 60 PL/m^2 to 110 PL/m^2.

Similarly to most shrimp producing countries in Asia, China's shrimp production has been hampered by natural disasters (typhoons, floods etc), adverse environmental conditions (high and cold temperatures), diseases (white spot syndrome virus and early mortality syndrome) as well as increasing costs such as higher pond rents and labour costs. However, Chinese shrimp farmers continue to find solutions. Some farmers learn to culture shrimp following traditions, superstition and Feng Shui whilst others merely continue as they realise that they cannot control natural disasters but must live with them. Others seek new technologies and new culture models.

A new model

Recently, a new shrimp culture model in Donghai island of Zhanjiang, Guangdong is generating a lot of interest. This is an improved model from the traditional high-elevation culture ponds with smaller ponds, separate water supply and drainage systems. It was developed by the technical service team of Guangzhou Hinter Biotechnology Co.,Ltd and associated feed mills. Hinter is the largest aquafeed premix supplier in

Table 1. A comparison between two models for vannamei shrimp culture.

Item	Traditional high-elevation pond	New model
Size	Large. 7~10 mu* (0.47-0.67 ha)	Small. 3~5 mu (0.2-0.33 ha)
Central waste discharge	Difficult	Easy
Management	Difficult	Easy
Water quality	Unstable. Easy to change but difficult to control	Relatively stable. The separate small ponds with separate supply and drainage system can allow for more water exchange.
Success rate	Low at about 20%	High at about 85%
Profit levels	Low	High

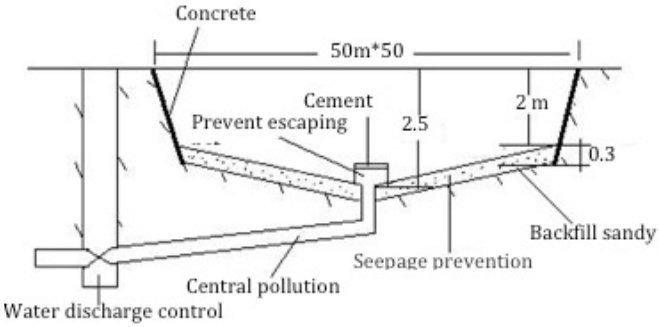
** 1 mu ≈0.0667 ha ≈666.7 m^2*
1 ha=15 mu

Table 2. Comparison of culture parameters of the two models.

Parameters	Traditional high-elevation pond	New model
Density (PL/mu)	120,000 (180 PL/m^2)	300,000 (450 PL/m^2)
Survival rate (%)	60	80
Growth (pcs/kg at 75 days)	80	100
Price (RMB/kg)*	26 (USD 4.10/kg)	24 (USD 3.78/kg)
Production (kg/mu)	900 (13,500 kg/ha)	2,400 (36,000 kg/ha)
FCR	1.0~1.3	1.0~1.3
Production Cost (RMB/kg)	16 (USD 2.52/kg)	16 (USD 2.52/kg)
Input (RMB/mu)	14,400 (USD 34,020/ha)	38,400 (USD 90,720/ha)
Profit (RMB/mu)	9,000(USD 21,263/ha)	19,200 (USD 45,360/ha)

** Farm gate price was collected in Zhanjiang on 7/9/2011; 1 RMB = USD 0.1575*

Picture 1. Construction design for the ponds



China and mainly delivers total practical solutions for aquafeed mills to help them produce high quality aquafeed.

The higher cost for construction of new ponds or for modifications of an existing farm is compensated by high density, high survival rate and high production. Table 1 shows the differences between the traditional high-elevation culture pond and the new model. The culture parameters of these two models are listed in Table 2.

This new farming model pays particular attention to water quality which is the main criteria for the high production and high profit margins. Some key features of the model are discussed below.

Smaller size pond

These small sized ponds translate to more dams, roads and less available farming area, which lead to higher costs. A reconstruction of the traditional high-elevation ponds into smaller ponds (Picture 1) costs about RMB 10,000/mu (USD 23,625/ha) with ten labourers working on 1.5 mu per day. To construct these new small ponds from a new area will cost around RMB 30,000 mu (USD 70,875/ha). The advantage of having the small independent ponds is that they are easier to manage.

Pre-treatment of water

Seawater will be drawn during neap tides and passed through a sand filter and stored in the storage tank which occupies 20% of the total farm area. The water will be pumped into a tank containing sand to be filtered again before it goes into the different ponds through separate pipelines. A silk screen with 60~80 mesh placed at the end of a pipeline will stop the entry of harmful organisms.

Some 3-4 days prior to stocking, the aerators will be running in the culture ponds filled with water to a depth of 0.8 m. During this time, the necessary disinfection of the water will be carried out. Before stocking post larvae, the water quality should be as follows: pH 7.8~8.6, dissolved oxygen (DO) > 4 ppm, total alkalinity > 100 ppm, ammonia nitrogen < 0.5 ppm, nitrite < 0.15 ppm, hydrogen sulphide (H_2S) < 0.1 ppm, Secchi disc transparency 25~50 cm.

Fresh water conditions

Based on our experience in Guangdong, we know that vannamei shrimp is fast growing and is resistant to some saline pathogens when cultured in freshwater. Thus, it is recommended to decrease salinity gradually from 24 ‰ to 4 ‰ by addition of freshwater. Some 15 days before harvest, seawater should be added to increase the salinity to about 12‰ so the shrimp will have the taste as shrimp cultured throughout in saline ponds. As it may not be easy to get a supply of freshwater from a river in some areas, the utilisation of underground water is proposed.

Aeration

An important requirement is good water quality which in turn also requires adequate DO from an efficient aeration model. There are many types and brands of aerators in the Chinese market but we recommend the water-car type (local name), which is already very popular. There are several brand names for this type of aerator. When running, this aeration system will circulate water and bring the waste feed and faeces to the central area, which is 20~30% of the pond area.

Cleaning the sand filter

Water supply with independent pipes

In the new model small culture ponds ranging from 3 to 5 mu (0.2-0.33 ha) are used

Post larvae and feeds

In the new model, specific pathogen free (SPF) vannamei shrimp post larvae perform better than any other local or domestic vannamei post larvae. An untiring and careful management of the post larvae is also important for a successful new culture model.

A good quality shrimp feed with high crude protein such as at 40% is important. It is also important to keep to the recommended total daily feeding volume but a change in feeding frequency at 8 times/day instead of the commonly used frequency of 3 times/day is suggested.

Pond bottom management

This is extremely important to ensure a consistently good environment for the shrimp. This is detailed in Table 3.

Table 3. Pond bottom management in the new model.

	1~30 days	31~60 days	61~90 days	>90 days
Waste-discharge (Discharge the waste after feeding)	-	3 times/day	3 times/day	4 times/day
Waste removal (removal in the 20% central area)	-	once every 5~7 days	once every 3~5 days	once every 1~3 days
Water exchange	-	once every 7 days, with 10~20 cm each time	once every 3 days, with 15~25 cm each time	once every 2 days, with 20~30 cm each time

Production experiences

Farmer Wu from Zhanjiang De Hai Industry has started to use this new model. In June 2009. he invested RMB 600,000 (USD 94,500) to reconstruct his two ponds with an area of 9 mu each into six ponds with an area of 2.5 mu each. The profits in the same year were RMB 800,000 (USD 126,000) with two successful crops. In 2010, he was

The waste is discharged from the middle of the pond

successful with three crops with 250,000 kg shrimp from the six small ponds and the net profit was RMB 1,500,000 (USD 236,250). The cost analysis for Wu's farm is given in Table 4.

Table 4. Cost analysis of the shrimp culture at Zhanjiang De Hai Industry.

Pond condition			
Area/Depth	2 ponds with 2.5 mu each. Water depth was 1.8 m. 10 water-car aerators		
Culture cycle	15th April, 2011 ~ 30th June, 2011. 75 days in total.		
Post larvae	1,600,000 PL with 1 cm body length. RMB 12.8/1000PL (USD 2.02/1000PL)		
Output			
Average size	Production	Ex-farm price	Sales volume
80 pcs/kg	19,000kg	RMB 30.4/kg (USD 4.8/kg)	RMB 577,600 (USD 90,972)
Farming analysis			
1. Good quality feed for tiger shrimp with FCR 1.2.			
2. Feed cost 1.2 X RMB8/kg = RMB 9.6/kg. The total input was about RMB 16/kg, the net profit was about RMB 14.4/kg. (Inputs include feed, RMB 9.6/kg: post larvae, RMB 1/kg; labour RMB 0.8/kg; electricity RMB 1.8/kg; animal health treatments, RMB 1/kg; pond rent and others RMB 1.8/kg			
3. Shrimp size could reach 80 pcs/kg in 75 days with a high survival rate at around 95%.			
4. High production with 3,800 kg/mu (5.7kg/m^2 or 57,000 kg/ha)			
5. Net profit: RMB 14.4/kg*3,800 kg/mu =RMB 54,720/mu (USD 129,276ha), total net profit for 5 mu was RMB 273,600 (USD 43,092).			

In 2009, some farmers obtained high production with 3,500 kg/mu (5.25 kg/m^2). In 2011 the highest production record was 5,000 kg/mu (7.5 kg/m^2) and the average production was 3,000 kg/mu (4.5 kg/m2). More and more farmers are trying this new model, but the high investment is a deterrent.

However, this farming model is not without problems. With such high stocking density, farmers have to be on the lookout for signs of slower growth and some diseases especially when the shrimp reach a size of 100 pcs/kg. The system cannot withstand typhoons and has not been proven efficient in inland freshwater soil bottom ponds. Furthermore, the use of underground water is not environment-friendly. New technologies, such as biofloc should be investigated to control water quality and improve on this new model concept.

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Special feeding practices for pangasius catfish in Andhra Pradesh

By D Linga Prabu and M Kavitha

These enable the farmer to reduce cost of production and impact of feeding on the pond environment.

The farming of the pangasius catfish *Pangasius hypophthalamus* is increasing in Andhra Pradesh state (AP), India because of the high production yields in comparison with that of the carp. The pangasius farmed in India, originally came from Vietnam and since 1989 from Bangladesh. In 1995, it was brought into West Bengal state and then later to AP in 1997. The culture started only in 2000 in AP, and the fastest development and maximum production was seen in 2008. Moreover, being an exotic species, its farming was actually banned in India until December 2009 when the government lifted the ban.

Pangasius farming in AP is seen as a diversification from carp farming. In addition, former low saline shrimp ponds are now being used for pangasius culture, after the farmers continuously faced disease problems in the farming of the monodon shrimp. Today, some 70,000 ha are used for pangasius and farmers in the main districts of East Godhavari, West Godhavari and Krishna are intensifying production.

Seed stock supply

The supply of pangasius fry and fingerlings is mainly from Bangladesh via West Bengal mediators. A limited number of farms have succeeded in induced breeding of the pangasius and can meet their seed stock requirements. They also sell excess production to nearby farmers at higher prices than fry from Bangladesh. In inducing spawning, pituitary gland extracts have been more successful than using artificial inducing agents (Ovaprim, Ovatide etc.). Sticky eggs are transformed to non-sticky ones by using a locally well-known ayurvedic herbal mixture.

Prices are highly variable according to market demand, size and season (Table 1). However, seed stock is also sold based on counts/kg. If there are 2,000 pieces/kg then each piece will cost around INR 0.9 to 1 and if the numbers are 4,000/kg each piece will then cost only INR 0.5. The costs of stunted yearlings range from INR 2 (USD 38.4/1000pcs) and INR 3.5 (USD 67.2/1000pcs) for 30 g and 80-100 g size, respectively.

Table 1. Prices for pangasius fry and fingerlings.

Size in inches (cm)	Cost for one fry/fingerling in INR (approx. in USD for 1, 000 pcs)*
<2 (5)	INR 0.4 -1.00 (USD 7.7-19.2)
>2-4 (5-10.2)	INR 1.5 (USD 28.7)
>4 -5 (10.2-12.7)	INR 2 (USD 38.4)
>5-6 (12.7-15.2)	INR 2.5-3.00 (USD 48-57.6)
**Exchange rate, One USD=INR 52.11*	

Broadcasting wet mash feed to pangasius fingerlings (courtesy of Arun Sudhagar)

A stunted pangasius yearling (picture by D L Prabu)

Nursery culture

The stocking rate in nursery ponds varies from 1 to 5 million fry/ha according to the size of the fry and depth of pond. Fish are fed four times a day with powdered fish meal and rice bran at a ratio of 1:1 for about 10 days. Some farmers in this region rear the fry in nursery ponds with a *Moina* bloom, to get better growth and minimise feed cost. Fry grow to about 4 -5 inch (10.2-12.7 cm) within 6 weeks, when they are harvested and stocked in grow-out pond or earmarked for stunted-yearling production, according to demand. Survival rate is estimated to be 80-90% in the nursery phase of 60 days.

Stunted fingerling production

This concept of stunted yearling production for better growth performance and reduction of the culture period was introduced in India by AP fish farmers. Fingerlings are stunted for 10-12 months by maintaining them at high stocking densities and feeding them at 2-3% of their body weight which is just sufficient to ensure survival but not for growth. The stunted yearlings reach 100-150 g. The purpose for the production of stunted yearlings is that when fish are later stocked in grow-out ponds, they will grow faster and reach a marketable size of 700 g-1 kg within 6-8 months. Although there has been a lapse of one year for stunted fingerling production, this negative factor is overcome by the production of a higher number of yearlings due to high stocking density, higher growth rate in grow-out ponds and subsequent

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Feeding grow-out pangasius with floating pelleted feeds (picture by D L Prabu)

reduction in the culture period and feed cost.

Stocking density

This varies according to the size of the seed stock. With less than 3 inches (7.6 cm), the stocking density is 5 pcs/m^2 and when the fry is more than 5 inches (12.7 cm), the stocking density will be 4 pcs/m^2. However, most pangasius farms practise high stocking density from 25,000-50,000 pcs/acre (62,500-125,000 pcs/ha). Farmers with their own land prefer to stock optimum numbers such as 10,000-15,000 pcs/acre (25,000-37,500 pcs/ha). Due to the small margins, farmers working on leased land often go for high stocking density so as to quickly profit from high production.

Generally, the seed stock is not of uniform size and age (some fingerlings may be 6 months old and some may be 1-year old stunted fingerlings) and in high stocking density ponds, growth will vary accordingly with initial weight and size. Hence, in ponds with a high stocking density, the days of culture to marketable size (1.2-1.5 kg) will go up to 12 months, versus 6-7 months in low stocking density ponds. Again, the total pond carrying capacity would not allow for all of the biomass to remain in the pond until the end of the culture period (12 months). When prices are reasonably good and fish is of marketable size, the farmer will opt for partial harvesting. The overall biomass will be reduced and will allow for the remaining fish to grow faster. In ponds, with a mixed culture of pangasius and carp, the pangasius is usually harvested first after 7-8 months when it reaches marketable size and when there is market demand.

Pangasius harvest (picture by D L Prabu)

Water quality

Unfortunately, most pangasius farmers in AP pay little attention to water quality management, believing that the fish, being a hardy species, can withstand even unfavourable water conditions. For better growth and survival of the pangasius, it is good to maintain at least 3 ppm of dissolved oxygen (DO) even though it can withstand the low 0.5 ppm DO levels for a short duration. Pangasius can also tolerate up to 10 ppt salinity but growth is lower. If the salinity rises to more than 10 ppt, there will be gradual mortality. Salinity up to 4 ppt is good for growth without any problems; hence, low saline water areas are also suitable for pangasius culture.

Fertilisation is not necessary since there is no need of phytoplankton in monoculture systems. In polyculture with carps, waste outputs from uneaten feed and faecal matter provide the nutrients for natural productivity for the carps. Probiotic application is practised after 15-20 days of culture based on pond water conditions and water exchange.

Feeds and feeding

Pangasius is a voracious feeder and feeds almost throughout the day. It is an omnivorous feeder during the first year and will become herbivorous for the rest of its lifecycle. Farms in AP have adopted the broadcasting method of feeding of either pellets or mash feed (cooked broken maize and rice). Bag feeding was tried during the early phases of culture but it was not effective in comparison to the broadcasting method. Feeding frequency is twice/day- in the morning and evening. Feeding rations vary with age and size of fish. Floating pellets are used in pangasius culture to achieve the best feed conversion ratio (FCR) of 1:1.1.

The cost of pangasius pelleted feed with crude protein levels of 22%, 26% and 28% are INR 21/kg (USD 0.40/kg), INR 24/kg (USD0.46/kg) and INR 28/kg (0.54/kg) respectively (as of 31.7.2012). This makes it cost effective for large scale farmers. In the case of small farmers, feed cost is the highest investment cost and as such some use only boiled corn or soaked wheat middlings for both feedings in a day or intersperse feeding of these with pelleted feeds. A reasonably good FCR at 1:1.5-1.8 is achieved even when feeding fish with only cooked corn.

In the initial stage of pangasius rearing (stocking size 3-4 inches), soaked groundnut oil cake (GNOC) and pelleted feed mixed in 1:1 ratio are provided up to 2 months of culture to obtain 120 g size for better growth and digestion. Some farmers start feeding small diameter sinking pellets from day one of culture. At present most of the seed producers/nursery farmers use small diameter floating pellets.

Table 2. Composition of commercial feeds for pangasius.

Nutrients	Inclusion level
Crude protein	28%
Crude lipid	3%
Crude fibre	5%
Minerals	0.5%
Vitamin	0.5%
DE	2,750 Kcal/kg

Table 3. An example of a feeding chart for pelleted feeds.

Age (days)	Average body weight (g)	Feed in g/fish/per day
1-15	1-50	3
15-45	50-150	4.5
45-75	150-300	5.5
75-105	300-500	8
105-135	500-700	9
135-165	700-1000	10

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—Steve Jobs

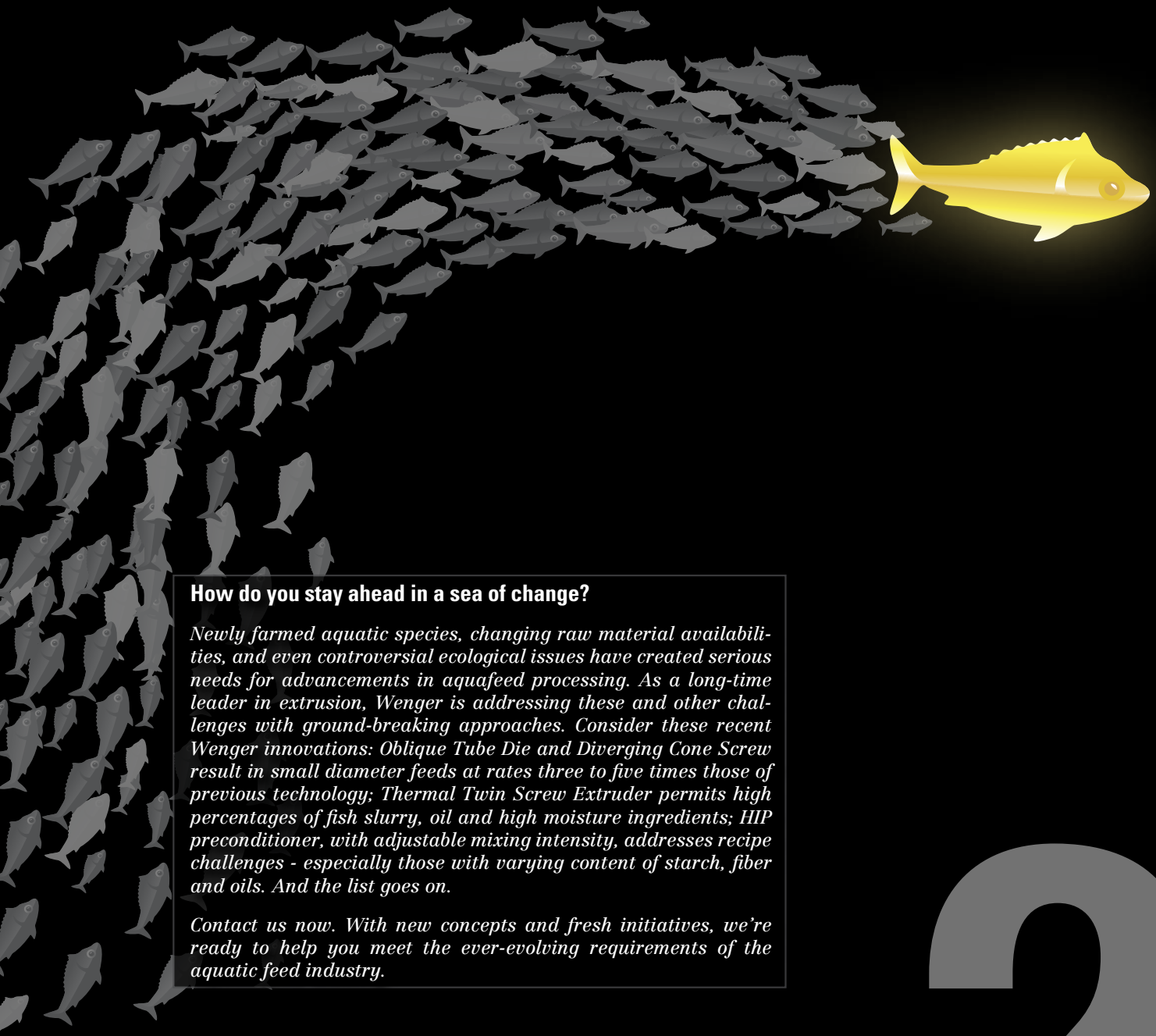

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Table 4. Recommended pellet size of feeds for different size groups of pangasius.

Size in (g)	Pellet size (mm)
1-10	1-1.2
10-30	2
30-75	3
75-250	4
250-500	4.5
>500	5

Pause feeding

This or feeding holiday is when the farmer uses a simple feed management practice of not feeding the fish at regular intervals. Usually, the fish are not fed one day in every ten days and this allows the farmers to save on feed costs and cut down significantly on the total cost of production. This practice of feeding holiday is supported scientifically by the fact that starvation and subsequent feeding augment the feed intake and enhance digestion, hence improving growth rate through compensatory growth.

Split feeding

Another concept in feed management followed by AP farmers is that an increase in feeding frequency will lead to a uniform size in a population of pangasius. If the total feed ration per meal is applied in a single meal, the larger fish or shooters will dominate and consume most of the feed, leaving only leftover feed for the relatively smaller fish. This leads to unequal size of fish among the population by harvest time which in turn affects the market price of fish. Hence, farmers have devised split feeding or break feeding as a new technique to solve this problem. Here the ration for each meal is split into two portions and applied at an interval of 30 minutes. During the feeding of the first portion, the dominant fish will feed to satiation, while the smaller fish will reach satiation feeding from the second feed portion. This helps to minimise size variation at harvest and avoid the need for partial harvesting.

Alternate feeding schedule

The alternate feeding schedule is another cost reduction measure carried out without compromising growth of fish. Farmers alternatively feed the fish one day with extruded floating feeds containing high protein and the next day with feeds containing low protein. This is also practised on alternative weeks. This alternative feeding schedule not only helps in reducing costs of production but also reduces the impact of high levels of nitrite, ammonia and phosphorus outputs into the pond environment.

Disease management

Occasional occurrences of red disease, columnaris and rare infection by gill flukes are common. Red disease can be treated with endroflaxacin through diet at the rate of 10 g/tonne of fish biomass. This will be

Pangasius culture pond (courtesy of Arun Sudhagar)

Feeding frenzy on floating pellets (Courtesy D L Prabu)

continued for four days of regular feeding. DO and toxic gases problems are rarely a threat to this fish but farmers are frequently using probiotics, water sanitisers, lime, zeolite and salt. The use of approved antibiotics to prevent or control diseases is rarely practised. Survival is approximately 90-95% of total stocked biomass.

Harvesting and marketing

In partial or selective harvesting fish is usually harvested three times within the culture period. This starts after 5-6 months of culture. Fish reach 1-1.2 kg in 5-6 months and 2 kg in 8-10 months of culture with proper pond management. It can attain 3–4 kg in 12-15 months. Total production varies according to stocking density, survival, types of feed used and level of management. On average, total production ranges from 10-15 tonnes/acre (25-37.5 tonnes/ha). The highest reported was 20 tonnes/acre (50 tonnes/ha).

Marketing is the major problem in pangasius culture as output is higher than demand. Two years ago, the ex-farm price of pangasius was INR 60/kg (USD 1.15/kg) but today, prices fluctuate from INR 51 (USD 0.97/kg) for 1.2 kg size and INR 56 (USD 1.07/kg) for 2 kg fish. Owing to the reduction in market price, profit margins have eroded to as low as INR 5/kg (USD 0.1/kg). Until pangasius is processed and exported, better prices will not be possible as production will continue to increase.

Conclusion

The progressive entrepreneurs in AP are increasingly diversifying their farming operations from the Indian major carps to pangasius and other fish species. They are showing the way to succeed in fish farming to other farming communities in the country. In addition, nutritional experts and fish farmers have also joined together to combine efforts and focus on best management practices in feeds and feeding. This will significantly reduce production cost and improve on revenues as well as achieve sustainable aquaculture practices.

D Linga Prabu

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50 years in aquafeed production

In 2012, BioMar celebrates its 50 years in the aqua feed business. It has made a mark in European aquaculture with environmentally friendly high performance diets and its BioSustain program in 2007. The company applies its R&D experience with new performance feeds developed for tilapia in Latin America, where it already holds a leading position in feed for salmonids.

The global gathering of industry, aquaculturists and academia provided the opportunity for celebrations with customers at Aqua 2012 the joint conference and trade show of the World Aquaculture Society and European Aquaculture Society in Prague, Czech Republic from September 1-5. As the Gold sponsor, BioMar supported industry, recirculation aquaculture, and tilapia sessions. The company prides itself on its green efforts, a leader in replacing polluting moist feeds in the 1960s and later introducing the Ecoline reducing emission to the water environment in 1988. This won the company the Danish environmental award. In 1997, it started to push the concept of sustainability in aquaculture with gradual replacements of marine raw materials and ten years later launched the BioSustain program and a special feed program targeted at farming with recirculation systems.

BioMar had a turnover of €975 million in 2011 and produced 0.9 million tonnes of fish feed for more than 30 species. Sales are done globally to more than 60 countries while production takes place in Norway, Scotland, Denmark, France, Spain, Greece, Chile and most recently Costa Rica. Feeds for salmon, trout, European sea bass, and sea bream are the most important in terms of volume. Other specialities include feed for turbot, sturgeon and eel. "R&D plays a significant role with major inputs and works in parallel with business decisions, the latest being the start of tilapia feed production in Costa Rica" say **Patrick Campbell**, Global Research director and **Henrik Aarestrup**, International Marketing manager in the BioMar Group in Prague.

From a regional to global R&D

Previously, R&D was locally based in group companies across Europe and in Chile. As the company began to evolve into a regional and recently a global entity, the R&D department followed quickly. Research activity is now organised and coordinated globally, but BioMar continues to have R&D personnel in all eight countries, where the company has factories.

"This makes us different from our competitors with centralised R&D activities. This strategy requires communication and organisation to make it successful. However, the benefits of having R&D personnel close to our markets and customers are very important for us" says Campbell. "Basically the knowledge on requirements is about how you actually work on them and it is not necessarily species specific. The same development model can be applied across species and markets."

Patrick Campbell (right) and Henrik Aarestrup (left) with Joost Blom, sales manager Eel & Pike Perch

Cost effectiveness and reduced marine content

Over the years, R&D has set the pace of feed development taking into consideration an increasing number of factors including: costs of production, reduction of marine content, sustainability, and specific demands from retailers. One of the major achievements has been an improved cost effectiveness of the feed.

According to Campbell, the Norwegian salmon farmer is still more focussed on cost per kg of production and getting value from the feed. This means high performance with low feed conversion ratios. The record feed conversion ratio (FCR) has been reported at 0.9 for a production cycle, but the typical range is 1-1.3.

"We have many customers seeking high value feeds both in order to get a better fish quality at harvest and because it results in a better total economic performance in the farming activity. As such, even though the feed is nutrient rich and thus expensive, the farmer will buy the feed which will give him better economic returns."

In addition to the economic performance, there is the need to fulfil requirements with regards to sustainability. One of the first issues in this respect has been a reduction of marine content.

"Some ten years ago, the level of marine raw materials was high in feed for most species in Europe and Chile, but intensive research has made it possible to reduce fish meal and fish oil content without compromising performance and quality. Current salmon feeds may

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CEO Torben Svejgaard cuts the cake at BioMar's booth during Aqua 2012.

have only 10% fish meal. Replacement of fish oil is more complicated as this does not just depend on what will make the fish grow, but also on what retailers and consumers want with regards to EPA and DHA levels for human health," says Campbell. Typical replacement levels are now 70% plant oils and 30% fish oils, but again this depends on the type of fish oil and the actual relative prices."

Aarestrup adds that while a reduction of the marine content has been important for the salmon industry one should notice that marine raw materials can actually be very sustainable if they are sourced from areas with proper stock management.

Fish oil and bespoke feeds

The European market is moving towards healthy eating of high quality end products, but they must be produced cost effectively. In the highly competitive Scottish market, cost/kg is critical, but yet key players have differentiated themselves such that bespoke products are very common. In Norway and Chile, salmon is more of a commodity, not linked to the same extent to specific retailers and more standard products are used.

"Different markets have different expectations on the levels of EPA and in the fillets. In Scotland, retailers insist on high levels of EPA and DHA and this is conveyed to the Scottish farmers. Here there is a proliferation of feed products for the different customers. In the salmonid feed business. Our researchers are used to formulating bespoke feeds and our product development department has to work in cooperation with customers."

In other markets, such as trout, sea bass and sea bream bespoke products are less common. In most countries in the European Union fish producers are generally smaller than in the salmon business, and this eventually leads to more diverse feed requirements and also to an even stronger role of some retailers in defining the demands to the feed industry.

Feed performance versus prices

Advances in nutrition research have paved the way for reducing marine raw material content in feeds and with this, new protein and energy sources have been introduced. This has been achieved while maintaining or even improving the growth performance. This requires changing the nutrient density and using digestible protein and energy and available amino acids as a base in recipes. Since 1990, the number of raw materials used in a typical fish diet has more than doubled. With a wider usage of land animal meals, it will be possible to lower further fish meal usage. In mid 2013, the European Commission will allow poultry and feather meals in fish feeds.

"The decision whether we use these meals will depend on our customers. For example at the moment, we are allowed to use haemoglobin meal in fish feeds, but BioMar only uses this in certain markets because of customer preferences", says Campbell.

"As we move away from the mentality of feed cost per kg to

production cost per kg, we should also move to cost of production per kg of edible flesh (i.e. fillet yield). This is the feed performance that we should aim for and demonstrate to the customer."

It is important that a feed supplier can substitute to the most cost efficient raw material combination at any given time taking into consideration both nutritional value and actual raw material costs. If, in times of increasing raw material prices the feed supplier switches to cheaper but less efficient raw material combinations the feed cost might fall – or at least not increase - but growth performance will suffer and this will often make cheaper solutions less attractive. "We are, with our Performance Concept, always focusing on achieving a specific performance level based on digestible energy and digestible protein and available amino acids using a changing selection of raw materials. A customer who has been used to high levels of fish meal may think that the feed is inferior if the crude protein level and fish meal levels are reduced, but this is not the case if protein sources with a higher digestibility and/or a better amino acid profile are selected as substitutes. We actually spend a lot of time engaging with farmers to explain this and the advantages of continuous optimisation of feed recipes in a situation with volatile raw material prices."

Aarestrup says that it is important to understand that within Europe, the farming environment is different in every country. It becomes even more complex as not just the individual farmer might have an idea of the type of feeds he wants, the retailers too may impose their specifications. "A main task for our R&D is continuously to be able to live up to these very diverse market needs, and even to be ahead of the markets, so we can maintain our position as market leader in the majority of the European countries."

Sustainability

As part of a green profile BioMar has been a pioneer in developing more sustainable and environmentally friendly diets, but Campbell

The new plant in Cañas, Costa Rica

underlines that the term sustainability is far too often used even if only minor improvements are made on single issues linked to sustainability.

"The way forward is to evaluate all processes from the primary production of raw materials to consumption behaviour and disposal and to evaluate all types of ingredients and optimise on the sum. For each raw material we use we have today a sustainability profile comprising a number of different factors such as carbon footprint, land use, depletion of resources and potential environmental risks. These profiles are indexed and can be used in our feed formulation" says Campbell.

"Annually we add 25 different sources of protein and lipids to the list of potential ingredients and all are evaluated with regards to sustainability. In 2012, BioMar became the first company to be certified as practising an integrated total environmental impact in

Ole Christensen

feed formulation," says Aarestrup.

"With our BioSustain tool, we can show the sustainability of different types of feeds against the production of 1 kg of fish. It is also possible to calculate which changes to a feed recipe will give the best improvement in the sustainability profile compared to the effect on costs."

Feeds for recirculation systems

In Europe, more than in other parts of the world, land and sea-based aquaculture is undergoing change with stricter regulations on water use and disposal and increased competition for space. Recirculation aquaculture is one of the answers for future mass production with a smaller environmental footprint and with lower water consumption. In 2010, BioMar launched a revolutionary feed, which set new standards for low emissions and in particular optimised farm economy in recirculation farming. ORBIT feed line has combined focus on fish growth performance and bio filter performance and it allows farmers to produce up to 25% more than with a standard feed in a given recirculation system. This obviously improves the return on the capital invested in the recirculation farms." explains Aarestrup. Challenging R&D areas include; high performance feeds with low environmental impact, low emissions of phosphorus and nitrogen and high water stability of faeces.

Aarestrup says, "In Continental Europe we have had to live with the strictest environmental regulation for decades and it has forced us to be innovative. BioMar delivers above 70% of the feed for recirculation systems in the European continent, and even if the recirculation segment is still small compared to what is produced in marine farms it is an important growth market for BioMar".

Moving into tilapia feeds

Although the company has been producing tilapia feeds for markets in Africa and Latin America for several years, it is the joint venture with Aquacorporacion Internacional SA (ACI) in 2011 which gives it a solid foothold in grower feeds for tilapia. Full production of a completely new range of tilapia feeds began in July 2012 from the new feed mill with an initial capacity of 50,000 tonnes per year in Costa Rica. It will supply markets across Central America.

Tilapia aquaculture is a well-developed industry, in terms of feeds, culture management and even genetics. Therefore, what can BioMar bring to this industry?

Aarestrup says, "Our decision to enter the tilapia feed market is simple. There has been a good growth of the salmon feed market in Norway and Chile, but it is a small market relative to the total world aquaculture production. We will need to be in the tilapia market if we want to continue as a serious global player. We already have developed the framework in R&D for salmonid feeds and many other species so why not utilise the knowledge that we have for some of the other important species in global aquaculture?"

"We have been working a lot on the tilapia in the last couple of years and have a good nutritional understanding of the species. The nutritional requirements for the tilapia are well established and we will use these to our advantage. But, interestingly, when we look at the tilapia, we see the potential of getting more out of the fish than what is being achieved now by focusing on feed cost and growth performance. I believe that the tilapia can be farmed at much lower FCR than they are now. Our concept is that we will look at the cost per kg of flesh. In tilapia, this is important as fillet yield is only 30%. Any improvement from feeds, taking into account genetics, will be important," added Campbell.

Performance concepts for tilapia

In his presentation during the industry session at AQUA2012, BioMar R&D manager Ole Christensen showed how R&D at BioMar approaches tilapia requirements as they have done with salmonid requirements. This includes studying the body composition throughout the production cycle and focusing on minerals to formulate specific dietary mineral levels. Trials with changing digestible protein and digestible energy ratios (DP/DE) provide the models to match nutritional values of raw material to the requirements of fish at the different stages of growth. These models also make production more predictable and enable farmers to produce fish at the right time with the right quality at the expected cost. He added that the performance concept is not based on a fixed formulation but based on fixed performance goals such as specific growth rate and feed conversion.

As for Asia, Campbell says, "Feed technology is always improving and with the feed business, it matters to be at the right place at the right time. We would like to enter Asia at a larger scale and we are investigating opportunities either alone or with partners."

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Can tilapia get more out of your current feed formulation?

By Giovani Sampaio Gonçalves, Manoel Joaquim Peres Ribeiro, Diogo Villaça and Peter Coutteau

The study shows better cost efficiency of feeds for tilapia farmed in cages in Brazil with addition of digestibility enhancers and also underlines the importance of maintaining the nutritional balance in feed to maximize the benefits of a digestibility enhancing concept.

Feed represents the largest production cost in tilapia *Oreochromis niloticus* farming. As a result of increasing raw material prices, nutritionists are under continuous pressure to reduce formulation cost and search for cheaper, alternative ingredients. The use of feed additives to improve the digestibility of nutrients is an important tool to improve cost-efficiency in intensive production of tilapia.

Digestibility enhancing additives that are compatible with the digestive physiology of each fish species, have the potential to improve nutrient utilisation from cheap ingredients. Furthermore, they can stimulate the conversion of nutrients into meat gain and reduce the fat accumulation in muscle and viscera. Previous work has revealed the potential of synergistic blends of digestive phytobiotics, natural emulsifying agents and co-factors of digestion to improve feed efficiency and growth and to reduce visceral depositions in Nile tilapia under lab conditions (Ceulemans et al., 2009).

However, the optimal application of novel feed additives requires field evaluations to provide information on optimal dosage at different life stages of the fish, and their effects on farm economics and processing qualities of the fish. In the pangasius catfish in Vietnam, the optimal application of a digestibility enhancer for pond production was shown by van Halteren et al (2009). The economic gains for the farmer was up to 2.4% reduction in feed cost/kg of whole fish produced and 16.4% shortening of the production cycle. For the fish processor, it was up to 7.5% improvement in filleting yield.

In the current study, we compared the effect of different application strategies of a digestibility enhancing feed additive on productivity and profitability of tilapia production in cages in Brazil. Reserving a limited budget in the feed formula (often only a fraction of the increase of budget for standard ingredients) for performance enhancing feed additives seems a sound strategy to improve feed cost efficiency, particularly in situations where ingredients prices reach new historic records.

The cage trial

The study covered the entire production cycle of tilapia, including the processing of commercial size fish, and was carried out by the Instituto de Pesca in collaboration with a commercial tilapia integration in the Sao Paulo region of Brazil.

The cage trial was performed during two consecutive phases in 7m^3 cages: phase 1 (from 28g to approximately 170g) and phase 2 (from 170g to 750g, i.e. commercial size). In phase 1,880 juveniles of Nile tilapia (GIFT strain, initial weight 28g) were stocked in each cage. Ten replicate cages were fed the control feed, consisting of a commercial feed (36% crude protein). The treatment feed consisted of the control feed supplemented with a digestibility enhancing feed additive (Aquagest® OMF, Nutriad; 3 kg/tonne of feed). The treatment group consisted of 15 replicate cages.

In phase 2, the stocking density was 800 fish/cage and 4 different treatments were run with 5 replicate cages per treatment:

- Control: fed a commercial feed with 32% crude protein;
- AG3: control feed supplemented with the feed additive at 3 kg/tonne throughout the entire cycle;
- AG 3/1.5: control feed supplemented with the feed additive at 3 kg/tonne until 350g and subsequently at 1.5 kg/tonne until the end of the trial;
- LC-AG2: low cost feed, formulated with protein of lower digestibility and poorer amino acid profile, supplemented with 2 kg/tonne of the feed additive (7% reduced formula cost compared to the control feed).

Tilapia was grown from 28 g to commercial size in 7m^3 cages

During phase 2, the control group was stocked with fish originating from the control group during phase 1; whereas the other treatments were recruited from fish receiving the additive treatment diets during phase 1.

Feeds were produced in a commercial extrusion line and the additive was included directly in the mixer with all other ingredients prior to extrusion. Feed distribution was based on feeding tables. It was 4 times/day during phase 1 and 3 times/day during phase 2. At the end of phase 1, all fish were weighed, average daily weight gain and feed conversion ratios were determined. At the end of phase 2, all fish from each experimental cage were weighed and counted. At harvest, 5% of the population per cage was processed for filleting. The evaluated parameters included survival, daily weight gain, feed conversion, filleting yield, viscera weight, liver weight and visceral fat weight.

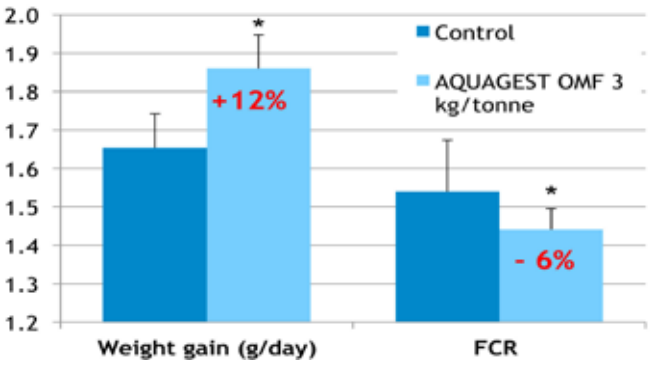
Better performance

At the end of phase 1, fish supplemented with the feed additive showed significant improvements on performance compared to the control group. Daily weight gain was 12% higher, survival, 5% higher and there was 6% improvement in feed conversion (Figure 1; Table 1).

Table 1. Performance of Nile tilapia (from 28g to approx.170g) fed different diets during phase 1. Data is average from 10 and 15 cages for control and treatment groups, respectively.

	Control	AG3*	Difference	P value
Survival (%)	92.5	97.2	5%	0.00618
Initial weight (g)	28.0	28.0	0%	
Final weight (g)	168.6	186.1	10%	0.00029
Weight gain (g/day)	1.65	1.86	12%	0.00029
Feed intake (kg)	177.0	177.0	0%	
Feed conversion ratio (FCR)	1.54	1.44	-6%	0.00204
**Aquagest OMF 3 kg/tonne*				

Figure 1. Daily weight gain and feed conversion of juvenile Nile tilapia during phase 1 (from 28 to approx. 170g) fed the control diet with or without the supplementation of a digestibility enhancing additive. * indicate significant differences (P<0.05) and deviations from control are shown as percentages in red.



Feeds were extruded in a commercial feed mill

During phase 2, the best results were obtained by supplementing the control feed throughout the production cycle with 3 kg/tonne of the feed additive (treatment AG3). This resulted in a significantly better final weight and reduced amount of feed consumption at the end of the cycle (Table 2; Figure. 2). Compared to the control group, treatment AG3 showed improved survival (+2.8%), daily weight gain (+5%), feed conversion (-6.4%), filleting yield (+1.5%), visceral fat deposition (-9.9%), hepatosomatic index (-22%), and viscerosomatic index (-10.7%). When the inclusion rate of the additive was reduced from 3 to 1.5 kg/tonne during phase 2, there were still interesting benefits on growth, feed conversion and visceral fat but filleting yield was not affected.

Figure 2: Survival, daily weight gain, and feed conversion of Nile tilapia during phase 2 (from approximately 170g to commercial size) fed different diets (see text for explanation of the treatments). Different letters indicate significant differences (P<0.05) and deviations from control are shown as percentages in red.

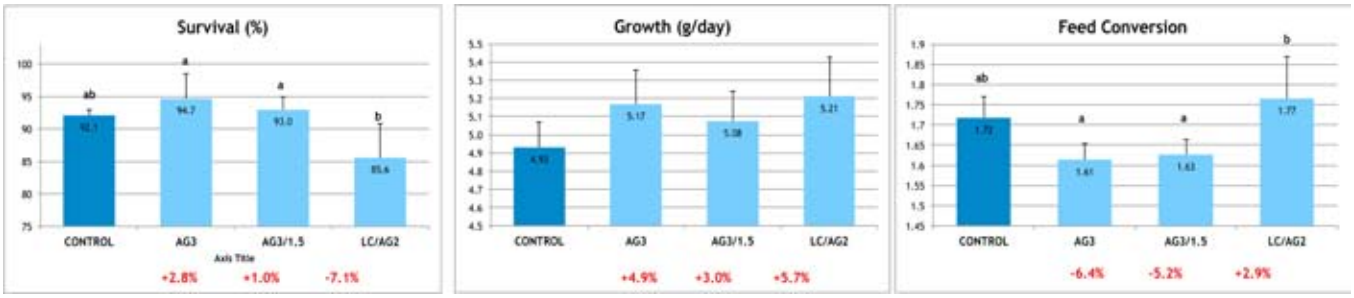


Table 2: Fish performance and processing parameters (filleting yield, visceral fat, hepatosomatic index HSI, viscerosomatic index VSI) of Nile tilapia (from approximately 170g to commercial size) fed different diets during phase 2. Different letters indicate significant differences (P<0.05).

	Control		AG3		AG3/1.5		LC-AG2	
Fish performance								
Survival (%)	92	ab	95	a	93	a	86	b
Initial weight (g)	167		177		167		161	n.s.
Final weight (g)	714	b	751	a	730	ab	739	ab
Growth (g/day)	4.93		5.17		5.08		5.21	n.s.
Feed intake (kg/cage)	676	b	645	a	655	ab	662	ab
FI as (% ABW/d)	3.09	ab	2.91	a	2.93	a	3.18	b
FCR	1.72	ab	1.61	a	1.63	a	1.77	b
Processing parameters								
Fillet yield (%)	33.4	a	33.9	a	33.3	a	31.5	b
Visceral fat (%)	4.76		4.29		4.17		5.00	n.s.
HSI (%)	1.07		0.83		0.96		0.84	n.s.
VSI (%)	8.84		7.89		8.18		8.67	n.s.

Significance of quality protein

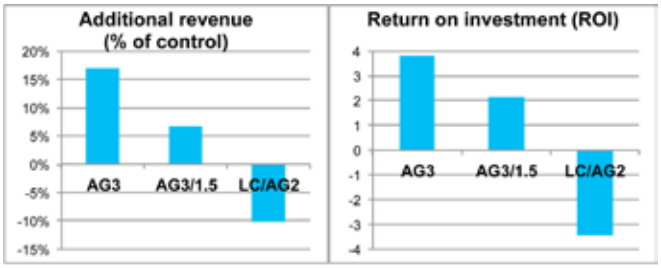
The low cost feed performed significantly worse compared to the control feed in most parameters, particularly in terms of survival, feed conversion and filleting yield. The addition of 2kg/tonne of the feed additive was only capable of improving growth but the nutritional impact of reducing the protein digestibility and amino acid balance in this feed heavily affected the overall performance, particularly FCR and survival. The trial results showed that the tilapia is highly sensitive to reducing the quality of the dietary protein in the feed. The digestibility enhancer was not capable of rectifying the effect of inferior nutritional specifications, which finally resulted in a less cost-efficient feed for the producer.

Considering the cost efficiency of the different feeds, the optimal additive treatment (3 kg/tonne throughout the production cycle) improved farm revenues with 17% compared to the unsupplemented control group and showed a return on investment (ROI) of 3.8:1 (Figure 3). Reducing the additive inclusion to 1.5 kg/tonne of feed once fish reach 350 g still resulted in 7% improved revenues compared to the unsupplemented control group and a ROI of 2.1:1. The application of the low cost feed supplemented with 2 kg/tonne of the additive resulted in important economic losses (10% reduced revenues compared to control).

This study clearly indicated the potential of improving cost efficiency of tilapia feeds through the use of digestibility enhancing additives. The results showed the importance of maintaining the nutritional balance in the feed in order to maximize the benefits of a digestibility enhancing concept. It is important to note that the economic impacts of performance enhancing feed additives (having a relatively stable cost, independent from standard commodity ingredients) increases dramatically with increasing ingredient cost.

At the end of the trial, fish were processed and evaluated for filleting yield, viscera fat weight, somatic liver index and somatic viscera index.

Figure 3. Economic evaluation of different application strategies for a feed additive in tilapia farming. Feed ingredient costs used for this study dated early 2012. Data show change of farm revenues and return of investment, relative to the non-supplemented control group. Treatment groups differ in inclusion of the feed additive and formulation: AG3 (control feed + 3 kg/tonne throughout the production cycle), AG3/1.5 (control feed + 3 kg/tonne till 350g; followed by 1.5 kg/tonne till harvest), LC/AG2 (low cost feed + 2 kg/tonne).



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Tilapia LVHD cage production in Hainan

By Zhou Enhua, Zhang Jian, Michael C. Cremer and Timothy O'Keefe

The results of ASA-IM China Feeding Demonstration with 24%, 28%, 32% and 36% protein soy-based feeds.

A tilapia feeding demonstration was jointly conducted in 2010 by the American Soybean Association International Marketing (ASA-IM) and the Hainan Fish Breeding Farm of the Beijing Municipal Fishery Extension Center, Haikou City, Hainan Province. The objective of the demonstration was to demonstrate the optimal feed protein level for maximizing economic return for tilapia cultured in low volume, high density (LVHD) cages. The demonstration compared tilapia growth and production cost with feeds varying in protein level from 24% to 36%. Optimizing feed protein level is critical to maximizing economic return in tilapia operations, where the current economic environment and increasing competition have narrowed profit opportunities.

Cage feeding trials

The 2010 tilapia LVHD cage feeding demonstration was conducted in Baitang Reservoir near Haikou, Hainan Province, China under the jurisdiction of the Hainan Fish Breeding Center of the Beijing Municipal Fishery Extension Center. Twelve, 4-m^3 LVHD cages were used for the comparison study. There were three replicates cages for the four test feeds. The cages were outfitted with opaque covers to reduce light and external motion stress. A feed enclosure approximately 1m^2 in size was installed inside each cage. The feed enclosure extended sufficiently above and below the water line to contain extruded, floating feed pellets. The cages were tied along surface rope bridles in rows, with a distance of 2m between cages within the same row, to allow sufficient water exchange, and a minimum distance of 50m between cage rows.

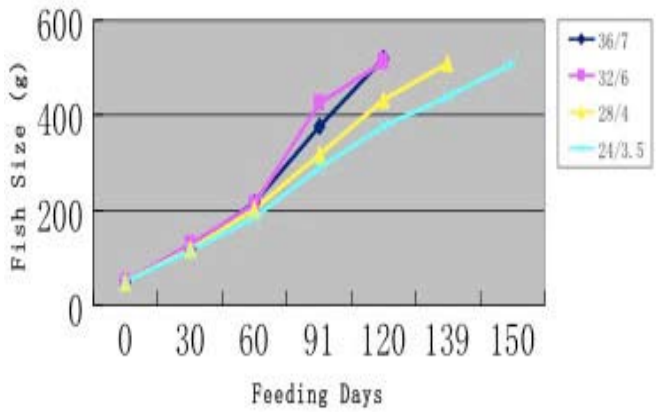
The 12 demonstration cages were stocked on 25 June 2010 with all-male, GIFT strain tilapia produced locally. Tilapia averaged 50g in weight at the time of stocking. The tilapia fingerlings were stocked at a density of 300 fish/m^3 (1,200 fish per cage). The target harvest size was 500g/fish and tilapia in the three replicate cages for each of the four feed treatments were to be harvested when the average fish size for that feed treatment reached 500g.

Tilapia were fed one of four test feeds for the duration of the demonstration. The four feeds differed in crude protein level but had the same digestible energy to digestible protein (DE:DP) ratio (Table 1). The four feed crude protein levels were 24%, 28%, 32% and 36%, with corresponding lipid levels of 3.5%, 4.0%, 6.0% and 7.0%,

Table 1. Feed formulations for the four protein level feeds compared in the 2010 ASA-IM LVHD cage demonstration with tilapia. DE:DP ratio for all four feeds was constant at 8.4 kcal of energy per gram of protein. The feeds were least-cost formulated by ASA-IM and based on available ingredients in China.

	Treatments			
Ingredient %	24%	28%	32%	36%
Soybean meal 46%	25.50	33.00	43.00	44.20
Wheat middlings 16%	28.00	35.00	31.30	14.00
Soybean hulls (low-fat)	30.00	11.90	-	-
Fishmeal, anchovy 64/9	1.00	2.00	2.50	5.00
Wheat, feed flour 13.2%	6.00	8.00	10.00	16.50
Corn gluten meal 61%	3.00	3.00	4.00	6.00
Blood meal spr. 90/0.5	2.00	2.00	2.00	5.00
Fish Oil, anchovy	0.75	0.60	1.00	1.00
Soy oil	-	-	1.80	4.50
Soy lecithin	0.50	1.50	1.50	1.00
Ca Phosphate Mono 21%	2.21	1.94	1.92	1.83
Vit PMX F-2	0.50	0.50	0.50	0.50
Min PMX F-1	0.25	0.25	0.25	0.25
Choline Chloride 50%	0.10	0.10	0.03	0.03
DL Methionine 99%	0.12	0.14	0.13	0.12
Stay C 35%	0.03	0.03	0.03	0.03
Antioxidant	0.02	0.02	0.02	0.02
Mold Inhibitor	0.01	0.01	0.01	0.01
Mycotoxin binder	0.01	0.01	0.01	0.01
Total	100.00	100.00	100.00	100.00

Figure 1. Growth curves for GIFT tilapia fed the ASA-IM formulated, extruded and soy-based feed with protein levels of 24%, 28%, 32% and 36% in 4-m³ LVHD cages at Baitang Reservoir, Haikou, Hainan Province, China. Tilapia fed the ASA-IM 24% protein feed grew from 50g to 511 g with an average FCR of 1.74:1 in 150 days; while the tilapia fed the ASA-IM 28% protein feed grew from 50g to 511 g with an average FCR of 1.55:1 in 127 days; the tilapia fed the ASA-IM 32% protein feed grew from 50g to 512 g with an average FCR of 1.41:1 in 110 days; the tilapia fed the ASA-IM 36% protein feed grew from 50g to 521g with an average FCR of 1.25:1 in 110 days.



respectively. The DE:DP ratio was constant for the feeds at 8.4 kcal of energy per gram of protein. The 32% protein and 6% lipid diet was the ASA-IM standard growout feed for tilapia and served as the control for purposes of determining whether the tilapia exhibited typical production performance in the demonstration. All feeds were produced by Ningbo Techbank Feed Company, Zhejiang Province using ASA-IM formulations and under ASA-IM technical guidance. All feeds were least-cost formulated from available ingredients.

All test feeds were fed in extruded, floating pellet form. Feed pellet size was increased appropriately as the tilapia grew, with pellet size maintained at approximately one-half the full open mouth size of the fish. Fish in all cages were fed twice daily using the ASA-IM 90% satiation feeding technique. Feedings were at approximately 8:00 am. and 4:00 pm. daily. Fish in the three replicate cages of each feed treatment received an identical amount of feed each day and at each feeding, but the 90% satiation feed amount was adjusted separately for each feed treatment. Daily feed records for each cage were kept by the cooperator. Daily feed amounts were added together and recorded in the ASA-IM Demonstration Data Book for each respective sampling period and for each feed treatment.

The four test feeds were analysed at the Feed Research Institute of Chinese Academy of Agricultural Sciences, Beijing. Dry matter was analysed by drying the samples to constant weight at 105°C. Crude protein was determined by digestion using the Kjeldahl method (AOAC 1997) and crude protein content estimated by multiplying nitrogen by 6.25. Crude lipid was measured by acid hydrolysis with a Sotex System Hotplate 2022 Hydrolyzing Unit (Foss, Hillerød, Denmark), followed by Soxhlet extraction using a Sotex system 2050 (Foss, Hillerød, Denmark). Gross energy was determined by Parr 1281 Automatic Bomb Calorimeter (Parr, Moline, IL, USA).

Growth performance

The number of culture days for tilapia to grow from 50g to the targeted 500g market size was inversely proportional to the protein level of the feed, with the shortest time to market of approximately 110 days obtained with the 36% and 32% protein feeds, and the longest time to market of approximately 150 days obtained with the lowest protein feed (24%) (Table 2, Figure 1).

Highest and lowest daily weight gains for tilapia were obtained with the 36% and 24% protein feeds, respectively. The feed conversion ratio (FCR) was also inversely related to the protein level of the feed, with the lowest FCR of 1.25:1 obtained with the highest protein feed (36%), and the highest FCR of 1.74:1 obtained with the lowest protein feed (24%) (Table 2).

Table 2. Production results for tilapia cultured with four different protein level feeds in 4-m³ LVHD cages in Baitang Reservoir, Haikou, Hainan Province, China.

Feed treatment	Harvest weight (g)	No. culture days[1]	FCR2	Survival (%)
24% protein	511	150	1.74:1	94.7
28% protein	511	127	1.55:1	90.8
32% protein	512	110	1.41:1	85.43
36% protein	521	110	1.25:1	93.6

[1] Tilapia were cultured to larger than 500g. Number of culture days to 500g was determined for each feed treatment from sampling data and calculated growth curves.
[2] FCR was calculated from actual feed fed during the number of culture days to fish size 500g.
[3] The survival of tilapia with the 32% protein feed was lower than the average because some fish escaped during the heaviest typhoon and storm in the past 50 years in Hainan.

The protein retention ratio (PRR) was inversely proportional to the protein level among the four test feeds. The 24% protein feed had the highest protein retention ratio, followed by the 28% and 32% protein feeds. The 36% protein feed had the lowest protein retention ratio(Table 3) because it was over formulated for tilapia and some were deposited as fat.

Table 3. Protein retention ratio in tilapia fed four different protein level feeds in 4-m³ LVHD cages in Baitang Reservoir, Haikou, Hainan Province, China.

Feed Treatment	Protein retention ratio (%)
24% protein	42.97
28% protein	40.85
32% protein	37.80
36% protein	37.21

The lowest feed cost per unit of fish gain, the highest net economic return, and the highest return on investment (ROI) were all obtained with the 32% protein feed (Table 4). Feed cost per unit of fish gain was RMB 7.07 for the 32% protein feed, in comparison to RMB 7.30, RMB 7.08 and RMB 7.22 for the 36%, 28% and 24% protein feeds, respectively. The 32% protein feed had an average price of RMB 5.05/kg (USD 0.68/kg), and was 13.7% less expensive than the 36% feed, and 10% and 17.8% more expensive than the 28% and 24% protein feeds, respectively.

Net income with the 32% protein feed was 3.85 times and 2.67 times greater than with the 24% and 28% protein feeds, respectively. There was less than a 2% difference in net income between the 32% and 36% protein feeds. Return on investment (ROI) was highest (20.2%) with the 32% protein feed, and lowest with the 24% protein feed. ROI was less than 7% and 5% with the 28% and 24% protein feeds, respectively.

Table 4. Economic parameters for the four protein level feeds fed to tilapia in the 2010 comparison feed demonstration conducted in Haikou, Hainan Province, China.

Parameter	36% Protein	32% Protein	28% Protein	24% Protein
Feed cost/kg (RMB)*	5.85	5.05	4.55	4.15
Feed cost per kg fish gain (RMB)	7.30	7.07	7.05	7.22
Net income/cage (RMB)[1]	956	972	363.6	252
ROI (%)[2]	17.5	20.2	7.0	4.6

[1] Net income per cage is an average of the three replicate cages for each feed treatment

*[2] ROI is an average of the three replicate cages for each feed treatment. Fish price was dramatically dropped at the end of production season in response to market saturation of freshly harvested fish. *RMB 6.50 = USD1.00*

Summary

Results of the demonstration indicate that formulating feed to optimize protein can yield significant production, economic and risk advantages for tilapia farmers. A feed protein level of 32% was found to yield the lowest feed cost per unit of fish gain and the highest net economic return and return on investment ROI. Tilapia stocked at 50 g obtained a target market size of 510g with the 32% protein feed in approximately 110 days, 40 days less than with the 24% protein feed. This significantly shortened the time to market and therefore production risk over the lower protein diets tested.

The FCR of 1.41:1 with the 32% protein feed was slightly high because some fish escaped during the heaviest typhoon and storm in the past 50 years in Hainan during that year. The higher FCR with the 28% and 24% protein feeds resulted in an approximately 20% higher waste input into the water system than with the 32% protein feed. As a result, the low protein feeds increased risk by increasing the potential for disease, water quality and other factors to impact the fish crop in response to the higher waste input.

Global tilapia farmers are encouraged to use a nutritionally balanced, 32% protein, soymeal-based feed to culture tilapia as a means to maximize economic return and improve sustainability through reduced environmental impact.

Acknowledgements

ASA-IM gratefully acknowledges the participation and cooperation of the Hainan Breeding Center of the Beijing Municipal Fishery Extension Center in conducting this feeding demonstration in cooperation with ASA-IM China. All of these organizations contributed time, personnel, facilities and funding for this water conservation demonstration for aquaculture sustainability. ASA-IM also like to thank Ningbo Techbank Feed Company for producing all demonstration feeds; Chengdu Phoenix Aquafeed Company for producing the vitamin and mineral premix; ADM, Qinhuangdao Goldensea Foodstuff Co., Ltd and Yihai (Fangchenggang) Soybeans Industries Co., Ltd, Yihai Group for the free contribution of SPC product and Novus for the free contribution of antioxidant (Solis Mos).

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Acidification in monogastric fish: limits and potentials

By Christian Lückstädt

The impact of acidifiers on the proper digestion of high protein diets.

In monogastric animals, including a wide variety of different fish species (ranging from salmon and trout, tilapia, sea bass to pangasius), the chemical breakdown is next to others achieved in the stomach through acidification. According to Wikipedia 'a monogastric digestive system works as soon as the food enters the mouth. Saliva moistens the food and begins the digestive process. After being swallowed, the food passes from the esophagus into the stomach, where stomach acid and enzymes help to break down the food. Bile salts stored in the gall bladder empty the contents of the stomach into the small intestines where most fats are broken down. The pancreas secretes enzymes and alkali to neutralize the stomach acid.'

The 'stomach acid' working in all monogastric animals is hydrochloric acid, a very strong inorganic acid, which is produced by gastric glands (parietal cells). This acid is able to lower the pH in the stomach to levels between pH 1-3. The hydrochloric acid production at birth is negligible, but it will increase with the age of the animal. The more the acid is produced in the stomach, the lower is the pH.

The present pH is involved in the activation of pepsin, which is a proteolytic enzyme. This is needed in the digestion of protein. Pepsin is secreted as an inactive zymogen, called pepsinogen (inactive in order to not 'digest' the stomach itself when no food is available). Its conversion into the active form is catalysed by the action of the acid. Similar to every enzyme, pepsin has certain optimal conditions in which it is works best. The optimal pH for pepsin activity is 2.0. At higher pH levels the activity is severely reduced.

Monogastric aquaculture species

What are the implications of this for monogastric aquaculture species, which are heavily depending on the high protein inputs and on its proper digestion of these expensive ingredients?

One of the possible answers may come from feed additives. The use of organic acids or acid salts has been studied and reported in numerous publications over the past half-century in animal nutrition (Cole et al., 1968). Supplementing diets with organic acids reduces the pH in the stomach, it stimulates thereby the activation of pepsinogen to pepsin and thus may improve protein digestibility and decrease the rate of gastric emptying. It further improves protein digestion by increasing the rate of proteolysis of large protein molecules (Theobald and Lückstädt, 2011).

The reduction of pH in the feed and stomach largely depends on the buffering capacity of feed ingredients. Animal protein (e.g. fishmeal), extensively used in aquaculture diets, has a 15 fold higher buffering capacity compared to cereals. These effects are especially important in view of the low hydrochloric acid output in young animals, as described before (Freitag, 2007). Most of these data are however stem from monogastric livestock, such as pig. Its investigation in aquaculture diets however has been done only very recently.

Bucking and Wood (2009) looked into the effect of feeding on stomach pH. The authors fed rainbow trout (mean weight 350g) a commercial trout feed with 41% crude protein in a single-meal (2% body weight ration) and monitored the resulting pH in the stomach. Just before feeding the stomach pH was at ~2.7, whereas the pH one hour after feeding went significantly up to pH 4.9. It remained there for at least 8 hours, thereby being far above the optimum for pepsin activity. The chyme was released into the duodenum 8 hours after feeding, at far too high pH-levels. The authors speculated that the buffering capacity of the feed was a major contributor to the increased pH of gastric fluids. It took the fish more than 24 hours to reach the 'low' initial pH of the stomach (Figure 1a and 1b).

The effect of diet buffering capacity on the gastric acidification in juvenile fish was proven as well by Marquez et al. (2011a). They found that fishmeal diets had a 10-fold higher buffering capacity and therefore needed more energy for acid secretion per digestion cycle, than test-diets without animal protein meals.

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

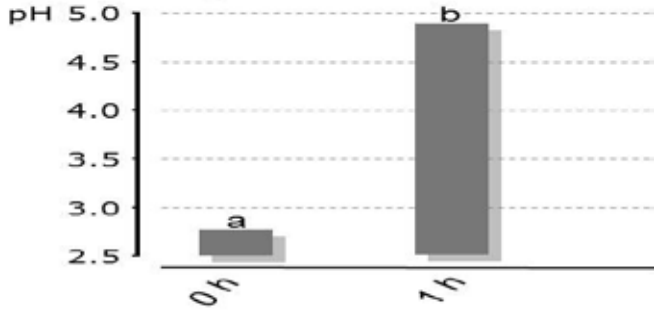
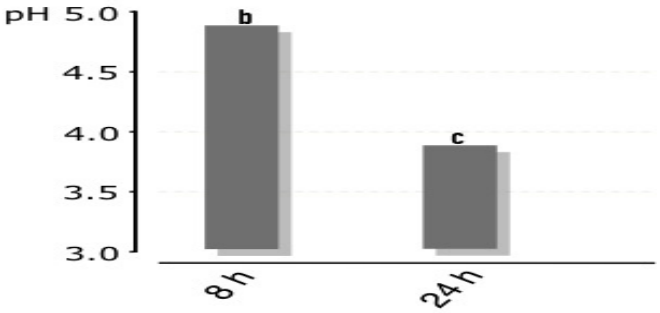


Figure 1b: Stomach pH in trout during digestion.



Figures are adapted from Bucking and Wood (2009).

Similar observations on feeding and gastric pH have been made by Yufera et al. (2011). This Spanish research group fed juvenile gilthead seabream in three different ways: once, twice or continuously and monitored the resulting pH-levels in the stomach. Feeding was done either at 9:00 or at 9:00 and 17:00, or continuously between 9:00 and 21:00. The gastric pH exhibited significant daily rhythms under the three tested feeding regimes (Figure 2). Only in the feeding regime with continuous offer of feed the stomach pH remained for a while in the region of the pepsin optima. This may be a reason for the significant greater weight of the fish from that feeding regime. It could be also explained by higher gastric activity in fish with gastric pH-levels below 4.5, as documented by Marquez et al. (2011b).

A subsequent study from Yufera et al. (2012) took this a step further. This time, the authors looked at the connection between stomach pH and pepsin activity in juvenile marine fish. Fish were again fed either a single-meal, twice or continuously the same diet at the same times as mentioned above. In comparison, fish fed only once again had pH levels in the stomach around 4.5, while the highest pepsin activity was actually reported before the feeding with 30 pepsin activity units per fish. Contrary to that, continuously fed fish reached a minimum pH in the stomach of ≈2.5 and had a resulting pepsin activity of almost 280 units per fish in the late afternoon. This clearly demonstrates the impact of low pH on pepsin activation (Figure 3a and 3b).

Figure 2. Stomach pH in sea bream after feeding three different feeding regimes.

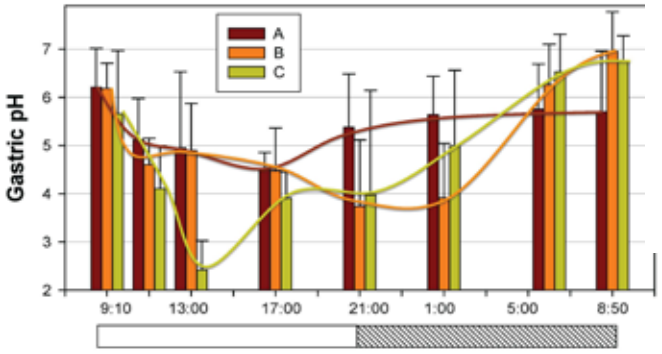
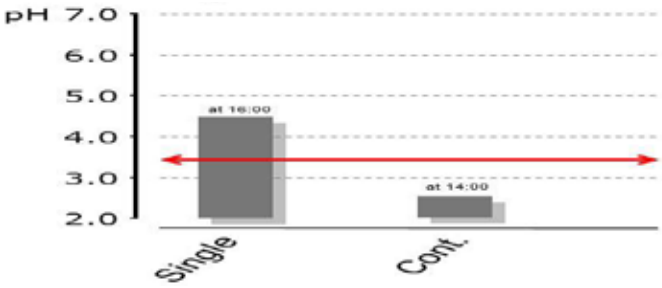


Figure 3a. Stomach pH in differently fed marine fish

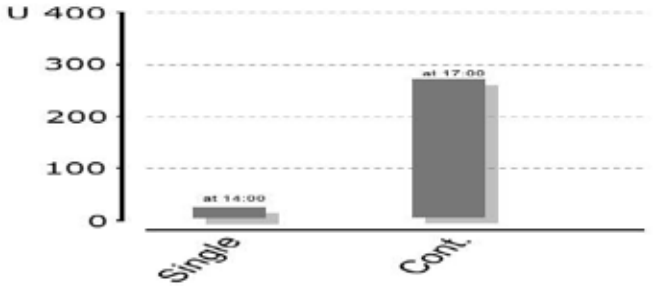


What are the implications?

The use of acidifiers is gaining more interest in recent years (Lückstädt, 2008). However, most of the described effects are thought to stem from the anti-bacterial mode of action of organic acids. The impact on protein digestion is often overlooked. A recent meta-analysis for potassium diformate (Aquaform, ADDCON) found significantly improved weight gain and feed efficiency for tilapia in levels which can be already described as 'growth promotion' (Lückstädt, 2012).

These results may not stem only from the surely existing anti-bacterial effects. Since an acidifier, if chosen properly, may have impacts on buffer capacity and/or stomach pH they will also have an impact on the digestion processes in the gastric tract. It may be time to look into this further.

Figure 3b: Resulting pepsin activity in the stomach of marine fish



(Figures 3a &b are adapted from Yufera et al., 2012.)

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Retail concentration and demand for seafood products

By José Fernández-Polanco

Today's producers need to increase efficiency and fit into key demands for quality, safety and sustainable production. Increasing production in a highly fragmented small scale industry causes a negative impact on prices and producers should adapt to current market conditions with mergers and strategic alliances.

Worldwide seafood demand has been increasing in the last decade and it is expected to continue rising. This trend brings opportunities for the development of aquaculture, which accounts for 50% of the global supply of fishery products, according to FAO estimations. Fish and shellfish farming in the near future will boost food supply and supplement the supply from a stagnating wild capture fisheries production to satisfy an increasing demand from a growing population with enhanced preferences for seafood. Furthermore, improvements in quality, safety and sustainability, which appear as today's key drivers of consumers' preferences are easier to achieve under a controlled production which gives market advantages to aquaculture in contrast with a fishery.

Despite this promising prospect for aquaculture production, some issues and market turbulences make the path for success more difficult than expected. Although statistics show growth in production, increasing production does not always imply business success. Production has grown faster than commercial demand, negatively affecting world seafood prices and supply. Prices of some species have fallen faster than production costs, which have resulted in loses and bankruptcies and jeopardising the future of the industry.

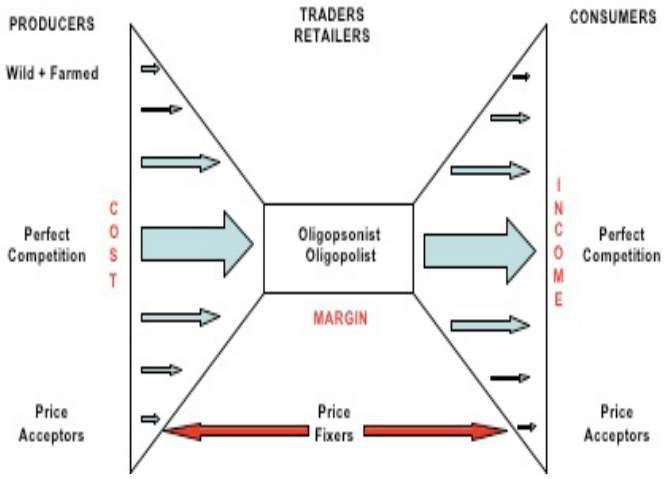
Competition with wild seafood supply

The supply from capture fishery is still a keen competitor. Relationships between both industries and across farmed species are not always peaceful. Morever, even increases in wild seafood supply will not be much but sustainable fishery management policies will ensure that it remains a relevant food source with a stable supply in the future. Aquaculture is still a new industry in the minds of most consumers, causing confusion and mistrust with regard to safety in many segments. This is especially in some communities with a long tradition of seafood consumption. The information provided to the market is not always clear. Consumers have to deal with favourable and unfavourable news on the industry and its products, affecting the perceived value of farmed seafood.

Imperfect market conditions

Retail concentration and the development of large international chains have contributed to important changes in the business environment. Traders are economic agents looking to maximize their profits. They will focus on cheaper seafood meeting the quality standards to increase their margins with respect to consumer's prices. These policies may also hurt producers' revenues and reduce their profits, especially if there is any urge to sell. Retailers have become arbitrators for consumers, determining, by their supply decisions, what are going to be the most consumed species at any time. Under this framework market competitive conditions are imperfect. A large number of producers deal with a small group of traders, who intermediate with a huge number of consumers (Figure 1).

Figure 1. Market concentration and power in the seafood supply.



Producing and selling fish is no longer enough to achieve business success. A product is a composite of values. Quality goes beyond physical attributes and needs to be proven both to retailers and consumers. Marketing, organisational and transactional aspects are growing in importance. Retailers are not just looking for fish and shellfish. They demand the sort of attributes that do not necessary match with consumers' preferences in a first instance. These attributes are: price; volume and timing; raw material specifications; product range and differentiation; production process; and transaction costs.

Pricing

As traders will be trying to increase their margins, pricing becomes important. However, cheap fish is not all that they require. Product prices should be linked with market prices, relative to the same and other competing or complementary goods. Retailers will also be interested in quantity discounts and convenient payment conditions. Prices then become flexible according to market forces and the terms of the agreements between producers and traders. Lack of flexibility may result in barriers for contract renewals.

Ability to deliver

Volume and timing of delivery is also an important requirement from customers. As the concentration in the supply chain increases, customers demand larger quantities of product, but having a big production is not enough. Deliveries need to be regular avoiding stock breakages that may make the traders lose sales in the short term and customers that can be attracted by competing suppliers. Producers also need to be able to satisfy unexpected requests from their trade partners, which imply flexibility in delivers and an adaptive stock management policy.

Flavour, flesh and size

Product physical attributes are, in ultimate terms, those determining the achieved levels of satisfaction by consumers. Quality attributes such as flavour and flesh consistency are quite important. Also a range of alternative sizes makes the product more attractive for retailers. Another important factor is consistency in quality, since any variation will disappoint customers.

Differentiation and reputation

Special considerations are required for differentiation. ie. those that make consumers perceive it as unique in comparison with the rest of competing species or commodities. The first level of differentiation in seafood markets is the species, but producers of the same species also can differentiate their production from other competing products. Processing can provide alternative product varieties, from raw and whole to pre-cooked recipes in different local or global styles. Private labels and brands also provide value for traders and consumers when the producers behind them are reputable. This reputation in customers' minds, especially across consumers, can only be achieved with the necessary communication effort by means of promotion and advertising.

A way in which products can also be differentiated is through the specific characteristics of particular processes of production. This is being done today mainly with certification schemes, whether by third parties or private, which verify that certain conditions are being observed when farming aquatic species. Some of the most relevant aspects with regard to production process which retailers want to be assured are issues related to safety conditions, including feed materials and antibiotics use; environmental impacts; animal welfare; and working conditions. This trend toward controls on the way the seafood is produced is increasing in importance for all these concentrated traders and retailers.

Finally, transaction costs are also a matter of concern for customers. Costs of negotiation, control and enforcement, transportation and storage can be reduced by concentrating supply.

Efficiency and adaptation

This scenario of seafood commercial distribution imposes producers to increase their efficiency in order to fit with this variety of customers' requirements. Concentrated industries such as the salmon have shown to better adapt to the current market conditions. In order to improve their relations along the supply chain, farmers should look at how to increase the size of their firms, by mean of merges or strategic alliances. Increasing production in highly fragmented small scale industries does have negative impacts on prices and revenues of companies in the same way as other farmed and wild species. This can cause of conflicts between producers and importing countries. These conflicts also affect the business at both sides of the borders. Of course, there is also the chance to focus on local niche markets. However, this is a feasible option for a firm or a group of firms, but maybe not enough for a full industry.

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Update

The European shrimp market

In issue July/August 2012 (pages 46-47), we published tables for shrimp imports into the EU. Subsequently, the author, Herve Lucien-Brun was notified that Eurostats system codes have change and the published graphs required updating. Below, are the new graphs for Figure 5 Volume of imports to Europe in 2010, 2011 and up to April 2012 and Figure 6, Value of imports to Europe in 2010, 2011 and up to March 2012.

Figure 5. Volume of imports to Europe in 2010, 2011 and up to April 2012.

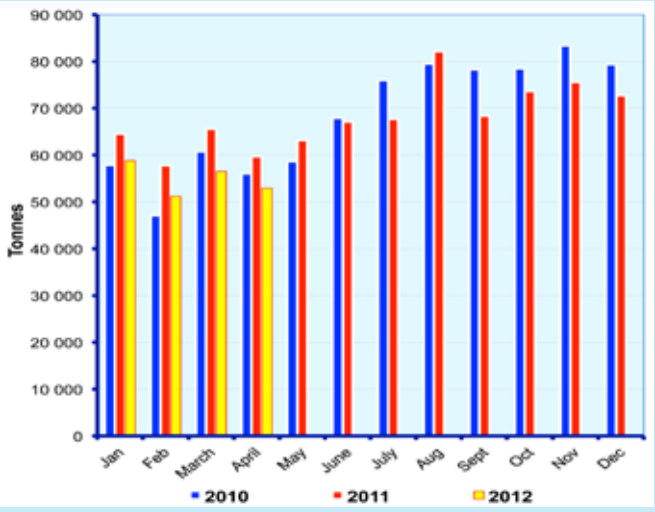
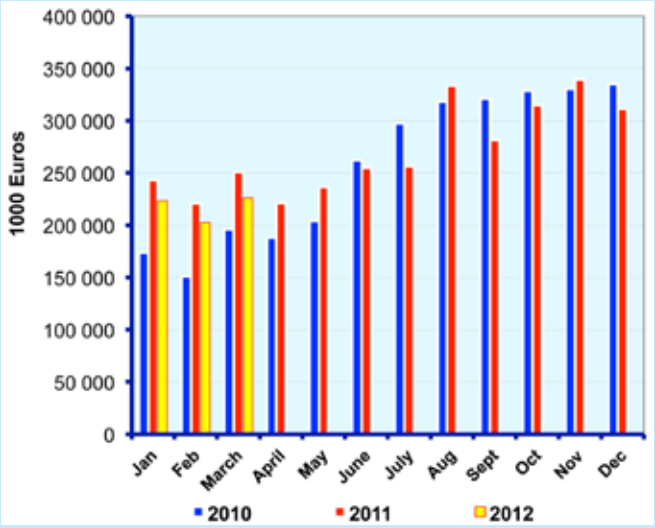


Figure 6. Value in Euros of imports to Europe in 2010, 2011 and up to March 2012.



Smart aqua additives for the blue revolution

The Nutriad team in Europe presented the latest developments on feed additives for cost effective and sustainable aqua feeds at a dinner seminar for customers mainly from the EMEA region (Europe, Middle East and Africa). This was held during AQUA 2012 conference and trade show from September 1-5 in Prague, Czech Republic.

Nutriad is an industry leading specialist in the development, manufacture and marketing of animal and Aqua feed additives worldwide. The headquarters in Belgium are supported by 5 manufacturing facilities in the US, UK, China, Spain, the Netherlands and Belgium. In 2009, the feedmill specialties division of INVE Aquaculture was integrated into Nutriad to become Nutriad's Business Unit Aquaculture. Nutriad offers species-specific R&D capabilities, innovative products and nutritional/technological expertise for the Aquaculture industry. Key products include species specific digestibility enhancers to reduce feed cost and improve performance (AQUAGEST®), palatability enhancers and attractants (AQUABITE®), specialized additives supporting the prevention of diseases and parasitic infections (SANACORE®, AQUASTIM®, APEX® AQUA), mycotoxin inactivators (TOXY-NIL® AQUA), additives to preserve aqua feeds and marine ingredients (OXY-NIL®, SALMO-NIL®, MOLD-NIL®), and low inclusion pellet binders (NUTRI-BIND).

The global aqua team comprises Dr Peter Coutteau, Business Unit manager, Alexander van Halteren, technical manager and Sam Ceulemans, R&D manager. Nutriad sells in over 80 countries world wide and its aquaculture activities are supported by regional aquaculture managers located in key markets for aquafeed such as Asia Pacific, Brazil and Mexico. In presenting Nutriad's mission in aquaculture, Coutteau said, "At today prices for the marine shrimp and fish, we have lost the luxury of high prices as before. With increasing prices of raw materials, we will need to do our homework on nutrition and study how we can optimise the use of functional additives for maximising nutrient utilisation and gut health. Nutriad has products which can address these challenges and today, we will familiarise you with them."

During the seminar, brief updates were presented on field and lab research with different specialty additives being commercialised for aquaculture by Nutriad. **Sam Ceulemans** showed case studies on the extreme replacement of fishmeal with vegetable proteins in marine fish. He said, "In general, this is not easy as aside from the nutritional replacement with crystalline amino acids, trace and macro

minerals, we have to look at other parameters such as palatability, fat digestibility and cost efficiency of the feed." The work with the American Soybean Association replaced fish meal with vegetable proteins and fats, mainly soybean meal and soy protein concentrate (SPC). Extreme replacement of fishmeal by vegetable protein in practical diets of gilthead seabream is possible if diets are nutritionally balanced in terms of amino acid profile, phospholipids and available phosphorous; and compensated in terms of functional properties using palatability/digestibility enhancers. A diet with 10% fishmeal performed better than diets without fishmeal.

Michalis Tzouramanis, manager Nutriad Hellas, shared some experiences with gut parasites in marine fish farmed in Greece. He discussed the prevalence of *Enteromyxum leei* in red seabream *Pagrus pagrus* which causes 5 to 10% mortality. The mortality rate is 40-50% in sharpsnout seabream *Diplodus puntazzo* whereas in Gilthead seabream *Sparus aurata* it is less at 2-5%. As for prevention strategies, he documented the use of Sanacore® GM to reduce the impact of the myxosporian gut infestations on mortality in cage farms in Greece, where the dosage used was 2.5 to 3 kg/tonne.

In Brazil, the current main challenge for tilapia production is the strong increase of raw material costs. **Alexander van Halteren** proposed the use of Aquagest®OMF which is a synergistic blend of

The Nutriad team in Prague, from left; Serhat Inegol, Nutriad Turkey, Sam Ceulemans, Michalis Tzouramanis, Karl de Bruyne, regional director, Europe, Middle East and Africa (EMEA), Peter Coutteau and Alexander van Halteren

digestive enhancers for tilapia, catfish and other omnivorous fish. A cage study with tilapia was performed by the Instituto de Pesca, SP, Brasil evaluating the optimal application of Aquagest® OMF in function of fish size and feed formulation. The optimal application resulted in significant improvements in production parameters (growth, FCR, survival) and fileting yield compared to the non-supplemented controls. For the tilapia integration in Brazil, farm revenues increased with 17% due to the use of the additive at 3kg/ tonne of feed.

Shrimp has a limited capacity to utilise lipids (see pages 32-34). This can be seen as lipid vacuolisation in histology samples of the hepatopancreas. A higher degree of vacuolisation is a sign of better health. **Karin van de Braak**, independent consultant, reported on a study on the manipulation of the hepatopancreas condition of *Penaeus indicus* and evaluating effects of production parameters at the National Prawn Company in Saudi Arabia. She showed the results from an inclusion of Aquagest®S at 2.5 kg/tonne. Growth was 30/kg at 122-129 days of culture and detailed histological analyses showed a three-fold increase of the percent of shrimp with a high degree of lipid vacuolization in the hepatopancreas after this supplementation. The results of the pond study revealed some clear trends on improved biomass gain, mainly due to a better survival. Aquagest®S is a functional feed additive improving the lipid digestion and hepatopancreas condition in shrimp which are key factors to optimize survival and growth in production.

Dr. Peter Coutteau closed the technical sessions with an update of Nutriad's recent research on quorum sensing disruption as a new mechanism to fight disease in aquaculture. Quorum sensing (QS) is the mechanism behind specific natural growth promoters. When bacteria reach a quorum, they are activated to become pathogenic. A solution is to disturb the signalling that is used by bacteria to communicate about the status of the quorum. This requires a QS interruptor. Quorum quenching is a promising mechanism capable of preventing diseases. In vitro studies with pathogenic *Vibrio harveyi* and *in vivo* challenge trials with Artemia showed that products such as Sanacore®GM have quorum quenching activities.

More information: www.nutriad.com

Best practice manuals on groupers

Indonesia is a major producer of the grouper seed stock with hatcheries in northern Bali producing 200,000 to a million tiger grouper *Epinephelus fuscoguttatus* per month and other species. The Australian Centre for International Agricultural Research (ACIAR) has funded research by Indonesian and Australian agencies to show how grouper nursing can provide an alternative to shrimp farming. As marine fish fin continues to develop in the Asia Pacific region, there will also be potential for specialised nursery culture in other countries.

The ACIAR project FIS/2002/077 on improved hatchery and grow-out technology for marine finfish aquaculture in the Asia Pacific region has produced two manuals which gives practical guidelines in the hatchery management and nursery culture of groupers. The guidelines have been developed from the ACIAR- funded research as well as experiences from Indonesian, Philippines and Australian scientists and commercial hatchery operators.

Hatchery management of tiger grouper (*Epinephelus fuscoguttatus*): a best-practice manual

ISBN: 978 1 921962 52 3 (print) 978 1 921962 53 0 (online) Date Released: 01/08/2012

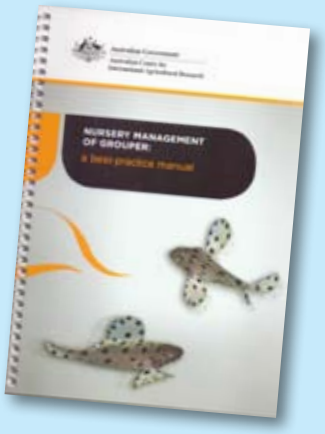
Authors: Ketut Sugama, Michael A. Rimmer, Suko Ismi, Isti Koesharyani, Ketut Suwirya, N.A. Giri and Veronica R. Alava

The tiger grouper is a popular throughout South East Asia as a candidate for aquaculture because of its rapid growth, hardy nature and good market price. This 66-page hatchery manual provides guidelines for the production of tiger grouper fingerlings. It outlines best-practice methods for brood stock maintenance, spawning, egg incubation and rearing of larvae through to 2–3 cm, fully metamorphosed juveniles. The manual provides a valuable aid for improving the availability of grouper seed stock to support sustainable small-scale aquaculture in the Asia–Pacific region. The manual begins with an introduction to tiger grouper and the hatchery technology, discusses brood stock management, egg handling, larval rearing procedures and fingerling production. It also deals with problems with larval rearing.

Nursery management of grouper: a best-practice manual

ISBN: 978 1 921962 54 7 (print) 978 1 921962 55 4 (online)
Date Released: 01/08/2012

Authors: Suko Ismi, Tatam Sutarmat, N.A. Giri, Michael A. Rimmer, Richard M.J. Knuckey, Anjanette C. Berding and Ketut Sugama



This manual provides practical guidelines for those engaged in the nursery culture of groupers in Indonesia as well as elsewhere in the tropics. The nursery phase is an intermediate step between hatchery production of seed (ACIAR Monograph No. 149) and stocking of grow-out farms. It involves growing delicate juvenile fish of 2–3 cm long through to physically robust animals of 5–10 cm long. The manual provides information on husbandry of groupers in the nursery phase, to reduce losses due to disease and cannibalism, and thus to increase the profitability of grouper nursing. There are chapters on tank and pond culture, stocking grouper fingerlings, management and cannabalism, water quality and health management and economic evaluation. A sample data sheet for grouper nursery culture is also included.

Both these manual can be ordered or downloaded (PDF) from the ACIAR web site:
Hatchery management of tiger grouper: http://aciar.gov.au/publication/MN149
Nursery management of grouper: http://aciar.gov.au/publication/MN150

World Nutrition Forum

Erich Erber (left) with John and Doris Naisbitt

At the aqua breakout session. Patrick Sorgeloos (second right) with from left, Jorge Dias, Brett Glencross, Shane Hunter and Goncalo Santos, Biomin, Austria.

The fifth Biomin World Nutrition Forum was held in Singapore, where 'East meets West'. This was a first for the WNF, which has been held in Austria since 2004. Erich Erber, chairman and founder of Biomin, emphasised that the theme, 'we talk future – not products' which characterises the WNF from the start, is reflected by a distinguished list of speakers. The two-day conference in October was attended by almost 800 participants from 75 countries. Breakout sessions addressed species-specific issues and for the first time, aquaculture was included.

"The future focus at the conference is on e+f=g^2; where Economics+ Generation F = Geopolitical change X Geriatric change," said Erber. "We are entering a new era called the age of scarcity with the end of low food costs. The turning point was in 1999. Prices went up whilst availability of resources went down. The answer to the change lies in innovative use of raw materials as well as better utilisation. The new game is moving away from FCR (feed conversion ratio) to FER (feed efficiency rate), stronger integration with better supply chain management and a greater focus on productivity within the industry."

The keynote address focused on China's key economic, cultural and political transformation. Author of the book, "In search of a new global model", John Naisbitt and Doris Naisbitt, director of the Naisbitt China Institute in Tianjin discussed how these impact the global business landscape. Their messages were; "To build tomorrow's global community, we have to let go of yesterdays' thinking; the lifeline of sustainable change and progress is to focus on the demands of time and needs of the people."

Short presentations in the sessions; People, Performance, Profit and Planet complete with some take home messages for the audience. In People, Jürgen König, University Vienna, Austria said that the consumer awareness are 90% on toxins in food such as mercury in fish; genetically modified foods and animal welfare. In animal feed assessments, John Gilbert, Food Life International, Turkey, said that in risk assessment, there is a need to understand uncertainties, safety margins, threshold of toxicity and modelling of exposure.

In Performance, and to achieve the genetic potential of broilers, V. Ravindran, Massey University, New Zealand, said that it is essential to focus on immune and nutrition interactions and use feeds that fit the specific age of the animals. In Profit, the message from Felicia Wu, University of Pittsburgh was that we can derive lessons on how we can further control mycotoxins by looking at the control of infectious diseases in human health. Planet addressed issues of the environment and M. Paterson, University of Minho, Portugal gave scenarios on the impact of climate change/mycotoxin issues to create an awareness for sustainable animal production.

Aquaculture out of the pond

At the aqua breakout session, five experts gave 'out of the box' thoughts for aquaculture of the future. Chairman of the session, **Dr Patrick Sorgeloos**, Ghent University, Belgium, said that aquaculture only supplies 2% of the global food supply and the rest is from land-based production. However, with limitations on land use, this has to change as aquaculture needs to contribute a larger portion to feed the burgeoning world population estimated at 80 billion. To be able to increase supply of aquaculture products, it is time to change the approach to a knowledge-based industrial technology from the current largely empirically-based systems.

"Knowledge-based means understanding the underlying mechanisms of some of the common practices in aquaculture such as using Vitamin C to relieve stress. We need to look over the fence at biotechnology for an interdisciplinary approach. Where are we today? In marine seed production, we face 20% survival rates whereas we know that seabass survival can be 50% in gnotobiotic or bacteria-free environments. Predictability in production is essential and these are some of the priorities for research. The concept of multi-tropic aquaculture where we balance fed aquaculture with extractive aquaculture needs to be explored too."

Mass production of reliable quality fish is a major bottleneck in aquaculture and problems are with variable spawning performance in terms of fecundity, egg quality, low larval and fry survival, stress and diseases, size variation and sub optimal growth. **Dr Jorge Dias**, University of Algarve, Portugal said in mammalian models, prenatal and early neonatal events such as maternal nutrition, abiotic factors result in lifelong contribution to post natal growth potential and health status. Could this metabolic programming be a breakthrough in fish nutrition? He discussed some developments in environmental cues to program regulatory systems in fish and nutritional challenges at early stages of development. A study with Atlantic salmon showed water temperatures during embryogenesis dictate adult myogenic phenotype.

According to **Dr Brett Glencross**, CSIRO, Australia, there is a lot of interest in the use of nutritional models to achieve the growth potential of fish, estimating feed utilisation demands and even in feed specification designs. One of the empirical models being used is bioenergetics factorial models, which are relatively simple to compartmentalise the demands for energy and/or nutrients for maintenance and growth respectively. A variation is one developed for the barramundi over a more expansive thermal range (20-40°C) to define the maintenance energy demands to reach target growth. The outcome shows the revised model that will make allowances for effects of temperature.

"The key value in nutritional models lie in their ability to explore ideas and assist in the refinement of experimental designs for further empirical studies," said Glencross.

As aquaculture involves about 220 species and nutrient requirements vary, it is not possible to arrive at a single set of nutrient requirements for all species, said **Dr Victor Suresh**, Integrated Aquaculture International, Brunei. "Moreover, in the case of aquaculture

Prof Simon Davies, University of Plymouth, UK (left) BK Murthy, Shree Vijay Aqua Feeds

Audience at the aqua breakout session

nutrition, information is unfortunately not so readily available. However, with advances in information technology, we have better dissemination of scientific literature but which in turn can mean information overload for the end user. But, the advantage is that databases can be created that will enable entry, quality control, archival, search, retrieval and analysis of data at an affordable cost. This allows for nutritive value predictions that are preferably integrated into a formulation software or at least provide the values in a format that can be easily read."

Shane Hunter, Aquabiotech Group, Malta said that for aquaculture to grow, it needs innovative fish farms and technologies. In cage aquaculture, he described cages holding 250 tonnes of fish to reach for better economics of scale. Land based farms include the National Prawn Company in Saudi Arabia, converting low value land into highly productive ponds producing 30,000 tonnes per year through vertical integration. In Norway, the requirement to produce more fish in the same volume of water has seen an explosion in recirculation aquaculture systems (RAS). Vertical farming within cities such as the high rise farming in Hong Kong brings farms near to markets. Other innovations are scanners to detect deformity in larval fish, 3D imaging techniques and fish/shrimp counters.

Developments at Biomin

WNF CO_2 offsets program and ISO 14040

At the WNF press conference, Andreas Kern, CEO, Biomin Holding, announced that for the first time in its history, a CO_2-emissions analysis was conducted for the event in Singapore. All emissions produced by participants' travel, consumption of electricity and local transportation will be offset by a photovoltaic plant with 420 solar panels near Ho Chi Minh City, Vietnam. In addition, all offices and lab buildings in the new factory will receive an extra layer of insulation to reduce energy demanded by air conditioning systems.

He added that Biomin is one of the first companies in this industry to receive ISO 14040 certificationin recognition of its environmental sustainability measures. The gate to grave assessment evaluated the performance enhancing effects of Biomin products in animals and associated reductions in CO_2 equivalent emissions. By optimising feed use and improving animal performance, it is possible to reduce emissions from livestock operations. For example, studies have shown that a tonne of CO_2 invested in a Biomin product reduced CO_2 equivalent emissions in broiler production by up to 120 tonnes.

New enzyme

During the WNF, it was reiterated that feed additives and enzymes in particular are the future of increased efficiency in feed formulations. Michael Eder, CEO Biomin America announced that the company has finally began the science to market process for a Fumonisin degrading enzyme called FUMzyme®, ushering in a new area of expertise for the company. As the first isolated enzyme to come out of the R&D pipeline, Biomin will emerge as a forerunner in the field of feed enzymes in addition to the mycotoxin-degrading ones. Production will begin in the Tulln plant in Austria, and there are plans to scale up production in the Brazil plant to tap on economics of scale.

Research and development

Biomin's turnover in 2011 was €160 million and 4% of this was spent on R&D. R&D play a major role in the innovation process, which is part of the long-term strategy of Biomin and the Erber Group as a whole. With the current space constraints in Tulln, Austria, there are plans for an additional area in the near future with the start of a 'research campus' next to the existing facility, said Dr Eva Maria Binder, vice president, R&D, Erber AG, Austria. "There is a worldwide research co-operation with various universities and institutes. Biomin enjoys a solid reputation among academic circles as can be seen from the high profile of academic visitors who have come to the WNF, and the high quality of the scientific poster sessions."

From left; Jan Vanbrabant, Eva Maria Binder and Dr Gerd Schatzmayr, director R&D, BIOMIN Research Center, Tulln, Austria.

Market expansion

"Asia will be also a source of continuous growth. For this reason, we are currently completing a new production facility in Ho Chi Minh City, Vietnam. Plans are also underway for another one in Wuxi, China, for all acidifier products as well as for a new line of products to be launched in the Chinese market. Indonesia has a strong growth potential and we have a dedicated aqua team for this market," said Jan Vanbrabant, CEO, Biomin Asia. The company located its headquarters in Singapore since 1998. Here, there is a manufacturing and service base, to be close to customers and sister company Romer Labs has a mycotoxin reference centre.

In 2011, Biomin's first own foray into Africa began with an operation in South Africa. High on the agenda are Mexico and Brazil in South America and the Middle East. "However, smaller markets offer huge potential and should not be ignored. In addition, the US and Canada have registered healthy growth lately," said Vanbrabant.

More information: www.biomin.net; email: cristian.ilea@biomin.net (Cristian Ilea)

Health workshop a success

INVE Aquaculture, the global leader in the research, development, production and marketing of feed and health products for hatcheries and farms organised an internal workshop in September which focused entirely on their extensive health product range.

Twelve commercial representatives from across the world met with the product manager, Dr Olivier Decamp, in Bangkok, Thailand to discuss actual and trending health issues related to rearing both shrimp and fish across the world. In order to benefit from the wide range of expertise and local market knowledge in the company, the workshop included extensive technical and practical presentations on the existing Sanolife, Sanocare and Sanoguard ranges, and a first glimpse at the company's latest innovations. Additionally, each of the participants shared their experience with dealing with major challenges of their local markets, such as diseases, impact on the environment, cost efficiency, etc.

In line with INVE Aquaculture's vision, shaping aquaculture together, the workshop also included visits to local hatcheries and farms. This proved once again to be a very efficient way to exchange information between customers and the global staff.

New insights in battling health issues

Among the topics discussed were details of the mode of operation from European sea bass farms that were shared with the Thai farm managers. Also, the different ways to cope with White Spot Syndrome virus, Infectious Myonecrosis virus and Early Mortality Syndrome (EMS)/ Acute Hepato-Pancreatic Necrosis Syndrome (AHPNS) were exchanged among staff from Bangladesh, Brazil, China, India, Indonesia, Mexico, Thailand and Vietnam. Last but not least, the design and operation of biofloc and semi-biofloc systems were discussed by staff from Indonesia, Vietnam and Latin America.

This clearly illustrates the company's idea that building and maintaining a strong, close relationship with its partners and, most importantly, its customers, is crucial in the further development of the aquaculture industry.

The complete workshop equipped the commercial staff not only with a better knowledge of the products' uses and benefits, but also enables them to bring a new insight in dealing with health issues in their own markets and continue to provide strong technical solutions to their customers. More information: www.inveaquaculture.com; Email: o.decamp@inveaquaculture.co (Olivier Decamp).

'Only one' shrimp farming program

In Vietnam, CJ Vina Co Ltd is committing itself for a larger role for a sustainable aqua industry with a new shrimp farming program.

"This program was designed after 2 years of observations to fulfill the needs of the whole industry, from the producer to markets. This means that food safety is the target and in turn it implies production with no antibiotics, unapproved chemicals and applying standard farming and environmentally friendly protocols. Production is fully traceable," said Yong Duk Park, president director, CJ Vina Ltd. The company is a subsidiary of CJ Cheiljedang Corporation of Korea.

CJ Vina and Blue Aqua International have a mutual partnership to instill improvements in the shrimp farming industry. The target is higher production, quality products and at lower costs of production.

Based on the adage that 'seeing is believing', the program started with a familiarisation tour from 6-9 September to Lampung Indonesia. This is where the program has been practised successfully for 5 to 6 cycles (3 years) at the farms of Henry Wijaya, Franz Anthony, Iwan Susanto and Pingping. Each of the visits included open discussions and technical training with farm technicians. The visits were coordinated by Shrimp Club Indonesia and CJ Lampung.

The official launch of the program was held on 17 September 2012 in Ho Chi Minh City. The memorandum of understanding (MOU) was signed between CJ Vina and Blue Aqua International. The details of the program, which included 24/7 technical support in addition to applicable farming protocols and performance feed was presented by Dr Victor Suresh, Integrated Aquaculture International, Brunei. Guests at the launch comprised farm owners and technicians from Soc Trang, Binh Thuan, Tien Giang, Ho Chi Minh and Tra Vinh, representatives from the Research Institute of Aquaculture 2 (RIA2), Vietnam Association of Seafood Exporters and Producers (VASEP), Asian Institute of Technology Vietnam, Sumitomo Vietnam, BIM Group and International Enterprise of Singapore.

During the visits, visiting farmers also shared information on how to pre-empt the early mortality syndrome (EMS) in Indonesia.

The MOU was signed by Yong Duk Park (left) and Dr Farshad Shishehchian , Blue Aqua International (right).

10th AFAF 2013 Yeosu and CAA4

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

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

Sessions

10th AFAF

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

CAA4

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

The Korean Society of Fisheries and Aquatic Science
10AFAF /CAA4 Home Office
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AQUA 2012

Science responds to industry needs

Every six years, the European Aquaculture Society (EAS) and World Aquaculture Society (WAS) organise a joint conference and trade show and this year AQUA 2012 was held in historic Prague, Czech Republic from 1-5 September. The previous joint event was in Florence in 2006.

Much has changed since then and this is reflected in the theme 'Securing our Future'. "This has an implication on global and regional food security and aquaculture trade, placing aquaculture products in the global seafood market. It also refers to economic and environmental sustainability and the image of aquaculture activities. Our future is what we make of it now - how we manage our future resource needs and especially how we educate, train and manage knowledge for the next generation of aquaculture researchers, producers and other stakeholders," said the organisers.

This was a truly global conference with almost 2,100 participants from 52 countries. At the 100 booth trade show, some 29 companies introduced their new products such as feed additives, alternative ingredients to fish meal, equipment for hatcheries, farming equipment including cages for brood stock and a fish/shrimp counter. The scientific program covered 4 days with 13 concurrent sessions for oral presentations covering a wide range of farmed fish, shellfish, algal and crustacean species from all climatic zones and continents. Of particular interests were the industry sessions. A general aquaculture farmer's day saw presentations on markets and aquaculture products (see article on p.40-41), multiple feed needs of different species and production environment, development of tilapia feeds, European mollusc industry and shrimp farming in Asia.This was followed by an industry forum which covered issues such as the impact of health management, aquaculture sustainability, applied nutrition strategies, tools to boost performance and productivity and critical factors for industry to develop successfully.

Securing our Future

The plenary speakers looked at this in two ways: **Dr Petter Arnesen**, Marine Harvest ASA, Norway gave an industry perspective whilst **Dr Geoff L. Allan**, NSW Department of Primary Industries, Australia looked at the science of aquaculture. According to Allan, if consumption remains at the 2008 level, global demand for seafood will be 138 million tonnes by 2025 and 159 million tonnes by 2050 This is 22 and 42 million tonnes above current production.

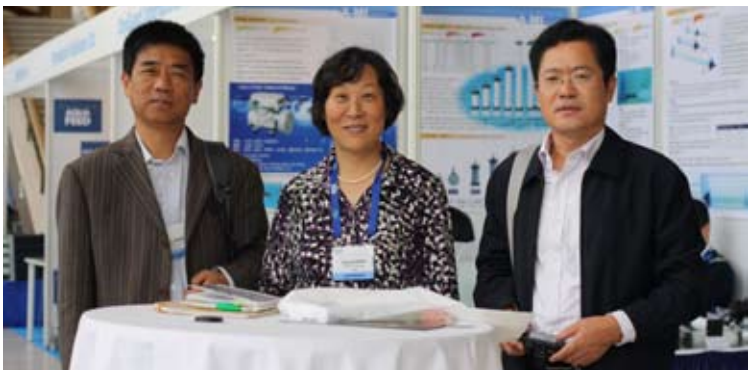
Dr Petter Arnesen

Dr Geoff L. Allan

"Even though the importance of aquaculture as an economic activity and as a contributor to food security is recognised by governments all over the world, constraints for further development of the sector are often related to slow development of policies and legislation. One example is the time/resource demanding process for obtaining new production sites in some countries and how this is holding the industry back due to lack of production capacity," said Arnesen.

Knowledge based management is required for securing ecological and economical sustainability of the aquaculture industry. To achieve this it is necessary to invest in R&D and the sector can benefit from establishing close links with research institutions in order to secure sufficient quality R&D assistance.

"In Norway for instance, the salmon industry has a long tradition of working with both scientists and regulators and there is general agreement that this model has been of significant importance for industry development. The EU aquaculture sector has established the European Aquaculture Technology and Innovation Platform (EATiP) and research needs are being defined through development of a Strategic Research and Innovation Agenda (SRIA) for European aquaculture for the coming two decades.



Dr Wang Qingyin (left) and Xin Fuyan (right) from the Yellow Sea Fishery Research Institute, with, Zhang Suping (middle), Institute of Oceanology, Qingdao, China. Wang presented on shrimp farming in China.

"The aquaculture industry being primarily focused on growth and sustainability faces challenges to communicate with other stakeholders; politicians and bureaucrats, who do not always share their enthusiasm and are at the same time being lobbied by special interest groups and NGOs against further development. A major challenge for the industry is to educate all stakeholders and the general public of the benefits and sustainability of the sector to coastal and rural communities," added Arnesen.

Priorities in aquaculture

According to Allan, to secure the future seafood supply, our challenges and priorities in aquaculture, will be in hatchery production, genetic stock improvement, nutrition and feeds, health management and production systems. However, at the same time, we need to reduce the environmental cost of aquaculture systems, to educate stakeholders so that they will have a correct notion on the benefits of aquaculture and improve post-harvest and supply chain management.

"Large-scale hatchery has driven the production of several species but significant challenges of increasing larval survival, growth rates and cost-efficiency still remain. The production of larvae and fingerlings of the pangasius catfish escalated in Vietnam in recent years but it still needs improvements in survival rates at each phase, better hormone management and better genetic stocks. We still have many 'difficult' species, including tunas, for which hatchery production remains at the research level. Priorities for those species include better understanding of biological development of early life stages, nutritional requirements (matched with changing digestive developments) and understanding and maintaining larval health," added Allan.

The future is with genetic improvements for several species. In addition, it needs a better knowledge of interaction between traits and use of genomic tools for genetic improvement programs. "This will need to be accompanied by research to better understand and manage the risks this new technology poses, including for containment, and the public will need to be convinced that appropriate safeguards are being applied."

To meet the estimated seafood demand for 2025, aquafeed production will need to increase to between 56 and 75 million tonnes per year. The primary challenge to meeting this production demand will be availability and competition for ingredients from other livestock and pet feed industries, biofuels and for human food. Concerns persist on the sustainability of using fishmeal and fish oil and their partial replacement with alternative protein and energy sources will need to be accelerated.

Vietnamese student Loc Tran (third from left) presented work done on the early mortality syndrome affecting shrimp in several countries in Asia at the OIE Reference Laboratory for Shrimp Diseases, University of Arizona, USA.

Integrating health and production

"Advances in health management are coming from better culture management practices and increases in knowledge of the genetic and physiological basis of immunity. Vaccine development is progressing and improved methods of delivering those treatments that are safe offer hope.The future priorities are also to seek molecular advances in diagnosis and to have integrated health management programs comprising culture system, organism, immunity modulation, nutrition, genetic improvements, biosecurity and other environmental factors."

The advances in production systems have contributed greatly to existing success and will be increasingly important in the future. Increasingly important are production systems for large-scale, offshore aquaculture, cost-efficient recirculation technologies, and integrated multi-trophic aquaculture. The coordination of aquaculture with energy systems in offshore environments also offers the potential for synergistic benefits.

European aquaculture in 2030

Innovation is the centre of European aquaculture at the European Aquaculture Technology Platform (EATiP). European aquaculture involves 35 species and in 2010, the production was 330,000 tonnes of freshwater fish, 1.6 million tonnes of marine fish and 650,000 tonnes of molluscs. It produced 4 billion juvenile fish and 2.7 million tonnes of formulated feeds. This is a €7 billion industry. It faces many challenges to its progress, among which are: competition in the marketplace, access and competition for space, health and welfare maintenance and improvement of resource use (EATiP, 2012). The vision of EATiP is to have sustainable and globally competitive aquaculture by 2030. It should provide 4.5 million tonnes of products worth €14 billion through a minimum annual growth of 4% for cold water and Mediterranean marine fish and 1.5% for freshwater fish.

Sustainable feed development

To advance knowledge on the long term effects of alternative feed ingredients, a new project ARRAINA – Advanced Research Initiatives for Nutrition and Aquaculture has started. This has a budget of €8 million, comprising a consortium of 21 partners and coordinated by National Institute for Agriculture Reseach (INRA), France (ww.arraina.eu). The project will identify targeted integrated tools to accurately measure and predict metabolic and health effects of the target species and to use the tools to test effects of diets over the full life cycle of farmed fish. One of the objectives will be to evaluate and tailor the potential of fish to use alternative feeds through nutritional programming.

The SEAFDEC group from the Philippines, from left, Maria Lourdes Cuvin-Aralar (left), Dr Relicardo M. Coloso (second right) and Roland Parkingking, Jr (right) with Dr Thomas Wilson, Thai Luxe Feeds, Thailand. Cuvin-Aralar presented on cage culture of Litopenaeus vannamei in the Philippines.

Patrick Sorgeloos (right) with EAS 2010-2012 President Yves Harache

EAS Honorary Life Membership

At the opening plenary session of the AQUA 2012, Patrick Sorgeloos, Director of the Laboratory of Aquaculture and the Artemia Reference Centre of the University of Ghent in Belgium, was presented with an Honorary Life Membership of EAS.

This highest EAS award is given to those persons that have had a marked impact on the development of European aquaculture. Since 1981, EAS has bestowed this award on only 10 persons. Past EAS President Selina Stead said Patrick Sorgeloos is a household name in aquaculture – not only in Europe but across the whole planet – and hence one of the reasons why EAS wished to make this award at its global event, AQUA 2012.

She described Patrick's exceptional vision. At about the time of the founding of EAS in the 70s, he realised the potential of a small crustacean that would affect aquaculture production in Europe and also throughout the world. Most cultured marine species require the use of live feed such as Artemia at the larval rearing stage. Patrick promoted the culture and use of Artemia to break a severe bottleneck in the commercial production of fish and shrimp. He founded the Artemia Reference Center and the International Study on Artemia, so important for world aquaculture. He created one of the global leaders in specialist aquaculture feeds and he is probably the world's most travelled aquaculture expert, having been to just about every country on the planet where aquaculture is practised. He created the 'standard' for a Masters course in Aquaculture and for specialist training on Artemia. More recently, he pushed the main industry players to create the EATiP that has just completed its vision and strategic research and innovation agenda which was presented at AQUA 2012.

On his part, Patrick dedicated the award to his beloved wife 'Mama' Magda and to her love, care and affection to the students, past and present, of the laboratory of aquaculture in Ghent.

Trade at AQUA 2012

Feed ingredients

Among the range of ingredients at Beneo-Animal Nutrition (www.beneo-an.com) is wheat gluten, a concentrated plant protein source with a crude protein content of more than 80%. This is suitable as an alternative to marine meals as studies with various species, rainbow trout Atlantic salmon and sea bream, show that almost 100% of fish meal can be replaced by wheat gluten. However, the first limiting amino acid is lysine which means that at high inclusion rates, a supplementation of lysine will be required. Wheat gluten is also a nutritive binder. The company also presented rice starch as an extrusion enhancer. Other products in its portfolio are rice flour, inulin and oligofructose and prebiotics from chicory.

In Europe, the reintroduction of processed animal proteins (PAP) derived from non-ruminant animals into feeds for farmed animals is expected in July 2013. Subsequently, Sonac (www.sonac.biz) a leading manufacturer of ingredients of animal origin is looking forward to this legal change. In Prague, the company discussed its existing portfolio of sustainable animal proteins, fats and minerals and an improved and newly developed hydrolysed protein and natural pellet binder for the aqua feed market. The proteins are processed in order to reach high digestibility levels. In its specialities portfolio, there are gelatin based pellet binders, Pro-Bind Plus, an effective, natural and low inclusion rate binder with more than 85% crude protein. Sonac also produces a fully hydrolysed mucosa protein. This product is an ideal attractant in juvenile aqua feeds in general and shrimp feeds specifically.

Chris Stock at the booth of Ziegler Bros, USA showed their alternative to Artemia, EZArtemia larval feeds for zoea 1 to post larvae (PL1) and PL1-PL15.

At American Soybean Association –International Marketing (ASA-IM) booth, from left, Michael Cremer, Dwain Ford, Bob Haselwood, United Soybean Board, and Lukas Manomaitis.

Tilapia

Acuaplan Genetics from Mexico (Email: info@acuaplan.com) is a pioneer in commercial tilapia fry production and was the first private laboratory for the genetic improvement of tilapia in South America. Founded in 1995, it is located in Tabasco state, in the middle of Mexico's rain forest. It offers the breeder stocks for hatcheries. It has salt water and cool water tolerant lines of brood stock. The company uses improved genetic bases such as GIFT tilapia to create superior lines and introduces last generation breeders annually. The project is sponsored by Mexico's National Council of Science and Technology (CONACYT).

Algae production

The potential of algae as substitutes for fish meal in fish and shrimp diets as well as the role of algae such as chlorella in improving fish health status and for biofuel production was elaborated in several presentations at the event. Algae cultivation will play an important role in the future and LGem (www.lgem.nl) has an easy to operate GemTube system which makes it possible to produce algae at a low cost. It is the first Dutch company to use closed photobioreactors to produce microalgae on a commercial scale. Since 2007 freeze-dried algae powder has been produced and sold all over the world as a food supplement. The innovative cultivation process has been steadily improved, resulting in a stable, robust and easy-to-operate production platform. In 2009, GF Piping Systems joined the development team, introducing new components. As a result of this fruitful collaboration, the tubular PBR has evolved into a cleverly designed system, with low operating costs. Top quality made affordable without compromises. All piping components of the PBR system products, ensuring highest possible quality for growing various algae strains. Essential elements have been patented.

Quick and simple counting of small organisms

A counter for fish and shrimp post larvae has been developed by a hi-tech start-up XpertSea Solutions Inc. in Quebec City, Canada (www.xpertsea.com). The company develops and commercialises aquaculture solutions based on optical technology and telemetry. The XperCount™ was demonstrated by the team at their booth. The company took a year to develop this technology and another year to market it. It is now in use in a shrimp hatcheries in Asia and marine fish hatcheries in Europe and North America. Academics and industry have worked together to achieve this, led by the president Valérie Robitaille.

"This is a simple device, portable and adapted to the marine environment. It has low maintenance and measurements can be performed using small volumes of water from 500 ml to 10L. You add the organisms to be counted, cover and press the button to initiate counting. The results are available within 10 seconds and the final output can be numbers or the concentration per ml," said Cody Andrews, vice-president.

The counter generated a lot of interest at the show. The technology is based on a programme stored in a SD card on the lid of the counter. It will also store many different applications which the company will continue to develop for the aquaculture industry.

The tests carried out showed that the counter can be used to numerate the following: Penaeid species (*Penaeus vannamei, P. stylirostris* etc) from eggs to 12-20mm juveniles at numbers of 1-2 million eggs to 7,500 -500 juveniles; sea bream and barramundi from eggs to 15-45mm fingerlings at numbers of 20,000 to 500,000 and 1000 to 200 juveniles and microalgae such as *Chaetoceros* at 6-100 million/ml.

The XpertSea team, from right, Valérie Robitaille, Cody Andrews, Sylvie Lavigne and Louis-Simon Bourgault. On the left is the counter bucket.

Looking East

RICH S.A. has an range of innovative larva diets for the shrimp and marine fish and is now looking at markets in Asia.

Since 1990, RICH S.A. has been producing innovative products for the aquaculture industry. It is based in Athens, Greece. The products cover marine fish larvae and shrimp larval culture. In the case of marine fish larvae the main products are ESSENTIAL RICH and REPLACE 0 for green water application, M0 PLUS for rotifer culture, (n-3) TOP RICH for Artemia enrichment as well as REPLACE IIB, 150-200µm and REPLACE III, 200-400 µm for larvae culture.

In the case of the marine shrimp larvae, ESSENTIAL RICH and REPLACE 0 are natural diets based on algae and algae extracts applied during the initial zoea stage. The other range of REPLACE diets from 50-400µm (REPLACE I, IIA, IIB & III) cover the other shrimp larval stages from mysis to post larva stages.

"We have won several awards for our innovations in these feeds. The feeds are sold worldwide but mainly in Mediterranean hatcheries. In 2012, we are looking at the expansion of our markets and as Asia is the fastest growing market for small aqua feeds, we are looking for distributors," said Dr Antonios Komis, technical director.

"Quality for us is very important" added Komis. "We are using only top quality natural ingredients, that combine high nutritional value and very clean water medium". More information: Web: www.rich.gr; Email: komis@rich.gr

New name for R&D laboratory in Singapore

A research and development laboratory that has significantly contributed to the rapid growth of warm water aquaculture health over the past 12 years has changed its name to MSD Animal Health Innovation Pte. Ltd. The new name reflects the laboratory's parent company, MSD Animal Health (known as Merck Animal Health in the US and Canada), which is the world's leading developer of vaccines and pharmaceuticals for aquaculture and is the animal health business of MSD, a global healthcare leader.

The 9,000m^2 research facility is the Asia-Pacific region's only research laboratory specialising in warm water aquaculture. It was previously known as Intervet Norbio Singapore Pte. Ltd., which along with Intervet/Schering-Plough Animal Health was acquired by MSD in 2009. Since 2000, the laboratory has accumulated more than 2,300 bacterial strains plus 16 viral isolates of pathogens and 20 cell lines. This has already led to the development and commercialisation of eight vaccines for temperate and warm-water fish species. "We have been adding to our knowledge base of diseases and epidemiology," said Siow Foong Chang, R&D manager at the Singapore research facility.

Not just for Asia

This enhanced understanding of aquatic animal diseases has also benefited Latin America and other producers of warmwater fish. "Fish are cold-blooded and each species has an optimal temperature range at which they can be cultured economically," said Luc Grisez, director aquaculture R&D at MSD Animal Health. "The optimal temperature for a fish species is linked to the optimal temperature range for the pathogens affecting that species. Hence, disease agents among tilapia in Asia are similar or identical to the disease agents in Latin America and similar markets. Likewise, pathogens affecting yellowtail in Japan also affect European sea bass, since these species are cultured in similar temperatures."

According to Grisez, the Singapore facility was designed to conduct research with aquatic species in freshwater, full-strength seawater or anything in-between. In addition, water temperature can be set within a range from 18°C to 34°C. The laboratory includes 100 tanks, which enables scientists to adjust to virtually all temperate and warm-water aquatic conditions in the world.

Vaccines for warm-water aquaculture

Unlike the livestock industry, which has accumulated extensive knowledge of diseases and their effects on performance, there is still "very little information, let alone epidemiology, on aquatic animal diseases in warm water fish species," Grisez said. "So, when we opened the laboratory in 2000, the first thing we did was to start collecting samples from fish farms and to develop identification systems for relevant pathogens," he said. "I am convinced that our Singapore facility has the best insight of diseases in warm water aquaculture. There is nothing that comes close to the fully-typed strain collections we have built over the years and the experience we have gained in product development for the different warm water fish species."

This R&D effort has paved the way for MSD Animal Health to develop vaccines for warm water fish, such as tilapia and catfish as well as marine fish such as yellowtail, Asian sea bass (barramundi) and red sea bream. "Diseases have been a bottleneck for expansion of aquaculture in Asia," Chang said, "and in some markets, there has been an over-reliance on antimicrobials. Vaccination is an important component of the comprehensive, sustainable health programs that are needed to ensure good production performance and profitability."

Collaboration with AVA

The development of vaccines for warm water aquaculture has also created demand fordiagnostic services, which the Singapore laboratory routinely provide for MSD Animal Health customers. The downside to that trend, however, was that diagnostic services quickly stretched the resources of the R&D facility and interfered with its original mission to develop new products for aquaculture. For this reason, the company has recently started collaboration with the Singapore government's Agri-Food and Veterinary Authority (AVA) to better serve the aquaculture industry.

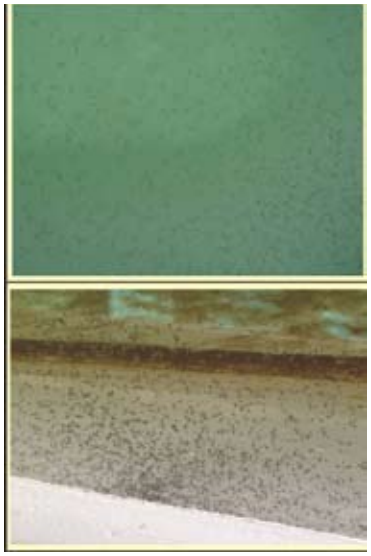
"It's a win-win situation," Chang explained. "By collaborating with AVA, we can provide our customers with diagnostic services while monitoring trends and devoting more resources to developing new products for aquaculture. This also allows the company to focus on research and build on its role as the leading developer of vaccines and pharmaceuticals for aquaculture."

More information: www.aqua.merck-animal-health.com

Fine particle size grouper feeds and nozzle aeration series

Taiwan's Hai Yu Enterprise showed new advances in feeds for the groupers and the nozzle aeration series at Vietfish 2012.

"Grouper culture is gaining momentum in Vietnam and we attended Vietfish 2012 to introduce our hatchery and juvenile feeds for the grouper, produced using a double adjusted extraction system for particle sizes from 800 µm to 2mm for the juvenile fish. Our GUDA range of four types of juvenile fish feeds is suitable for fish of 0.8-1.2 inch (2-3cm)", said Jeffrey Liu, general manager.



Giant grouper feeding on Guda SSS Transmicron microparticles after day 3 (top) and feeding on Guda S Transmicron microparticles after day 12.

Small particle size feeds

He added that with a new trans-micron technology, Hai Yu can offer feed options from the initial feeding stages to harvest. "Our challenge in producing feeds for grouper larvae, especially at the open mouth stage, has been the size of each particle. A bigger challenge is first feeding for the giant grouper *Epinephelus lanceolatus* which needs much finer particles. Conventional machines will only produce a minimum of 30µm. Working on this for the past ten years, we have come up with the trans-micron technology which produces particle sizes of 10-20µm to 20-50µm for the initial feeding of groupers such as the green grouper *E. coioides* and malabar grouper *E. malabaricus*. The feed for the grouper contains more than 59% crude protein, 8.4% crude fat, less than 2.9% crude fibre and is enriched with DHA and EPA fatty acids.

However, specifically for the giant groupers, we need to produce 2µm to 8µm size particles. Now we also have feed sizes available ranging from sizes 50µm -100µm for D3 to D6 and 300µm-800µm for D14 to D40 larval fish. These are now marketed in Taiwan for hatcheries producing groupers, cobia, barramundi and the marble goby *Oxyeleotris marmoratus*. With this success, the company is now ready to expand its markets into Vietnam."

Nozzle aeration in shrimp ponds

Hai Yu has long history in Taiwan's shrimp aquaculture industry. It is credited as the first to develop larval shrimp feeds in Taiwan with the introduction of the 'Iy Miao Pao'. In the last two decades, it has maintained itself as a leading supplier of feeds, from the hatchery to grow-out and also with pond management solutions such as water treatment. A new product for aeration in ponds and hatcheries is the neg-ion nozzle (NINS) series where each nozzle releases very fine bubbles which increases dissolve oxygen in every corner of the pond. Liu claims that this could help to solve some problems associated with the early mortality syndrome (see page 8) in shrimp ponds.

"This is an aeration technology which could help by providing a healthy and stable environment for the shrimp. As I see it, each nozzle produces 6-9 tonnes of dissolved oxygen which is 5-8ppm per hour. How the negative oxygen ion works in the pond is through the release of negative electrons into the water which will ensure no free oxygen radicals and eliminate bacteria in the water", said Liu.

He also compared this with the conventional aeration systems where the aeration reaches only surface water and oxygen created evaporates into the atmosphere. The middle and lower layers often lack oxygen. In the NINS, very fine bubbles are created by a diffuser under water and on the surface. More information: www.hai-yu.com.tw.

NINS equipment

Pentair Aquatic Systems Business Acquires Point Four Systems Inc

The Aquatic Systems global business unit of Pentair Ltd has announced the acquisition of Point Four Systems Inc. (PFS), a leading provider of engineered solutions and equipment for water quality monitoring and treatment. Point Four Systems has its headquartes in Coquitlam, British Columbia Canada and has international subsidiaries in Puerto Montt, Chile and Suzhou City, China.

"PFS adds critical water quality technology to Pentair's equipment portfolio while increasing our global reach," said Karl Frykman, president of Pentair's Aquatic Systems global business unit. "The combination of PFS along with our recent acquisition of Aquatic Eco-Systems, Inc. allows Pentair to be the single point of contact with the client while adding more technological capability and reaching a more global customer base."

Robert D. Miller will continue in his role as CFO of Pentair's Aquatic Systems business and has been appointed to lead the day-to-date operations of its aquaculture business, including PFS.

Pentair's Aquatic Systems business provides equipment, accessories and water technology solutions to the swimming pools and aquaculture industries. Aquatic Systems produces a broad line of products from pumps and filtration equipment to thermal products, automated controls, lights, automatic cleaners, water purification and treatment technology, water features and more. More information: www.pentair.com; email: jim.lucas@pentair.com (Jim Lucas, VP, Investor Relations), betsy.day@pentair.com (Betsy Day, manager, Corporate Communications).

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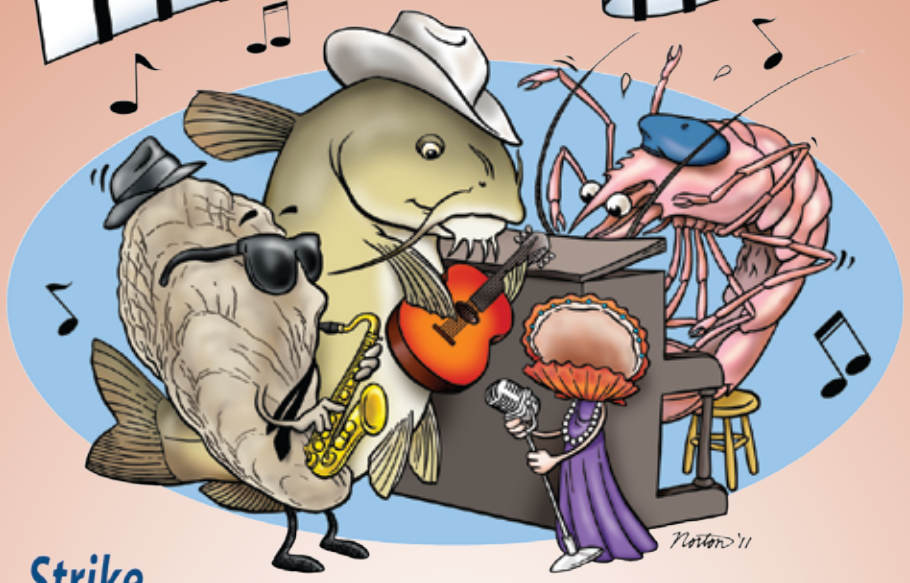

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Second edition of Aquatic Asia coming up in March 2013

The second edition of Aquatic Asia is coming up soon. After a successful introduction of Aquatic Asia in 2011, organiser VNU Exhibitions is ready to take this event to the next level. Aquatic Asia will become the meeting place for all who are active in the complete aquaculture supply chain from 13 to 15 March 2013.

Just as in 2011, Aquatic Asia will be organised in co-location with VIV Asia. At VIV all main suppliers from 'feed to meat' will be present to showcase the latest developments for the production of poultry and pigs. The organisers have seen a great synergy between the production chains of poultry, pigs and aquaculture. A further integration can be seen in companies that are not only active in the production of eggs or meat, but are also diversifying into the aquaculture business.

Large target groups, as top management of big Asian integrators and feed mills, have been present at VIV in the past. By co-locating Aquatic Asia these top decision makers have an additional reason to be present in Bangkok. However, a strong synergy between two events alone is not enough to attract more specific buyers to Aquatic Asia. This is why an extensive supporting program will be set up, on fish farming, shrimp farming, seafood marketing, aqua feed milling, treatment of upcoming diseases, probiotics and certification.

Aquatic Asia wants to be a practical platform where international expertise can be shared. Therefore the conferences will bring practical knowledge to visitors.

At Aquatic Asia around 30 companies will present the latest developments and products in feed additives, animal health, breeding, RAS technologies and Aquaculture farming equipment. Next to this around 80 major international players in feed milling technologies, feed additives and animal health will have joint livestock and aquaculture presentation at their respective booths in VIV Asia.

The visitor marketing campaign of Aquatic Asia will focus mainly on South East Asia, mainly Indonesia, Vietnam, Philippines, Malaysian and Thailand. In addition to this, specific campaigns will be set up in South Korea and India. With the support of the 100 A-Head program of TCEB, international delegations will be further supported to come to Bangkok and visit the show. To make sure Thai visitors will be able to visit the show, there will be collaborations with local media partners and the Thai Department of Fisheries. Even bus programs are being planned to make it easier for visitors from the southern and northern regions of Thailand to visit the show.

In 2011 Aquatic Asia attracted 1,350 dedicated visitors to the show, 450 visitors to the conference and over 5,500 visitors coming over from VIV Asia and demonstrated their joint interest in both livestock and aquaculture. The organisers are aiming to exceed these numbers as well as the quality of dedicated visitors with specific marketing efforts which will start from the beginning of November.

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

What can you expect from AQUA Culture Asia Pacific in 2013

In 2013, we can expect more developments as aquaculture plays its role as the leading source of seafood for the global market. Aquaculture in Asia will need to become an industry with an integrated supply chain. In order to be sustainable, we must learn how to control diseases in shrimp and marine fish while reducing costs of production through optimization of feed ingredients and feed management. AQUA Culture Asia Pacific can be a vital tool for your marketing needs. During this 9th year of our publication, we invite you to join us to look at opportunities and how we can help market your products and services.

Volume 9 2013						
Number	**1 – January/ February**	**2 – March/April**	**3 – May/June**	**4 – July/August**	**5 – September/ October**	**6 – November/ December**
Issue focus *Recent developments and challenges for the next step*	Aqua feed Production	Health Management	Hatchery & Breeding Technology	Food Safety & Traceability	Sustainable & Responsible Aquaculture	Culture Technology
Industry Review *Trends and outlook, demand & supply*	Marine Shrimp	Tilapia	Marine Fish	Catfish	Marine Fish	Freshwater Fish/ Prawn
Feeds & Processing Technology *Technical contributions influencing the final value of aqua feeds*	Feed Additives Processing technology	Novel Feed Ingredients Extrusion	Fish Meal /Oil Replacement Feed Management	Feed Enzymes Product Quality	Feed Probiotics Good Manufacturing Practices	Nutrition & Formulation
Production Technology *Technical information and ideas*	Culture Management & Biosecurity	Genetic Improvement	Recirculation Aquaculture Systems	Hatchery Technology	Certification and Regulations	Hygiene & Food Safety
Aqua business *Feature articles*	Experiences from industry, including role models, benchmarking and opinion articles in shrimp/fish culture					
Markets	Market trends, product development and promotions at local and regional trade shows					
Show Issue *Distribution at these events as well as local and regional meetings* **Show preview*	**Aquaculture 2013** February 21-25 Nashville, Tennessee, USA **VIV-Aquatic Asia 2013** March 13-15, Bangkok, Thailand*	**ESE 2013** April 23-25, Brussels, Belgium **10th Asian Fisheries & Aquaculture Forum& Fourth International Symposium on Cage Aquaculture in Asia (CAA4)** April 30 - May 4 Yeosu, Korea	**Vietfish 2013** June 25-27 Ho Chi Minh City, Vietnam	**The Aquaculture RoundTable Series (TARS 2013)**-Finfish Aquaculture August 21-22, Singapore	**18th China Seafood & Fisheries Exposition 2013** November China*	**Asian Pacific Aquaculture 2013** December 10-13 Ho Chi Minh City, Vietnam*
Deadlines Articles	**November 14 2012**	**February 1**	**April 2**	**June 1**	**August 1**	**October 1**
Deadlines Advert bookings	**December 3 2012**	**February 8**	**April 9**	**June 7**	**August 7**	**October 8**

PRACTICAL SHORT COURSE ON FEEDS & PET FOOD EXTRUSION

February 3-8, 2013, Texas A&M University, USA

A one week practical short course on Feeds & Pet Food Extrusion will be held from February 3 to 8 2013 at Texas A&M University by staff, industry representatives, and consultants. The program will cover information on designing new feed mills and selecting conveying, drying, grinding, conditioning and feed mixing equipment. Current practices for production of pet foods, preparing full-fat soy meal; recycling fisheries by-products, raw animal products, and secondary resources; extrusion of floating, sinking, and high fat feeds; spraying and coating fats, digests and preservatives; use of encapsulated ingredients and preparation of premixes, and least cost formulation are reviewed. Practical demonstration of pet food, vacuum coating, and several others are demonstrated on four major types of extruders - (dry, interrupted flights, single and twin screw), using various shaping dies. Reservations are accepted on a first-come basis. For more information, programs and application forms, Contact: Dr Mian N. Riaz, Food Protein R&D Center; 2476 TAMU, Texas A&M University; College Station, Texas.

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

2012

December 6-8
International Fisheries Symposium- IFS 2012
Can Tho, Viet Nam
Email: ntnlien@ctu.edu.vn or caf@ctu.edu.vn (Nguyen Thi Ngoc Lien)
Web: www.ctu.edu.vn/colleges/aquaculture/ifs2012/

December 7-8
Ildex Myanmar
Yangon
Web: www.ildex.com
Email:wara@vnuexhibitionsap.com (Wara Rujataronjai)

December 7-9
Shanghai International Fisheries & Seafood Expo 2012 (SIFSE 2012)
Web: www.sifse.com/en
Email: kim.yang@gehuaexpo.com (Kim Yang)

2013

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

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

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

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

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

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

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

May 30-June 2
Aquarama 2013
Singapore
Web: www.aquarama.com.sg
Email: aquarama_2013@online.ubmasia.com.sg

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

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

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

APA13

POSITIONING FOR PROFIT

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organized by the Asia Pacific Chapter of the World Aquaculture Society.

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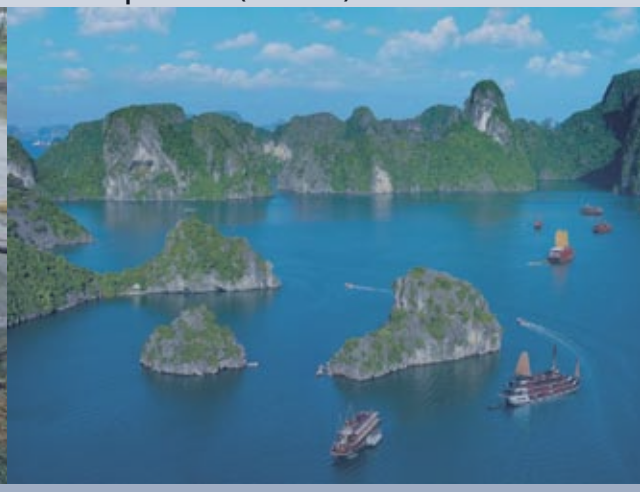
HO CHI MINH CITY, VIETNAM

Hosted by Ministry of Agriculture and Rural Development (MARD)





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