TROPECA TRIP REPORT

Bangladesh case study visits and Vietnam planning workshop, 2003

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Prepared for: TROPECA Project, AFGRP, DFID

TRIP REPORT

Nautilus Consultants Ltd
Natural resource economists

Introduction

Between 17th October and 23rd October John Hambrey (TROPECA Project Leader) and Rod Cappell (Project Manager) undertook a fieldtrip in Bangladesh visiting the two case study areas for TROPECA in Bangladesh as well as meeting with the Research Managers, Partner NGOs and National Co-ordinator. They went on to participate in a 3-day workshop organised by the Vietnamese TROPECA team held at RIA1, Haiphong, Vietnam.

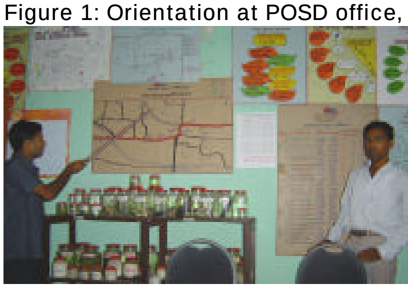
The following report details discussions and outcomes chronologically.

Bangladesh

2.1 Inland case study, cages pond, Rajishai

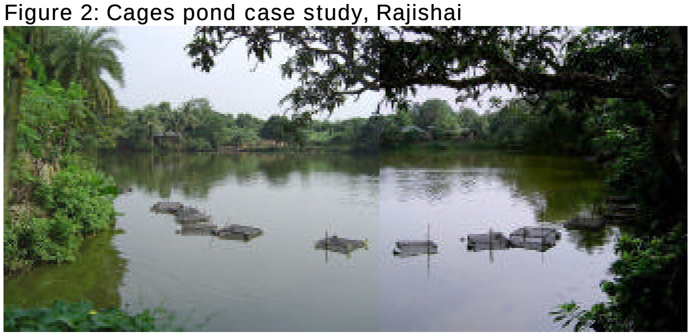
A presentation from the NGO partners, POSD followed by a visit to the case study site.

Figure 1: Orientation at POSD office, Rajishai



The case study concerns a village, which has an on-going interest in the use of cage aquaculture techniques following the CARE Cages project. The main area under study is a 3 acre pond and a smaller 33 decimal pond (1/3 acre). 7 families own the pond, but have leased it to a single farmer on a 3 year basis. This farmer uses the pond as a nursery pond for carp fry, but currently permits the families to use the pond for a variety of purposes including cage culture.
Each family receives 33,000 taka (approx. £370) in total for the three year lease giving an income of £123, which represents 10% of annual income for the wealthier families and around 20% of income for the others.

Figure 2: Cages pond case study, Rajishai



Culture Practices

The cage farmers grow tilapia as they are quick growing (can get 2 cycles per year compared to eg. Pangas 1 year) and achieve a good market price (higher than pangas).
Tilapia fry are purchased locally and initially feed on the phytoplankton and zooplankton within the pond. Later in the growing cycle, supplementary feed is added (kitchen waste, specific leaf matter

The cage farmers do two growing cycles per year, using fry from a brood stock pond within the village. The tilapia is generally harvested and sold when it reaches 100 grams (after 4 months).

Issues

- Mixed use fish culture is causing problems with the tilapia breeding in the cages causing the resulting fry to enter the pond and ‘pollute’ the carp fry resulting in lower prices paid to the leasee for his carp fry.
- While of interest in a pond management agreement context, this does not have direct implications for environmental capacity of the system being considered. The concerns may be valid or a means of lowering the rental price next time. They do currently sit together in a friendly way.
- The suggested constraint to cage culture increases is seed availability. However as all supplies are from a said to be from a single pond in the village with relatively low-productivity (probably due to excessive shade) this constraint could be removed easily and seed may already be available from elsewhere.
- When using the HACH kit, the confidence levels of detection should be recognised so that zero recordings are not interpreted as absent, but below detectable levels.

Progress

There have been a number of delays with this case study due to cold weather delaying start of culture season.
Researchers have been collecting water samples on a regular basis, finding relatively moderate levels of nitrogen and acceptable DO, but have found elevated levels of phosphorous.

Tasks – in conjunction with the guidance notes on the ‘Tropeca framework’ see annex 1.’

A great deal needs to be done to ensure simple models can be developed for this case study. The researchers must gather detailed information on the inputs and outputs to this system in order to permit mass balance modelling. Although water quality remains at an acceptable level, this simple modelling may allow researchers to pinpoint areas that may cause problems for environmental quality in the future and pre-empt problems through pond management user agreements. Specifically the researchers must:

- Create a detailed map in order to determine water volume
- Identify and quantify inputs into the system (including leachate).
- Identify and quantify outputs from the system.
- Determine the C, N & P levels for each of those inputs (through literature and/or sampling)
- Flushing rate is not needed for this relatively closed system. But the levels of input through rainfall and levels of evaporation should be known on a seasonal basis along with temperature to determine changes in water volume and assimilation rates.
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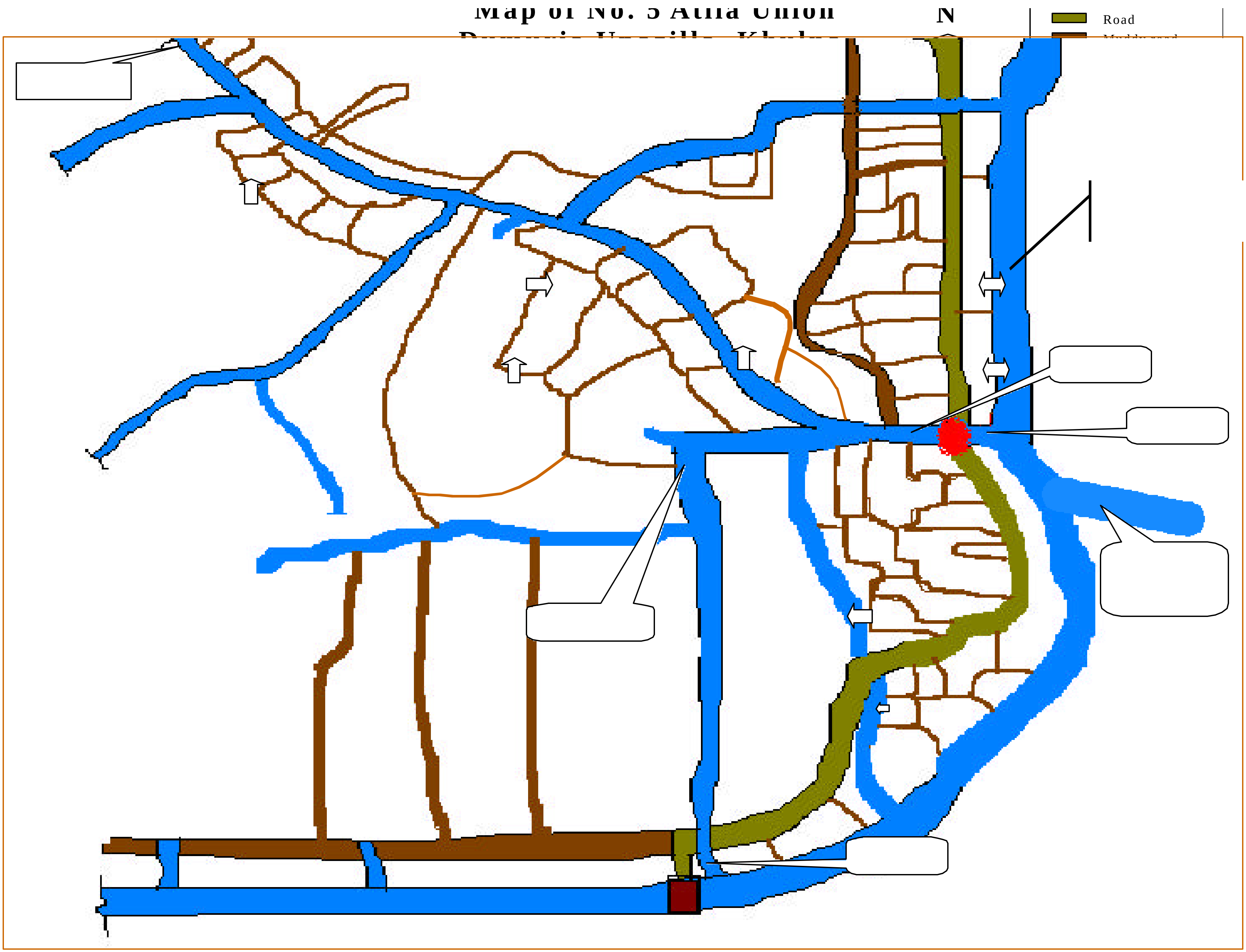
2.2 Coastal case study, shrimp/rice culture, Dumuria Upazilla, Khulna

(see map overleaf)

Originally a group of 25 farmers were involved in the gathering of information. The researchers now have a core of 10 farmers that co-operate with the project on a regular basis, but more attend workshops and have a keen interest in results.


Map of No. 5 Atlia Union
N
Road

Culture Practices

Figure 3. Gher ponds, Dumuria, SW Bangladesh

Farmers in the region generally practice alternate shrimp/rice culture in *Ghers*, however low-lying farms are unable to drain ponds to the extent that would enable rice planting and therefore operate continuous shrimp culture either on a batch system or continuous harvest.

In Kathaltola there is a practice of one cycle paddy production. Most of the farmers dig a canal near the border of their land and used the soil for making a dyke and to store water to their farm. That particular canal used as nursery pond (*Top*) for shrimp fry. Few percent farmers tailor the soil by tractor and use phosphate (10 kg per bigha) and or lime. There are inlet and outlet facility used for receiving and outing the water. Most of them use the same gate for inlet and outlet. Spring tides are for water inlet and Neap tides for water outlet. Most of the farmers exchange farm water very often, But there are a few that change the water rarely.

The 10 farmers have been keeping records of their actions and occurrences in an events diary to be filled in weekly. The farmers use a variety of farm practices with regard to fertilising the pond, water exchange, feeding, stocking, etc. Pond depth depends on situation compared with tidal heights. Water is sourced either directly from the river, from the canal (sluice gate opened twice a month or following permission from local chairman), from bore well or other farms. Farmers recognise direct linkage is ideal.

Issues

- Production levels are low and mortalities are frequent occurrences.
- Most ponds appear to be below optimal depth – this is recognised by farmers but digging deeper ponds means additional costs.
- A variety of water quality indicators are recognised, however the causal link is not currently fully understood.
- The practice of rice culture including fertilising the pond and leaving six-inches of leaf material following harvest is likely to be impacting significantly on nutrient levels for shrimp culture.
- The paddy culture surrounding the shrimp ponds and upstream of the shrimp ponds is also thought to be impacting on the quality of water used for shrimp culture. Shrimp ponds in this instance may be acting as a nutrient sink for the system. This requires further investigation.

Progress

The following presents a revised research plan and progress. Method of nutrient load estimation and release to wider aquatic environment are also in consideration. The following matters have been assessed:

1. Methods of nutrient load estimation of shrimp farm and its fate to wider aquatic system as well as some query related to the procedure
2. Finalisation of frame survey questioner
3. Institutional analysis for shrimp aquaculture
4. Activity chart

Our recent progress at a glance:

Sl.	Activities	Progress
1	Nutrient load estimation procedure	Determined tentatively and will be finalized after your recommendation
2	Literature review of nutrient load and environmental capacity	Going on
3	Regular water quality monitoring and seasonal nutrients (NH_4-N, P) variation	Going on
4	Frame survey in wider area	Initiated from January
5	Institutional analysis for shrimp aquaculture	A guideline developed and send to NGO to Initiate.
6	Paper preparation for seminar in Malaysia	Will be started soon

Additional funding requirement:

Additional funds required for nutrient budget and field trip are mentioned in the following table.

SL.	Function	Amount (Tk)
1	Reagent for test of nutrient mainly P for nutrient load estimation	10,000
2.	Nitrate test kit, Method : Color disk, Range: 0-10 mg/l, Cat # 14161-00 (Company: HACH)	****
3	Field trip for wider area survey	7,000

**** It is decided to return the present Nitrate test kit as it is ranged from 0-50. We need lower ranged test kit but it is not available in Bangladesh. So, is it possible to send a nitrate kit box (specification mentioned in the above table) from UK?

Tasks

- Further detail on map to permit calculation of water volume and flushing rates.
- Adaptation of map to show ownership/operators in the area
- Investigation of shrimp/rice nutrient dynamics both through sampling and extensive literature searches.
- Undertake a frame survey of 50 farmers in the surrounding area to investigate preliminary findings further – particularly the linkages with water quality indicators and performance and the impact of rice culture.

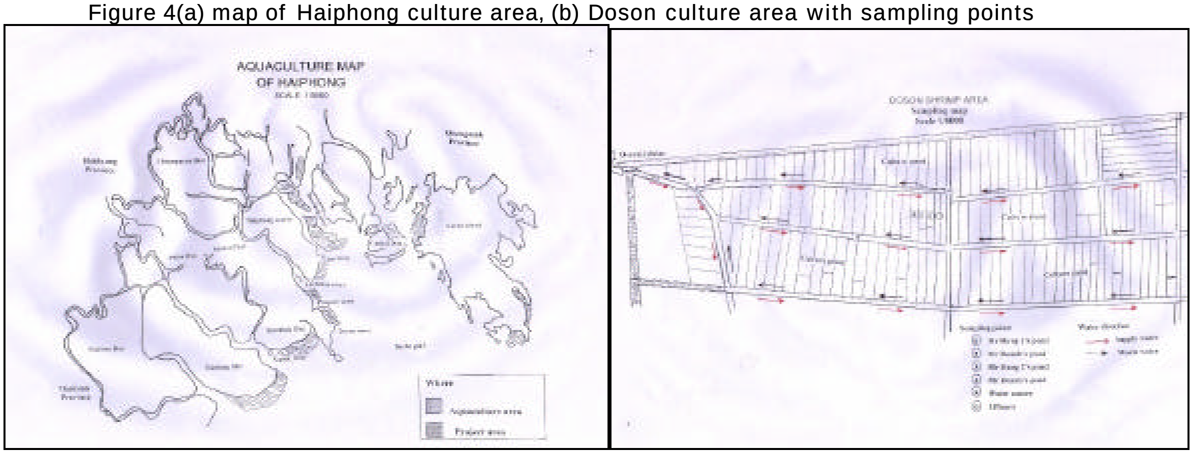
Vietnam

The Vietnam team met at a three-day workshop hosted by RIA1 at their brackishwater research centre in Haiphong. The national co-ordinator provided information on overall project progress and all research managers presented progress and preliminary findings on their own case studies. These presentations are shown in the appendix. A summary of case study progress, issues and tasks is presented below.

3.1 Doson case study

The Doson case study involves a shrimp culture area situated 16km east of Haiphong behind a large dyke separating the area from the Lachtray River estuary entering the Bacho Gulf (see maps below).

Figure 4(a) map of Haiphong culture area, (b) Doson culture area with sampling points



Culture Practices

This colder northern district has a short growing season during which high temperatures and high rainfall are experienced. Most therefore only attempt one crop of shrimp. During the colder months mud crab, tilapia and are grown, but some who experience mortalities in the first crop may re-stock with shrimp later in the season. Seaweed was harvested from the ponds, but the price for the seaweed is so low.

As table 1 illustrates, production levels for all types of culture are very low:

Table 1 Recent production levels for various shrimp culture practices in Haiphong

Culture model	Year 2000			Year 2001			Year 2002		
	Area (ha)	**Yield (ton/ha)**	**Prod. (ton)**	**Area (ha)**	**Yield (ton/ha)**	**Prod. (ton)**	**Area (ha)**	**Yield (ton/ha)**	**Prod. (ton)**
Extensive	5,459	0.12	655	3,950	0.14	553	4,251	0.12	510
Semi-intensive	600	0.34	204	2,091	0.27	556	1,900	0.25	475
Intensive	0	0	0	18	0.51	9.18	8	0.60	4.8
Total	**6,059**		**859**	**6,059**		**1,118**	**6,159**		**990**

Table 2 shows that production rates have fallen off in the Doson area over the last 5 years

Table 2 Yield and production in Doson 1999 - 2003 from the 1st crop *(excl. fish & seaweed prod.)*

Year	Yield (Ton/ha)	Total produc. (Ton)
1999	0.50-0.55	381.7
2000	0.45-0.50	312.3
2001	0.15-0.20	104.1
2002	0.15-0.25	133.9
2003	0.20-0.25	173.5
Grandtotal		**1,110**

Features of the area include:

- Poor investment with 99% improved-extensive culture.
- Poor culture techniques.
- Poor quality of feed : Most of feed are low-quality home made feeds: fresh bivalves, trash fish *Pond preparation:*

- Let water out when the tide goes down (impossible to dry the pond).
- Gather seaweed and other unexpected fish and shrimp.
- Take water in and fertilize the pond bottom, usually with decomposed manure (checken's manure, pig's ...), 400-600 kgs/ha (up to 1 tonne/ha).
- Wait for about 5-7 days before stocking.
- *Some households used disinfection to kill pathogens in water before stocking (chlorine, $KMnO_4$ ...)*

- 50% of farmers start feeding shrimp 2-3 week after stocking:
- 20% of farmers start feeding shrimp one month after stocking:
- 12% of farmers start feeding shrimp 1-2 weeks after stocking:.
- 18% do not add supplementary feed

Water exchange;

- 45% do no water exchange regime:
- 30%.do regular water exchange (4-6 times/months) with 30 % of the water volume in the pond each :
- 25% do llimited water exchange (1-3 times/month)

Issues

Low survival and production rates due to:

1. <u>Climate</u>

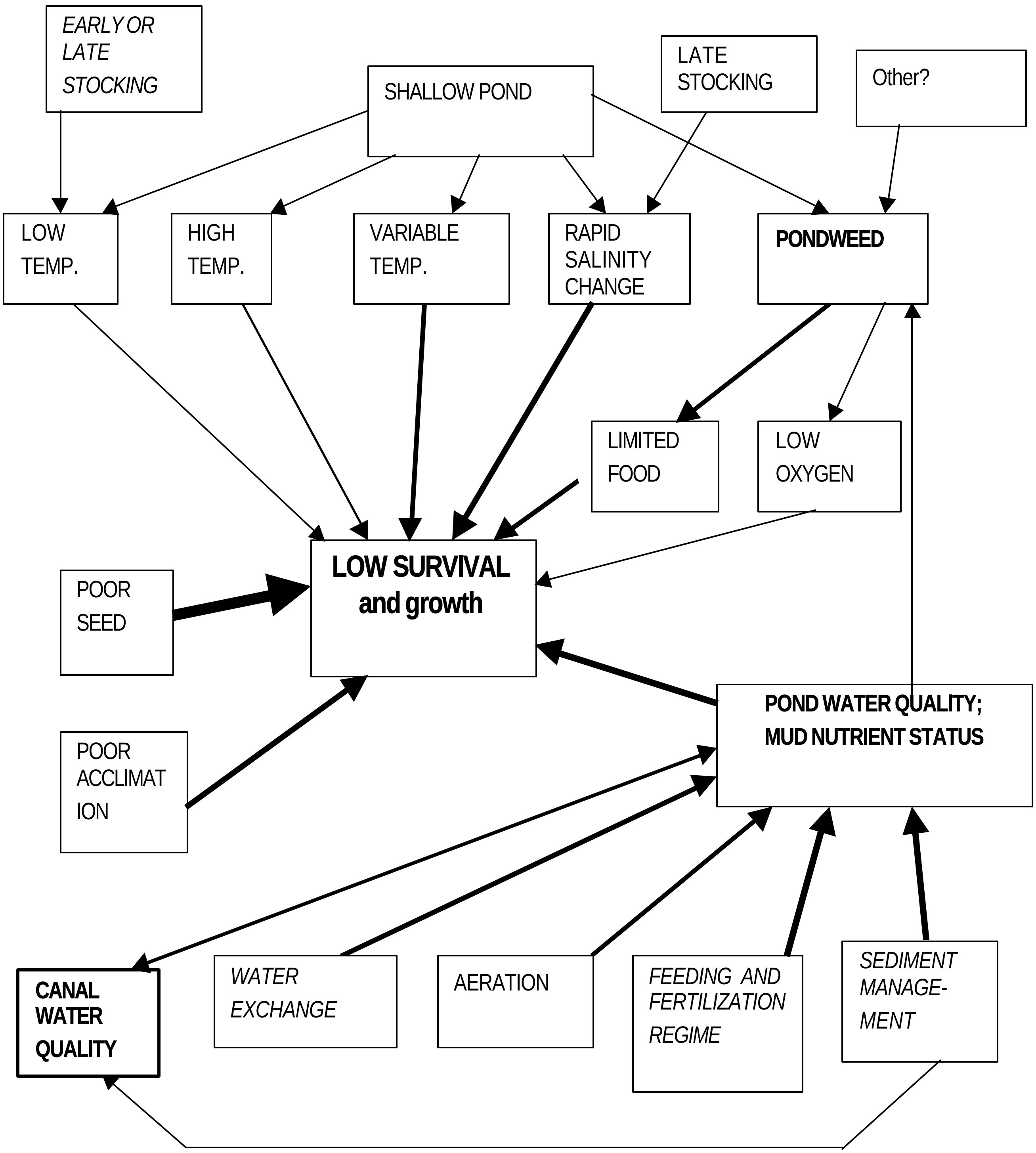
- Low temperature when stocking
- High temperature later on
- High rainfall changing salinity

2. <u>Farm management</u>

- Nutrient status of the pond is a problem – poor during shrimp cycle so low growth rates
- Getting the right type of plant growth difficult and not understood (pond weed instead of plankton) Farmer does not know how to keep the water at the right colour
- Growth of the weed occurs in shallow ponds with clear water and difficult to reverse cycle
- Some fertilise with manure during pond preparation – negative consequences for water quality with too much ammonia
- Highly fertile ponds but still add fertiliser during pond prep.
- Disease possibly a consequence of these conditions
- Poor control in water depth due to poor pond structure (leaked, depression, collaps …).
- Lack of separated water supply and effluent system.

- Bottom of the pond treatment before and during crop
- Source water results show that it is lower in nutrients than the canal water. This may be due to farmers dumping organic material, mud, weed etc. from pond into the canal.

Figure 5 Graphical representation of management issues



Progress

- Conducted a survey on environment, shrimp disease in 6 main culture areas.
- Chose a volunteer group who took part in recording and kept track of the environmental changes and shrimp behaviour.
- Produced a projected map and outlined sampling plan.
- Undertook sampling and analysis.

Tasks

We should be able to estimate the flushing of the entire system and the nutrient budget. If we see that there is a massive accumulation of nutrients in the pond then that could be a key issue for future pond management.

Want to see if growth of the problem weed relates to specific conditions so want history of the ponds already sampled (nutrient input and production).

Depth may be the critical factor to performance and this may be clarified through larger sample of farmers.
If depth is not the dominant factor then multi-variant analysis may show what is the key factor. We can identify what critical factors are through farmer interview and then potentially suggest they implement some of the changes that could alter their operation to their benefit.
Then you would have time to track effect of changes.

If depth one approach is to make a smaller deeper nursery pond, stock later in the year

We need to understand the nutrient budget for the whole system so we must:

1 Add scale and dimensions to map.
It is essential to work out dimensions of the various water bodies to be able to determine water volume and thus flushing rates

2 Carry out sampling of flow rate during water exchange to determine flushing rates
Need to work out the water volume and water exchange.

A low tide nutrient sample plus a high tide nutrient sample will allow an estimate how much the level may be diluted and so work out nutrient flushing rate. Based on the difference between low and high tide at the source point as well as in the canal. Do this for total N and total P. They do water exchange at the sluice gate 8 times/month – 6 times let water in and out. 2 times only water out.

Change sampling regime to one outside the system and one at exit point of system. At the sluice gate point want to sample what's coming in during the inflow cycle and what is going out during the outflow cycle. Want a sampling regime from Mr. In relating to sampling in relation to sluice gate operation (announce when they will do it – based on tide table) and shrimp culture cycle.

3. Undertake finer analysis of the individual ponds to identify indicators and determine their links with performance.
Take 20 or so sediment samples throughout the canal system to record colour, smell, redox potential (maybe total N and P) – do this at same time as frame survey of farmers (take a sediment sample from 1 farmer in two interviewed).

4. Sample from another couple of data points in the canal at equidistant points from the source water to show a gradient.

5 Interviews and water/sediment samples from a large number of farmers (over 40).

It is essential to conduct the frame survey to establish inputs and outputs. The analysis of existing data will show what sort of questions should be asked. The survey should look for relationships between:

- Performance
- Indicators
- Practice/events
- Nutrients

Total number of farms in system is 40 households – should interview them all. Should also investigate conflicts. The survey of more farmers will allow multi-variate analysis (MVA) and ground-truth any mass-balance modelling as will give a much better idea of inputs and outputs.

Overall:

- Need to know feed amounts as well as types
- Need to do simple comparative analysis between parameters and farm practice
- Need to compare ponds with canal and source water.

Indicators:

- Need a colour indicator as well as turbidity. Relate all these calculations to farm practice, environmental conditions
- Indicator of floating substances – sounds like it is algal bloom decomposing and gases trapped causing it to rise to surface.
- Farmers think the jellyfish is no good for shrimp (occur in clear water and/or high temperature or just a seasonal stochastic event? Occurs at same time in RIA1 experimental pond). Where pondweed overgrows, there is no jellyfish.

Management:

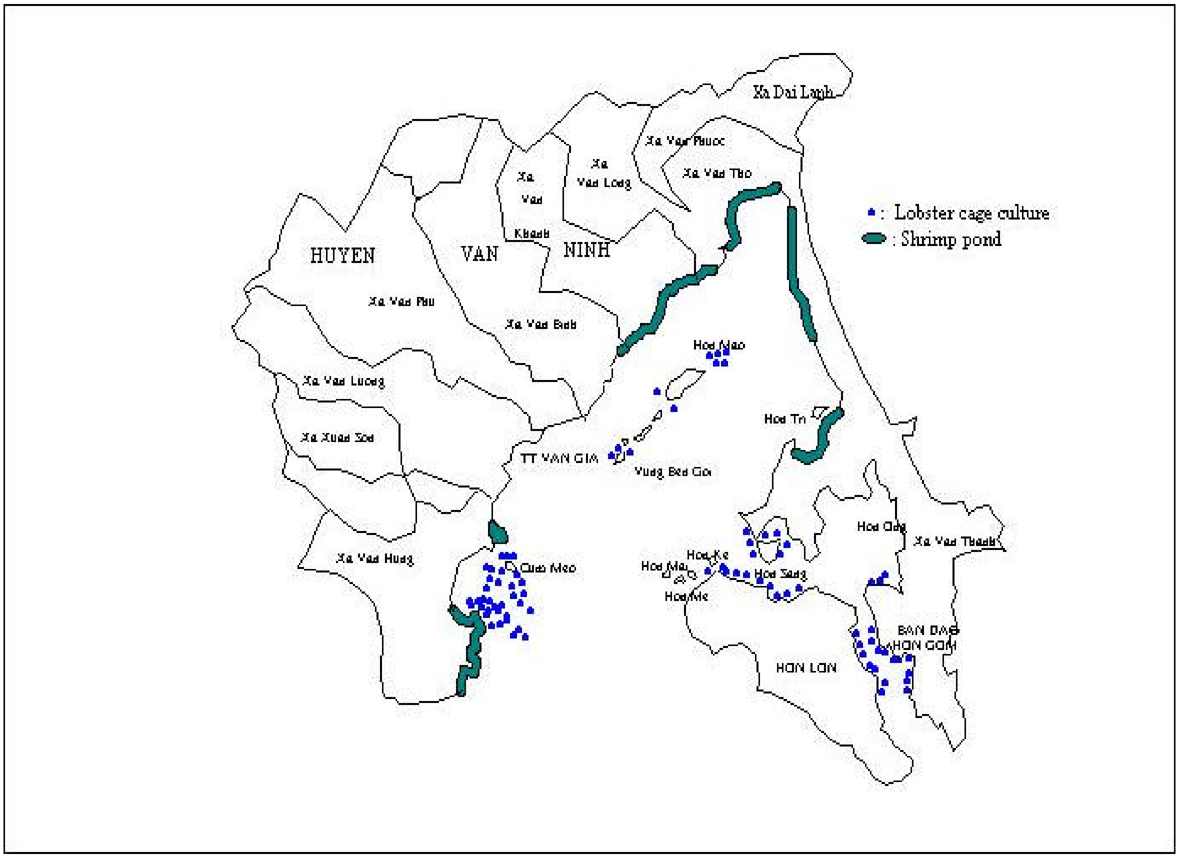
Final issue is should we be able to get agreement, on what aspect and whether we should try. Conflicts have reduced as local authority controls them – if farmer do not abide by general rules on taking water in and out (eg. disease) based on tide table then they will punish them. But it is very difficult to get solid waste out by any other means. Want to use survey to find out these specific issues.

Will this work support the argument for the new canal system proposed strongly enough to ultimately lead to farmer co-operation?

3.2 Xuan Tu Lobster Village. UoF, Nha Trang case study

Xuan Tu village is 60km north of Nha Trang. The size of the culture area is 118 ha within the Xuan Tu Bay that totals around 472 ha which is part of the larger Van Phong Bay (503 km^2)

Fig. 4. Map of lobster cages and shrimp farms in Van Ninh district (after Boi, 2002)



Culture Practice

The main center for lobster cage culture is Xuan Tu village in Van Hung commune. This is the place where lobster cage culture started in 1992. Today, due to favourable conditions such as low depth, slow waves, labours availability and convenience for transportation, lobster cage culture has developed rapidly in Xuan Tu village and faces problems due to high cage density.

Around 700 households from Xuan Tu village have constructed over 2,000 cages in the bay to farm lobster estimated to be valued at around $3million/year. But this figure has not been achieved recently due to poor survival rates. The area also supports sweet snail farmers, fishermen and other shrimp and fish culture.

The distance of cages were at least 200 m from the shoreline in Xuan Tu village. Three respondents had cages as far as 1500 m away from the shoreline and nine respondents have located cages about 900 m away from the shoreline. The farmer claimed that they have to move their cages away from the shoreline to avoid pollution.

The cage density is a major problem in Xuan Tu village. Fifteen respondents said that their cages have only 1-2 m distance from the neibourer's cages (Fig. 7). According to

Thong, (2002) Xuan Tu was affected by discharged water from agriculture and black tiger shrimp culture activity (volume of water discharges could reach as high as 24,000 m^3 per time and these discharged are said to contain a number of toxic chemicals).

Issues

- Low survival rate is being experienced with 30% of cages failing
- Farmers are moving further out into the bay to access cleaner water, but this results in greater costs and risk as stronger cages required in more exposed sites in deeper water and storm damage more likely.
- Several other inputs likely to be entering the Bay including from shrimp, agriculture, human population etc.
- Some conflicts between lobster farmers and other farmers (sweet snail etc.) as some blame the other users for poor survival rates and mortalities.

Progress

- Water data were collected *in situ* along 2 transects Variables measured and used in subsequent analyses were: Temperature, Salinity, pH, Dissolved O_2, Transparency Sediment samples were collected using a tube piston corer enabling approximately 300 cm^2 of sediment to be collected
- The sediment was stored in plastic bags containing 10% formaldehyde and refrigerated
- Analyses in the laboratory: Soil pH, % Organic C, Total Nitrogen, Total phosphorus ,% Clay, % Silt, % Sand.

- The sediment samples in 10% formaldehyde were sieved It was then decanted (gentle sieving and decanting of the suspension)
- Next it was placed in 4% formaldehyde and the fauna identified and counted.

Analysis
Multivariate analysis using PRIMER

- **PCA** Plot of Environmental Data **MDS** plot of fauna **ANOSIM** (ANalysis Of SIMilarities) to look for statistically significant differences between groups of samples
- **SIMPER** *(SIMilarity PERcentages)* : *to see which species are most important in accounting for the differences between groups of samples.*
- **BIOENV** correlates the two data matrices with one another & will select the best correlation

Data analysis: Mass-balance model

- Nitrogen and Phosphorus budgets
- C=N/FU C = the elevation of nutrient concentrations caused by lobster farms (or any other source of nutrient input) N = the rate of nutrient input F = the flushing rate U the volume
- Scenario 1: min FCRs

  the rate of nutrient input = **3454.1 mt/yr**

From shrimp farms:	2593.0 mt/yr (?)
From sweet snail farms:	309.0 mt/yr
From lobster farms:	552.1 mt/yr

  flushing rate = **0.5**
  Water volume (m^3) = **10,856,000**
  Nutrient concentration (g/ m^3) = **0.6**

Standard for Aquaculture water (g/ m^3) = **0.4**
Overload (g/ m^3) = **0.2**

***Comment**: Need to check where the shrimp farms' sludge is deposited*Scenario 2: max FCRs

- the rate of nutrient input = **4221.4 mt/yr**
- From shrimp farms: 3298.2 mt/yr (?)
- From sweet snail farms: 332.1 mt/yr
- From lobster farms: 591.1 mt/yr
- the flushing rate = **0.5**
- Water volume (m^3) = **10,856,000**
- Nutrient concentration (g/ m^3) = **0.75**
- Standard for Aquaculture water (g/ m^3) = **0.4**
- Overload (g/ m^3) = **0.35**

***Comment**: Need to check where the shrimp farms' sludge is deposited*

Tasks

- **Revise sampling** with a transect suitable to show any nutrient gradient from land source and from cages.

Looking to do three analyses:
1. MVA using primer (but may be better to do the simple comparisons first before getting more complex as this will inform the MVA)
2. Theoretical mass-balance modelling based on estimated inputs
3. Mass-balance modelling based on sampling

On mass-balance models looking to incorporate dispersion model. Trevor to provide tools (software package) and support as this will increase in-country capacity. If this remote support does not work, we may make alternative arrangements.

The 4 main areas to address are
- farm performance
- management,
- indicators and
- sampling

(drawing all these together is important.)

Overall nutrient budget – table showing sources and sinks (see example table below)

	SOURCE					
SINK	Lobster feed	Snails	Shrimp feed	Other agri	Human pop	other
Water column						
Pond sediment						
Bay sediment						
Removed						
Flushed						

- **Management**

Need to develop classifications of various practices.

It may be that the impact on water quality overall is greater from surrounding shrimp farms than the lobster cages. Localised impacts from farmer practice are likely to still be significant though. Management measures for the bay therefore extend beyond management of the cages. The potential for management agreements is good, as a Marine Protected Area has already been established nearby.
Could possibly get to a point where we can show costs of poor farm performance and compare with mitigation measures (eg. establishing sludge removal from shrimp farms).

3.3 Trang My Shrimp Culture, Can Gio. UAF, HCM City case study

Figure 5 Map showing Trang My case study area

Trang My, a small hamlet of Ly Nhon commune in Can Gio district consists of 30 households involved in shrimp/salt production over 45ha.

Shrimp culture only began in this area 2 years ago and there is generally a low level of technical expertise among the farmers in the area.

Elsewhere in the region is shrimp/paddy culture and various shrimp culture systems from improved extensive to semi-intensive.

Culture practice

In the case study area semi-intensive shrimp culture is rotated with salt production. Shrimp culture is practiced in rainy season (June - December) and salt production in dry season (January – May). The time of shrimp stocking is depended on the farmers' judgment.

Salt-production fields were slightly modified for shrimp culture.

- Only lime was applied for pond preparation. Seed was bought from other provinces with a stocking density was low: 5-8 shrimp/m^2
- Feed for shrimp was rice bran, cooked trash fish and small shrimp, and pelleted feedWater depth was maintained about 60 cm The ponds are supplied water by pumping from canals and drained by gravity Water is added twice a month.Aeration and chemicals were not applied during culture period
- Average yield was 500 kg/ha.crop

Issues

- No disease occurred in the first yearSome farmers had to harvest shrimp early due to yellow head and white spot diseases

Water in disease-infected ponds were treated with (chlorine or permanganate potassium) followed recommendations of local officials

- The quality of water sources was assessed normal or poorer but the failure of shrimp culture was mainly caused by disease, an unavoidable cause
- The farmers expressed a desire to intensify performance if they had chances to do so

Local authorities' opinions:Ly Nhon commune has been planed for semi-intensive and intensive shrimp culture

There were 7 persons from outside to rent land for shrimp culture (11 ha)

In 2003, the city government invested in irrigation systems in shrimp culture areas. It also allocate and invested in a site for sludge dumping.

The local authority have requested that the Tropeca researchers select a rice-shrimp system in Binh Khanh commune further north as a case study site as this practice is more common. This new area was explored in September. The district plan for the various communes are presented below in table 3.

Table 3 Area shrimp culture development plan to 2005

Commune	Area in 2005			
	Total	Intensive	Semi-intensive	Rice-shrimp
Binh Khanh	2,210	-	410	1,800
Tam Thon Hiep	750	400	100	250
An Thoi Dong	2,250	450	700	1,100
Ly Nhon	1,780	230	1,150	-

Progress

- Progress delayed due to researcher leaving plus change proposed by local authority
- Local workshop held in June 2003.
- Sampling undertaken with semi-intensive and intensive culture systems
- Semi-intensive & intensive culture: Water and mud sampling for nitrite, nitrate, ammonia, phosphorus analysis
- peaks in ammonia and nitrite relate to farmer practice – either in-pond treatment or harvesting by intensive culture near-by.

Tasks

- A farmer meeting is to be held November 2003 t oexplain project and seek co-operation wit ha view to start physical analysis Nov '03 to Sep '04
- Project managers keen not to change location at this stage given the interesting preliminary results and the proposed timing is too late
- Propose to maintain site 1 developing the sampling regime and undertaking a frame survey to investigate the findings further and discuss local environmental indicators
- Also undertake co-operative work at site 2 focusing on technical and social aspects rather than more sampling. Facilitate discussion at workshops regarding water management and co-operative practices (water exchange, use of chemicals on paddy etc.)

This case study is far behind the others and significant work is required to gather sufficient information in order to understand the nutrient regime for the system. Again, a good map with scale and dimensions is an essential starting point to determine water volume and show hydrodynamics.

Water sampling at various stages of the tide to establish any nutrient changes (flushing) as well as seasonally to establish links with other activities such as paddy culture.

3.4 How to proceed

1 Case study management systems – pond and whole system (data analysis)
There are 4 tasks each RM must carry out:
(a) Fully write-up analysis of data collected already
(b) Develop and carry out a frame survey exploring resulting relationships
(c) Nutrient inputs – getting more detail through more interviews (frame survey) and literature
(d) Hydrodynamics – this may allow you to say where the nutrients end up.

A **Research plan** should be drawn up detailing how you intend to go about this work.
Need to recognise trade-off between the simpler nutrient cycles and more complex modelling – in research plan establish how much effort should be allocated to each. May feel that flushing/dispersion not cost-effective.

2. Environmental indicators
Establishing suitable indicators is more important than the science. The wide variety of potential indicators need to be explored fully. The include:

- Colour (of water and sediment) – try to develop a colour chart based on and to aid discussions with farmers
- Smell (both water and sediment)
- Behaviour of culture organisms (movement, mortality, growth performance, etc.)
- Animals and plants (present/absent, abundance in sediment or water) in culture area and source/receiving waters

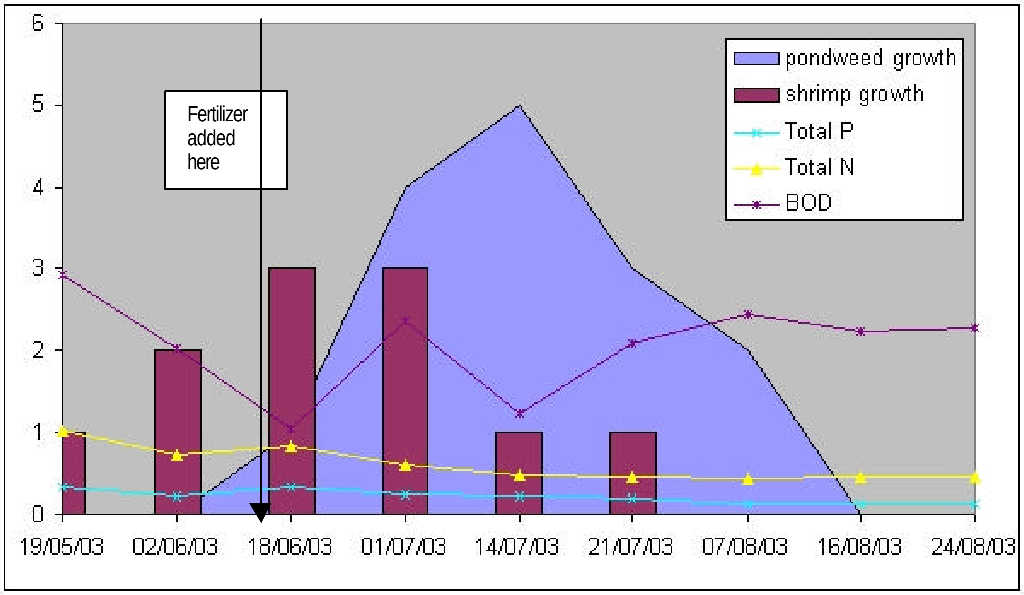
3. Data collection and analysis
All researchers have more sampling to do in order to better understand the systems being considered. Sampling should be sufficient in scale to illustrate any gradients (distance from culture area) and sufficient in time to cover a full culture period (from pre-stocking/preparation) to post-harvest.

Any of potential indicators identified need to be linked to:
(a) results from the sampling over the growing season,
(b) environmental conditions such as temp, salinity, rainfall etc.
(c) farm performance (production level, survival rate, mortalities, disease events)
(d) farmer practice (what a farmer does either as usual practice or as a response to any of the above)

These should then be presented graphically in order to highlight any linkages. A crude example using some data from the Doson case study is shown in figure 5 below to illustrate the combination of environmental parameters, indicators and farm performance. Indicators may be measurable or a simple scale applied to suggest levels of abundance – in this case pond weed growth. Shrimp growth is also presented to show impact on crop – it may take the form of either a calculation of crop biomass or again an indicative scale. Any specific events (eg. heavy rainfall or disease events) could be plotted or laid over the graph to show when they occurred.
MVA (within PRIMER[1]) can also be used to further investigate linkages of these varied information sources. A number of combinations of the various parameters, indicators and farm-based records etc. from a, b, c and d should be considered and those illustrating both positive or negative correlations presented.
The most suitable format for illustrating these linkages should be explored.

[1] Tuan provided a brief explanation of PRIMER and the basis for Mass balance modelling. He will provide further guidance on PRIMER with additional support where necessary from UK team.

Figure 6 Example simple graphic combining the varied information sources being collected.



For putting these findings in context, research managers should establish the environmental limits for culture of all of these species to determine the critical levels of the parameters being measured. It is also sensible to find the ranges for these parameters in terms of good farm practice from literature.

4. Management protocols

Development of a management agreement will not be possible or appropriate for all case studies. The following is the current situation in relation to the three case studies in Vietnam – this may change.

	UAF Shrimp	**UoF Lobster**	**RIA 1 – Doson**
Need for agreement	**Guidelines** required not management agreement	**Both** guidelines and agreement	**Agreement** required
Issues to be covered	Relations with intensive system and their impacts	Feeding and effluent discharge	water use & waste exchange control to improve performance
Opportunity for development of agreement/guidelines	Can advise on pond management and strengthen capacity of local officials in environmental issues, but not so interested in possible wide-scale change to regional planning.	Agreement between shrimp farmers and lobster farmers could come from community based management system as both on committee. Also local official keen to sort out problems as lobster important to district	Possible through local fisheries official. If they find farmers break the rules they cut contract with farmers.
Experience	Local authority decided to invest in sludge collection ,but not clear on full system (where to put it)	MPA project has shown such agreement possible and local government invested in sludge treatment.	Last month made an agreement with local aquaculture enterprise
Dissemination	Bring farmer and local authority together to show importance of environmental considerations to aid compliance.	Careful as may find one user contributing more nutrients, but can show both users that more planned waste exchange is of benefit to all. Through district official will help	Best way to spread results of the project is to talk to the farmer group leader as there are more than 600 involved in Doson culture area.

With all of these management discussions it could help to show an idea of costs (Cost Benefit Analysis) related to improved practice as a tool to facilitate agreement.

As well as an issues diagram we need an institutions diagram that will help all to discuss and decide how far we can go within the project in terms of advising local management. Also qualitative description of these case studies will help – can bring them together into a semi-popular article.

Address in research plan how we can contribute to the existing process and relationships.

5. Co-operation and relations

It is an important finding if we show that it is not feasible to work out the environmental capacity in systems because it is too complex and variable. We need to mention these practical constraints to something everyone has agreed is the right approach. The farm indicators are more important than the science.

3.5 Timing

Case studies

	UoF Lobster	**RIA 1 – Doson**	**UAF Shrimp**
Analysis (will inform research plan and frame survey) plus form basis for semi-pop article	A lot done already (nutrient budget) but need to plot data on transects to Flushing rate/dispersion to be informed by Trevor	Work up data and farmer info on practice collected in agreed graphical format (include climatic/enviro info)	Work up data and farmer info on practice collected in agreed graphical format (include climatic/enviro info)
2 *Analysis deadline & Research plan*	End of December 2003	End of November 2003	End of November 2003
3 *Semi-pop article*	End of January 2004		

Project timing*

Annual report submission (incl. research plan)	December 2003
Carry out research to plan (see 4 tasks above)	January – August 2004
Quarterly report (substantial) showing progress	March 2004
Definite end of Case study work	Early September 2004
Regional workshop (Bangkok)	End of October 2004
TROPECA Ends	December 2004

* Make sure we write up as we go whenever possible!

3.6 Project Management

- Include Rod and John on exchanges with Trevor – he is useful to bounce the research ideas off. (t.c.telfer@stir.ac.uk)

- Rod relying on Tuan for report outputs so he needs to keep in regular contact with other research managers.

- Any money transfer problems please say straight away.

4 main types of output are proposed:

1. **Case study reports**

2. **Working papers** (some published as semi-popular articles and/or on our websites) – see annex

Proposed subjects:

- Nutrient cycles and indicators
- Nutrient budgets and mass balance relations
- Flushing rates dispersion modelling
- Management agreements on farm nutrients
- Adaptive research – how we have undertaken the project (practice and experience in Vietnam and Bangladesh
- Institution and governance (Bangladesh only – already exists for Vietnam)

3. **Journal papers**:

- Application of environmental capacity concepts and models to aquaculture in developing countries
- Value and application of qualitative and quantitative indicators of water quality in developing countries

3. Final report

Should mainly be made up of a summary of these outputs and so not take so long.

Annexes

- Framework for approach and final case study reports
- Powerpoint presentations:
  1. Tropeca progress, Vietnam
  2. UoF Lobster Village case study
  3. RIA1 doson shrimp case study
  4. UAF Can Gio shrimp case study

Framework for approach and final case study reports – John Hambrey, Project Leader

Tropeca is "adaptive research" therefore it is difficult to establish a generic "Tropeca" approach. We now have to focus the research more tightly, building on the learning process we have all been through. While the 5 case studies are different in terms of key management issues, and will require significantly different emphasis and effort in the coming year, we have to work to some overall common framework.

Working with the concept of environmental capacity, applying it where appropriate, testing environmental capacity models, and adapting the concept and the models to the situation and needs in developing countries are our main tasks.

In practice this means that all case studies must address at least the following key elements. These should form the framework for your final CASE STUDY REPORTS, which should be presented at the final regional workshop provisionally planned for October 2004. Obviously most of you have covered a good part of these already.

Key elements

1. **Issues and institutions** analysis – farm level and wider environment
2. **Indicators** - identification of existing and potential farmer level environmental indicators
3. **Nutrient variation/dynamics** over the cropping cycle
4. **Environmental capacity models.** Main sub-components/types:
    - Nutrient budget/mass balance (inputs, outputs, residual) for the pond/cage and for the wider aquatic system
    - Flushing rate of ponds, and wider aquatic system
    - Nutrient dispersion/mixing with aquatic system
5. Water, sediment, and other multi-use **management needs**, protocols and guidelines
6. **Management agreement** - potential for a user group management agreement

The relative effort you put into addressing components 1, 2, 3 and 4 will depend on the cost effectiveness of such effort in terms of generating improved management guidance, and will vary from case to case. For example, flushing rate is largely irrelevant to the pond case study in Rajshahi, since the pond is effectively closed. Components 3 and especially 4 can be done qualitatively or quantitatively, and at varying degrees of accuracy and detail. You need to weigh your resources, and decide where your effort will be most usefully focused. However, its is essential that you do not get so tied up in the technical difficulties of 4 that you limit your efforts wrt 2 and 3. An important outcome of this research will be guidance as to how useful and cost effective environmental capacity models are, in practical terms, in developing countries.

Below I elaborate on some of these components, corresponding questions, and some ideas on how to address them. Please get back to me or Rod if you have any problems. Queries related to dispersion and flushing rates should all be copied to Trevor at Stirling as well as to me and Rod.

Management issues and decision making

What are the key management issues for aquaculture and other users of aquatic resources in the case study area?

- at individual farm level; and (crucially)
- for the wider aquatic system and all its users

What is the importance of environmental and water quality issues relative to other management issues – again at both farm level, and with respect to the wider environment (or shared resources)?

How do all these issues relate to each other and to environmental quality?
Will the relative importance of these issues change in the future, for example as a result of increased use, or intensification?
What are the formal and informal institutions which govern/influence decision making with respect to these issues?
Tools/presentation: network diagrams (see example from Dosun below); Venn diagrams, decision trees, power relations/ranking, comparative ranking of problems/issues by different stakeholders

Indicators and performance

What are the measurable and qualitative (farmer) indicators of water quality and sediment quality, and how do these relate to individual farm performance, and to the performance of all users of the aquatic resources in the case study areas?
How do nutrient levels, indicators, farm activities, rainfall, salinity etc change over the production cycle, and how are these events and conditions related to each other?
(It is particularly important to identify indicators which farmers already use – or new but simple indicators which they could easily use (e.g. sediment colour, texture, smell, bubbling; indicator species (snails, worms, jellyfish, shellfish, plants, insects; water colour, turbidity, foam, bubbles, taste; behaviour of cultured organisms; disease etc) and if possible relate these to both farmer performance (disease, production, survival) and scientifically measurable water/sediment quality indicators (TN, TP, redox etc).
Tools/presentation: indicator *(e.g.*colour) charts to discuss with farmers; interview survey (correlation analysis; regression of variables and indicators; multi-variate analysis)

Nutrient trends and dynamics

How do environmental conditions (indicators/water quality parameters) change in ponds/canals/wider environment over the year/over the production cycle, and how do these relate to events (farmer activity (eg fertilisation, stocking, harvest)/seasonal change in temp, rainfall, salinity)
Tools/presentation: indicator/water quality trend graphs with key events marked

Environmental capacity models

There are three major components to this. All cases should generate an overall rough nutrient budget. Where relevant and feasible, simple flushing/average dilution estimates should be made assuming perfect mixing. More detailed analysis of dispersion of wastes within the system may or may not be appropriate according to the case study. Any researcher wishing to model detailed dilution/dispersion should consult with Trevor)

Nutrient Budget

What is the nutrient budget and nutrient mass balance for individual ponds, for supply/effluent canals, and for the whole aquatic system?
Where do all the nutrients end up?. i.e. what is the total nitrogen, phosphorus and organic matter load and where does most of it end up?.
How much of the load is removed as crop, or in effluent water, or in removed weed or sediment?.
What is the residual which must be accumulating, or being broken down within the system?.

Tools/presentation: Pie charts to show inputs and outputs/sinks; Bar charts to compare nutrient concentrations in ponds, adjacent canals, main system canals/water gates etc; Qualitative and/or quantitative flow diagrams to show nutrient flows to different system components (see flushing rate also)

Flushing rate/nutrient exchange with wider environment (total water exchanged with wider environment x difference in concentration between influent and effluent (pond v canal; canal v estuary or river)). Flushing rate is a useful parameter (= (water exchanged/water volume in system) per tide, crop, month, year as appropriate (be consistent!))

What is the flushing rate for individual ponds, for sub-components of the wider aquatic system, and for the wider aquatic system as a whole?
Tools/presentation: flow diagram with corresponding volumes of subcomponents and indications of total water exchange and dissolved/suspended nutrient exchange over a cropping cycle or year. This may be linked in with nutrient budgets to give enhanced presentation of nutrient flows.

Dispersion and dilution

How are nutrients (including organic matter) dispersed and diluted within the aquatic system?. In some cases it may be desirable to go beyond the simple mass balance and flushing rates described above to establish empirically, or model theoretically, nutrient gradients and the dispersion and dilution of nutrients within the system
Tools/presentation: nutrient gradients along canals, or along transects from sources; flushing rate and nutrient budget estimates for sub-components; qualitative and quantitative flow diagrams.

1. Management protocols/guidance/agreements

Can water or sediment management of individual farms, and the wider aquatic system, be improved to generate improved performance/benefits for all users, long term sustainability, and reduced conflict between farmers and or between farmers and other users?
Can simple agreements or guidelines be developed to promote these improvements?
Tools: discussions with stakeholders; workshops; testing of possible agreements

Publication and dissemination planning

We all have to start generating outputs. The following is a provisional list. It would be best to split effort a little on this, so please let me know which of the more specialist publications you would like to/feel you can make a significant contribution:

Working papers and semi popular articles (NAGA, Infofish, Asia Aquaculture, World Aquaculture; ID21; nautilus and other websites)

Name is of the person responsible for first draft and coordination of inputs from others. Please let us know which of these you would like to make a significant contribution, and get your name on…

1. Case studies: qualitative description and identification of issues (John, Nov 03)
2. Nutrient cycles/cropping cycles; practice; indicators and performance (Tuan, Jan 04)
3. Nutrient budgets and mass balance relations (Rod, Feb 04)
4. Flushing rates, dispersion, and environmental capacity models (**John**) Sep 04
5. Management agreements relating to farm nutrients (Rod**,** sep 04)
6. Adaptive research – models and experience in VN and Bdesh (John)
7. Institutions and governance of aquaculture in Bangladesh (Rod, Anis June 04)

Journal articles (*suggested****)***

1. Application of environmental capacity concepts and models in developing countries (John. Dec draft; June final)
2. The value and application of qualitative and quantitative indicators for water and sediment quality management of aquaculture in developing countries (Rod. Dec 2004)

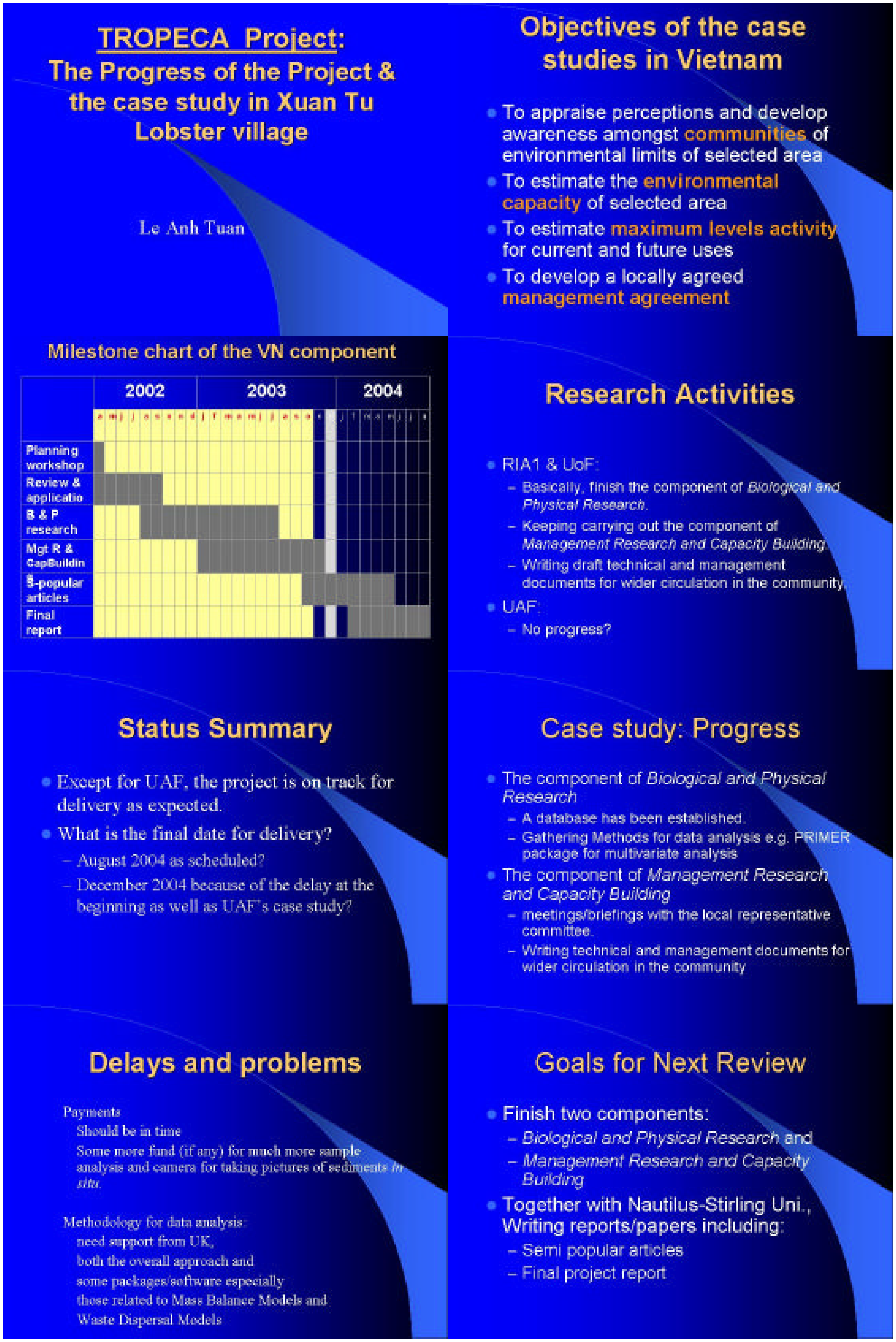
Final Report

Rod, everyone (December 2004)
This will be a concise summary and overview of all case studies with finalised working papers bound in as appendices.

National/regional dissemination initiatives

National coordinator should develop a national dissemination plan. We will put all these together and seek additional funds from DFID AFGRP to develop appropriate materials, e.g. local guidelines, national guidelines, training leaflets, training courses etc

1. TROPECA Progress – Mr. Le Anh Tuan, National Co-ordinator




Thank you!

2. UoF Presentation - Mr. Le Anh Tuan, National Co-ordinator

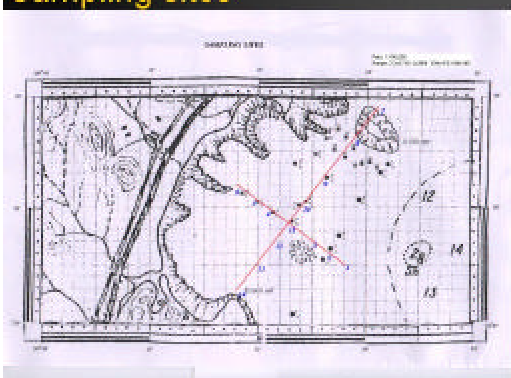
Lobster village Case study: Data & Analysis

Le Anh Tuan

Introduction

- Xuan Tu Village:
  - 60km N of Nha Trang
  - Size:
    - culture area = 118 ha
    - Xuan Tu sea = 472 ha
    - Van Phong = 503 km²
- Problems
  - 30% farms failed
  - Survival rate low
- Causes:
  - Polluted
  - Disease

Sampling sites



Sample collecting (1)

- Water data were collected *in situ*
- Variables measured and used in subsequent analyses were:
  - Temperature
  - Salinity
  - pH
  - Dissolved O_2
  - Transparency

Sample collecting (2)

- Sediment samples were collected using a tube piston corer
- This enabled approximately 300 cm² of sediment to be collected
- The sediment was stored in plastic bags containing 10% formaldehyde and refrigerated
- The following sediment variables that were used in subsequent analyses were measured in the laboratory:
  - Soil pH
  - % Organic C
  - Total Nitrogen
  - Total phosphorus
  - % Clay
  - % Silt
  - % Sand.

Sample collecting (Bottom fauna)

- The sediment samples in 10% formaldehyde were sieved
- It was then decanted (gentle sieving and decanting of the suspension)
- Next it was placed in 4% formaldehyde
- And the fauna identified and counted.

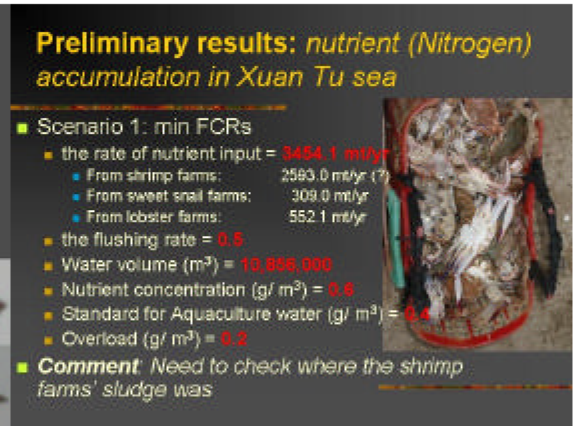
Data analysis: Multivariate analysis using PRIMER routines

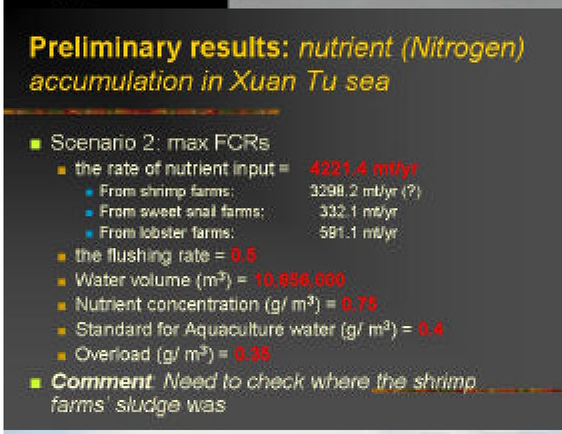
- **PCA Plot of Environmental Data**
- **MDS plot of fauna**
- **ANOSIM (ANalysis Of SIMilarities) to look for statistically significant differences between groups of samples**
- ***SIMPER (SIMilarity PERcentages) : to see which species are most important in accounting for the differences between groups of samples.***
- **BIOENV correlates the two data matrices with one another & will select the best correlation**

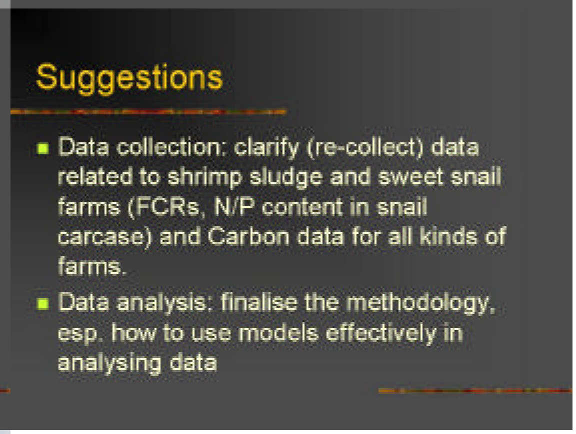
Data analysis: Mass balance model

- Nitrogen and Phosphorus budgets
- C=N/FU
  - C the elevation of nutrient concentrations caused by lobster farms (or any other source of nutrient input)
  - N the rate of nutrient input
  - F the flushing rate
  - U the volume


Preliminary results: Practical indicators
Indicators: need to confirm with farmers.
Fauna: Polychaetes vs molluscs
Sediment smell, and
Sediment colour


Preliminary results: nutrient (Nitrogen) accumulation in Xuan Tu sea
Scenario 1: min FCRs
the rate of nutrient input = 3454.1 mt/yr
From shrimp farms: 2593.0 mt/yr (?)
From sweet snail farms: 309.0 mt/yr
From lobster farms: 552.1 mt/yr
the flushing rate = 0.5
Water volume (m³) = 10,856,000
Nutrient concentration (g/ m³) = 0.6
Standard for Aquaculture water (g/ m³) = 0.4
Overload (g/ m³) = 0.2
Comment: Need to check where the shrimp farms' sludge was


Preliminary results: nutrient (Nitrogen) accumulation in Xuan Tu sea
Scenario 2: max FCRs
the rate of nutrient input = 4221.4 mt/yr
From shrimp farms: 3298.2 mt/yr (?)
From sweet snail farms: 332.1 mt/yr
From lobster farms: 591.1 mt/yr
the flushing rate = 0.5
Water volume (m³) = 10,856,000
Nutrient concentration (g/ m³) = 0.75
Standard for Aquaculture water (g/ m³) = 0.4
Overload (g/ m³) = 0.35
Comment: Need to check where the shrimp farms' sludge was


Suggestions
Data collection: clarify (re-collect) data related to shrimp sludge and sweet snail farms (FCRs, N/P content in snail carcase) and Carbon data for all kinds of farms.
Data analysis: finalise the methodology, esp. how to use models effectively in analysing data


Thank you!

3. RIA1 Presentation – Mr. Vu Van In, RIA1, Haiphong

TROPECA Case study Doson 2003

Location: Doson shrimp culture region, 16 km east of Haiphong

Duration: 2002-2004

Status: on-going

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Activities in 2003 (Jan. – Sep)

- Conducted a survey on environment, shrimp disease in 6 main culture areas.
- Chose a volunteer group who took part in recording and kept track of the environmental changes and shrimp behaviour.
- Draw a projected map and outlined sampling plan.
- Sampling and analysis.
- Held meeting with farmers and discussed about enviromental quality indicators the way to improve environmental practices.
- Made agreement with farmers about indicators and the criteria for design of ponds and water system.
- Recommendation and proposed activities in the coming time.

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Current aquaculture in Haiphong

Table 1: Coastal aquaculture area in Haiphong 2000 - 2003

Model \ Year	2.000	2.001	2.002	2003
Semi-intensive and Intensive	1.829,0	2.091,0	2.200,0	2.100
Improved-extensive + Extensive	7.394,5	8.629,0	8.620,0	8.800
Total area (ha)	9.223,5	10.720,0	10.820,0	10.900,0

(Source: Haiphong Fisheries Depart's report, 2003

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Shrimp culture model and its production in Haiphong

Culture model	Year 2000			Year 2001			Year 2002		
	Area (ha)	Yield (ton/ha)	Prod. (ton)	Area (ha)	Yield (ton/ha)	Prod. (ton)	Area (ha)	Yield (ton/ha)	Prod. (ton)
Extnesive	5.459	0,12	655	3.950	0,14	553	4.251	0,12	510,12
Semi-intensive	600	0,34	204	2.091	0,27	556	1.900	0,25	475,0
Intensive	0	0	0	18	0,51	9,18	8	0,60	4,8
Total	6.059	0	859	6.059		1.118	6.159		990

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Shirmp culture production in Doson

Total area: 683 ha with 706 people involved.

- Table 3: Yield and production in the year 1999 - 2003 in the 1st crop *(excl. fish & seaweed prod.)*

Year	Yield (Ton/ha)	Total produc. (Ton)
1999	0.50-0.55	381.7
2000	0.45-0.50	312.3
2001	0.15-0.20	104.1
2002	0.15-0.25	133.9
2003	0.20-0.25	173.5
Grandtotal		1.110,4

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Integrated stocking

Table 4: Stocking composition in the second crop - 2003

No.	Composition	Area (ha)	% of area	Stocking den. (P/m²)			Yield (kg/ha)	Prod. (ton)	Note
				Shrimp	Crab	Tilapia			
1	Shrimp-crab	416	60.9	5-7	0.5-1	0	50-80	27.04	
2	Shrimp-Tilapia	166	24.3	5-7	0	2-3	300-400	[illegible]	
3	Monosex tilapia	12	1.8	0	0	5-7	300-1.000	[illegible]	
4	Mud crab	69	10.1	0	1-5	0	20-50	[illegible]	
5	Seaweed	20	2.9	0	0	0	2.000	40	Dried
Total		683	100					[illegible]	

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Current culture techniques

- Poor investment with 99% improved-extensive culture.
- Poor culture techniques.
- Quality of feed : Most of feed are low-quality home made feed: fresh bivalves, trash fish …

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Pre-stocking step (preparation)

- Let water out when the tide goes down (impossible to dry the pond).
- Gather seaweed and other unexpected fish and shrimp.
- Take water in and fertilize the pond bottom, usually with decomposed manure (checken's manure, pig's …), 400-600 kgs/ha (up to 1 tonne/ha).
- Wait for about 5-7 days before stocking.

Some households used disinfection to kill pathogens in water before stocking (chlorine, $KMnO_4$ …)

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Stocking

Origin of Juvenile shrimp: Middle part of Vietnam (65%), China (30%), in-house production (5%).

Price: 35-40 VND/1 Ind.

Quality: China- originated juvenile is not as good, therfore, farmers prefer in-country made seedlings. However, it is not easy to distinguish between the two.

Source: Haiphong fisheries depart 2003

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Feeding practice 1

Starting feeding shrimp one month after stocking: 20%

Starting feed shrimp 2-3 week after stocking: 50%

Starting feed shrimp 1-2 weeks after stocking: 12%.

No feeding: 18%

Source: Haiphong fisheries depart 2003

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Feeding practice 2

- In the first month: Boiled trash fish
- Following this by factory-made feed.
- After 2 months and half: starting feed with bivalve mollucs. The volumne of bivalve counts on feed consumption.

Source: Haiphong fisheries depart 2003

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Water exchange regime

- No water exchange regime: 45%.
- Regular water exchange (4-6 times/months) with 30 % of the water volume in the pond each : 30%.
- Limited water exchange (1-3 times/month): 25%.

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Harvest

- Equipment used for harvesting
  - Bamboo trap is most common.
  - Harvesting net.
- Harvesting method
  - Collect shrimp with bamboo trap day by day.
  - Drainage out the pond and harvest all.

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Constrains

- Low investment in equipment to support the environment quality and monitoring.
- Poor control in water depth due to poor pond structure (leaked, depression, collaps ...).
- Lack of seperated water supply and effluent system.
- Bottom of the pond treatment before and during crop.

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Epidemic status

No	Disease	Stage infected	Pathogen	%
1	Luminuos	Juvenile shrimp	*V. parahaemolyticus*	5
2	Red spot dis	Adult	*V.alginolyticus*	40
3	Black gill dis.	Adult	*Fusarium sp* *V. anguillarum.* *Vibrio.sp*	20
4	White spot dis	Adult	*WSBV* *V.alginolyticus* *V. vulnificus*	35

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Water quality management

- Chemical and pro-biotics usage
  - Saponin to kill unexpected species with concentration of 7=10 ppm.
  - Use some common pro-biotics to improve the water quality in the pond such as: Pond clear, Bio-DOW, NTL, Taiwan made bio-product ...
- Disease prevention: No obviously effective measure. However, each households follow their own way.

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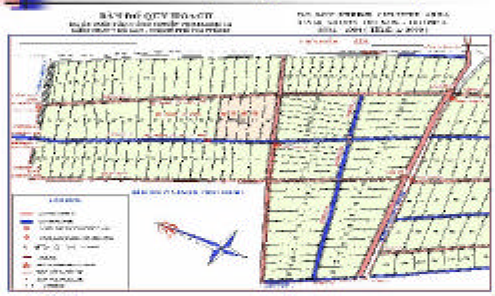
Water sampling and analysis



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Description of sampling ponds

No.	Description	Area (ha)	Depth (m)	Density (con/m²)	Feed	Manure	Note
1	Water source		1,5				
2	Pond T1	1,3	0.98	6,8	Trash fish, bivalve, factory-made	NPK	
3	Pond T2	1.2	0.85	6.8	Trash fish, bivalve, factory-made	NPK + Chicken manure	Seaweed grow, [illegible] dis. Low Pond
4	Pond T3	1.3	0.88	5,4	Trash fish, bivalve, factory	NPK + Chicken manure	Red spot Dis, Low pond.
5	Pond T4	1.3	0.75	6,6	Trash fish, bivalve, factory	Chicken manure	Seaweed overgrown, Low pond
6	Inland		1.5-2.0				

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Indicator

- Water color: *25-30 cm is recommended.*
  - *Water depth: 1-1,2 m is recommended.*
  - *Lack of DO: Shrimp swin toward the surface layer around the pond sides, in early morning where pond weed overgrows.*
  - *Indicator of bottom becoming polluted: floating substances on the water.*

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Recommendation 1

- To local fishery authorities
  - Complete *master plan for shrimp farming*
  - *Strengthen quarantine quality of shrimp juvenile .*
  - *Increase budget for farming farmers and other technical support.*

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Recommendation 2

- To farmers
  - Should hold farming group to help and exchange experience more regular.
  - *To buy some essential test kit to check the quality of water during farming period.*
  - *Reduce home-made feed.*
  - *Strictly disinfect water before discharge when disease is found.*

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Conclusion

- Shrimp farming in Doson is a low tech, low yield, low profit but high risk. About 60% of households who lost their money or just remain their investment.
- Farmers are from poor background with low income, low education and low techniques.
- Water management is poor and disease is still a big problem for farmers but they don't have any effective treatment.

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4. UAF Presentation – Mr. Nguyen Van Tu, UAF, HCM City

Environmental capacity for tropical aquaculture (TROPECA)

FoF/UAF
(Oct./2003)

TROPECA

- Project implementation
  - Local workshops (Aug./2002)
    - To explain objectives of the project
    - To gather information and identify issues related to environmental management and shrimp culture performance in the area
    - To set up research plan

TROPECA

- Project implementation
  - Local workshops (Aug./2002)
    - Less understanding of environmental problems by the farmers
    - Few research-based supports for sustainable development
    - '*Environmental capacity*' was a new concept to the farmers and extension workers

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- Selected site
  - Trang My hamlet of Ly Nhon Commune of Can Gio District of HCMC
    - 30 salt production households
    - total production area about 45 ha

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TROPECA

- Shrimp culture system
  - Socio-economic aspects
    - Farmers are poor and low level of education
    - Livelihood is based on agriculture activities
    - Shrimp culture was developed 2 years ago
    - The farmers are lacking in know-how of shrimp culture

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- Shrimp culture system
  - Culture system description
    - Semi-intensive shrimp culture is rotated with salt production
    - Shrimp culture is practiced in rainy season (June - December) and salt production in dry season (January – May)
    - Starting time of shrimp stocking is depended on the farmers' judgment

TROPECA

- Shrimp culture system
  - Culture system description
    - Salt-production fields were modified simply
    - The ponds were supplied water by pumping from canals and drained by gravity
    - Water depth was maintained about 60 cm

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Shrimp culture system

Culture performance

- Only lime was applied for pond preparation
- Seed was bought from other provinces
- Stocking density was low: 5-8 shrimp/m^2
- Feed for shrimp was rice bran, cooked trash fish and small shrimp, and paletted feed

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Shrimp culture system

Culture performance

- Water was added twice a month
- Aeration and chemicals were not applied during culture period
- Average yield was 500 kg/ha.crop

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Data collection

Semi-intensive

- Water and mud sampling for nitrite, nitrate, ammonia, phosphorus analysis

TROPECA

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TROPECA

Data collection

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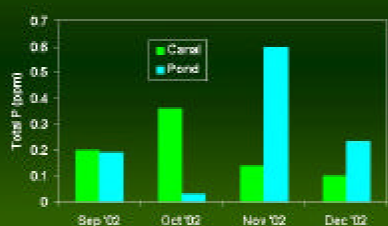


TROPECA

Data collection

Semi-intensive

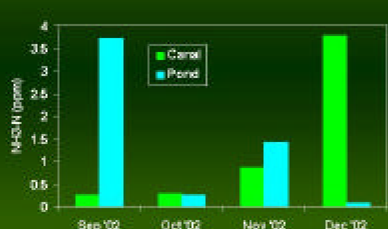
- Water and mud sampling for nitrite, nitrate, ammonia, phosphorus analysis

TROPECA

Data collection

Intensive

- Water and mud sampling for nitrite, nitrate, ammonia, phosphorus analysis



TROPECA

Data collection

Intensive

- Water and mud sampling for nitrite, nitrate, ammonia, phosphorus analysis

TROPECA

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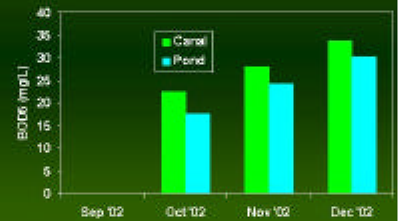

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Results of shrimp culture

- No disease occurred in the first year
- Some farmers had to harvest shrimp early due to yellow head and white spot diseases
- Water in disease-infected ponds were treated with (chlorine or permanganate potassium) followed recommendations of local officials

TROPECA

Local workshop in June 2003

Farmers' opinions

- The quality of water sources was assessed normal or poorer but the failure of shrimp culture was mainly caused by disease, an unavoidable cause
- The farmers expressed a desire to intensify performance if they had chances to do so

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Local workshop in June 2003

Local authorities' opinions

- Ly Nhon commune has been planed for semi-intensive and intensive shrimp culture
  - There were 7 persons from outside to rent land for shrimp culture (11 ha)
- In 2003, the city government invested for irrigation systems in shrimp culture areas

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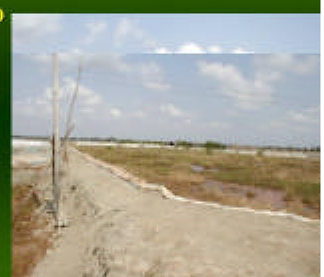
Local workshop in June 2003

Local authorities' opinions

- In 2003, the city government allocated site and invested for pond mud dumping



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Local workshop in June 2003

Local authorities' opinions

- To select rice-shrimp system in Binh Khanh commune as case study
- Poor households have been based on shrimp culture for their livelihood

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Targets of shrimp culture development plan of Can Gio in 2005

Commune	Area in 2005			
	Total	Intensive	Semi-intensive	Rice-shrimp
Binh Khanh	2210	-	410	1800
Tam Thon Hiep	750	400	100	250
An Thoi Dong	2250	450	700	1100
Ly Nhon	1780	230	1150	-


TROPECA
Local workshop in June 2003
Local authorities' opinions
The new potential site was explored in September
It might be in Binh Thanh hamlet of Binh Khanh commune


TROPECA
Coming up activities
Farmer meeting
Early Nov. 2003
Environmental data analysis
Early Nov. 2003 to Sep. 2004
Data finalization
Sep. 2004
Local workshop
Oct. 2004