Australian Nuffield Farming Scholars Association

Epsom Road, Ascot Vale VICTORIA 3032.
Telephone (03) 9281 7424

Report of the Study Tour to Thailand, Taiwan and Europe

By Russell Reid
1995 Northern Territory Nuffield Scholar

SUBJECTS:
Prawn Farming and Aspects of Aquaculture

SPONSORS:

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An International Scholarship for Australian Farmers

The Nuffield Farming Scholarship Scheme is now firmly established in the United Kingdom, Australia, New Zealand, Canada, Zimbabwe and France and it is probable that other countries will join the scheme in future years.

Each country has its own independent Association responsible for funding, selection and administration.

The United Kingdom remains the focal point of the Scheme, with the United Kingdom Nuffield Farming Scholarship Trust providing an overall secretarial / liaison service.

Since 1950, more than 800 Nuffield Farming Scholars from the participating countries have criss-crossed the world studying a range of agricultural, trade, political and cultural issues.

Each country awards two or more scholarships annually and as a general rule, scholars from all countries assemble in the United Kingdom in February each year for approximately four weeks of group study before pursuing their individual programmes in the United Kingdom and / or other countries.

The interchange of scholars between countries is facilitated, costs are reduced and the standards of study enhanced by the Association and individual scholars in each country accepting an obligation to assist visiting scholars with itineraries, introductions, travel arrangements and accommodation.

This "Nuffield Network" has become a potent force within the overall scholarship scheme and it is constantly reinforced through the holding of a World Conference in one of the participating countries every three years.

These conferences are usually attended by over 150 former scholars at their own expense. They are concerned with the maintenance and improvement of the scholarship scheme and at the same time they provide an opportunity for former scholars to further expand and increase their knowledge of farming and related issues.

The Scholarship

The scholarships are awarded annually by the Australian Nuffield Farming Scholars Association to enable established farmers to travel to the United Kingdom and other countries for the purpose of increasing their knowledge of practical farming and the broader issues of agricultural production.

Obligations

Scholars are required to devote the whole of their time to a programme approved by the Australian Management Council; to resume residence in Australia upon completion of the scholarship; to submit a written report to the Association covering the study programme completed under the award; and to communicate details of their newly-acquired knowledge and experience to other Australian farmers.

Eligibility

The scholarships are open to Australian citizens of either sex who are engaged in farming of any kind in their own right or managing a commercial farming enterprise, and intend in the future, to enagage in farming in Australia. The preferred age is between 25 and 40 years, although outstanding applicants outside of these age limits may be considered.

Tenure and Location

The scholarships are tenable for four months. Initially a minimum of six weeks must be spent in Asia and the United Kingdom; a group orientation study with the Award winners from other countries is undertaken during this period. Scholars are then able to pursue their individual study programmes.

The United Kingdom Farming Scholarship Trust, the national Farmers Union and the Ministry of Agriculture provide generous support and assist in the development and execution of these programmes. Should successful applicants have farming interests which are not practised in the United Kingdom, they are permitted to complete their study programmes in the country or countries best suited to their pursuits.

Application Procedure

The Australian Nuffield Farming Scholars Association allocate a scholarship to each of the States and the Northern Territory once every three years in rotation.

Applications are invited by advertisements in the daily press from February to May; final selection takes place in August and the scholars are expected to arrive in the United Kingdom in February of the following year.

Further information is available from:

The Secretary
The Australian Nuffield Farming Scholars Association
Royal Showgrounds
Epsom Road
Ascot Vale VIC 3032
Telephone (03) 9281 7424 Facsimile (03) 9376 2973
Email rasv@melbourne.net

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Overview

My study program was designed around studying prawn farming in mainly Asia. I also took up the opportunity to investigate any developments on Mud Crab farming. I am pleased to say that most of my curiosity was founded, and I now walk away from this experience with a lot more confidence in prawn farming and general Aquaculture. Unfortunately, the subject of Mud Crab farming was a bit of a let down, as it appears that our very own aquaculture department, the Darwin Aquaculture Center, is already well advanced compared to some of the developments made in Asia.

The greatest interest for me on this study tour was the invaluable insight into Water Quality and the wealth of knowledge that Prof. Claude Boyde provided me with, hence the reason why some of this report may look a little technical.

Objective

To study the developments made in Prawn farming, this would include new technology, techniques and practices. Also to study any developments made on the farming of Mud Crab.

Study Plan

Visited primarily those countries involved in my topics. Pre-planned arrangements were made for Thailand, and Taiwan, the opportunity was also made to visit some other countries that have a history in Aquaculture, they were Scotland, Denmark, and Germany.

Introduction to the Prawn Industry

Whilst in Thailand I was lucky enough to attend a lecture given by a Mr James Wyban from Hawaii who describes the current world situation on Prawn Aquaculture, and I would like to quote part of his speech;

"Penaeus Monodon (Black Tiger Prawn) is the most important farmed shrimp in the world. Accounting for more than 60 % of world production, more that 450,000 tonnes of P. monodon were farmed in Southeast Asia in 1994. Thailand's 1994 exports of P. monodon were worth more than US $ 1 billon. Virtually all of this tremendous industry is based on the use of wild animals. More than one million wild P.monodon broodstock are needed yearly to supply Southeast Asia's seed demands. In contrast, other meat production industries such as poultry, swine, and cattle use domesticated stocks that are certified free of major decease-causing pathogens and genetically selected for improving production performance."

Whilst Mr Wyban's figures are impressive, we can not ignore that the industry has also had some major problems in the same period. Countries such as China, Taiwan, the Philippines , Indonesia, Thailand, Japan and Ecuador all have had serious disease out breaks that have either destroyed or devastated the industry.

Australia's proportion of farmed prawns has grown to 100 tonnes in 1989 worth $ A 1m, to 1600 tonnes in 1995 worth $A 20m. Most farmers and industry people would agree that Australia has not yet realised it's potential in the prawn farming industry, with similar growth trends predicted for the next decade.

Another very important factor to consider, is how new this industry is to Australia. It is widely publicised that Australian prawn farms have learnt and copied many techniques of prawn farming from those of our Asian neighbours. And even today we still rely heavily on information from Asia, whether it be on disease or better farming techniques.

Being an infant in this fast growing industry can be exciting and also dangerous, particularly if you happen to be one of the last developing countries in the world to take up the challenge. Some countries such as Ecuador, Philippines, Thailand, India, Central America have very low production costs, mainly due to cheaper labour. The danger with this is that these under-developed countries do not have the money to spend on problem solving, particularly disease. Rather if the problem occurs then they simply tend to manage around it or avoid it by changing species and in some cases they have even changed industries (aquaculture to agriculture). This has meant that countries like the US have now got involved ... even though it's own industry is very small, it has based itself on selling the technology. In the past 3-4 years Australia's growth in the industry has pressured government agencies into playing a more active role in Aquaculture, particularly in the line of defence against pathogens. Which I might add is the topic of issue on almost every farmers lips and agenda's around the world !

Thailand

World Aquaculture Conference '96

I visited Thailand prior to going onto Britain for the Tour, this enabled me to attend the largest gathering in the world for aquaculturists, hosted by Thailand and it's Royal family, coordinated by the US based World Aquaculture Society, it was called " World Aquaculture '96 ". What made this years event so significant was that it was the first time this or any similar conference was held in the largest prawn producing area of the world ... Thailand. Many of the delegates were prawn farmers or researchers specialising in the prawn industry and naturally, this environment provided me with just about every contact I needed to further my studies.

The conference was of tremendous help, with such a wealth of knowledge under one roof.

Information gathered either formally or by social gatherings are included under the specific topic.

Water Quality Course for Black Tiger Prawns

This 2 week course was held in Southern Thailand amongst the largest producing area in the country, and was conducted be Professor Claude Boyd of the Auburn University, Alabama, in conjunction with the local Fisheries Department of Southern Thailand. This course dedicated itself solely to water quality,.. and the changing dynamics of water in prawn ponds. Covering topics from water chemistry to fertilisation strategies. Prof. Boyd is regarded as the worlds leading expert on Water Quality Management, and is highly sought after in many Aquaculture circles. I felt privileged and honoured to have spent this valuable time with him. The small group of 11 delegates attended from all over the world, places such as India, Malaysia, Thailand, Philippines, and Jamaica.

Once again much of the information learnt from this experience is detailed below.

As part of this course we conducted many field trips to local prawn farms, thus allowing us the opportunity to discuss some of the local issues that they face and the chance to pick up some of the local farming techniques.

Taiwan

Here I made contacts with the major manufacturer of Aeration equipment in Taiwan, who were kind enough to show me some of the local industry up close. I also met with my Australian contact (Taiwanese investors in Australia), who also showed me various farms that include prawns, fish, mud crab, and abalone farms. All of which was invaluable to understand the industry.

I had three main missions to accomplish in Taiwan, one was to learn from the prawn farming industry, the second was "what caused the industry to collapse" and learn from it, and the third was to investigate what new species were being developed.

It would appear that Australia has already picked up many of the techniques that the Asians have developed and not much has changed since. The insight to land value was however, valuable as it played a major influence on how farms were setup. For example, due to the high cost of farm land ($ US 20,000 per hect.) all farm ponds were constructed of concrete walls and earthen bottoms, this was done as a means of saving vital space and increasing production and yields on each property.

Why did the industry Collapse?

The reasons why such a huge industry collapsed... is unfortunately not clear cut. Certainly, zoning of land is a major problem, for example in Australia... local government have control over land use and as a result zoned particular areas for different use. In Taiwan you can quite often see a prawn or fish pond with the farmers house on one side of the pond and a major shopping complex on the other. Farms are literally scattered through major industrial and residential areas, and as a result, much of the water supply needed for farms is drawn from public waterways, which are often polluted by either civil, industrial, and even other prawn farm wastes. This has been in the past, and is still very obvious now, as the major reason for disease related problems, although this is not the direct cause, it does put a lot of stress on the prawns which then become susceptible to disease.

New Species

New species being currently commercialised in Taiwan are fish (Grouper), and Abalone. Unfortunately the Grouper is a good example of commercialisation, in a very short time many prawn farms saw the culturing of fish as a way of over coming the prawn disease problem (fish are less susceptible) and as a result a situation has occurred where supply exceeds demand. The Abalone is very interesting however, I think that the sheer capital outlay and demanding labour will see a slow growth in this area of aquaculture. Mud Crabs were the other major interest too me as we have seriously considered commercially farming this species in Australia. To give a little back ground information on the Mud Crabs,... currently there is no technique developed for breeding Mud Crabs, however, there is on-going research in Australia, Philippines and Taiwan with this intention. (All existing Mud Crab farms get the crabs from the wild and fatten them before sale). After visiting the research centre in Taiwan who were thought to be leading the way, I discovered that our very own Government research centre in Darwin is not very far behind, if not comparable with Taiwan.

Europe

Whilst in Thailand I noticed that some of the larger Seafood Processing Companies were using equipment from Denmark. So while I was in Europe I visited them, and was pleasantly surprised as to the development in automating the processing side of the industry. They have successfully automated systems from grading to cooking and packing seafood. Although this particular company is leading this form of technology in the world, it is unfortunately very expensive.

I continued my travel down into central Germany, where I visited another manufacturer who specialised in fish harvesting equipment. We have previously imported some of there equipment. Even though he is a great contact, he was unable to help me with any equipment for prawns.

Topics

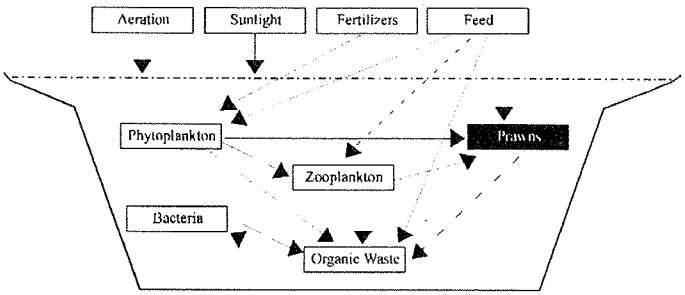
The following are some of the issues that I studied whilst overseas.

Water Quality

Discovering more about water quality was probably my greatest highlight whilst overseas, particularly with the valuable influence from Prof. C. Boyd.

Water quality to an aquaculturist is just as important as soil to a grain farmer, understanding water composition is the back bone of my industry. I also discovered from this that pond bottom soil also plays a much larger role in the cycle than I previously thought.

The following diagram shows the food chain of a pond, and how it can effect water quality.



Water Exchange

Continuously exchanging water in ponds has gone unchallenged for years, and as a result many farmers continue it as a daily routine. In the past water exchange serves several traditional purposes in aquaculture;

- one is too flush out excessive nutrients and algae bloom concentrations to avoid phytoplankton crashes,
- too flush out toxic metabolic wastes such as ammonia,
- to keep salinity low during the dry season as evaporation increases,
- another is to add dissolved oxygen to your pond.

Two important points have been learnt in this area; one is that, the best effects of water exchange can be achieved by first lowering the pond by 1/3 to ½ then refilling as quickly as possible. The simple philosophy behind this is given in the example, that if ammonia is the problem then by draining half the water, then refilling with water that has no ammonia then your problem is halved. Unfortunately, many farmers pump water into a pond while letting it overflow(constant water exchange), the problem with this is that as the new water enters the pond it mixes with the old and the discharge is a mixture of both old and new.

Prof. Claude Boyd is a strong believer in "less water exchange is better", and for the farmer the key to this knowledge is understanding the pond dynamics. As explained above, one way of dealing with ammonia is to flush the pond, the other is too flush less ! By restricting water exchange this creates a more stable environment for algae which is important for increasing Dissolved Oxygen, this inturn creates a favourable environment for bacteria. This stable and preferred environment is called aerobic, and under aerobic conditions the bacteria will convert ammonia to nitrate, which is non-toxic to aquatic life.

The advantage this knowledge brings is that it creates a healthier environment for the prawns, which should be relative to increased growth. The other big advantage is that we can run our water pumps for less time, thus reducing electricity costs.

The other highlighted topics on water exchange came from a lecture given by the Waddell Mariculture Centre of South Carolina, USA. This lecture highlighted " sustainable technology", with emphasis on the growing industry in aquaculture and the need to become more intensive to compete

with those countries that have resource advantages, ie. labour, etc. And also from an environmental view, " In a number of cases, intensive prawn culture operations have resulted in significant negative impacts on the adjacent estuarine and coastal environments". Primarily we are talking about the discharge water from farms having a major impact on local rivers and creeks, potential problems can be; increased suspended solids, algae blooms, the release of non-indigenous species, pathogens, etc. Thus, the need for more closed recirculating water systems on the farm. Work has been carried out on the benefits of recirculating systems with very positive results, however, there is still a lot of scepticism about this, more than likely it is fear and a lack of knowledge about Water Quality that has stopped many farmers in the past from trying this new theory.

Bacteria

In Thailand, prawn farmers are increasingly reluctant to use water exchange as a method of maintaining good water quality. This is due to the farmers perception that the influent water is the principle source of disease and water quality problems in their prawn ponds. In order to minimise water usage, various methods are now being proposed to maintain pond water quality without water exchange, thus creating the closed system. The use of bacterial water quality remediation products is now widespread in Thailand as a means of reducing ammonia and nitrite, organic matter and sediment organic concentrations.

The use of this product assumes that the existing bacteria population of the pond is incapable of removing the ammonia produced by the intensive culture system. However, according to the University of Sterling, Institute of Aquaculture, none of the bacterial products tested had any significant effect on ammonia or nitrite concentrations, and in fact the natural sediment used in the trials had all the bacteria necessary for the removal of ammonia and nitrite.

Bacteria has probably been the most controversial topic in the industry for the past few years. For many years "salesman" have tried to convince aquaculture farmers that bacteria is the key to a healthier pond. And as a result an industry has been built around the sale of bacteria. This usually comes in the form of a small bottle or a 20 ltr drum of living bacteria, that is then added to the pond to improve the pond bottom and overall dynamics of the pond.

I strongly believe that bacteria do play a very important role in the overall pond dynamics, however, Prof. Boyd has convinced me that introducing bacteria to a pond is a waste of time and money, because in many cases bacteria naturally live in all aquatic water ways. The real key is too know how to create an environment that will encourage and maintain good natural bacterial growth.

Stratification

In tropical aquaculture stratification plays a very important role in the daily management of ponds. In the tropics, a pond that is not mixed thoroughly develops steep temperature differences between the surface water and the water near the bottom, often being cooler near the bottom. The major concern of stratification is that when a pond has a significant algae bloom it will prevent sunlight reaching the bottom of the pond, thus creating a high dissolved oxygen (DO) concentration near the surface and a low DO near the bottom (as a direct result of photosynthesis). The water near the bottom may then become depleted enough to risk the health of prawns. To overcome this problem constant mixing of the ponds is important, this is easily achieved with the use of paddlewheels or mixing equipment.

PH

The control of acidity and alkalinity has often been mentioned in aquaculture literature as an important and fundamental criteria for farming fish and prawns. What was highlighted during my visit to Thailand was the importance of acidity and alkalinity in both water and soil.

Soil PH can be the cause of future problems in water quality, as acidic soils can leach into the pond water. Therefore good preparation of the pond bottom is essential. It was noted that many coastline areas have lower PH (acidic) than some areas that are more inland. The coastline that I'm referring too is of course land that is very close to mangroves or beaches, and it is these areas that are often used for aquaculture.

Acidic soil is often the result of land that was once mangrove or swamp land. Over generations, fallen timber and organic matter become buried in layers of soil. Layers of soil can best be described as either aerobic or anaerobic. The anaerobic and aerobic reactions are the result of Bacterial organisms decomposing organic matter, Decomposition occurs best in the surface soil, where there is an abundance of oxygen, and Facultative Bacteria, this oxygen is used for respiration and the by-product is carbon dioxide. Any deeper than this then Obligate Bacteria are more present, however, instead of using oxygen they will utilise the nitrogen in the organic matter for respiration and as a result they will also convert this nitrogen to carbon dioxide . Carbon dioxide is acidic, and a major influence on PH in soils.

Unfortunately, the by product of bacterial respiration is also harmful too it's own existence, as it is noted that bacteria also need favourable PH levels (4+) to flourish.

Apparently if the soil is sterile of bacteria, and the practise of just adding Lime was used, then on going problems with soil PH will continue, as it is a joint effort between bacteria and lime that will increase PH.

PH in pond bottom soil should be higher than 6.5, and preferably not exceed 10.

Preparation of a pond bottom, includes;

1. Tilling of the soil. This will encourage further bacteria reaction, and the quicker the bacteria can use up readily available organic matter the better. Tilling will expose more of the soil to oxygen, thus creating an aerobic condition, and faster decomposition of the soil. Depending of the PH level of the soil, liming maybe necessary, as too low a PH will also inhibit the growth of bacteria, and thus decomposition. After tiling, compaction is preferred, to avoid erosion of the pond bottom.
2. The above is probably the most preferred and cheapest method, however, it is worth noting that some farms in the Philippines had trucked in loads of crushed limestone to cover the bottom of the pond, as this was a cheap alternative and was easily available too them.

PH in water is a significant factor, this occurs from leaching of the soil and directly from the by product of bacteria and other aquatic respiration. PH in water should be tested twice daily, because the ratio of oxygen and carbon dioxide varies between daylight and night. And a fluctuation between morning and night of no more than approx. 0.5 can be tolerated by prawns.

Salinity

Before I left for this study tour I knew that manipulating salinity levels for faster growth was an unsettled topic, and nearly every farm in Australia had their idea of what was the best salinity level.

I discovered that there is a number of reasons why salinity can vary growth rates;

1. In higher salinity prawns require more energy to excrete the salt from their body, thus using valuable energy that can be otherwise used for weight gain.
2. Levels of salinity that are either too high or too low can also cause stress, and result in slow growth.
3. Fluctuations of salinity over short periods can also increase stress.
4. Too low a salinity can result in a calcium deficiency, although this issue is often debateable.

So what is the best salinity level? Well that depends on which country you visit. I found that almost no farm in Thailand manipulated salinity levels, they simply use the available sea water. This is probably due to Thailand's good rainfall and the large retaining capacity of the Gulf of Thailand, which apparently maintains salinity year round.

Taiwan like Australia however does not have this luxury. In Taiwan, so much under ground water has been pumped to the surface that it is now common place to see some of the country areas sinking. Whilst driving

around Taiwan I have very vivid images of seeing a whole cemetery sunk more than 3 feet from it's original level.

There is no doubt in my mind that salinity is a very important factor in the growth and health of prawns, however you may note that I'm purposely trying too avoid telling you what that exactly is for very good commercial reasons!

Phytoplankton

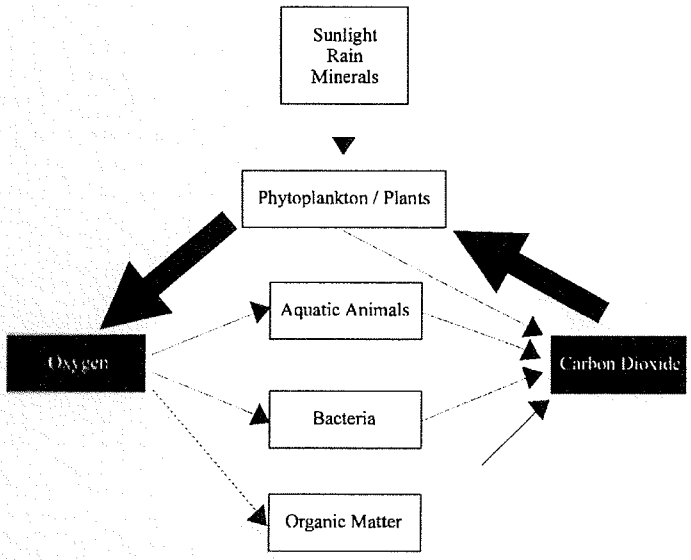
Algae growth in pond culture plays a very important role in the overall aspects of pond management. And the benefits are many fold;

Firstly, algae is grown in ponds by simply using a combination of Nitrogen and Phosphorus fertilisers, these maybe either organic or chemical based. The NP is usually mixed on site to encourage a desirable algal bloom, and can vary depending on the natural NP in both the Sea water and fresh water.
During daylight, aquatic plants remove carbon dioxide from water for use in photosynthesis. Both plants and animals are continually releasing carbon dioxide into the water by respiration. However, during daylight, aquatic plants usually remove carbon dioxide from the water faster than it can be replaced by respiration, thus fluctuating levels of PH between daylight and night. Furthermore, in photosynthesis, inorganic carbon in carbon dioxide is reduced to organic carbon of sugar. Light energy is converted to chemical energy of sugar and oxygen is then released.

This can be summarised by saying that a good algae bloom will increase oxygen levels during the day, and keep PH in control. However, if the algal bloom is too thick then it will create very high levels of oxygen during the day, but consume large amounts of dissolved oxygen during the night, and furthermore, it will lower PH too a dangerous level (as a result of carbon dioxide). Too light an algae bloom and you will have to operate aeration equipment continuously, thus increasing costs.

Creating a balance with phytoplankton is often the source of control for both PH and oxygen.

From this diagram you can see the importance of phytoplankton in a pond. (modified from Prof. C. Boyd)



Fertilisers

Usually only Nitrogen and Phosphorus fertilisers are used for encouraging phytoplankton. Prof. Boyd did however highlight the advantage of mixing your own NP to encourage a desirable plankton. Two main sources of Nitrogen and Phosphorus are used in aquaculture, Chemical based made from ammonium, and organic based usually from chicken manure or agricultural legumes. We have quite often used Lucernes as a cheap source of nitrogen in ponds. Some other countries such as South America will use molasses. The disadvantage with using organic fertilisers is that the Nitrogen or phosphorus is not consistent. It does however, offer some "body" to the nutrient level in the pond and therefore can produce algae blooms that are a little bit more stable.

Black Sludge

To many aquaculturists, this is looked upon as being in the same category as Toxic Waste. And it wasn't until I read Prof. Boyds revelations on Pond Sediment, that I become converted.

A pond has many by-products from farming fish or prawns, either from dead algae, excretions, waste feed, etc. Usually this is very noticeable when the pond in drained at the end of a crop. Recognisable by the small hill formed in the centre of the pond, it is black in appearance and soft and slushy by touch, and gives off a foul odour.

It scares most farmers because it is mis-understood, and because of it's appearance it is assumed as being bad. However, Prof. Boyd has concluded from many tests that there is really nothing to be afraid of;

- it is black because it is anaerobic and lacks oxygen,
- it is primarily made up of minerals from soil erosion.
- it is usually less than 5 % organic matter

And the best way to manage it after the pond is drained is it aerate it and let it oxidise, letting the bacteria work on decomposing it, reducing it too mere mineral.

If it is a problem during a crop, then it is a more sensitive matter. It should not be disturbed, as the organic matter trapped under the water will have built up Hydrogen Sulfide gases which will be toxic too any aquatic life. Rather, according to Prof. Boyd. and other aquaculture farmers that I have visited, it is best too create an oxidised layer on top of it, thus trapping the toxic gases until the pond is drained.

Prof. Claude Boyde talks encouragingly of leaving this Bluck Sludge in the ponds as a form of fertilizer for the the next crop, also for continuing the on-going bacteria community. He does recommend that the Black Sludge is aerated and dried before refilling a pond, however, he does not rule out the possilbe use of constantly continuing the use of a pond, as he often mentions the use of ponds in the Catfish industry of the US, where he uses examples of where a pond was not emptied for 30 years.

If not for the salt content in the sludge, it maybe viable to process this as fertiliser for agricultural use.

Lime

Lime is used extensively throughout Asia, many believing that it is a solution to their disease problems. More often than not, most farmers do not even know why they are adding lime, except to say that it has worked at another neighbouring farm. Unfortunately, a lack of education is too blame for this.
However, it is fair to say that Thailand uses vast quantities of lime on the dry pond bottoms to increase the PH of their acid sulfate soils.

Lime does have its benefits;

1. Adding lime to the pond water will raise the PH, allowing a more suitable environment for bacteria and decomposition of waste organic matter.
2. Some farmers will tell you that the prawns will eat the lime, if there is a calcium deficiency is their diet. This is still unfounded, and controversial.

Keep in mind however;

3. That lime does not dissolve efficiently in salt-water.
4. Research has not proven that lime will reduce the risk of disease.

Disease

Disease would have too be the aquaculture industries biggest threat, and it is already taken a strangle hold in some countries.

China, Taiwan, Thailand, Central America all have serious outbreaks of potentially disastrous viral diseases.

I don't think anyone can really say for sure why the problem has occurred world wide. Except that during my travel the most convincing answer was related to the stress placed on these animals.

The explanation comes in three parts;

1. Firstly, stress placed on the broodstock caught from the wild. When a female prawn (ready to spawn) is captured from the wild, and placed in an artificial environment, she is placed under enormous stress and as a result the larvae spawned can be weak and fragile. Once the larvae are in such poor condition they are very susceptible to common diseases.

2. The second level of stress is environmental. That is stress from poor water quality. This can be a result of polluted water sources from either industrial waste or other aquaculture operations dumping their waste into your water source, this is a very common problem in Taiwan and Thailand.

3. Stress can also occur from malnutrition, because prawn nutritional needs are still not understood completely, many feed companies base their formulas on a combination of research, and " try and see " practices.

Many agree that the first step to reducing the current disease problem is too improve the quality of larvae that are produced from broodstock.

Broodstock

Unanimously, research is now concentrating on producing superior broodstock or " super mums", some of these efforts are on producing broodstock that are raised on the farm, although not a new concept, it has been hindered by many failures.

Other research has been concentrating on producing Specific Pathogen Free (SPF) larvae. This work has concentrated on detecting specific diseases in the larvae and possibly solving the problem before it reaches the farm.

Larval Rearing

Possibly the most interesting news in this area is what the Taiwanese are doing. Traditionally larvae have been looked after in the hatchery up until the age of 15 days, from there they are stocked directly into the ponds. However, a new industry has been formed in Taiwan based solely on looking after the larvae from age 15 to 40 days. This approach has given the end farmer more confidence in survival rates of his stock, because without doubt this period is the most vulnerable for larvae.

Survival

One of the underlying problems that Australia has at present, is poor larvae stock. More often than not it will be the supply of poor larvae that determines the success of a farm, and not the actual farming practices.

Feeding Strategy

Providing the right amount of feed it absolutely critical, and when you can't see whether you animals are eating the feed, it is even more diffucult. On average most farms tha I visited using the following method;

1. First calculate the biomass of prawns in the pond, taking into account;

- mortalities (your best guess!)
- average weight (throw a cast net, and get an average from your sample)
- then use a figure that determines the amount of feed that they should be eating at that weight. This figure is debatable depending on whether you use another prawn farmers experience, or the feed companies recommendations (which may be biased, in order to sell more feed).

2. Then feed the pond, by distributing the feed as evenly as possible.
3. Directly after you feed the pond, place a small percentage of feed on feed trays. The percentage of feed is also debatable depending on your source of information. Feed trays are usually round and about 800mm in diameter with a 50 mm lip around the edge, 2 or 3 of these are placed around the pond.
4. Approx. 1.5 - 2 hrs later check these feed trays too determine if the prawns are hungry or not. This will help you decide what volume of feed is required next time.
5. Feeding is normally 3 to 4 times per day, from 6am to 11pm.
6. Each day must start with step 1.

Fine tuning steps 1 to 6 are some of the issues that I addressed whilst in Asia, but found that we in Australia, are applying the same procedures as they are. With the only exception being some of the amounts used, particularly the Percentage of feed based on Body Weight, and the delay between feeding and checking feed trays. However, it seems that even between Asian farmers there is disagreement.

Stocking Densities

For the farmer adjusting the stocking density per square meter is a valuable tool that can influence yields. The industry could be divided into the 4 following areas;

Extensive, using a stocking level of between 5 and 15 prawns per sq.mtr.
Semi-intensive, between 15 - 35 per sq.mtr
Intensive, between 35 - 60 per sq.mtr
Super intensive, 60 +

A number of farms in Asia during the past have been doing intensive and super intensive farming for years, with some densities being as high as 200 per sq.mtr. However, it is fair to say that the majority of farms are now semi intensive, which I dare say has influenced Australia in the past few years, as we are on par with this.

Interestingly Central and South America are extensive, apparently due to difficulties with electricity supply that is needed for aeration, in addition there is an abundance of cheap labour.

It is common knowledge however, that better growths can be achieved in extensive farming, yet the disadvantage is directly related to a lower yield per hectare, for example, the average yield in Central America is approx. 300 kg / hectare. Whilst in Australia and Asia it varies between 4 and 8 tonnes per hectare. Striking the balance between good health and growth is essential for sustainable prawn farming in Australia.

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