Fisheries Sector Programme Support Phase 2
Component No. 3: Sustainable Development of Aquaculture (SUDA)

Risk profile of household scale production of *Pangasius* and shrimp in the Mekong Delta of Vietnam

(Start to conduct a technical and environmental risk analysis of current aquatic production systems in Vietnam 2008 SUDA activity 3.2.1)

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Contents

1 Executive Summary ................................................................................................................. 3
2 Approach and methodology ................................................................................................. 6
  2.1 Objectives ...................................................................................................................... 6
  2.2 Methods ....................................................................................................................... 6
  2.3 List of consultees ........................................................................................................... 7
  2.4 Map of the Mekong Delta showing provinces referred to in the text ..................... 9
3 Overview of the Tra catfish farming sector in Vietnam ................................................... 10
4 Overview of the shrimp farming sector in the Mekong .................................................... 12
5 Areas of risk and specific hazards ...................................................................................... 14
6 Overview of risks in the production of Tra in the Mekong Delta ..................................... 17
7 Mitigation of risks to household scale Tra farming .......................................................... 20
8 Overview of risks in the production of shrimp in the Mekong Delta ............................... 23
9 Mitigation of risks to household scale shrimp farmers ...................................................... 27
10 Discussion and conclusions .............................................................................................. 30
  10.1 Overview and comparison of risks affecting household scale Tra and shrimp production ......................................................................................................................... 30
  10.2 Priorities for action and opportunities for mitigation .................................................. 31
  10.3 Analysis of need, opportunity and cost-effectiveness of research. ............................ 31
  10.4 Risk analysis methods and application ......................................................................... 32
11 References ......................................................................................................................... 33
Annex 1: Risk analysis of key hazards for Tra catfish production in the Mekong Delta ....... 34
1. Price variation ...................................................................................................................... 34
2. Price level and trends ......................................................................................................... 39
3. Access to international markets ....................................................................................... 42
4. Access to local markets .................................................................................................... 44
5. High price of feed ............................................................................................................. 45
6. Feed quality ..................................................................................................................... 48
7. Poor seed quality or infected seed ................................................................................... 50
8. Water quality .................................................................................................................. 52
9. Excessive use of antibiotics ............................................................................................. 54
10. Disease in pond sediment ............................................................................................... 57
11. Disease in supply water ................................................................................................. 58
Annex 2: Risk analysis of key hazards for shrimp (P. monodon; L. vannamei) production in the Mekong Delta ......................................................................................................................... 60
12. Price variation .................................................................................................................. 61
13. Price level and trends ...................................................................................................... 66
14. Access to international markets ..................................................................................... 73
15. Access to local markets .................................................................................................. 75
16. High price of feed .......................................................................................................... 76
17. Feed quality .................................................................................................................... 79
18. Release of L. vannamei ................................................................................................... 81
19. Poor seed quality or infected seed ................................................................................... 84
20. Water quality .................................................................................................................. 88
21. Excessive use of antibiotics and chemicals .................................................................. 90
22. Disease in pond sediment ............................................................................................... 92
23. Disease in supply water ................................................................................................. 93
1 Executive Summary

Background
Risk analysis has been widely promoted in recent years as an important tool to focus assessment, action or research in critical areas. The key elements of risk analysis include:

- a rigorous assessment of the sources of risk (hazards);
- the "release" and pathways by which these risks are realized;
- the exposure of particular groups of people (or elements in the ecosystem);
- the likelihood and severity of the associated negative effects or consequences; and
- the influencing factors which modify likelihood and severity of these consequences.

This approach can be adapted to a very wide range of issues and applied at different levels of detail. It can help focus on critical issues in EIA or Strategic Environmental Assessment, as well as focus on needs or opportunities for mitigation. When applied in detail to a specific issue, it can be used to identify critical control points or opportunities for cost effective management interventions. It is also useful in identifying priorities for research.

The objective for this research was to:

“.... start to conduct a technical and environmental risk analysis of current aquaculture production systems in Vietnam and based on the findings make recommendations for changes to optimise current production systems, while also reducing both technical and/or environmental based risks”.

At the inception meeting it was agreed that the study should focus on the risks to household scale producers of “tra” (Pangasius hypophthalmus) and shrimp in the Mekong Delta.

Main findings

Tra

1. Tra catfish farming is a very high risk activity for household scale production. Input costs (and associated borrowing) represent a very high proportion of production cost/market price, margins are slim or negative, and market price is unstable. Household scale producers in particular are vulnerable to chronic disease – which effectively increases production cost and makes operation non-viable.

2. Although a range of mitigation measures is applicable to all scales of production, effective implementation will be difficult for many small scale producers. In the medium-long term they are likely to go out of business.

3. The overall the risk profile of Tra catfish production is such as to make it unsuitable for household scale production in the medium-long-term, unless very efficient small scale producer organizations can be established. The sector is likely to move toward large scale vertically integrated operations.
Shrimp

4. Shrimp production is also a high risk business, though less so than Tra. Input costs comprise a lower proportion of production costs, and because this is a relatively mature market, farm gate price, though seasonally variable, is less unstable than is the price of Tra.

5. In the longer term household scale producers will find it difficult to compete with large scale production of small shrimp (likely to be dominated by white leg shrimp (L. vannamei) production). There may be less competition in the smaller market for larger shrimp. Household scale extensive producers with lower labour costs may have a comparative advantage in this market.

6. Disease remains a chronic problem, and is by far the most serious risk facing small scale producers. This risk may be exacerbated by the current release of L. vannamei, which is only partially under control. An illegal “black market” for seed and significant unauthorized production represents a significant hazard in terms of disease introduction and transfer to P. monodon.

Recommendations

Research

7. The analysis suggests several areas as priority for cost effective research to address the most serious risks facing small scale producers:

- Market research (and effective dissemination to producers) on price trends and comparative advantage in domestic and international markets
- Market research on opportunities for niche products from small scale producers for domestic and international markets
- Detailed risk analysis on the import and distribution of L. vannamei to identify critical control points
- Research on marketing and distribution infrastructure, and in particular the need for, and optimal location of, cold storage facilities
- Research on production strategies to exploit seasonal price variation
- Research on improving the quality and reducing the costs of pelleted feeds in Vietnam

Mitigation

8. Many mitigation measures in relation to production risks are already well known. The requirement now is for more widespread implementation.

9. A key precondition for the effective implementation of most mitigation measures is for household scale producers to become better organized. This should allow them to:

- Establish cost effective product traceability systems
- Increase bargaining power, and develop cost effective group marketing initiatives
- Reduce the cost and increase the quality of inputs
- Develop cost-effective group environmental management and biosecurity measures
10. Further mitigation measures are listed in table 6 of this report and analysed in more detail in relation to specific risks in Annexes 1 and 2.
2 Approach and methodology

2.1 Objectives
According to the TOR, the objective of this consultancy is to "... start to conduct a technical and environmental risk analysis of current aquaculture production systems in Vietnam and based on the findings make recommendations for changes to optimise current production systems, while also reducing both technical and/or environmental based risks".

At the inception meeting in Hanoi it was agreed that the scope of this was too broad given the time available, and that we should focus on just two or three systems in the Mekong Delta:

- Household level production of *Pangasius hypophthalmus* (tra) catfish;
- Household level production of *Penaeus monodon* and *Litopenaeus vannamei* shrimp.

It was also agreed that the study would focus primarily on risks to producers rather than risks to others or to the wider environment. This work should therefore complement rather than overlap the parallel work being conducted on environmental impact assessment of *Pangasius* production.

2.2 Methods
This report and the associated annexes offer an overview of risk issues relating to household scale production of *Pangasius* and shrimp production in the Mekong Delta. Specifically they address:

- The nature of the main hazards and associated risks, and the pathways through which negative consequences to household scale producers are realised.
- The quality and availability of information and analysis relating to each hazard and associated risks and consequences.
- The relative importance of each hazard – in terms of exposure of household scale producers, probability, severity (extent, reversibility etc) and uncertainty associated with negative consequences.
- The type of analysis which can be used to explore and communicate the various risks.
- Preliminary assessment of possible mechanisms to reduce negative consequences (mitigation).
- Recommendations for more detailed analysis in critical areas.
- An overall evaluation of the potential and application of risk analysis as a tool for improved planning and management of aquaculture in Vietnam.

Key risk issues and hazards were identified through the literature, and through discussions with academics, fish farmers, national and provincial officials, traders and others associated with the industry. The pathways through which the risks are
realised, and the consequences for household scale farmers were also explored in interviews, and followed up through further research.

The study drew on two key sources on risk analysis for aquaculture:


2.3 List of consultees
The study was based primarily on semi-structured interviews with key informants who offered a wealth of knowledge, as well as their perception of the nature and importance of the various risks faced by household scale producers of shrimp and Tra. Thanks are due to all of these for their insights, and for the time offered up in discussions.

<table>
<thead>
<tr>
<th>Meeting with</th>
<th>Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUDA &amp; DoA’s leaders</td>
<td>Scope of activity</td>
</tr>
<tr>
<td>Mrs Minh &amp; Mr Duc (DoA)</td>
<td>Environment &amp; diseases</td>
</tr>
<tr>
<td>Dr Pham Anh Tuan (STED-MARD)</td>
<td>Genetics</td>
</tr>
<tr>
<td>Dr Nguyen Huu Dung (VASEP)</td>
<td>Market, etc.</td>
</tr>
<tr>
<td>Dr Le Thanh Luu (RIA 1)</td>
<td>General issues</td>
</tr>
<tr>
<td>Dr Le Tieu La &amp; staff (VIFEP)</td>
<td>Planning, management, etc.</td>
</tr>
<tr>
<td>Mr Paul Nichols</td>
<td>POSMA</td>
</tr>
<tr>
<td>Mrs Phan Thi Van &amp; Mr Tai (RIA 1)</td>
<td>Diseases &amp; Environment</td>
</tr>
<tr>
<td>Mr Pham Co Thach &amp; Mr Dao Van Tri (RIA 3) (by phone)</td>
<td>White-leg shrimp</td>
</tr>
<tr>
<td>Drs Le Thanh Hung, Nguyen Van Trai, Nguyen Minh Duc &amp; Nguyen Phu Hoa (Nong Lam Univ.)</td>
<td></td>
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<tr>
<td>Dr Nguyen Thanh Tung (VIFEP - South Branch)</td>
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<tr>
<td>Drs Nguyen Van Hao &amp; staff (RIA 2)</td>
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<td>Mr Nho (Ben Tre DARD staff)</td>
<td></td>
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<tr>
<td>Mr Huy (Tiger shrimp seed producer, Vannamei PL &amp; feed distributor)</td>
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<tr>
<td>Mr Tu (Feed distributor in Binh Dai)</td>
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<tr>
<td>Mr Duc (Tra farmer)</td>
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<tr>
<td>Mr Dung (Ben Tre DARD staff) &amp; Mrs Nga (Vice Director, Ben Tre DARD)</td>
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<td>Mrs Banh</td>
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<td>Mr Tho</td>
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<tr>
<td>Drs Nguyen Thanh Phuong, Minh, Lan, Tam, Le Xuan Sinh (CTU)</td>
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<tr>
<td>Mr Hai, Mrs Dien (Can Tho DARD)</td>
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<tr>
<td>Mr Chanh (Director - Aquaculture Extension Centre, Ca Mau DARD)</td>
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<tr>
<td>Mr Sa (Technician working for Thuan Kieu Feed Agency in Ca Mau)</td>
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<tr>
<td>Mr Thanh (Intensive shrimp farmer in Dam Doi district)</td>
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<tr>
<td>Mr Ba (Intensive shrimp farmer in Dam Doi district)</td>
<td></td>
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<tr>
<td>Mr Hieu (Improved extensive shrimp farmer in Dam Doi district)</td>
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<tr>
<td>Mr Tho (Vannamei shrimp farmer, through Mr Tung)</td>
<td></td>
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<tr>
<td>Mr Tung (CJVinaAgri Feed company)</td>
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<td></td>
</tr>
</tbody>
</table>

Meeting with

SUDA & DoA’s leaders

Mrs Minh & Mr Duc (DoA)

Dr Pham Anh Tuan (STED-MARD)

Dr Nguyen Huu Dung (VASEP)

Dr Le Thanh Luu (RIA 1)

Dr Le Tieu La & staff (VIFEP)

Mr Paul Nichols

Mrs Phan Thi Van & Mr Tai (RIA 1)

Mr Pham Co Thach & Mr Dao Van Tri (RIA 3) (by phone)

Drs Le Thanh Hung, Nguyen Van Trai, Nguyen Minh Duc & Nguyen Phu Hoa (Nong Lam Univ.)

Dr Nguyen Thanh Tung (VIFEP - South Branch)

Drs Nguyen Van Hao & staff (RIA 2)

Mr Nho (Ben Tre DARD staff)

Mr Huy (Tiger shrimp seed producer, Vannamei PL & feed distributor)

Mr Tu (Feed distributor in Binh Dai)

Mr Duc (Tra farmer)

Mr Dung (Ben Tre DARD staff) & Mrs Nga (Vice Director, Ben Tre DARD)

Mrs Banh

Mr Tho

Drs Nguyen Thanh Phuong, Minh, Lan, Tam, Le Xuan Sinh (CTU)

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Mr Hieu (Improved extensive shrimp farmer in Dam Doi district)

Mr Tho (Vannamei shrimp farmer, through Mr Tung)

Mr Tung (CJVinaAgri Feed company)


2.4 This document

This document comprises a short overview report and two detailed annexes, each of which presents a formal risk analysis (Annex 1 for Tra; Annex 2 for shrimp). The overview report illustrates the relative importance of the various risks (in terms of likelihood and severity). The annexes offer a more detailed analysis of the nature of the various risks, the exposure of small scale farmers, and opportunities for mitigation. Most mitigation is already well known; the key is to ensure that such mitigation is promoted, facilitated or regulated for the most important risks as identified in the overview.
2.5 Map of the Mekong Delta showing provinces referred to in the text
3 Overview of the Tra catfish farming sector in Vietnam

The *Pangasius* sector of Vietnam has gone through enormous growth over the last few years. Beginning on a relatively small scale using Basa (*Pangasius bocourti*) in cages in the Hau and Tieng rivers several decades ago, it has developed into a major industry producing over a million tonnes of Tra (*P. hypophthalmus*) in highly intensive cages, pens and ponds. Yields are exceptionally high for aquaculture at between 50 and 300 tonnes per ha per crop in ponds and up to 1,000 tonnes/ha per crop in net pen enclosures. Export growth has been spectacular in the last few years, rising from around 75,000 metric tonnes of processed product (mainly frozen fillet) in 2004 to more than 600,000 tonnes in 2008, worth more than $1 billion US. The area in production is unclear but probably lies somewhere between 5,000 and 9,000 ha.

Since 1997 artificial breeding has been the main source of fry, produced from perhaps 450 hatcheries. A large number of nurseries (perhaps as many as 150,000) grow the fry up to 3-4.5 cm over a period of around 90 days. Growout takes between 5 and 8 months.

Many of the broodstock are now sourced from farms, and this may be leading to genetic degradation. RIA2 now operates a breeding programme (PanGI) producing high quality broodstock and seed. It is hoped that the decline in fry quality can be reversed through widespread distribution of quality broodstock to hatcheries.

Commercial pellets and homemade feed is used in growout, with smaller scale producers tending to use a higher proportion of homemade feed. Though homemade feed is cost effective, the flesh quality of the finished product is less good, and “finishing” with pelleted feeds is a common practice. There is some evidence that *Pangasius* offal has been recycled into feed production, but the current extent of this practise is not clear.

Most farmers depend on credit, often from feed companies, to finance their inputs.

Not surprisingly, given the intensity and concentration of production, disease incidence has increased in recent years, from 10% a few years ago to between 30 and 50% for most farmers last year.

Processing capacity has increased rapidly, and there are now around 40 *Pangasius* processing companies, developed to the highest international standards, located mainly in An Giang and Can Tho provinces with a capacity of 3,300 MT/day. An additional 32 are planned in the next few years and more thereafter.

*Pangasius* was originally exported mainly to the US, but partly as a result of anti dumping proceedings, is now exported to a large number of countries. In 2008, the bulk of production went to the EU (40%), Russia (13%), Australia (9.4%), Asean countries (5.2%), and the US (5.4%).

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2 Dr Hao, RIA2; Dr Tam, Cantho University – pers. Comm..
3 Mantingh op cit
4 Vietfish International. Vol 6 Issue 1 Jan-Feb 2009
Unfortunately prices have declined in recent years, and last year many farmers made significant losses and ceased production. Prices have strengthened again recently, but it is clear that the industry is vulnerable to significant price fluctuations.

A recent pre-assessment of the sector (Mantingh and Dung 2008) identified the following significant risks through interviews with key informants:

- Price instability of the product
- Outbreak of diseases
- Degradation of fingerling quality
- Inadequate supply of raw material (processors)
- Price fluctuation
- Animal welfare scandal in EU
- High residue levels in the product and import ban
- Environmental problems, and pollution associated with uncontrolled growth of the sector and the economy more widely
4 Overview of the shrimp farming sector in the Mekong

The Mekong Delta in the southern part of Vietnam covers 12% of the total area of the country and has great potential for increased agriculture and aquaculture production. The Delta possesses more than four million ha of natural land area, of which water bodies excluding rivers comprise 954,350 ha. Of the total water area, brackish water areas comprise 313,000 ha [5]. The Mekong Delta is by far the most productive area not only for freshwater aquaculture but also brackish water aquaculture in Vietnam because of its favourable environmental conditions.

Penaeid shrimp has been farmed in this region for 25 years. Total production of farmed shrimp in the Delta reached nearly 160,500 tons in 2008. Shrimp production in the Mekong Delta now comprises more than 76% of the country’s total production. With the rising importance of shrimp aquaculture in the Mekong Delta, considerable income has been generated for local communities. Three commercial shrimp species are exploited including Penaeus monodon, P. merguiensis and P. indicus, with P. monodon being the main species farmed. Recently, with the Central government’s permission, white-leg shrimp (L. vannamei) has been introduced to the region.

At the end of August 2008, the shrimp-farming area in the Mekong Delta was nearly 540,000 ha, accounting for approximately 90% of the total shrimp-farming area of the whole country.

The trend in shrimp production in the Mekong Delta is for a decrease in extensive culture areas having low productivity (80-250 kg/ha/yr) and replacement by intensified culture systems (semi-intensive and intensive) having better productivity of up to 6-10 tons/ha/crop. It was estimated that about 47,600 ha of shrimp farming areas operated at semi-intensive and intensive levels in 2008. Semi-intensive culture was first practiced in 1992, when hatchery-reared post-larvae started to be mass-produced, while intensive culture is a fairly recent development. However, this rapid development has contributed to considerable loss of mangrove forest and environment degradation [1]. For this reason, improved-extensive systems either integrated with mangroves or alternated with rice production are considered desirable. Mixed shrimp-mangrove forestry farming has been developing in the Mekong Delta, especially in the southernmost part of Vietnam, in Ca Mau Province, where large areas of mangrove are available. The objectives of this system are twofold: to promote reforestation and slow the rate of mangrove destruction while achieving poverty alleviation among coastal communities through shrimp culture [1].

In coastal provinces of the Mekong Delta, alternate rice-shrimp farming has been widely practiced with success [2]. With the conversion of unproductive rice land to rice-shrimp farming as mentioned above, this system has become prevalent in areas of saline water intrusion or where rice is cultivated only during the rainy season. Rice is produced during the months from June to November when water salinity is close to freshwater conditions, while shrimp culture is carried out from December-January to May-June of the following year when water salinity does not exceed 15 ppt. The system is operated at an improved extensive level with stocking density being 2-5 post-larvae per square meter. This system is proving to be sustainable and suitable for most farmers in terms of resources and technical knowledge [2].
Table 1. Shrimp yields by farming system type in the Mekong Delta [3]

<table>
<thead>
<tr>
<th>Culture system</th>
<th>Yield (ton/ha/crop)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive</td>
<td>3-10</td>
</tr>
<tr>
<td>Semi-intensive</td>
<td>1.2-2.56</td>
</tr>
<tr>
<td>Mixed shrimp-forestry</td>
<td>0.1-0.29</td>
</tr>
<tr>
<td>Rice-shrimp</td>
<td>0.33-0.5</td>
</tr>
</tbody>
</table>

Currently, due to short production cycle, many farmers are shifting from tiger shrimp to white-leg shrimp farming, both legally and illegally.

**key issues**

- Price variation: tiger shrimp price has fallen VND 20-30,000 per kg.
- Disease
- Limited education/training of farmers
- Too small-scale farms, spontaneously developed with little planning
- Low water quality locally
- Lack of a master plan for the whole region
- Lack of high quality feed/seed supply
- Lack of an effective technology transfer system
- Inappropriate processing factory network distribution
- Weak environmental monitoring system
- Lack of infrastructure for aquaculture in general, etc.
## 5 Areas of risk and specific hazards

Fish farming is associated with a very wide range of risks and associated hazards. The main areas of risk and associated hazards – as gleaned from the literature, from consultees, and from first principles – are listed in table 2.

**Table 2. Risks to producers**

<table>
<thead>
<tr>
<th>Area of risk</th>
<th>Specific hazard</th>
<th>potential consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>Price fluctuation</td>
<td>erratic earnings; cash flow problems; loss/insolvency</td>
</tr>
<tr>
<td></td>
<td>Long term price decline</td>
<td>cash flow problems; loss/insolvency</td>
</tr>
<tr>
<td>Limited market access</td>
<td>Low earnings; loss/insolvency</td>
<td></td>
</tr>
<tr>
<td>(local)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited market access</td>
<td>Low earnings; loss/insolvency</td>
<td></td>
</tr>
<tr>
<td>(international)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed</td>
<td>High feed price</td>
<td>low earnings; loss/insolvency</td>
</tr>
<tr>
<td></td>
<td>Low feed quality</td>
<td>poor growth; poor flesh quality; low earnings; loss/insolvency</td>
</tr>
<tr>
<td>Disease</td>
<td>Poor seed quality</td>
<td>poor growth; introduction of disease; susceptibility to disease; low earnings; loss/insolvency</td>
</tr>
<tr>
<td></td>
<td>Widespread release of infected <em>L. vannamei</em></td>
<td>disease transfer and spread; introduction of new disease (e.g. Taura); low earnings; loss/insolvency</td>
</tr>
<tr>
<td></td>
<td>Poor water quality</td>
<td>Poor growth; susceptibility to disease; loss of crops; low earnings; loss/insolvency</td>
</tr>
<tr>
<td></td>
<td>Increasing pathogen resistance to antibiotics</td>
<td>chronic and epidemic disease; loss of crops; low earnings; loss/insolvency</td>
</tr>
<tr>
<td></td>
<td>Disease in pond sediment</td>
<td>chronic and epidemic disease; loss of crops; low earnings; loss/insolvency</td>
</tr>
<tr>
<td></td>
<td>Disease in supply water</td>
<td>chronic and epidemic disease; loss of crops; low earnings; loss/insolvency</td>
</tr>
<tr>
<td></td>
<td>Disease from carriers</td>
<td>chronic and epidemic disease; loss of crops; low earnings; loss/insolvency</td>
</tr>
<tr>
<td>Climate</td>
<td>Temperature extremes (more severe in shallow ponds)</td>
<td>increased susceptibility to disease; poor growth;</td>
</tr>
</tbody>
</table>
Salinity fluctuation (more severe in shallow ponds) | increased susceptibility to disease; poor growth; mortality; low earnings; loss/insolvency

Salinity change (long term) | loss of opportunity; loss of income

Flooding and erosion (more severe closer to sea level) | loss of stock; mortality; low earnings; loss/insolvency

Storm (wind) damage | General damage to equipment

<table>
<thead>
<tr>
<th>Area of risk</th>
<th>Specific hazard</th>
<th>potential consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>Effluents and sediments</td>
<td>toxic algal blooms; poor water quality intake on other farms; higher water exchange costs; higher mortality in other farms; reduced earnings; loss/insolvency</td>
</tr>
<tr>
<td>Chemicals</td>
<td></td>
<td>wider effects on human and animal health; loss of biodiversity; poor growth</td>
</tr>
<tr>
<td>Habitat change</td>
<td></td>
<td>loss of ecosystem function/services (water purification; nursery functions; soil creation)</td>
</tr>
<tr>
<td>Hydrology change</td>
<td></td>
<td>effects on other users; susceptibility to flooding; erosion/deposition</td>
</tr>
<tr>
<td>Release of alien species</td>
<td></td>
<td>competition with/loss of native species; spread of disease (geographically and between species)</td>
</tr>
<tr>
<td>Salinity change</td>
<td></td>
<td>change to or loss of opportunity (farming, fish farming etc)</td>
</tr>
</tbody>
</table>

Table 3: Risks to others arising from poor farm siting or practice

In practice these “hazards” may be allocated to a variety of different “areas of risk” according to the perspectives of various stakeholders. For example: financial risk, production risk, technology risks, environmental risk, ecological risk etc. Equally they can be arranged according to stage in the farming or production process.

This study was concerned with *risks to producers* (Table 2), and specifically those affecting household scale production. Discussions and desk research revealed that the most important areas of risk for household scale producers of both Tra and shrimp were market (price); cost of feed; and disease. Although climate was occasionally mentioned (and especially by government and academics) it was not seen as a pressing issue by those farmers we talked to – and certainly nothing like
as serious as price issues and disease. While climate change may be an issue in the long term, it should be possible to adapt. In the short/medium term the issue is survival, and in this regard, market price, feed and disease issues were considered to be paramount. *Given the limited resources of this study and the need to focus on issues of pressing importance, and taking into account the complexity of climate change issues, we have not considered this issue further in this report.*

For each of the hazards identified in Table 2, and for both Tra catfish and shrimp production, we have undertaken a simple risk analysis (Annexes 1 and 2 respectively). Given the number of hazards (26) these assessments are necessarily superficial and based on the opinions of consultees and readily available information.
6 Overview of risks in the production of Tra in the Mekong Delta

A summary of the estimated relative risk associated with various hazards to which household scale producers of Tra are exposed is presented in Table 4. This assessment is based on the detailed analysis presented in Annex 1 – but remains largely subjective. It is clear that the sector faces a range of serious risks, and household producers are generally the most exposed. It is likely that most will go out of business in the medium term, leaving an industry dominated by commercial producers with well established links with processors.

Table 4. Characteristics of main risks affecting Tra producers

<table>
<thead>
<tr>
<th>Hazards</th>
<th>likelihood</th>
<th>severity</th>
<th>uncertainty</th>
<th>potential for mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price fluctuation</td>
<td>high</td>
<td>high</td>
<td>low</td>
<td>moderate</td>
</tr>
<tr>
<td>Market access (international)</td>
<td>high</td>
<td>high</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Long term price pressure</td>
<td>moderate</td>
<td>moderate</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Market access (local)</td>
<td>low</td>
<td>low</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td><strong>Feed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed price</td>
<td>moderate</td>
<td>high</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Feed quality</td>
<td>moderate</td>
<td>moderate</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td><strong>Disease</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed quality</td>
<td>high</td>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Increasing resistance to antibiotics</td>
<td>high</td>
<td>high</td>
<td>moderate</td>
<td>high</td>
</tr>
<tr>
<td>Disease in supply water</td>
<td>high</td>
<td>high</td>
<td>moderate</td>
<td>high</td>
</tr>
<tr>
<td>Water quality</td>
<td>moderate</td>
<td>moderate</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Disease in pond sediment</td>
<td>moderate</td>
<td>moderate</td>
<td>low</td>
<td>high</td>
</tr>
</tbody>
</table>

By far the biggest risk is low and unpredictable farm gate price. In the short term this is a critical issue for both commercial scale and household scale production of Tra. If price is high many farmers stock, and when they all harvest the price inevitably goes down. Many make losses, and the low price discourages new stocking. There is then a shortage of supply, and price rises again….and so on. This, coupled with variations in market demand, means that predicting future price is almost impossible. The greater the flexibility of the sector – in terms of ability to stock in response to high price, the greater the price fluctuation and the higher the investment risk. The investment risk for Tra is particularly high because inputs comprise more than 80% of production costs.

This price variation affects both commercial and household scale producers. In some respects household producers, with lower homemade feed costs, are less at risk than commercial producers. However, chronic disease has led to slower growth and increased FCR in recent years which may have wiped out this advantage.
Access to international markets is likely to become an increasing issue. Historically anti dumping has reduced access to American markets; in the future, failures in terms of product quality and chemical contamination will be the key issues. Although contamination incidents will affect all producers to some degree, lack of traceability is likely to become a critical issue. The smaller the farmer, the more difficult and costly traceability becomes. Processors will increasingly rely on strong trading connections with a few large scale and trusted suppliers. Household scale producers will again be much more highly exposed.

In the longer term prices will stabilize at 10-15% above production costs of the most efficient producers – unless other species/products of similar quality can be produced more cheaply⁵. The most efficient (lowest cost) producers in Vietnam are likely to be larger scale commercial producers. Prices will tend to be somewhat lower for smaller scale producers because of higher transaction costs and lower bargaining power. Their margins are therefore likely to be extremely slim, and they will become ever more vulnerable as efficiencies increase in the commercial sector. Commercial producers will generally have access to higher quality seed and have better bio-security measures.

Loss of access to local markets is less of an issue, and indeed this may represent an opportunity for small scale producers in the short-medium term. However, as the domestic market develops, and there is a shift to more processed convenience products, the same issues of safety and traceability will begin to emerge nationally, and again those producers that cannot demonstrate traceability will suffer.

The high price of feed is widely seen as a major risk to producers. In a genuine competitive market this should not be an issue. Feed ingredients are global commodities. In the absence of significant tariffs, cost variations between countries should be small, and Vietnam should not be at risk from lower prices in competitor countries. By standardizing or abolishing tariffs, and ensuring healthy competition in the feed manufacture sector, such risks can be removed. However, small scale producers are at a disadvantage, as our analysis in Annex 1 shows. They may pay in excess of 10% more for their feed than larger scale commercial producers⁶. Given that feed costs represent more than 80% of production costs, this puts them at a significant disadvantage - if they are to use commercial pellets.

Quality of feed is also an issue, especially for smaller scale farmers. They will not usually be able to have feed tested, and the risks to feed companies of mis-selling feed to household scale producers is lower than it would be for major large scale producers/customers. This again can have devastating consequences in terms of slow growth, poor quality and high FCR when margins are already tight.

Poor seed quality was an issue raised by many consultees. Mortality in catfish farming has increased steadily in recent years, and while this may be due to accumulation of pathogens in the ponds and water systems, many attribute it to inbreeding and poor quality seed, and there is some evidence to support this (see Annex 1). Again, household scale producers are most at risk, since they will tend to buy cheaper seed and may be less alert to specific signs of poor quality. This is a particularly serious problem, since susceptibility to disease will increase the overall

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⁵ This seems unlikely given that Tra will thrive on relatively cheap and low quality feed, and can be grown so intensively. Semi-intensive Tilapia production (supplementary feed only) may be competitive in areas where land costs are relatively low.

⁶ However…the pricing system is complex. Although household scale farmers may pay higher prices to “agents”, in return they may benefit from interest free credit.
innoculum and increase the risks for those producers using high quality seed. It also has potential to put people out of business very quickly. As profit margins reduce to 10-15% for the most efficient producers, those who lose 10-15% of stock, in parallel with a 10-15% increase in FCR are likely to go out of business. Given that mortality rates of 30% or more have been widely reported, this is a major problem.

**Excessive use of antibiotics** is an increasing problem. Our respondents suggested that increased disease incidence has been kept at bay (in part) through increased use of chemicals. Although the proportion of banned chemicals used may be declining as farmers become aware of the possible consequences in terms of market access, the use of large quantities of antibiotics generally is a fundamentally risky strategy – both in terms of increased resistance of fish pathogens, and reduced efficacy of antibiotics more generally, including for human use. Small scale producers may be both the main source of release, and the most at risk. They are more likely to have less effective biosecurity, use poor quality seed, and be vulnerable to mis-selling of banned chemicals. In so far as this has the potential to undermine the future of the industry itself as well as have potentially serious consequences for human health, this should be considered a very serious risk.

There is little doubt that disease often enters farms in the **supply water**, and most farms do not have pretreatment of any kind. The level of risk is clearly higher in areas where the density of farms is highest.

The effects of **poor water quality** are extremely hard to assess, especially for a fish which is fundamentally tolerant of poor water quality. However, there is a direct effect on market price through yellowing of the flesh in poor quality water, and it may be assumed that poor water quality is associated with higher incidence of disease. The extent of poor water quality is not established, and the associated risks are difficult to assess, but they are unlikely to be as serious as some of the other issues discussed above.

In systems as intensive as catfish farming with yields of 60 tonnes or more per hectare per crop, and massive feed inputs, there is a substantial **accumulation of sediments**. Although a significant proportion of these are removed, and ponds disinfected in most cases, this is not always done, and will be more difficult in less well designed or sited ponds – more typical of household scale production. In this case the risks of disease transfer between crops are significant. There is no information or data available on this issue, so assessment is difficult, but yet again smaller scale producers are probably more at risk.

Overall, and taking into account likelihood, severity and uncertainty, the risks to household scale producers can be ranked in terms of priority for action and research:

1. Price instability/fluctuation
2. Access to international markets
3. Seed quality
4. Excessive use of antibiotics
5. Feed price and quality
6. Pathogens in water and sediments
7. Long term price pressure
8. Access to local markets
7 Mitigation of risks to household scale Tra farming

Most of the risks discussed above are well known, and it is unclear that a superficial risk analysis adds much to what has already been discussed in many meetings and workshops. However, the process has highlighted the great dominance of price variation as by far the most serious risk, especially to household producers.

It also highlights the very high level of risks to which small scale producers are exposed more generally. This is a very high risk business, and not well suited to small scale production. It is arguable that the various measures discussed below, while reducing risks, are unlikely to do so sufficiently to make this an attractive business for small scale production in the medium and long-term.

Mitigation measures are generally well known and some address several risk issues, as summarized in the following table. The mitigation measures are presented in more detail in the appropriate sections in Annex 1.

It is notable that farmer organization is an important mitigation tool in respect of several hazards of particular concern to small scale producers. Indeed, as others have noted, for the small scale producer it is a matter of “organize or die”.

Although GAP is frequently promoted as a key requirement for access to international markets, a precondition of demonstrating compliance is traceability. This has to be the priority, coupled with very simple GAP rules.

The analysis suggests that the priority for research should be on market research and feed price/quality issues. Although other issues are important, the potential for cost effective research (in terms of generating solutions) is lower. In respect of several important issues the priority is for action, not research.
<table>
<thead>
<tr>
<th>hazards/risks addressed</th>
<th>mitigation measure</th>
<th>Need and potential for cost effective research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price instability</td>
<td>Production license; increased cold storage; vertical integration; better market information; diversification; producer-processor contracts</td>
<td>high (market research)</td>
</tr>
<tr>
<td>Loss of access to international markets</td>
<td>Ensure traceability of product and apply strict codes of practice re chemical use and other key activities of concern; establish producer organizations to facilitate group traceability</td>
<td>low</td>
</tr>
<tr>
<td>Seed quality</td>
<td>Further investment in production and distribution of high quality broodstock; effective monitoring and certification of hatcheries; centralized sales and checking of nursed fingerlings; awareness raising of importance of quality seed</td>
<td>low</td>
</tr>
<tr>
<td>Excessive use of antibiotics</td>
<td>Wider availability/lower cost of high quality, disease free seed; vaccination against critical diseases; best practice to maximize fish health; promotion of bio-security measures; vigorous enforcement of law relating to sale of illegal chemicals, distribution and use; use of alumni networks to promote higher standards; improve/require traceability; provincial aquatic animal health strategy</td>
<td>moderate (vaccination)</td>
</tr>
<tr>
<td>Feed price</td>
<td>remove import tariffs on all feed ingredients; ensure healthy competitive market; buyer organizations; high quality and optimal economic use of farm made feeds; encourage/facilitate establishment of local feed companies; generate better scientific information on cost effectiveness of different kinds/quality feed; train farmers to understand/assess price-quality-FCR-growth relationships; improve husbandry to improve FCR</td>
<td>high (analysis of feed production costs in Vietnam and other countries;)</td>
</tr>
<tr>
<td>Feed quality</td>
<td>Increase rigor of government testing regime and penalties for mis-selling; improved understanding of feed price-quality-FCR-growth relationships; affordable feed analysis services for farmers; more competition in the sector?</td>
<td>high (research on cost effective feeds and feeding strategies)</td>
</tr>
<tr>
<td>Pathogens in water and sediments</td>
<td>Awareness and training of water quality issues; explore opportunities for group management and improved canal infrastructure; promote basic good practice for sediment management; require minimum distance between farms;</td>
<td>low</td>
</tr>
<tr>
<td>Long term price pressure</td>
<td>Improved survival and FCR; production timed to minimize competition; establish producer organizations; optimal use of cost effective homemade and pelleted feeds</td>
<td>moderate (as for feed quality)</td>
</tr>
<tr>
<td>Loss of access to local markets</td>
<td>Diversify to supply niche local markets</td>
<td>high (market research on domestic demand, processing and distribution opportunities)</td>
</tr>
</tbody>
</table>
8 Overview of risks in the production of shrimp in the Mekong Delta

A summary of the estimated relative risk associated with various hazards to which household scale producers of shrimp are exposed is presented in Table 6. This assessment is based on the detailed analysis presented in Annex 2 – but remains largely subjective. It is clear that the sector faces a range of serious risks. Although some of these are more serious for household scale producers, they are at less of a disadvantage relative to commercial producers than are small scale Tra farmers. In this sense, shrimp farming is arguably more suitable for household scale production.

Table 6: Characteristics of main risks affecting household scale shrimp producers

<table>
<thead>
<tr>
<th>Hazards</th>
<th>likelihood</th>
<th>severity</th>
<th>uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price fluctuation</td>
<td>high</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>long term price decline</td>
<td>high</td>
<td>moderate</td>
<td>low</td>
</tr>
<tr>
<td>Market access (local)</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Market access (international)</td>
<td>moderate</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Feed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed price</td>
<td>moderate</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Feed quality</td>
<td>moderate</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed quality</td>
<td>high</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Widespread release of infected L. vannamei</td>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Water quality</td>
<td>moderate</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Increasing resistance to antibiotics</td>
<td>moderate</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Disease in pond sediment</td>
<td>moderate</td>
<td>moderate</td>
<td>low</td>
</tr>
<tr>
<td>Disease in supply water</td>
<td>high</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Disease from carriers</td>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
</tbody>
</table>

Fluctuating farm gate price although a problem, is less so than for Tra. Shrimp is a more mature international commodity market, and Vietnam is one of many players. Local supply therefore has less impact on international price. However, there are significant seasonal variations caused by a combination of international seasonal variation and local variation in supply between wet and dry seasons. Shrimp farmers are also less exposed to a fall in price, since input costs (mainly feed and seed) and borrowing (typically 50% of input costs) represent a smaller proportion of total production costs. Household scale production is probably less exposed to short term price fluctuation than commercial producers, since the former typically operate more extensive systems. Farmers operating extensive systems (low feed costs) in particular are least exposed to short term price fluctuation.

In the longer term prices will tend to stabilize at 10-15% above production costs of the most efficient producers. The Mekong delta has comparative advantage in production of shrimp with well developed hatchery infrastructure, availability of P monodon broodstock, a significant fish feed industry, low labour costs and suitable year round temperatures (though wet season crops are less reliable). It is unlikely therefore that long term average price will fall below production costs in the Mekong. However, there is a caveat here in terms of land costs/rent which may be, or
become, higher than in some competing countries. Although prices for larger shrimp have declined in recent years relative to smaller shrimp, probably due to continuing expansion of processed product markets, there will always remain a smaller high value market for larger shrimp. Although household-scale producers will find it hard to compete with commercial producers of smaller shrimp, they may have comparative advantage in production of large shrimp. It is important that the more limited markets for these are sought.

**Access to international markets** remains an important issue, and lack of traceability will become an increasing problem if household scale producers wish to access premium markets – which they will have to do to survive in the longer term. Traceability will become a critical requirement for most internationally traded seafood, and is a pre-condition for entering any higher level quality labeling initiative. This will be more costly for small scale producers, and will reinforce the drive to seek out premium niche markets.

As for Tra, risks associated with **loss of access to local markets** are less of an issue, and indeed domestic markets may represent an opportunity for small scale producers in the short-medium term. There is a relatively small but high value market for larger shrimp (especially *P. monodon* and other native species). As commercial producers increasingly shift to smaller *L. vannamei* for the international market, there will remain a niche for household scale production to supply domestic and niche overseas markets with larger product.

As for Tra, **high price of feed** is also an issue for shrimp farmers. In 2007/8 they took a double knock from increased feed prices and relatively low shrimp prices – the former arising from general increase in cost of feed ingredients in 2007 (related to high demand and fuel costs) and the latter related to the global economic slowdown in 2008. While the prospects for increased demand and higher prices remain limited, the cost of feed ingredients is now falling, and this should help partially restore margins. Given that feed ingredients are global commodities, and in the absence of significant tariffs, cost variations between countries should be small, Vietnam should not be at risk from lower prices in competitor countries. By standardizing or abolishing tariffs, and ensuring healthy competition in the feed manufacture sector, such risks can be removed. However, small scale producers are at a disadvantage, as our analysis in Annex 2 shows. They may pay in excess of 10% more for their feed than larger scale commercial producers. Given that feed costs represent around 65% of production costs in semi-intensive systems, this puts them at a significant disadvantage and in order to survive small scale producers will need to achieve very low FCR and/or premium prices.

**Quality of feed** is also an issue, especially for smaller scale shrimp farmers. They will not usually be able to have feed tested, and the risks to feed companies of mis-selling feed to household scale producers is lower than it would be for major large scale producers/customers. This again can have serious consequences in terms of slow growth, poor quality and high FCR.

**Poor seed quality** is an issue especially for small scale producers. While the problem in Tra is mainly related to genetic degradation, the problem for shrimp farmers is the possibility of introducing disease. Although PCR testing is often available, in itself it does not guarantee disease free production (there are other

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7 However…the pricing system is complex. Although household scale farmers may pay higher prices to “agents”, in return they may benefit from interest free credit.
sources of disease) and as such is often considered “unreliable”. Although this misses the point (PCR properly conducted eliminates one source of disease), some farmers do not always demand fully certified seed. Our discussions however suggested that this may be changing and more farmers are prepared to pay a higher price for high quality certified seed.

*Release of infected* *L. vannamei* poses a significant risk to all shrimp farmers in the Mekong delta and elsewhere in Vietnam. It is estimated that around 80% of seed imported into Vietnam is from China, mainly untraceable and of poor quality. Disease can pass from this species to *P. monodon*, so the threat is to all shrimp producers in the Mekong delta. Household scale producers are at particular risk on two counts. Those who wish to try out *L. vannamei* (illegally) are likely to buy cheaper, uncertified seed; and biosecurity in general is less effective on smaller scale farms. There is a real danger that the progress made in recent years in terms of quality and traceability of *P. monodon* seed is undermined by widespread release of uncertified illegal *P. vannamei*.

**Excessive use of antibiotics** is probably less of a problem with shrimp compared with Tra. There is more experience of the dangers of market loss through contaminated product, and in any case the main disease problems with shrimp are viral - which are not treated effectively with antibiotics. In particular, use of antibiotics in the more extensive systems is relatively rare.

There is little doubt that disease often enters shrimp farms in the supply water, and most extensive farms do not have pretreatment of any kind. The level of risk is clearly higher in areas where the density of farms is highest.

**Poor water quality** is less of an issue for shrimp which – for household scale production – are generally reared extensively or semi-intensively in water of relatively high quality. Toxic algae are a periodic threat usually dealt with through extra water exchange. To the extent that some household scale farmers are constrained in terms of timing, volume or frequency of water exchange they are more exposed to this threat. More generally, since shrimp require relatively high water quality, increasing urbanization and industrialization represents a threat to the quality of supply water.

**Disease entering the farm in the water supply** is a chronic problem, and household scale farmers rarely have any form of water pre-treatment.

**Serious accumulation of sediments in ponds** becomes a problem with more intensive forms of shrimp farming, but viral disease can probably survive in most ponds between crops unless there is a significant fallowing period and pond bottom treatment. Household scale producers may find it more difficult to empty, dry and treat ponds, and there is greater potential for pathogen accumulation.

**Disease in carriers** such as crab and wild shrimp is a significant and probably increasing problem. Diseases such as whitespot which are now chronic may well be widespread in wild crustaceans. This represents a particular problem for household scale production since crab production represents an attractive alternative to shrimp, and farmers may wish to switch between the two in response to changing market conditions. In some cases they may wish to grow both species to reduce market risk.

Overall, and taking into account likelihood, severity and uncertainty, the risks to household scale producers of shrimp can be ranked in terms of priority for action and research. The relative priority is significantly different from that affecting Tra
production, with risks associated with disease replacing market risks as the most serious threats:

1. Disease spread related to illegal import/release of *L. vannamei*
2. Disease spread through carriers
3. Disease spread through water supply
4. Long term price decline
5. Seasonal price fluctuation
6. Seed quality
7. Access to international markets
8. Excessive use of anti-biotics
9. Feed price and quality
10. Pathogen accumulation in sediments

Overall, household scale shrimp producers are faced with somewhat less extreme risks, and are at less of a comparative disadvantage with respect to commercial scale producers, than are household scale producers of Tra.
9 Mitigation of risks to household scale shrimp farmers

This risk analysis has highlighted the importance of disease as the key issue to be addressed in shrimp farming, and in particular the increased risks arising from the introduction of *L. vannamei*. This presents a dilemma. The attempt to restrict introduction of *L. vannamei* to commercial scale production in specific areas has not been entirely successful, and there has developed an illegal sub-sector, which by definition is less well controlled. Significant quantities of uncertified seed are now being imported from China. There are therefore two possible solutions:

a) Legalise widespread use of *L. vannamei*, while at the same time ensuring very tight quality control;

b) Greatly increase enforcement of existing provisions with heavy penalties for sale or purchase of illegally imported seed.

Although the latter is the ideal, the former may well be the most realistic, given the difficulties of controlling illegal trade.

More generally for shrimp the priority is disease free seed and improved biosecurity. For the sector as a whole this can only really be addressed through a comprehensive disease prevention and response strategy including a wide range of integrated measures. As raised on many occasions, better farmer organization is a key to more effective implementation of such a strategy.

With respect to market risks, the key for household scale producers will be to avoid competition with more efficient large scale intensive producers, and as for Tra, to ensure traceability of product so that premium markets can be accessed. Again, better farmer organization will be required to ensure “cost-effective” traceability.

Mitigation measures are generally well known and some address several risk issues, as summarized in the following Table 7. The mitigation measures are presented in more detail in the appropriate sections in Annex 1.

In terms of research there is an immediate and urgent need for investigation of seed and broodstock movements of *L. vannamei* and the nature of any associated disease outbreaks. In respect of other issues, appropriate mitigation measures are in the main well known – the key is implementation.

Table 7: summary of hazards, and opportunities for mitigation and research (shrimp)

<table>
<thead>
<tr>
<th>hazards/risks addressed</th>
<th>mitigation measure</th>
<th>Need and potential for cost effective research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of disease through <em>L.</em></td>
<td>Strengthen control measures. Either… a) legalize wider use and production (thereby eliminating “black” economy) or b) greatly improve enforcement of existing controls</td>
<td>High. Identify in detail main pathways through which <em>L.</em></td>
</tr>
<tr>
<td><strong>vannamei</strong></td>
<td><strong>vannamei</strong> seed enters the country and is distributed within Vietnam; sources/quality of such seed; key potential control points; alternative strategies.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td><strong>Disease spread through carriers</strong></td>
<td>Provincial disease prevention and management strategy; and Discourage polyculture of crabs and shrimp; improve biosecurity measures. <strong>Moderate</strong> Mapping of incidence and distribution of main viruses in wild crustaceans; improved epidemiological monitoring information</td>
<td></td>
</tr>
<tr>
<td><strong>Disease spread through water supply</strong></td>
<td>Provincial disease prevention and management strategy; and Continued/strengthened promotion of water pre-treatment and post treatment. <strong>Moderate</strong> Improved epidemiological monitoring information</td>
<td></td>
</tr>
<tr>
<td><strong>Long term price pressure</strong></td>
<td>Improved survival and FCR; Identification/development of higher value markets for larger shrimp; Household scale producer/marketing organizations; and Product/market promotion <strong>High</strong> Research on improved wet season performance; targeted practical market research</td>
<td></td>
</tr>
<tr>
<td><strong>Price fluctuation</strong></td>
<td>Timing of production to exploit seasonal price variation; Increased strategically located cold storage; and Better market information; diversification <strong>High</strong> Market and strategic research</td>
<td></td>
</tr>
<tr>
<td><strong>Seed quality</strong></td>
<td>Continued awareness raising of medium term benefits of buying only high quality certified seed; and More effective licensing of hatcheries and traders coupled with appropriate checks and standards. <strong>Low</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Loss of access to international markets</strong></td>
<td>Ensure traceability of product and apply strict codes of practice re chemical use and other key activities of concern; establish producer organizations to facilitate group traceability <strong>Low</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Excessive use of antibiotics</strong></td>
<td>Provincial disease prevention and management strategy; Wider availability/lower cost of high quality, disease free seed; Best practice to maximize shrimp health; Promotion of biosecurity measures; Vigorous enforcement of law relating to illegal chemicals sale, distribution and use; and Use of alumni networks to promote higher standards; Improve/require traceability. <strong>Moderate</strong> (vaccination)</td>
<td></td>
</tr>
<tr>
<td><strong>Feed price</strong></td>
<td>Remove import tariffs on all feed ingredients; Ensure healthy competitive market; Promote/develop buyer group organizations; Generate better scientific information on cost effectiveness of different kinds/quality feed; <strong>Moderate</strong> Analysis of feed production costs in Vietnam and other countries</td>
<td></td>
</tr>
<tr>
<td>Issue</td>
<td>Action</td>
<td>Level</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Feed quality</td>
<td>Increase rigor of government testing regime and penalties for mis-selling; Improved understanding of feed price-quality-FCR-growth relationships; Affordable feed analysis services for farmers; and More competition in the sector?</td>
<td>Moderate</td>
</tr>
<tr>
<td>Pathogens in sediments</td>
<td>Promote basic good practice for sediment management.</td>
<td>Low</td>
</tr>
<tr>
<td>Loss of access to local markets</td>
<td>Diversify to supply niche local markets.</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10 Discussion and conclusions

Risk analysis has several potential functions or values:

- Assessment and comparison of different types of enterprise in terms of risk profile, so that more informed choices may be made by both farmers and policy makers;
- Analysis of priorities for action and opportunities for mitigation;
- Identification of critical “control points” or management/mitigation opportunities;
- Input to environmental impact assessment, strategic environmental assessment, and natural resource use planning;
- Analysis of need, opportunity and cost-effectiveness of research.

It is important however that risk analysis should be undertaken in support of specific policy, development planning or management initiatives.

10.1 Overview and comparison of risks affecting household scale Tra and shrimp production

Table 8 offers an overview and comparison of the risks affecting household scale Tra and shrimp farmers. This provides overall scores based on both likelihood and severity of possible impacts associated with particular hazards.

This suggests that shrimp farming overall is somewhat less risky, and while critical risks for Tra are associated with market price, those for shrimp are more serious with respect to disease. It is notable also that while significant mitigation is possible (if difficult) through better practice for most risks associated with shrimp farming, it is extremely difficult for either farmers or government to mitigate against price fluctuation or consistently low levels.

Table 8: Overall Levels of risk for different hazards for household scale shrimp and Tra

*Score is based on addition of likelihood and severity scores*

<table>
<thead>
<tr>
<th>Hazards</th>
<th>Tra</th>
<th>Shrimp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price fluctuation</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Long term price decline</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Market access (local)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Market access (international)</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Feed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed price</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Feed quality</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed quality</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Release of infected <em>L. vannamei</em></td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Water quality</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Increasing resistance to antibiotics</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Disease in pond sediment</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Disease in supply water</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Disease from carriers</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
10.2 Priorities for action and opportunities for mitigation

Several suggestions have been provided which might reduce the fluctuation and low levels of price for Tra, including in particular adequate and appropriately located cold storage, and the possibility of restricted entry/operation/production levels through a licensing system.

For household scale shrimp farming the mitigation measures are well known, but the key is to have a comprehensive and well implemented disease prevention and management strategy in each province.

10.3 Analysis of need, opportunity and cost-effectiveness of research.

In terms of the *need and opportunity for research* the overall significance of the risks, the uncertainty associated with them, and also the cost effectiveness of any research all have to be taken into account. There are some high risk issues for example, associated with high degrees of uncertainty, where research will add little in terms of reducing uncertainty and/or identifying cost-effective mitigation. This may be related to the complexity of the issues, and the fundamental unpredictability of specific outcomes, or the simplicity and effectiveness of existing solutions.

For example, loss of access to international markets is a significant risk to small scale producers if they fail to establish traceability procedures and demonstrate good practice. Further research will not help here; the need rather is for action to establish traceability as a first critical step. Pathogens in supply water are also a major risk, but detailed research on pathogen distribution would be extremely costly, and the benefits in terms of enhancing existing biosecurity recommendations limited.

The priorities for cost effective research include:

- Market research – to better understand and provide farmers with information on local and international price fluctuations and trends, to track the performance and production costs of competitors within Vietnam and elsewhere in the region, and to identify suitable niche premium markets for small scale producers.
- Market research - to identify potential of domestic markets for both Tra and shrimp, including examination of processing, distribution and marketing infrastructure needs.
- A detailed and focused risk analysis addressing the import and distribution of *L. vannamei* in order to identify “critical control points” and inform policy and action to reduce the risks of disease transfer and spread.
- Research on strategies to better exploit seasonal price variation through adjustments to cropping patterns without compromising production performance.
- Comprehensive research on ways to reduce pelleted feed costs in Vietnam, addressing:
  - Costs in competitor countries
  - Industry structure and competition
  - Import tariffs
  - Opportunities to increase use of local and/or cheaper feed ingredients
• Economically optimum feeds and feeding strategies: trade-offs between feed quality, feed cost, FCR and growth rates

10.4 Risk analysis methods and application

In recent years risk analysis has been widely advocated as a key tool to support EIA, SEA and aquaculture development planning. It can be applied at a relatively high (scoping study) level to help focus development policy, and sector management and research (as in this study), or in much more detail in relation to identified priority risks (for example in relation to the introduction of *L. vannamei* or market risks) or as part of a specific EIA or planning process.

In either case many of the assessments made will be to some degree subjective, and best practice risk analysis should include effective consultation and participation. In this study the scope of the issues addressed, and the limited resources available meant that the assessment has been based mainly on desk research and informal consultation. A follow up process to extend and validate the assessment through a series of expert workshops would be highly desirable, particularly in relation to the identified priority risks.

In practice risk analysis is undertaken informally as a matter of routine in feasibility studies, EIA, planning exercises etc. The process is presented in Annexes 1 and 2.
11 References


Annex 1: Risk analysis of key hazards for Tra catfish production in the Mekong Delta

1. Price variation

Character
Price variation is normal and significant for almost all agricultural and fishery products. Causes of price variation relate to supply and demand. In most cases demand shows a steady long term increase (although there may be predictable seasonal variations related to festivals etc) while supply fluctuates unpredictably depending on season, weather, disease, new entry etc. Demand and supply are therefore rarely in balance, and price will fluctuate significantly. Usually price does not fall below the production cost of the most efficient producers, although serious temporary gluts may occasionally force farmers to sell below cost because agricultural products, and especially fish, are subject to degradation. This leads to accusations of dumping and trade penalties – which has been a problem for Vietnamese Tra.

Many governments seek to stabilise the price of agricultural products through intervention (e.g. buying when the price falls to production cost levels) but this can be very costly, and does not address – indeed may exacerbate – excess supply. Government may also subsidize producers so that they are less vulnerable to market price, but this may allow inefficiencies and lack of competitiveness to develop.

Where government does not intervene, the consequence of significant price variation is that less efficient producers go out of business when the price falls, and there is significant longer term rationalisation of the sector – with fewer, larger, more efficient producers. This is the very nature of free trade and market economics.

Other factors may significantly affect demand and therefore price, including:

- Poor quality product
- Excess water/glazing
- Contamination (preservatives; antibiotics etc)

All of these may have widespread impact on the reputation of the product from a particular country and depress prices generally, irrespective of the quality of most of the product.

In the case of Tra catfish recent rapid changes in price have been caused by rapid development of the industry and temporary over-supply to the processors (localised temporary under-capacity) and possibly (though less clearly) over-supply to export markets. Exports in 2008 increased by 66% in volume and 48% in value compared with 2007. At the end of last year prices were as low as VND13,000/kg. However, price has risen again in recent months to 15,000-16,000 for top quality and 13,000-14000 for second grade.

Future prognosis
There is no doubt that short term mismatches of supply and demand will continue, and with it significant price fluctuation.
Exposure

Cost of production and cost structure
Enterprises with high input costs and low margins are most vulnerable to price variation.

All catfish farming, whether household or commercial scale, is intensive and dominated by feed costs – typically 70-80% - with the lower proportion associated with smaller scale production. This makes all producers highly susceptible to price variation. This is particularly the case since most household scale producers borrow around 50% of input costs.

Household scale producers:
Total production costs are typically VND13,000-14,000 – excluding investment costs.

Table A1.1 Typical production cost breakdown for household scale producers

<table>
<thead>
<tr>
<th>Cost</th>
<th>% of costs</th>
<th>VND/kg of product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed</td>
<td>80%</td>
<td>11,000</td>
</tr>
<tr>
<td>Chemicals</td>
<td>5%</td>
<td>700</td>
</tr>
<tr>
<td>Seed</td>
<td>7%</td>
<td>1,000</td>
</tr>
<tr>
<td>Other (fuel, labour, finance)</td>
<td>7%</td>
<td>1,000</td>
</tr>
<tr>
<td>Cost of production</td>
<td>100%</td>
<td>13,700</td>
</tr>
<tr>
<td>Market price</td>
<td></td>
<td>13-14,000</td>
</tr>
</tbody>
</table>

In practice costs are highly variable\(^a\).

Household producers tend to use homemade feed for the middle part of the production cycle. Where this is of good quality (there are standard DARD

\(^a\) Much relevant data has been collected as part of a NACA/Can Tho University survey of catfish farms
recommendations) the cost of feed per kilogram of production (determined by FCR and feed price) can be lower than for larger commercial farms. If this is used for the whole cycle, the product quality is lower and the price correspondingly lower, but if skilled, household scale producers may have a small advantage by using an optimal combination of homemade and pelleted feed.

**Commercial producers**

**Table A1.2: Cost breakdown for commercial producers**

<table>
<thead>
<tr>
<th>Cost</th>
<th>% of costs</th>
<th>VND/kg of product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed</td>
<td>76%</td>
<td>11,500</td>
</tr>
<tr>
<td>Chemicals</td>
<td>5%</td>
<td>700</td>
</tr>
<tr>
<td>Seed</td>
<td>7%</td>
<td>1,000</td>
</tr>
<tr>
<td>Other (fuel, labour, finance)</td>
<td>13%</td>
<td>2,000</td>
</tr>
<tr>
<td>Cost of production</td>
<td>100%</td>
<td>15,200</td>
</tr>
<tr>
<td><strong>Market price</strong></td>
<td></td>
<td><strong>15-16,000</strong></td>
</tr>
</tbody>
</table>

Figures approximated from several sources (academics, farmers, traders)

In practice these figures appear somewhat optimistic given the current cost of feed, and the need to finance both capital investment and inputs for each crop.

It is clear that both small and large scale producers are operating on very tight margins, and any significant reduction in prices below current levels is serious. By way of example, if the price for commercial producers falls to VND 14,000, and if production is 200 tonnes/ha, losses would amount to $11,000 or more per hectare.

**Break even export price**

Assuming a production cost of VND15,000, fillet yield of 33%, and processor markup of 10%, the break even export price for frozen fillet would be around US$2.81. Reference to figure A1.1 suggests that prices for both European and Russian markets have been consistently below this price. Prices in the European market were marginally above this level from mid 2006 to mid 2007, but since then have been below. Prices in the Russian market at their best were $2/kg (corresponding to a farm gate value around VND 10,500). This is unlikely to be viable for even the most efficient producers.

**Consequence**

According to scientists at Can Tho University 90% of farmers made a loss in 2008 (and the figures above support this), of whom perhaps 40-50% made serious losses. Most farmers probably made a loss of around 15%. Assuming production of 200 tons/ha this would correspond to losses of around US$25,000/ha.

According to VIFEP and the Mekong Delta Fisheries Association, and most of our consultees, 40-50% of catfish farmers ceased production in 2008, and most of these were small household scale producers. Some of these have lost their collateral (i.e. land/property) as a result, although the consensus amongst our consultees was that loss of assets as a result of bankruptcy has been relatively rare. Furthermore, there is some evidence that 30-40% of those who ceased production last year have started again.
Although there are alternative species, few farmers have resorted to this, but rather wait to see if market price rises again. Overall there is a widespread feeling that many small scale producers (up to 40%) will not survive.

Table A1.3: Approximate and partial industry mark-ups

<table>
<thead>
<tr>
<th>Market chain</th>
<th>Price/cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm gate price</td>
<td>$0.9</td>
</tr>
<tr>
<td>Equivalent FGP fillet (33% yield)</td>
<td>$2.7</td>
</tr>
<tr>
<td>Trader price to processing factory</td>
<td>$3.3</td>
</tr>
<tr>
<td>Lab tests, duties, sea freight</td>
<td>$0.2</td>
</tr>
<tr>
<td>Import cost</td>
<td>$3.5</td>
</tr>
<tr>
<td>Importer selling price?</td>
<td>$3.8</td>
</tr>
<tr>
<td>Supermarket sales price (Aldi)</td>
<td>$9.0</td>
</tr>
</tbody>
</table>

Data approximated from article in Spiegel Online

Mitigation

The primary cause of price fluctuation of Tra catfish is rapid development and temporary oversupply of the industry. The reasons for high exposure are low profit margins/high input costs coupled with high levels of indebtedness.

This problem is not unique to Vietnam, though it is perhaps more severe. The salmon industry has been dogged by fluctuating price for many years, along with accusations of dumping. Seabass and seabream are also suffering similar problems.

The ideal solution is to stabilize production and pursue a policy of steady growth in line with market demand. Where production is dominated by a few large companies these companies themselves can control supply to stabilize prices. There are several possible solutions or mitigating actions.

Production license

Salmon prices in Europe have been partially stabilised through constraints on production by government. In the case of Norway, the government periodically issues production licenses which companies can bid for. In the UK sites are associated with an environmental consent based on maximum allowable biomass, which effectively constrains rapid increases in production. Both of these will tend to constrain growth and stabilise prices. The issue of production licenses in Vietnam may be possible, though the large number of producers would make this fairly costly and difficult to police.

Cold Storage

Cold storage is particularly effective at ironing out short term (especially seasonal) supply and demand. Most private companies will have significant cold storage facilities and recent price fluctuations will encourage more private sector investment. An assessment of sector cold storage needs and opportunities, and cost effectiveness of increased capacity would be extremely useful for both the government and private sector.

Vertical integration

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Most processors have good knowledge of the international market and demand for their product. They have suffered in recent months from a shortage of supply following the collapse in price. This may encourage further vertical integration or longer term contracts with independent farmers to secure supply. However such integration is likely to further marginalise and disadvantage small independent farmers/household level producers, unless they can organise themselves into producer groups.

**Market information**

Many of the smaller farmers are relatively flexible and may be able to stop and start production according to the wider demand and supply situation. Access to good market information, and specifically good market prognosis over the coming year would allow them to reduce their risks in terms of timing of stocking, stocking density etc.

**Diversification**

Once freshwater ponds, cages, or pens are in place, they may be adapted for a variety of species, including Tilapia, mudskipper, carps etc and a wide range of fish for local markets and potentially export markets in the longer term. The constraint on this is mainly confidence and knowledge. Dissemination and training for production of a wider range of species will be essential to the future of freshwater fish farming in the Mekong delta.

**Overall risk summary assessment**

There is a strong likelihood of continuing price fluctuation. The consequences of such variation in a low margin industry are likely to be severe. Individual losses are likely to be significant and many farmers, at all scales of production, will be affected. To some degree these losses will be reversible – when prices rise again large profits will be made – but reversibility will be less for small scale producers with fewer assets, less credit and limited capital to draw on.

<table>
<thead>
<tr>
<th>Fluctuating price</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Likelihood</strong></td>
<td>high</td>
</tr>
<tr>
<td><strong>Severity</strong></td>
<td>high</td>
</tr>
<tr>
<td><strong>Uncertainty</strong></td>
<td>low</td>
</tr>
</tbody>
</table>

These risks can be significantly reduced through the range of mitigation measures described above.
2. Price level and trends

Character
As for price fluctuation, the key factors affecting long term price level and trends are demand and supply. Ultimately however the price will converge on the cost of production of the most efficient producers, plus an acceptable profit margin (typically 5-15%). Since producers will become steadily more efficient, and find the best places to farm fish, a long term decline in price is likely – usually relatively rapid during the rapid growth phase of the industry before levelling off in a “mature” and efficient industry.

On a seasonal basis catfish farmers in Cambodia may be able to produce more cheaply than those in Vietnam. They have access to large quantities of low cost trash fish from the Tonle Sap between October and March. Prices typically range from VND 6,000 to VND 10,000 per kg\textsuperscript{10}, which are lower than those typically found in Vietnam. However, this issue requires further research: the price of trash fish in Vietnam is highly variable and localised suggesting a poorly developed marketing infrastructure. Prices in Southern Central Vietnam where there is lobster and grouper aquaculture are typically VND 10,000-15,000 per kg\textsuperscript{11}, whereas the price of trash fish in the Mekong delta last year was VND8,000 per kg (a historic peak) and this year the price is as low as VND4,500 per kg

Price level may be distorted where the industry is small and where the relative power of buyer and seller is unequal. In the case of Tra catfish there is some anecdotal evidence that the processors/exporters have a partial monopoly and sufficient power to drive prices below production cost. While this is not in their long term interest (and they may already have suffered from the dramatic downturn in production) it may have allowed for significant short term profit taking.

Price level will also depend on quality and reputation of product, and typically larger margins can be maintained in sub-sectors with a high quality image. There is little doubt that, for example, American catfish farmers will be able to sell a premium product in their domestic market and continue to enjoy higher returns on labour than those achieved in Vietnam.

Future prognosis
The future price of Vietnamese product is exceptionally hard to predict, since it is a unique product which has grown so rapidly in recent years. However, it effectively competes in the global frozen whitefish fillet market. At around $2.5/kg export price it currently lies at the cheap end of this market despite being a relatively good product. With effective marketing and depending on good reputation it should be able to command somewhat higher prices – and therefore generate very good profits for processors – and assuming a healthy and competitive local industry – also for producers. Further instances of contamination with antibiotics and other chemicals will however have repercussions for the whole industry and depress prices for significant periods.

\textsuperscript{10} Mr Chhea Choeurn – Cambodian MSc student at NTU, pers. comm.
\textsuperscript{11} Data from NTU’s component, ACIAR lobster project.
Exposure
In the longer term all less efficient farms are at risk from falling long term prices. At present household scale producers are not significantly disadvantaged in terms of production costs, because the most skilled are able to achieve lower feed costs. However in the longer term it is likely that local manufacturers will be able to produce a more competitive pellet product which will bring down costs of larger producers to similar levels. Household scale producers will then need to produce to higher quality standards, while at the same time achieving high survival and low FCR rates.

Household producers are however significantly more vulnerable to lower prices offered by processors/exporters. The purchasing system is such that they have limited bargaining power. Producers can “phone round” for a good price for a crop ready for harvest, but this price may be depressed subsequently. The price is verbally agreed, dependent on quality. The buyer visits the farm to check quality and may suggest a lower price. While the buyer can go elsewhere for product, the producer has to sell quickly – larger fish consume much feed and price may decline for fish which are too large. The price may be further reduced at the time of harvest if any further problems are found.

Although some larger producers may face similar inequalities, their larger size and influence necessarily gives them more bargaining power. Some of the larger farmers may have binding longer term agreements or contracts.

Consequence
As noted above small scale farmers are not obviously at a disadvantage in terms of production costs and structure, but they may nonetheless receive below market value – and on occasion below production cost - because of their limited bargaining power. They are therefore more likely to go out of business than larger farmers.

Mitigation
In the longer term household producers must do four things in order to survive in the face of long term tight margins generated by competition within the sector, and with other producers in other parts of the world:

- Improve survival and FCR to keep feed costs to a minimum;
- When necessary adjust timing of production to avoid competition from Cambodian producers;
- Establish a stronger bargaining position through producer organisations representative of household scale producers; and
- Enter into more equal contracts where possible.

Efforts are being made in some of these areas with input from government, but risk remains significant.

Overall risk summary assessment

<table>
<thead>
<tr>
<th>Long term price pressure</th>
<th>Likelihood</th>
<th>Moderate?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Severity</td>
<td>moderate</td>
</tr>
<tr>
<td></td>
<td>Uncertainty</td>
<td>low</td>
</tr>
</tbody>
</table>
3. Access to international markets

Character
Vietnam has already suffered loss of access to the American market because of anti dumping cases, and to the Russian market because of chemical contamination.

Future prognosis
With regard to anti dumping there remain significant risks in the US market, but this now represents only 3.8% of volume and 5.4% of value of exports. Chemical testing is increasingly rigorous in most markets and the recent experience with Russia (18.4% of volume and 13% of value) shows that import bans remain a real threat.

Exposure
Any kind of import ban or anti-dumping case suddenly and dramatically reduces demand and therefore price. In the case of anti dumping large and small producers alike will be affected.

In the case of chemical residues, those farms least able to demonstrate compliance with best practice are likely to suffer most, since processors will be increasingly wary of their product.

Disease may be more likely in household scale production systems for several reasons:
  - Poor water and sediment management resulting in poor growing environment for the fish (see below);
  - Tendency to purchase cheaper lower quality seed to minimise investment costs;
  - Lower quality feed resulting in less vigorous fish; and
  - Poor biosecurity measures generally.

The response to higher incidence of disease is likely to be higher use of chemicals, and greater exposure to market access problems.

Consequence
It will be increasingly difficult for small scale low investment systems to produce a product of the quality and safety required in international markets. However, this will result in steadily increasing pressure as opposed to dramatic change, and the best educated, best located and best designed farms will adapt, improve and survive. The poorest farmers will lack the investment and knowledge to do this and will go out of business.

Mitigation
Group initiatives, effective training and extension, availability of finance to upgrade systems are all required to meet this challenge. GAP and other management certification systems will help, especially with medium and large scale enterprises, but these certification programmes are complex and demanding, and smaller household scale producers will be at a significant disadvantage. A more effective and equitable approach would be to implement far simpler industry wide standards relating to chemical use, product quality and traceability. Once these are in place, more sophisticated management systems may be introduced where clear market premiums are available.
Overall risk summary assessment
The likelihood of future restrictions on market access as a result of chemicals or dumping accusations is significant, but the industry is already adapting practice to meet more demanding requirements and the risk is likely to decline over time. Where access problems do occur, the severity of impact is likely to be less than in the past because of the diversity of countries to which Tra is exported. Uncertainty associated with this assessment is moderate.

<table>
<thead>
<tr>
<th>Access to international markets</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood</td>
<td>high</td>
</tr>
<tr>
<td>Severity</td>
<td>severe</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>moderate</td>
</tr>
</tbody>
</table>
4. Access to local markets

Character
This issue has two dimensions: firstly direct access to local markets of whole fish; secondly indirect access to local markets through processed frozen products destined for domestic rather than international markets.

Direct access to local markets is constrained primarily by competition – for example from residual fish left in ponds of major commercial producers after harvest. In other words this is an issue of price rather than access. There is likely to be a steadily increasing supply of fish from larger scale producers available for local markets and this is likely to depress prices.

Future prognosis
Domestic markets are growing fast, especially for convenience foods, and frozen Tra fillet is likely to be increasingly popular.

Exposure
Access to domestic markets more generally through processors will be constrained in many of the same ways as access to international markets. Although processors may be somewhat less demanding in terms of traceability and rigorous production standards for product destined for domestic markets, they will nonetheless be wary of product from less well managed and monitored sources, since differential standards for domestic v. international markets – especially for food safety – would be politically dangerous, and may damage Vietnam’s reputation in international markets.

As with export markets volume will also be an issue: transaction and transportation costs for smaller volumes of product will inevitably lead to lower farm gate prices for small scale producers, unless they are able to join together effectively in groups.

Broadly speaking small scale producers are significantly more exposed to market access problems than larger producers

Consequence
Smaller farmers will continue to suffer lower prices than larger scale producers, irrespective of final market (domestic/international). Prices for Tra going directly to local markets is also likely to decline as the increasing quantities of residual product come on the market.

Mitigation
Household scale producers may diversify into higher value/small volume species for the local market – for example Basa.

Overall risk summary assessment

<table>
<thead>
<tr>
<th>Access to local and domestic markets</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>moderate</td>
<td>moderate</td>
<td>low</td>
</tr>
</tbody>
</table>
5. High price of feed

Character/nature (=release)

The price of commercial pelleted catfish feed has risen significantly in recent years from around VND 6,000-7,000 in 2006/7 to 7,000-9,000 in 2008/9, depending on quality. In practice the price of feed to household scale producers is determined by several factors:

- Cost of ingredients (local; international)
- Import tariffs on feed ingredients
- "Unhealthy competition" between feed manufacturers
- Mark-up in the supply chain

There have been substantial increases in the cost of feed ingredients throughout the world in the last few years - for example soybean prices increased by 80%. Higher international prices for basic feed ingredients should affect all producers in a similar way. Although this represents a short term problem, for producers – especially if exporters have already agreed low prices for future deliveries of product - fish prices should rise to reflect increased production costs in the medium term.

Vietnam applies an import tariff of 5% on most feed ingredients including fishmeal, cornmeal etc, and a 10% import duty on lecithin and fish oil. There is evidence to suggest that formulated commercial feed costs are 10-15% higher in Vietnam than in Cambodia, Thailand, and China\textsuperscript{12}. Import tariffs are somewhat higher in Vietnam, but not sufficiently so to explain such a large price difference. Differences must be related either to more expensive local supplies (unlikely in major international commodities) or to lack of effective competition in the feed manufacturing sector in Vietnam.

Cambodia has a seasonal glut of trash fish which brings down their feed costs on a seasonal basis.

Two local companies have recently been established to manufacture feeds – Vinh Hoang Company and Caseamex. One feed mill is now functioning. Catfish are less demanding than shrimp in terms of nutritional requirements and there is significant potential for local production and cost reduction.

Many household producers prepare their own homemade feed. Ingredients are typically: trash fish (up to 50%) or fish meal, rice bran (30%), and cassava meal (20%). Prices of ingredients have also risen significantly over the last few years.

\textsuperscript{12} Dr Nguyen Huu Dzung pers. comm..
Future prognosis

Although feed prices are currently higher than those of competitors, several factors are likely to result in these coming in line with those of major competitors:

- Agro-feed ingredients are major international commodities. Prices in different countries should come into line as trade barriers reduce;
- Competition in the feed industry is increasing, with new local entrants. This should make for a “healthier” market such that prices come into line with international prices more generally; and
- Skills and knowledge relating to catfish nutrition should allow for optimal feed formulations in terms of cost effectiveness.

Exposure

At the present time commercial intensive farms totally reliant on commercial feed are at risk from high feed prices, as are small farms totally reliant on pellet feeds. Many household scale producers however use homemade lower cost feeds for the mid part of the production cycle and are partially insulated from these high prices.

Household scale farms are however significantly more exposed in terms of mark-up. Smaller farms buy smaller quantities of feed from agents (there are usually two levels of agent) and the markup along the chain is significant. Our informants suggested as much as VND 700-800 and VND 1,000-1,200 per kg for the first and the second agent, respectively, adding up to a total of VND 1,700 – 2,000 per kg from factory price to grower. The smaller and more isolated the farmer, the higher the markup.

These figures are highly significant and translate into a higher production cost of more than VND 2000/kg for small scale producers using pelleted feed. Given the tight margins, it is difficult to see how smaller scale producers can survive in the longer term, unless they can organise to get better terms.

Consequence

Catfish farmers are operating on very tight margins. If feed prices for farmers are higher than those of competitors (commercial farms in Vietnam; farms overseas) they are likely to go out of business rapidly.

Large scale commercial farms will be prepared to operate at very slim margins because of the highly intensive nature of catfish farming (generating high returns per
ha despite slim margins). This will tend to bring the price down to levels which are uneconomic for smaller scale producers, and the latter are likely to drop out of the business

**Mitigation**

There are many ways to reduce feed costs:

- Eliminate any unhealthy competition in the industry (government analysis and action).
- Encourage organisation of small scale producers to facilitate bulk buying of feed on better terms.
- Assist with preparation of high quality on-farm feed wherever possible and deploy for an optimal proportion of the growth cycle.
- Remove import tariffs on feed ingredients.
- Improve skills in feed formulation and encourage establishment of local feed companies.
- Generate more information on cost effectiveness of different feeds (e.g. the trade-off between low cost/high FCR and high cost/low FCR; the trade off between low cost/low quality and high cost/high quality).
- Generate more information on the variation in FCR with stocking density.
- Continue to refine and improve homemade feeds.
- Improve fish health and husbandry to minimise FCR through higher survival and better conversion performance (e.g. feeding areas; stocking density; water quality; seed quality).

The potential for reduced costs is substantial. According to scientists an FCR of 1.2-1.6 should be achieved. If FCR can be reduced from 1.7 down to 1.4 this corresponds to a reduced production cost of around VND2,700 /kg. However, if feed prices remain artificially high in Vietnam, then it will lose comparative advantage irrespective of any FCR related gains.

**Overall risk summary assessment**

Although this is a major short term risk, there are many practical ways to reduce impact, and the problem should be largely addressed in the medium term.

<table>
<thead>
<tr>
<th>High price of feed</th>
<th>Likelihood</th>
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<tr>
<td></td>
<td>Severity</td>
<td>high</td>
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<tr>
<td></td>
<td>Uncertainty</td>
<td>moderate</td>
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</table>
6. Feed quality

Character
In an industry with very tight margins and production costs dominated by feed, cost effective feeds and feeding practice are the keys to success.

There are four major issues associated with feed quality:

- Poor quality feed – poor formulation and poor quality ingredients;
- Use of cheaper feed of lower quality in an effort to reduce costs;
- Mislabelling of feed – for example in terms of protein content;
- Use of dangerous additives such as melamine or illegal antibiotics.

As feed ingredients rise in price, the incentive for manufacturers to reduce quality, or for farmers to use lower quality feeds is high. Tests undertaken by the University of Can Tho have established that feeds are not always what the label suggests they are. In particular feeds labelled as 30% protein have been found to contain as little as 26%.

There is anecdotal evidence that melamine may be being used to increase nitrogen content and create the impression of higher protein content.

Future prognosis
In so far as there are only a modest number of major feed manufacturing plants, quality control of feed by government, or by farmers seeking testing services from laboratories, should be relatively effective, and provide a strong disincentive to cheat.

Exposure
Small scale producers with limited power and knowledge are most vulnerable. While manufacturers cannot afford to deliver poor quality product to large scale and discriminating farmer customers, this is less true for small amounts, typically delivered through middle men, to small scale farmers.

In any case poor farmers will always have a tendency to buy cheaper product, especially when the benefits of more expensive varieties are unclear. Farmers to whom we talked suggested that when market price is low they tend to buy cheaper and lower quality feed – irrespective of its cost effectiveness (i.e. minimize price x FCR).

Consequence
The consequences of using poor quality feed intentionally or unintentionally may be serious in terms of:

- Poor FCR;
- Slower growth; and
- Poor condition and susceptibility to disease.

If it is established that melamine is being used in some feeds the consequences in terms of international reputation, and export price, will be very serious.

Mitigation
There are several effective forms of mitigation:
- Farmer training and understanding of feed quality issues;
- Better information and simple models to assess the cost effectiveness of feed – in terms of minimising (FCR x feed price) while maintaining growth rate and condition;
- Effective government sampling and testing of manufactured feed;
- Affordable feed analysis services for the private sector; and
- More competition in the feed manufacturing sector.

For farmer understanding and training there is an immediate need for scientists to put out regular analysis of the cost-effectiveness of different qualities of feed. A simple calculation based on one example illustrates the point:

a) Low protein feed price VND 7,000/kg; FCR average 1.7. Feed cost/kg of product = VND11,900
b) High protein feed price VND 9,000/kg; FCR 1.45. Feed cost per kg of product = VND13,050

In this case it is more cost effective to use the lower cost lower quality feed, although growth rate must also be taken into account (especially if the crop is heavily dependent on loan finance). Regular analysis and reporting of FCR, and calculations of this kind could save the sector very substantial amounts of money.

**Overall risk summary assessment**

<table>
<thead>
<tr>
<th>Poor quality or contaminated feed</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>moderate</td>
<td>moderate (to high – melamine)</td>
<td>moderate</td>
</tr>
</tbody>
</table>

49
7. Poor seed quality or infected seed

Character
Seed quality was widely cited as a critical issue and a significant risk to cost effective production – by academics, farmers, and government officials. This is unsurprising – it is the basic raw material and starting point for the whole process. Poor seed quality may result in:

- Poor growth
- Poor FCR
- Vulnerability to disease and poor survival
- Poor quality product

Furthermore, seed may carry disease which can become epizootic in the production system, especially where growing conditions or feeding regimes are sub-optimal.

Mortality in catfish ponds has shown a steady increase in recent years – from 10% a few years ago to between 30 and 50% for most farmers last year\(^{13}\) – mostly attributable to bacterial and parasitic (protozoan) diseases. Associated with this there has been a steady increase in FCR. In 2007 typical FCR was 1.5 – 1.6. By 2009 it is typically 1.5 to 1.8 with most farmers achieving 1.6-1.7.

Many farmers and scientists blame seed quality for this decline in performance. In practice there is no hard evidence, since poor growth and survival may also result from declining growing conditions in very intensively used ponds, and the steady increase in pathogen loading in the pond and water supply. Nonetheless, some genetic degradation has been demonstrated and there is anecdotal evidence of widespread use of farm reared fish as broodstock – which is likely to result in in-breeding. Tra catfish are also exhibiting early maturation (at 1kg compared with 3kg in the wild) which tends to support the view that seed quality is declining, probably through inbreeding.

There are perhaps 150-200 families involved in breeding *Pangasius*, and possibly a further 15,000 involved in nursing. Disease may be endemic and chronic in many hatcheries and nurseries.

Initiatives are being developed by RIA2 and Provincial DARDs (e.g. An Giang) to address these issues through production of quality broodstock (RIA2) for distribution to hatcheries, and for central collection facilities for nursed fingerlings where quality control measures can be put in place.

Release/supply
The Tra catfish industry is characterised by large numbers of small hatcheries, and even larger numbers of nurseries serving many growout farms. More than 90% of Tra catfish fry supply comes from small hatcheries with little if any quality control - beyond visual inspection of appearance and behaviour.

*Influencing factors:*
- Size of hatcheries and costs of certification, prevention etc
- Lack of checking/testing
- Lack of awareness of farmers/demand for cheap seed

\(^{13}\) Dr Hao, RIA2; Dr Tam Can Tho University – pers. Comm.
**Future prognosis**

**Exposure**
Small scale farmers are particularly vulnerable to poor quality seed. They will be more inclined to buy cheap seed, they generally have less knowledge and awareness of possible quality problems, and their location may make it difficult to access a high quality certified hatchery.

The overall conclusion must be that most small and medium scale producers are using uncertified seed of doubtful provenance and quality.

**Consequence**
The consequences of stocking poor seed are very serious. Not only may farmers suffer poor growth, high FCR and high mortality; they may also produce a product of low quality (flesh quality; yield). Poor growth and survival will encourage heavy use of chemicals to combat chronic bacterial and other diseases. This in turn may further depress growth and increase the likelihood of contamination and rejection or offer of low price from processors/exporters.

Although the causes are probably multiple, there is little doubt that poor seed quality has contributed to the serious decline in farm performance – and therefore increased production costs over the last three years. This - along with high feed costs and low market price - has been a key factor in the very high rates of failure (most farmers making a 10-20% loss) in 2008.

An increase in FCR from 1.5 to 1.7 would correspond to an increase in production cost (or reduction in profit) of VND700 to 1,400/kg. Given existing margins this could readily translate into a loss of more than $10,000 per hectare.

**Mitigation**
Work is on-going to address this issue, but efforts need to be stepped up. Measures include:

- Higher investment in production and distribution of quality broodstock;
- Effective monitoring and certification of hatcheries;
- Centralised sales and checking of nursed fingerlings; and
- Awareness raising of the importance of quality seed.

The scale and value of the industry justifies a major effort and investment in this area.

**Overall risk summary assessment**

<table>
<thead>
<tr>
<th>Poor quality or infected seed</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
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<tbody>
<tr>
<td></td>
<td>high</td>
<td>high</td>
<td>moderate</td>
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</table>
8. Water quality

Character
All fish farming depends on maintaining water quality in line with species requirements. If water quality consistently or significantly falls outside these basic parameters the growth, health and survival of the fish is put in jeopardy.

Tra catfish have a substantial advantage over many aquaculture products since they are air breathers and can therefore thrive in low oxygen and high organic matter conditions which would kill many species. Nonetheless consistently poor water quality may have a depressive effect on growth, survival and disease resistance. It also has a direct effect, causing a yellowing of the flesh associated with reduced market price.

Release
Most Tra catfish farmers exchange water regularly, although many – and especially household scale producers - are constrained by tidal regime. 100% farmers in An Giang and Dong Thap (upper area) exchange water regularly by pumping while most farmers in Ben Tre, Can Tho, and Vinh Long (lower area) exchange water by tidal exchange. Furthermore, although most farmers now pump sediment out of ponds – either illegally to the river, or to local rice fields/gardens – there is likely to be a build up of toxins and organic matter in the pond sediments, and water quality may well show a long term decline.

Future prognosis
Water quality management has probably improved over time: most farmers are keen to exchange as much water as possible – but smaller farmers, depending on location and geography, may be less able to remove sediments and/or exchange water.

Furthermore, in some areas the incoming water quality is already poor and may be affected by domestic and industrial pollution as well as contamination from other farms.

Exposure
Many household scale producers will have more limited options in terms of water supply and exchange, and may lack the means to treat influent water, or effectively remove sediments between cycles. Smaller farmers are also more likely to have sites further from major canals and/or surrounded by other farms. In general they are likely to be significantly more exposed to this risk than larger scale producers.

The overall extent of local water quality problems in the sub-sector is unknown, although DONRE collects basic data on water quality throughout the delta.

Consequence
Poor water quality may lead to loss of condition, stress, disease, low survival, and poor food conversion. It may have contributed – along with poor seed quality – to the significant decline in performance of farms in the last three years in terms of survival and food conversion (see hazard 7).

Mitigation

Source: Vo Thi Thanh Loc
Awareness and training with respect to water quality management are essential. However in many areas water quality management may be limited by location, geography, hydrodynamics etc. Canal infrastructure and “cluster management” initiatives may help reduce water quality problems.

**Overall risk summary assessment**

<table>
<thead>
<tr>
<th>Water quality</th>
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<tbody>
<tr>
<td>Likelihood</td>
<td>moderate</td>
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<tr>
<td>Severity</td>
<td>moderate</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>high</td>
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</table>
9. Excessive use of antibiotics

General characteristics

Tra catfish are vulnerable to certain bacterial and parasitic diseases (BNP whitespot, *Edwardsia ictaluri* and *Aeromonas hydrophila* (Red spot or *Aeromonad septicaemia*) bacteria), but so far (and very fortunately) have been less affected by viruses. Over the last three years there has been a steady increase in bacterial and parasitic disease, and in response to this steadily increasing use of antibiotic, though this is increasingly constrained in the latter stages of growth by market requirements and more rigorous testing for antibiotic residues.

There are hundreds of small chemical traders operating throughout the Mekong delta – including many graduates of aquaculture and fishery courses. The sub-sector is managed by the Fisheries Management Agency in each province, typically with one or two staff.

An example of chemicals used in Tra growout is provided in box A1.1

**Box A1.1: Chemicals used on Tra fish farm in Ben Tre (An Giang) Province**

- Bioflex
- C_HL
- Colistin (antibiotics)
- Co-trime (antibiotics)
- Electrolyte
- Enro (antibiotics)
- Hupro
- Hyperlive
- Mycostatin (antibiotics)
- Vitalec (Vitamine premix)
- Flophenicol (antibiotics)

Release

Significant use of antibiotics in the early stages of production is widespread, if not universal. Application is usually by mixing with homemade feeds. It therefore passes through the fish as well as being released directly to the environment in waste food. Release of legal antibiotics is therefore significant and widespread. Illegal antibiotics are also used, but data is necessarily poor. However, recent government raids on chemical suppliers premises revealed that 17% of establishments were stocking illegal chemicals. False labelling is common, and illegal antibiotics may be being sold under a range of other names.

There is also some data on occurrence of antibiotic and other banned chemicals from government testing of Tra flesh for residues.

Some indication of the extent of chemical use may be gleaned from production costs. Chemical costs typically comprise around 5% of production costs (VND 750/kg of product). At 200t/ha production this would correspond to roughly VND 150million (US$9,000)/ha/crop.

Reports of chemical residues in the product are now declining, but this probably represents careful management (i.e. no use in the last few weeks of growth) rather than lesser use overall.

Two major factors are driving increased use of antibiotics:

- Increased incidence of disease (related to a range of factors considered above); and
- Agents receiving commission on chemicals sales.

Set against these are several factors constraining use:
- Risks of lost reputation and market arising from contaminated product; and
- Government regulation and enforcement.

**Future prognosis**
The use of banned antibiotics is likely to decline as the costs of contamination are increasingly realised in the production chain. However this will take time – partly because of the lack of traceability, and partly because of the benefits of using some illegal substances in terms of fish response.

The use of antibiotics more generally will tend to increase in line with disease problems, which have been getting steadily worse, and are likely to continue to do so.

**Exposure**
Smaller poor farmers with poor biosecurity, who stock cheaper seed, are more subject to disease, and are therefore more likely to use chemicals. Furthermore, their lack of knowledge makes them more vulnerable to agents' mis-selling.

A huge swathe of fish and human pathogens in the waters of the Mekong will be exposed to a wide range of concentrations of legal and illegal antibiotics. Human pathogens in consumers may also be exposed throughout the world.

**Consequence**
Excessive use of antibiotics, at a wide range of doses and concentrations across wide geographic areas, can have serious consequences in terms of:

- fish pathogen resistance development;
- local resistance development in human pathogens through direct exposure;
- more widespread human pathogen resistance development as a result of exposure through contaminated product; and
- rejection of product in increasingly discriminating markets and poor reputation of Vietnamese food export products.

There has been a study at Can Tho university on antibiotic resistance-potential of bacteria *Edwardsiella ictaluri* which was the pathogen causing liver disease on Tra catfish. The study results showed that most of this bacteria had resistance-potential to streptomycin (83% bacterial strain), oxytetracycline (81%), trimethoprim (71%), and to quinolone group including flumequin (8%), oxolinic acid (6%) and enrofloxacin (5%). Especially, more than 73% of *E. ictaluri* strain had multi-resistance-potential to at least 3 kinds of antibiotics. (Tu Thanh Dung et al., 2009).

**Mitigation**
A suite of coordinated measures is required to address this serious issue:

- High quality disease free seed;
- Vaccination against critical diseases;
- Promotion of best practice to maximise fish health through appropriate feeding, stocking density and environmental conditions in ponds;
- More widespread adoption of biosecurity measures – in terms of pond soil treatment between crops, water supply disinfection etc;
- Vigorous enforcement of law on illegal chemicals primarily through traders and agents;
- Use of alumni networks to target traders to promote higher standards and codes of practice in sales and promotion;
- Improved traceability to ensure that misuse can be traced; and
- Effective provincial aquatic animal health strategy.

**Overall risk summary assessment**

<table>
<thead>
<tr>
<th>Use of antibiotics</th>
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<tbody>
<tr>
<td>Likelihood</td>
<td>high</td>
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<tr>
<td>Severity</td>
<td>high</td>
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<tr>
<td>Uncertainty</td>
<td>low</td>
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</table>
10. Disease in pond sediment

Character
Tra catfish is highly intensive and generates large quantities of organic waste. Much of this accumulates in the sediment over the production cycle and some is retained in the pond between production cycles.

This organic matter will undoubtedly harbour many of the parasites and bacteria to which Tra catfish are subject, and if this is not effectively removed, and ponds disinfected, there is a significant risk of steady accumulation of pathogens and transfer of disease between crops.

We are not aware of any studies which have been carried out on the concentration of disease inoculum in Tra pond sediments.

Release
No data is available on the proportion of farms which effectively remove sediments and disinfect ponds, or on their geographic distribution. Many farmers pump out the bulk of sediments either to rice fields or illegally to the river/canal. However, limited or ineffective pond sediment management is likely to be widespread, especially amongst smaller producers, and those with less well designed ponds.

Those who farm in pens or cages will effectively flush their waste and sediment directly to the river.

Exposure
All farmers who do not manage sediments to minimize disease are at risk, as are any farmers close to such farmers who do not disinfect intake water. Total exposure is unknown, but probably a high proportion of Tra catfish farmers.

Consequence
Catfish survival has decreased and FCR has increased steadily over the last few years, leading to increased production costs at the same time as declining price. The consequences have been severe. The particular contribution that poor sediment management has made to this is unclear, but is probably significant.

Overall risk summary assessment

<table>
<thead>
<tr>
<th>Poor sediment management</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
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<tr>
<td></td>
<td>high</td>
<td>high</td>
<td>moderate</td>
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Value of further analysis
Better pond sediment management is basic good husbandry. Further survey or analysis would be costly and add little to the assessment.
11. Disease in supply water

Character
The concentration of Tra catfish farming - up to 1.5million tonnes produced from around 6,000 ha – means that release and exchange of pathogens in the aquatic environment is likely. Few farms treat their influent or effluent water (although there will be a government requirement to use effluent sedimentation ponds in future).

Release
Release of water carrying pathogens is normal throughout the growing areas. The actual inoculum, or concentration of pathogens in the water, and their dilution in the wider aquatic systems is unknown.

Exposure
Exposure in this case is very similar to release. Almost every farmer is releasing, and most farmers are exposed through untreated water intake. Very few household scale farmers will have water intake reservoirs and water sterilization\textsuperscript{15}.

Exposure will tend to be lower for farmers higher up the river. However it should be remembered that there are also Tra catfish farmers upstream in Cambodia.

Consequence
Tra catfish survival has decreased and FCR has increased steadily over the last few years, leading to increased production costs at the same time as declining price. The consequences have been severe. The particular contribution that infected water supply has made to this is unclear, but is probably significant.

Mitigation
Mitigation measures are well known and require better planning and/or investment in water treatment. Government intervention to require, promote or facilitate appropriate response is however required.

The more densely packed the fish farms, the more concentrated the inoculum of disease organisms, and the greater the likelihood of transfer between farms. Setting minimum distances between farms should reduce both severity and exposure.

Water pre- and post-treatment should reduce the likelihood of both exposure and release.

Overall assessment

<table>
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<tr>
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<th>Infected water supply</th>
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<tr>
<td>Likelihood</td>
<td>high</td>
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<tr>
<td>Severity</td>
<td>high</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>moderate</td>
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</tbody>
</table>

\textsuperscript{15} According to Mr Tao (Ben Tre) 3-5% farmers had settling pond for pre-treatment in Ben Tre. Mr Tuan (An Giang) said there were no pre-treatment pond in An Giang.
Value of further information
Further information will be costly to collect and would probably add little to the overall assessment. The key is to implement what is already known to be effective mitigation.
Annex 2: Risk analysis of key hazards for shrimp (*P. monodon; L. vannamei*) production in the Mekong Delta
1. Price variation

Character

Price variation is normal and significant for almost all agricultural and fishery products. Causes of price variation relate to supply and demand. In most cases demand shows a steady long term increase (although there may be predictable seasonal variations related to festivals etc) while supply fluctuates unpredictably depending on season, weather, disease, and new entry. Demand and supply are therefore rarely in balance, and price will fluctuate significantly. Under normal circumstances price does not fall below the production cost of the most efficient producers, although serious temporary gluts may force farmers to sell below cost because agricultural products, and especially fresh fish and shrimp, are subject to degradation. This leads to accusations of dumping and trade penalties – although historically in Vietnam this has been less significant for shrimp than for Tra catfish.

Many governments seek to stabilise the price of agricultural products through intervention (e.g. buying when the price falls to production cost levels) but this can be very costly, and does not address – indeed may exacerbate – excess supply. Government may also subsidize producers so that they are less vulnerable to market price. Where government does not intervene, the consequence of significant price variation is that less efficient producers go out of business when the price falls, and there is significant longer term rationalisation of the sector – with fewer, larger, more efficient producers. This is the very nature of free trade and a market economy.

In practice price variation for shrimp has been less severe than for Tra catfish. This is because shrimp is a very well established international commodity with production from aquaculture and fisheries throughout the world. There is also a significant local market. Both demand and supply are therefore more stable. Nonetheless, price variation is significant and remains a major problem for small scale producers.

Figure A2.1: Seasonal variation in export price of shrimp (Source: VASEP)

Figure A2.1 shows the monthly average export price for shrimp from Vietnam from December 2005 to December 2008. Prices show a significant annual cycle with higher prices in the early part of the year (Chinese New Year) declining rapidly from May to July and remaining low for the rest of the year. The seasonal decline is typically around 15-20% but may be as high as 25%. Fortunately the seasonal production cycle in the delta is broadly in line with this, with most production in the dry winter months (December-April).

However, this international price variation does not seem to be reflected on the ground. Prices are reported as being much higher in the summer wet season. Price in March 2009 was around VND 60,000/kg (40/kg) and this has historically risen to
VND 140-150,000 in the wet season. According to farmers in Ca Mau price is low between June and August and high between September and Tet – although recently the pattern has been more erratic. This suggests that local supply and demand (in relation to processing) is at least as important as international prices. This may be related to a lack of processing capacity in the lower parts of the delta although there is excess capacity higher up.

Other factors may significantly affect demand and therefore price, including:

- Poor quality product
- Excess water/glazing
- Contamination (preservatives; antibiotics etc)

All of these may have widespread impact on the reputation of the product from a particular country and depress prices in that country more generally, irrespective of the quality of most of the product.

The mixed product from extensive production is of much lower but more consistent value – typically around VND 10,000/kg for mixed trash fish and shrimp

**Future prognosis**
There is no doubt that short term mismatches of supply and demand will continue, and with it significant price fluctuation. The nature of price variation and its causes is complex, relating to local factors (weather, processing capacity, cold storage, local demand) and international price issues. There is a general dearth of good market and industry analysis to explore these issues which should be addressed as a matter of urgency.

**Exposure**
*Cost of production and cost structure*
Enterprises with high input costs and low margins are most vulnerable to price variation. Input costs as a proportion of market price are significantly lower for shrimp than for Tra catfish and this makes shrimp producers somewhat less vulnerable to falls in price. Thus feed costs are around 50% compared with 70-80% for Tra catfish. Input costs of small scale extensive shrimp farming are also much lower than more intensive systems. More extensive producers are therefore likely to be better placed to weather a downturn in prices. The following gives examples of costs for a small scale semi-intensive system operated by a family farming around 1ha (3 ponds) and employing 1 labourer for 2 months of the cropping cycle (VND 800,000/month)

**Table A2.1 Cost structure for household scale producers (semi-intensive, producing 40 shrimp/kg):**

<table>
<thead>
<tr>
<th>Cost</th>
<th>% of costs</th>
<th>VND/kg of product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed</td>
<td>50.0%</td>
<td>31,000</td>
</tr>
<tr>
<td>Chemicals</td>
<td>24.2%</td>
<td>15,000</td>
</tr>
<tr>
<td>Seed</td>
<td>2.5%</td>
<td>1,550</td>
</tr>
<tr>
<td>Other (seed, fuel, labour, finance)</td>
<td>23.3%</td>
<td>14,450</td>
</tr>
<tr>
<td><strong>Cost of production</strong></td>
<td>100.0%</td>
<td>62,000</td>
</tr>
</tbody>
</table>
Market price (VND) | 60-150,000
--- | ---

Total production costs are typically around VND60,000 – excluding capital investment costs\(^\text{16}\) - and with market price currently around VND 50-60,000 (March 2009) it is clear that margins are tight. Being able to exploit seasonal variation in price is therefore a key requirement for longer term survival.

In practice these figures appear somewhat optimistic given current cost of feed, and the need to finance both capital investment and inputs for each crop. Consultees suggested that 100% of farmers borrow to pay for feed. Finance charges may be 20% per annum. This might translate to 5% on a crop and perhaps VND 2-3,000/kg of shrimp production.

Table A2.2 Cost structure for commercial shrimp producers: intensive \textit{L. Vannamei} (80-100 shrimp/kg)

<table>
<thead>
<tr>
<th>Cost</th>
<th>% of costs</th>
<th>VND/kg of product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed</td>
<td>50%</td>
<td>17,000</td>
</tr>
<tr>
<td>Chemicals</td>
<td>15%</td>
<td>5,000</td>
</tr>
<tr>
<td>Seed</td>
<td>12%</td>
<td>4,000</td>
</tr>
<tr>
<td>Other (fuel, labour, finance)</td>
<td>24%</td>
<td>8,000</td>
</tr>
<tr>
<td>Cost of production</td>
<td>100%</td>
<td>34,000</td>
</tr>
<tr>
<td><strong>Market price</strong></td>
<td></td>
<td>40-52,000</td>
</tr>
</tbody>
</table>

Figures approximated from several sources (academics, farmers, traders)

Margins appear to be somewhat healthier for (successful) intensive production \textit{L. vannamei} at the present time, and price for smaller shrimp for a very large international market may be more stable than those for premium larger shrimp. They are therefore less exposed to price variation at the present time.

Consequence

It has been estimated that 10-40% of farmers cannot pay off input loans. A small proportion of these (1-2%?) have to give up collateral. Others wait for the next successful crop and an upturn in shrimp prices\(^\text{17}\).

Mitigation

The primary causes of price fluctuation of shrimp are seasonal demand and inadequate infrastructure and marketing to deal with local seasonal variation in production. The reasons for high exposure are low profit margins/high input costs coupled with high levels of indebtedness. Poor farm gate prices are more likely for

---

\(^{16}\) Capital investment around VND100 million/ha (3 ponds) ($5,500). Labour: family labour + one employee for 2 months, costing VND 800,000/month including food. (Mr Thanh, Shrimp Farmer, Ca Mau)

\(^{17}\) Mr Huy, hatchery owner, pers. comm.
household scale production; whereas exposure in terms of high input costs is greater for more intensive and commercial systems.

Input costs as a proportion of market price are lower for semi-intensive shrimp than for Tra catfish, and are even lower for extensive shrimp production (see section 2).

There are therefore three approaches to mitigation:
   a) seek to stabilize farm-gate prices through improved marketing infrastructure;
   b) reduce feed and chemical costs per kg of production through better FCR, reduced disease, reduced feed price; and,
   c) operate more extensive systems.

The viability of c) will ultimately depend on the price or opportunity cost (rental value) of land (see section 2).

**Timing of production**
There will be a trade off between producing to meet peak seasonal demand and timing of production to minimise disease. *This requires more detailed analysis.*

**Production license**
Salmon prices in Europe have been partially stabilised through constraints on production by government. In the case of Norway, the government periodically issues production licenses which companies can bid for. In the UK sites are associated with an environmental consent based on maximum allowable biomass, which effectively constrains rapid increases in production. Both of these will tend to constrain growth and stabilise prices.

As also for Tra catfish the issue of production licenses for shrimp farming in Vietnam may be possible, though the large number of producers would make this costly and difficult to police. Its effectiveness is also likely to be less than for Tra catfish. While Vietnam is the main producer of Tra catfish and could in theory control the overall level of production, Vietnam is one of many shrimp producing nations, and constraining production in Vietnam is likely to have little effect on price.

**Cold Storage**
Cold storage is particularly effective at ironing out short term (especially seasonal) supply and demand. Most private companies will have significant cold storage facilities and recent price fluctuations will encourage more private sector investment. It is notable however that in the case of rice there is well developed storage capacity. This is more difficult and more costly for shrimp, and decline in quality through time is more rapid, but the investment may be worthwhile.

Cold storage is available in most provinces, and some major facilities in Long An and Ho Chi Minh city.

*An assessment of sector cold storage needs and opportunities, and cost effectiveness of increased capacity, would be extremely useful for both the government and the private sector.*

**Vertical integration**
As also for Tra catfish vertical integration within the shrimp sector has many attractions from a production and marketing perspective. However, it is less likely to lead to a better balance of supply and demand or to stabilize prices significantly,
since these are driven by a much more complex global production and marketing system.

**Market information**
Many of the smaller farmers are relatively flexible and may be able to stop and start production according to the wider demand and supply situation. Access to good market information, and specifically good market prognosis over the coming year would allow them to reduce their risks in terms of timing of stocking, stocking density, size of product etc.

**Diversification**
Once ponds are in place, they may be adapted for a variety of species, including crab, seabass, Tilapia, mudskipper etc., and a range of fish for local markets and potentially export markets in the longer term. The constraint on this is mainly confidence and knowledge. Dissemination and training for production of a wider range of species will be essential to the future of brackish-water fish farming in the Mekong delta. The issue of crab as a possible carrier/reservoir of viral disease also needs to be carefully considered.

**Processing capacity**
This is an issue which would need to be explored carefully. In Ca Mau for example there is 130,000 tonnes of capacity annually. Shrimp production last year was 94,000 tonnes. However this was produced mainly in the dry season, so capacity may well be seasonally stretched.

**Overall risk summary assessment**
There is a strong likelihood of continuing price fluctuation. The consequences of such variation for more intensive producers are likely to be severe, with significant losses in many cases. More extensive producers are better placed but will still suffer much reduced income.

<table>
<thead>
<tr>
<th>Fluctuating price</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>high</td>
<td>moderate to severe</td>
<td>low</td>
</tr>
</tbody>
</table>

These risks can be significantly reduced through the range of mitigation measures described above.
2. Price level and trends

Character
As for price fluctuation the key factors affecting long term price level and trends are demand and supply. Ultimately however the price will converge on the cost of production of the most efficient producers, plus an acceptable profit margin (typically 5-15%). Since producers will become steadily more efficient, and find the best places to farm shrimp, a long term decline in price is likely.

In practice shrimp price has remained (on average) significantly higher than production costs for more than two decades, allowing successful producers to make very large profits. This is because supply has only occasionally overshot demand despite the high profits - in part because the rate of increase in demand has been consistently high; and in part because disease has significantly constrained total production.

Notwithstanding this generally positive market situation, there have been periods of relatively lower prices. In 2007/8 in Ben Tre for example, price fell significantly and 15-20% of farmers ceased production. Land was left fallow or turned to alternative use.

Price level may be distorted locally where the industry is small and where the relative power of buyer and seller is unequal. This may be less of an issue for small scale shrimp producers since there is significant domestic demand and a large number of reasonably competitive intermediate buyers.

Price level will also depend on quality and reputation of product, and typically larger margins can be maintained in sub-sectors with a high quality image. This is the rationale for the promotion of organic production in the Mekong Delta. However, quality standards for all export shrimp production are being driven up and it is unclear that the organic premium will be sufficient to justify the additional expenses, especially for small scale production. This is likely to be the case especially during economic downturns of the type currently being experienced. While basic standards are likely to be maintained, demand for premium products will be hit hardest.

Future prognosis
It is likely that the historic strength of the shrimp market is now changing. Shrimp prices have declined since 2000 due mainly to slack demand from Japan and the US. This was partially compensated by strong growth in the EU market, but this is also now mainly in decline. A major turnaround is likely to be some way off and the prospects are not good in the foreseeable future. Much depends on the extent to which China and other Asian countries ride the economic downturn, and the state of their shrimp production sector.

Vietnam should have comparative advantage in shrimp production (though feed price is an issue – see below) compared with most other producing countries, but only if it can be highly efficient (land and labour productivity; FCR). There is likely to be rationalisation of production as a result of the current downturn, with less efficient producers going out of business. If Vietnamese producers can survive with very slim margins, they will be well placed to do well when the Western economies begin to recover and will be more competitive relative to Chinese and other competitors.
Increased production of *L. vannamei* globally is also likely to have an impact on price. Production has already increased rapidly and will continue to do so. The price for small shrimp will undoubtedly fall significantly as a result, and since there is some cross elasticity of demand between sizes, there will be some impact on the price of larger shrimp. However, this may be less of a factor than the fall in demand for premium large shrimp as a result of the global economic downturn.

**Exposure**

Exposure depends primarily on cost structure. This is radically different for the different forms of shrimp farming considered here, as exemplified in tables A2.3-4 and figure A.2.2. Table A.2.5 offers a comparative analysis of cost structure and implications for exposure and comparative advantage.

**Table A2.3 Comparison of cost structure and performance of different types of shrimp farming (data from interviews)**

<table>
<thead>
<tr>
<th></th>
<th>Improved extensive <em>P. monodon</em> farms</th>
<th>Intensive <em>P. monodon</em> farms</th>
<th>Intensive <em>L. vannamei</em> farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total production (kg/ha)</td>
<td>100-300</td>
<td>5000 – 10,000</td>
<td>7000 – 8000</td>
</tr>
<tr>
<td>Market price (VND1000/kg)</td>
<td>60 – 150</td>
<td>60 – 150</td>
<td>40</td>
</tr>
<tr>
<td>Revenue min (VNDx1000)</td>
<td>6,000</td>
<td>300,000</td>
<td>280,000</td>
</tr>
<tr>
<td>Revenue max (VNDx1000)</td>
<td>45,000</td>
<td>1,500,000</td>
<td>320,000</td>
</tr>
<tr>
<td>Production cost (x1000 VND/kg)</td>
<td>6.6 - 30</td>
<td>60 - 65</td>
<td>30 – 35</td>
</tr>
<tr>
<td>Production cost(x(10^6) VND/ha)</td>
<td>2–3</td>
<td>400</td>
<td>280 - 320</td>
</tr>
<tr>
<td>Feed (%)</td>
<td></td>
<td>45-60</td>
<td>50</td>
</tr>
<tr>
<td>Seed (%)</td>
<td></td>
<td>2.5</td>
<td>10–15</td>
</tr>
<tr>
<td>Others (%)</td>
<td></td>
<td>37.5</td>
<td>35-40</td>
</tr>
<tr>
<td>Profit margin (%)</td>
<td>43%</td>
<td>34%</td>
<td>35%</td>
</tr>
<tr>
<td>Loss probability (%)</td>
<td>0 (before 1997)</td>
<td>20-30% (main/dry crop)</td>
<td>20% (main/dry crop)</td>
</tr>
<tr>
<td></td>
<td>80% (1997 forwards)</td>
<td>20-70% (contrary/wet crop)</td>
<td>80% (contrary/wet crop)</td>
</tr>
</tbody>
</table>
Table A2.4. Operating cost of farming black tiger shrimp by farming systems in Mekong delta (Source: Le Xuan Sinh et al., 2006)

<table>
<thead>
<tr>
<th>Cost category</th>
<th>Small scale extensive</th>
<th>Small scale semi-intensive (household)</th>
<th>Commercial scale semi-intensive and intensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of observations</td>
<td>50</td>
<td>159</td>
<td>269</td>
</tr>
<tr>
<td>Average total fixed cost (x VND1000/ha/yr)</td>
<td>3283.4</td>
<td>6,193</td>
<td>10,840</td>
</tr>
<tr>
<td>% total cost</td>
<td>34.9</td>
<td>11.2</td>
<td>4.9</td>
</tr>
<tr>
<td>Average total variable cost (x VND1000/ha/yr)</td>
<td>6123.5</td>
<td>20,889</td>
<td>83,388</td>
</tr>
<tr>
<td>% total cost</td>
<td>65.1</td>
<td>88.8</td>
<td>95.1</td>
</tr>
<tr>
<td>Variable cost structure (%)</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Feed</td>
<td>0</td>
<td>29.06</td>
<td>54.75</td>
</tr>
<tr>
<td>Seed</td>
<td>39</td>
<td>22.39</td>
<td>9.68</td>
</tr>
<tr>
<td>Chemicals</td>
<td>0</td>
<td>6.81</td>
<td>12.89</td>
</tr>
<tr>
<td>Pond treatment</td>
<td>46.7</td>
<td>18.11</td>
<td>9.24</td>
</tr>
<tr>
<td>Fuel</td>
<td>1.2</td>
<td>5.05</td>
<td>4.56</td>
</tr>
<tr>
<td>Labor</td>
<td>0.2</td>
<td>3.24</td>
<td>4.37</td>
</tr>
<tr>
<td>Interest payment</td>
<td>3.5</td>
<td>13.22</td>
<td>1.61</td>
</tr>
<tr>
<td>minor repair</td>
<td>6.6</td>
<td>0.88</td>
<td>0.94</td>
</tr>
<tr>
<td>Tax &amp; other charges</td>
<td>0</td>
<td>0.45</td>
<td>1.04</td>
</tr>
<tr>
<td>electricity</td>
<td>0</td>
<td>0.63</td>
<td>0.57</td>
</tr>
<tr>
<td>Harvest and transportation</td>
<td>0.5</td>
<td>0.08</td>
<td>0.25</td>
</tr>
<tr>
<td>Consumables</td>
<td>2.3</td>
<td>0.08</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Figure A2.2. Comparison of shrimp farm operating costs for different levels of intensity

Comparison of operating costs per hectare for extensive, semi-intensive and intensive shrimp farming. (Data from Le Xuan Sinh 2006)
Table A2.5. Relative comparative advantage of small and large scale shrimp producers in terms of costs per unit of production

<table>
<thead>
<tr>
<th>Cost category</th>
<th>small scale extensive</th>
<th>small scale semi-intensive (household)</th>
<th>commercial scale semi-intensive and intensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital – pond construction</td>
<td>Overall investment in ponds tends to be much lower for these systems, but costs per unit production may be relatively high</td>
<td>Less intensive systems imply significantly higher pond costs per unit production. Household labour may be used to reduce the cash outlay</td>
<td>Significant up front investment, but written down as a relatively small proportion of operating costs</td>
</tr>
<tr>
<td>Capital - equipment</td>
<td>Very low</td>
<td>Typically lower investment per unit area, but higher per unit production, dependent upon levels of intensity</td>
<td>Significant up front investment, but written down as a relatively small proportion of operating costs</td>
</tr>
<tr>
<td>Land</td>
<td>Use (and therefore cost) of land per unit production is exceptionally high for these systems, though this may not be reflected in quoted production costs</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td>Equipment maintenance</td>
<td>Very low</td>
<td>Largely undertaken by family labour, payment for which is more flexible</td>
<td>Market rates required for labour at all times.</td>
</tr>
<tr>
<td>Feed</td>
<td>Low. Limited feeding and reliance on natural food</td>
<td>High Delivered price of feed likely to be higher than for commercial systems – small volumes, difficult access. FCR may be lower – intensive husbandry and “ownership”.</td>
<td>High Delivered price of feed likely to be lower than smaller scale semi-intensive systems – high volumes, easy access. FCR may be higher – larger scale, less close husbandry, less worker “ownership”.</td>
</tr>
<tr>
<td>Labour</td>
<td>High/flexible Family labour, availability more flexible; payment is more flexible.</td>
<td>High/flexible Labour productivity much lower than for larger scale production Family labour, availability more flexible; payment is more flexible.</td>
<td>Low/inflexible Labour productivity much higher than for small scale production Hired labour, availability less flexible; payment at standard rates irrespective of product price and profitability.</td>
</tr>
<tr>
<td>Chemicals</td>
<td>low</td>
<td>Very variable according to attitude and skills</td>
<td>Very variable according to attitude and skills</td>
</tr>
<tr>
<td>Fuel</td>
<td>Very low</td>
<td>Likely to be lower: great care will be taken to keep costs down</td>
<td>Likely to be higher: more stock, more risk – if in doubt keep the aeration/pumps going.</td>
</tr>
<tr>
<td>Farm gate price</td>
<td>Should be high Depends on market and distribution chain for larger shrimp</td>
<td>Lower for export market (small quantities; more difficult access; higher costs of demonstrating compliance with international standards); Higher for domestic market.</td>
<td>Higher for export market (large quantities; ease of access); lower for domestic market (too much product).</td>
</tr>
</tbody>
</table>
In the short term there may be little disadvantage for small scale producers, and indeed extensive producers are likely to be least exposed to market price decline. But as the opportunity cost of family labour rises (as it will with further development) and market demands for quality assurance and traceability increase, then these farms will become less competitive, and large enterprises with high labour productivity, lower input costs, better bargaining power and higher farm gate price will take over. The opportunity cost of land is also a major driving force toward consolidation and intensification in the sector. The rental value of undeveloped land (at VND7-8million/year) is somewhat higher than the minimum returns from extensive shrimp farming – stimulating the rental market, and in turn more intensive production to cover rental costs.

At the present time successful commercial producers of *L. vannamei* appear to be better placed because of the substantially lower feed costs. However, this will become an extremely competitive market in the medium term, and margins will be very slim.

**Consequence**

In some ways small scale producers may be better placed to ride out the current global recession since they have more flexible labour costs and in some systems (especially extensive) lower feed costs. In the longer term however they will suffer from low labour productivity and are likely to sell out steadily to larger and more efficient enterprises.

**Mitigation**

Household producers can do several things in order to survive in the face of long term tight margins generated by competition within the sector, and with other producers in other parts of the world:

- Improve survival and FCR to keep feed costs to a minimum;
- Adjust timing of production to exploit the seasonal price variation;
- Develop better market information systems – and in particular regular "market outlook" for farmers in each major producing region;
- Establish stronger bargaining position through producer organisations representative of household scale producers;
- Where land and labour costs are relatively low, shift to more extensive production systems during periods of intense price pressure;
- Focus on the "top end" of the market for which export prices are much higher (see table A2.6); and,
- Diversify – for example seabass, Tilapia. Domestic markets (and demand) for these products are likely to grow in parallel with development and urbanisation, as has happened in other countries in the region.

The economics of more extensive systems in different locations and under different price regimes deserves further attention.

A price premium may be payable on organic and similar labels. In some cases this may be an appropriate option, but the market remains relatively small (especially during an economic downturn), the premium is limited, and the costs of compliance, especially for small scale producers, are high. The real economic benefits for small scale producers associated with organic production need to be explored much more thoroughly and independently before this is widely promoted. Ensuring that
producers can get their product to market of the size and quality demanded by the $20/kg export market (Table A2.6) should be a priority.

Table A2.6. Price differential for different shrimp products

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Final product</th>
<th>Export price (US$/kg)</th>
<th>Raw material to final product ratio</th>
<th>Profit rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>shrimp</td>
<td>shrimp</td>
<td>20-22</td>
<td>1.1-1</td>
<td>3-5%</td>
</tr>
<tr>
<td>Big-sized</td>
<td>Heads-on</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shrimp, very</td>
<td>shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fresh, bright</td>
<td>fresh, bright</td>
<td>10-16</td>
<td>1.3-1.5:1</td>
<td>3-5%</td>
</tr>
<tr>
<td>shell and head</td>
<td>headless</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>head</td>
<td>shrimp</td>
<td>6-9</td>
<td>1.9:1</td>
<td>3-5%</td>
</tr>
<tr>
<td>Small-sized</td>
<td>Peeled shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shrimp, fresh</td>
<td>shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bright shell</td>
<td>shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>but dark</td>
<td>shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>heads</td>
<td>shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small-sized</td>
<td>shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shrimp, rather</td>
<td>shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fresh, dark</td>
<td>shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>head and shell</td>
<td>shrimp</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Dr Nguyen Anh Tuan, NTU, pers. comm.)

Overall risk summary assessment

<table>
<thead>
<tr>
<th>Long term price pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood</td>
</tr>
<tr>
<td>Severity</td>
</tr>
<tr>
<td>Uncertainty</td>
</tr>
</tbody>
</table>
3. Access to international markets

Character
Countries such as Vietnam, which are highly competitive in terms of labour costs and productivity, will always be vulnerable to restrictions on imports – often promoted by threatened local producers in importing countries. These restrictions may be related to product quality and/or unfair competition.

Future prognosis
Anti dumping is probably less of an issue for shrimp than it is for Tra catfish, at least in the medium term. The discrepancy between American and Vietnamese catfish farmers is huge and there is always the potential for cases to be brought. Shrimp is far more of a global commodity, with production dominated by developing countries with greater similarities between producer economies.

Restrictions relating to product standards are however likely to become increasingly stringent, initially in relation to product quality, and in the longer term in relation to production practice and socio-economic conditions. This will be driven both by legislation and the demands of corporate social responsibility on the part of some of the larger buyers (and especially supermarket chains such as Walmart and Tesco).

Exposure
Any kind of import ban or anti dumping case suddenly and dramatically reduces demand and therefore price. In the case of anti dumping large and small producers alike will be affected.

In the case of product quality (e.g. chemical residues, health risks) small scale and isolated semi-intensive producers will be most at risk, since both traceability and demonstration of compliance will be more difficult and more costly. Also small scale producers may be more likely to use banned chemicals through lack of knowledge or possible mis-selling of chemicals. Extensive producers would normally use few chemicals and should therefore be less at risk.

However, until such time as traceability of all shrimp product is well established, all producers share some risk, since a blanket ban may be imposed by some countries on all Vietnamese product.

Table A2.7. Limited market access: exposure of extensive, semi-intensive and commercial semi-intensive and intensive producers

<table>
<thead>
<tr>
<th>Access issue</th>
<th>household extensive</th>
<th>household semi-intensive</th>
<th>commercial intensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>product quality (general)</td>
<td>highly exposed</td>
<td>highly exposed</td>
<td>less exposed</td>
</tr>
<tr>
<td>chemical residues</td>
<td>exposed</td>
<td>highly exposed</td>
<td>exposed</td>
</tr>
<tr>
<td>legislative and market led demands for social responsibility</td>
<td>not exposed</td>
<td>not exposed</td>
<td>exposed</td>
</tr>
<tr>
<td>anti dumping</td>
<td>exposed</td>
<td>exposed</td>
<td>exposed</td>
</tr>
</tbody>
</table>
**Consequence**

It will be increasingly difficult for small scale low investment systems to produce a product of the *demonstrated* quality and safety required in international markets. However, this will result in steadily increasing pressure as opposed to dramatic change, and the best informed, best located and best designed farms will adapt, improve and survive. The poorest farmers may lack the investment and knowledge to do this and may go out of business.

**Mitigation**

Group initiatives, effective training and extension, availability of finance to upgrade systems are all required to meet this challenge. GAP and other management certification systems will help, especially with medium and large scale enterprises, but these certification programmes are complex and demanding, and smaller household scale producers will be at a significant disadvantage. A more effective and equitable approach would be to implement far simpler industry wide standards relating to traceability, chemical use, and product quality. Once these are in place, more sophisticated management systems may be introduced where clear market premiums are available.

Exports to a wide range of countries will reduce the overall effect of any specific infringement of standards.

Development of domestic markets (see below) will also be a key stratagem for smaller scale producers less able to meet international standards.

**Overall risk summary assessment**

The likelihood of future restrictions on market access as a result of product quality or dumping accusations is significant.

In terms of infringement (chemical residues), the household scale semi-intensive producers are most at risk, but without effective traceability across the industry the whole sector may be affected by resulting sanctions.

<table>
<thead>
<tr>
<th>Access to international markets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Likelihood</strong></td>
</tr>
<tr>
<td><strong>Severity</strong></td>
</tr>
<tr>
<td><strong>Uncertainty</strong></td>
</tr>
</tbody>
</table>
4. Access to local markets

Character
Rather little attention has been paid to local markets for shrimp because of the historically high export price. In this sense there are few risks related to reduced access to this market. The question is rather one of opportunity. As the world shrimp commodity prices come down, and as domestic markets strengthen in parallel with economic development and urbanization, the domestic market will become much more significant. China illustrates this trend well.

Modest amounts of farmed shrimp have always entered domestic markets, but the distribution infrastructure is relatively poor.

Future prognosis
Domestic markets are growing fast, and though this trend may slow down in the current economic downturn, there is significant potential in the medium and long term.

For shrimp producers in the Mekong, it has been estimated that 10% of product goes to local markets. This proportion is likely to rise, and small scale producers may be well placed to access this market.

Exposure
Access to domestic markets is less constrained by quality issues and traceability than is access to international markets – though this will change in the longer term. In some ways smaller scale and extensive producers are better placed to supply some parts of the domestic market (e.g. local markets and restaurants) while semi-intensive and larger scale producers may be better placed to supply a national convenience foods market to meet growing urban demand.

Overall there are few risks and significant opportunities associated with the domestic market.

Consequence
The availability of a growing domestic market, with lower associated risks may be a lifeline to struggling small and medium scale producers for whom certification to international standards will be difficult.

Mitigation
There are no significant risks to mitigate.

Overall risk summary assessment

<table>
<thead>
<tr>
<th>Access to local and domestic markets</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low</td>
<td>low</td>
<td>medium</td>
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</table>

Domestic markets offer a particular opportunity to smaller scale producers and there is a strong case for more serious market research.
5. High price of feed

**Character/nature (= release)**

The price of commercial pelleted shrimp feed has risen significantly in recent years from around VND 20-23,000 in 2006/7 to VND 22-25,000 in 2008/9 (i.e. a 10% rise), depending on quality. Given that feed comprises around 50% of production costs for semi-intensive and intensive shrimp systems, this translates to a 5% increase in production costs.

In practice the price of feed to household scale producers is determined by several factors:

- Cost of ingredients (local; international)
- Import tariffs on feed ingredients
- “Unhealthy competition” between feed manufacturers
- Mark-up in the supply chain

Around 80% of feed ingredients are imported - typically fishmeal from Chile/Peru; soy from Argentina/US; wheat from USA; and minerals and vitamins from Bayer international. Occasionally “Kisimex” fishmeal from Kien Giang province may be used. Higher international prices for basic feed ingredients should affect all producers in a similar way. Although this represents a short term problem for producers – in the medium term shrimp prices should rise to reflect increased production costs, and all else being equal Vietnamese producers should not be at any particular disadvantage.

Vietnam applies an import tariff of 5% on most feed ingredients including fishmeal, cornmeal etc, and a 10% import duty on lecithin and fish oil. There is evidence to suggest that formulated commercial feed costs are 10-15% higher in Vietnam than in Cambodia, Thailand, and China\(^\text{18}\). This is difficult to explain entirely on the basis of import tariffs, which are broadly similar across the countries in the region – although Thailand reduced tariffs on soybean meal from 4% to 2% in 2008. There may be differences related to cheaper local supplies (unlikely in major international commodities) or to lack of effective competition in the feed manufacturing sector in Vietnam.

Three companies are dominant in the Vietnam market: CP, Uni-president and Grow Best, with 70-80% of the market. Other major players include Tom Boy and Cargill and up to 30 smaller producers, which use a higher proportion of domestic ingredients.

**Future prognosis**

Although feed prices are currently higher than those of competitors, two factors are likely to result in these coming into line with those of major competitors:

- Agro-feed ingredients are major international commodities. Prices in different countries should come into line as trade barriers reduce.
- Competition in the feed industry is increasing. This should make for a “healthier” market so that prices come into line with international prices more generally.

\(^{18}\) Dr Nguyen Huu Dzung pers. comm.
Exposure
At the present time commercial intensive farms totally reliant on commercial feed are at risk from high feed prices, as are household scale semi-intensive farms. Extensive producers are not exposed.

Household scale farms are more exposed to feed price mark-up. Smaller farms buy smaller quantities of feed from agents (there are usually two levels of agent) and the markup along the chain is significant (our informants suggested as much as VND 2,500 from factory price to grower). The smaller and more isolated the farmer, the higher the markup. Discussions with farmers in Ca Mau suggested that transport costs for feed are modest and are not the major factor in price differentials. They typically amount to VND 100,000/tonne – or VND100/kg – a small percentage of feed price (VND23,000/kg).

Consequence
Shrimp farmers are operating on increasingly tight margins. If feed prices for farmers are higher than those of competitors (commercial farms in Vietnam; farms overseas) household scale semi-intensive producers are likely to go out of business rapidly.

This will not apply to extensive production systems – but they have other economic/financial disadvantages.

Mitigation
There are many ways to reduce feed costs:

- Eliminate any unhealthy competition in the industry (government analysis and action).
- Remove or reduce import tariffs on feed ingredients.
- Further improve skills in feed formulation and encourage establishment of local feed companies.
- Generate more information on cost effectiveness of different feeds (e.g. the trade-off between low cost/high FCR and high cost/low FCR; the trade off between low cost/low quality and high cost/high quality).
- Generate more information on the variation in FCR with stocking density
- Improve fish health and husbandry to minimise FCR through higher survival and better conversion performance (e.g. feeding areas; stocking density; water quality; seed quality; etc.).

The potential for reduced costs is substantial. The best tiger shrimp growers achieve FCR around 1.2, compared with an average closer to 1.5 (Huy pers. com) corresponding to a cost saving per kg of production around VND 6,000 and a major difference in profitability. FCR is also typically significantly lower for P vannamei with many producers achieving 1.1 (Huy pers. comm.). However, if feed prices remain artificially high in Vietnam, then it will lose comparative advantage irrespective of any FCR related gains.

Overall risk summary assessment
Although this is a significant medium term risk, it is one for which there are many practical ways to reduce impact, and the problem should be largely addressed in the medium term

<table>
<thead>
<tr>
<th>High price of feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood</td>
</tr>
<tr>
<td>Severity</td>
</tr>
<tr>
<td>Uncertainty</td>
</tr>
</tbody>
</table>
6. Feed quality

Character
In an industry with very tight margins and production costs dominated by feed, cost effective feeds and feeding practice are the keys to success.

There are three major issues associated with feed quality:

- Poor quality feed – poor formulation and poor quality ingredients;
- Mislabelling of feed – for example in terms of protein content; and,
- Use of dangerous additives such as melamine or illegal antibiotics.

As feed ingredients have risen in price, the incentive for manufacturers to reduce quality, or for farmers to use lower quality feeds has been high. There is some evidence that feed quality has declined in recent years\textsuperscript{19}. There is also anecdotal evidence that melamine may be being used to increase N content and create the impression of higher protein content, but this has not been found in any government tests. However, government sampling and testing is relatively limited – amounting to sampling at all feed stores in Can Tho city twice a year.

Future prognosis
The pressure on manufacturers to substitute lower quality ingredients in response to rising ingredient prices is likely to decline over the next two years, and in the mean time better control and regulation may be introduced so that when price pressure increases again after the economic downturn this form of cheating can be minimised.

Following a period of rapid price rise, the cost of feed ingredients – and feed - is likely to decline again in response to falling fuel prices and falling demand (global economic downturn). Unfortunately the advantages gained will probably be more than negated by falling product prices.

Exposure
Small scale producers with limited power and knowledge are vulnerable to purchase of poor quality feed. While manufacturers cannot afford to deliver poor quality product to large scale and discriminating farmer customers, this is less true for small amounts, typically delivered through middle men, to small scale farmers.

In any case limited finance means poor farmers will always have a tendency to buy cheaper product, especially when the benefits of more expensive varieties are unclear. Farmers to whom we talked suggested that when market price is low they tend to buy cheaper and lower quality feed.

Consequence
The consequences of using poor quality feed intentionally or unintentionally may be serious in terms of:

- Poor FCR
- Slower growth
- Poor condition and susceptibility to disease

\textsuperscript{19} Mr Hai pers. comm. (The head of the sub-department of Fishery Management at Can Tho city)
If it is established that melamine is being used in some feeds the consequences in terms of international reputation, and export price, will be very serious.

**Mitigation**
There are several effective forms of mitigation:

- Farmer training and understanding of feed quality issues;
- Better information and simple models to assess the cost effectiveness of feed – in terms of minimising (FCR x feed price) while maintaining growth rate and condition;
- Effective government sampling and testing of manufactured feed;
- Affordable feed analysis services for the private sector; and,
- More competition in the feed manufacturing sector.

In so far as there are only a modest number of major feed manufacturing plants, quality control of feed by government, or by farmers seeking testing services from laboratories, should be relatively effective, and provide a strong disincentive to cheat.

**Overall risk summary assessment**

<table>
<thead>
<tr>
<th>Poor quality or contaminated feed</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood</td>
<td>moderate</td>
</tr>
<tr>
<td>Severity</td>
<td>moderate (to high – melamine)</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>moderate</td>
</tr>
</tbody>
</table>
7. Release of *L. vannamei*

**Character**

*L. vannamei* is a native shrimp species of South and Central America which has been cultivated for many years. It is the main farmed shrimp product in the Americas and forms the bulk of tropical shrimp imports to the US market.

It is easier to grow than *P. monodon* in some respects, and is more tolerant of higher stocking densities, and temperature extremes. It will grow well on lower quality feeds and relatively low FCR can be achieved compared with *P. monodon*. It grows very quickly in the early stages. For all these reasons it is in many ways more attractive to grow-out farmers than *P. monodon*. Production may exceed 15 tonnes per ha per crop (Briggs 2005) meaning that effective wastewater management is required. The bulk of the market – mainly to the US - is for relatively small shrimp (80-100/kg).

The Government of Vietnam has approved its introduction into specified provinces subject to appropriate checks\(^2\). In most cases provinces have approved its introduction only in specified areas and for intensive production, with the assumption that this species is only suitable for large scale commercial and intensive production. Separate areas have been established in some provinces (e.g. Soc Trang) and co-cropping in others (Ben Tre). In some provinces (e.g. Ben Tre) special areas have not been assigned, but production is controlled.

*L. vannamei* was introduced in the South of Vietnam mainly Ba Ria – Vung Tau province in 2008. Stocking in the Mekong Delta has been officially sanctioned only since 2009. In practice many farmers are now trying this shrimp irrespective of regulations. *L. vannamei* was stocked in Ca Mau in September 2008. Most died. It was also stocked in Soc Trang where results were good. Overall it has been estimated that last year success rate in officially designated areas was around 50% (Nguyen Thanh Tung pers. comm). In the area of Ca Mau that we visited 7 instances of *vannamei* production were reported – but success was achieved in only one.

There are several possible risks to small scale shrimp farms in the Mekong delta associated with the introduction:

- Introduction of new diseases with imported seed or broodstock;
- Widespread and rapid adoption resulting in oversupply and market price decline; and,
- Pond degradation due to more intensive practices creating difficulties for reversion to *P. monodon*.

*L. vannamei*, like all farmed shrimp species, has been subject to serious disease outbreaks under farmed conditions. *L. vannamei* is a known carrier of Baculovirus penaei (BP), Whitespot disease (WSD), Yellowhead disease (YHD), Infectious Hypodermal and Hematopoietic Necrosis virus (IHHNV), Reo-like virus (REO), Taura Syndrome virus (TSV), Lymphoid Organ Vacuolization virus and Necrotising Hepatopancreatitis bacterial disease (NHP) (Overstreet et al., 1997; JSA, 1997, Ravichandran 2008). It is possible that these viruses and bacteria can be transmitted to native wild Penaeid shrimp populations and to farmed *P. monodon*.

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\(^2\) Instruction No 228/CT-BNN-NTTS of the Ministry of Agriculture and Rural Development on development of white-leg shrimp farming
Possible impacts on market price have been discussed above.

**Release**
The main sources of both seed and broodstock are Thailand, China and Hawaii as illustrated in Figure A2.3

Figure A2.3. Origin and entry of *L. vannamei* seed and broodstock to Vietnam (2008)

Overseas companies (CP, Grow Best, etc), government and domestic companies hatcheries are all involved in the legal import and distribution process. Hawaiian and Thai sources are mainly fully certified disease free, safe and of high quality. However, many small-scale hatcheries purchase non-certified broodstock, mainly from China.

Quang Ninh is a major centre for the import of seed and broodstock. Quarantine appears to be inadequate and only around 5% of batches are tested (Hao pers. comm.). However, the main threat in Vietnam is not through official channels for approved introductions. On the whole these are well monitored and policed, and seed/broodstock is probably of high quality and safe. However, there is widespread interest in *L. vannamei*, and many farmers outside approved zones wish to try it. At the present time they must resort to illegal routes – and most illegal routes (mainly from China) are neither safe nor certified. The illegal sub-sector therefore poses a high risk to the legal *L. vannamei* sector and also to the *P. monodon* sector.
Future prognosis
Increasing volumes of seed and broodstock will be imported into the country through illegal routes and spread relatively uncontrollably.

Exposure (L. vannamei and P. monodon farmers)
Most large scale commercial shrimp farms – and especially those approved for the introduction of L. vannamei are built with sophisticated biosecurity measures: water treatment, hygiene regulations; testing laboratories etc. Larger farmers may send samples to several testing services, including RIA2. Although in some cases they may be exposed, the chances of infection are significantly reduced.

Small scale farmers – especially those operating extensive and improved extensive systems - do not usually have such effective biosecurity and will be very vulnerable should disease be released into the environment or be taken up by carriers.

Small scale farmers who seek to start farming L. vannamei illegally themselves will be doubly exposed, since they will use illegal seed of unknown provenance, and will not have it officially checked for fear of conviction. They will not receive good advice.

Samples of P. monodon originating from several provinces of Indonesia have tested PCR positive for TSV suggesting that the disease can be transferred to P monodon – which is unlikely to have any significant resistance. The virus has also been found in L. vannamei from Maros (Sulawesi Islands) and Sumbawa Islands (Sunarto et al). Taura syndrome has now been reported in Phu Yen province (central Vietnam) causing mortality of 80-100% over an area of 24 ha among 546 ha of farming area in this province.

Consequence
The consequences of disease epidemics in shrimp farming systems are well known and destructive. The farming systems in the Mekong Delta, with a high degree of water sharing, are particularly vulnerable.

There are also a range of other risks, mainly associated with the market. P. vannamei is exclusively an export market product, so price could well be more volatile than that for P. monodon. By way of contrast the local market for P. monodon is around VND 50,000/kg – giving a good return to extensive producers.

Mitigation
It will be extremely difficult to clamp down on illegal import and widespread distribution of L. vannamei seed. Since illegality increases the likelihood of importing infected seed, the best available option may be to legalise general use - but to maximise national biosecurity measures to minimise risks. There is an urgent need for more detailed risk analysis and identification of critical control points for this hazard.

Overall risk summary assessment

<table>
<thead>
<tr>
<th></th>
<th>Introduction of infected L. vannamei</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood</td>
<td>high</td>
</tr>
<tr>
<td>Severity</td>
<td>high</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>low</td>
</tr>
</tbody>
</table>
8. Poor seed quality or infected seed

Character
Seed quality has always been a key issue in shrimp production. Given that seed is so important – yet a relatively minor proportion of total production costs - there is ample opportunity for investment to secure the highest possible quality of seed. Discussions with one hatchery owner suggested that farmers were prepared to pay a significant premium if they were convinced of higher quality.

Poor seed quality may result in:

- Poor growth
- Poor FCR
- Vulnerability to disease and poor survival
- Poor quality product

Furthermore, seed may carry disease which can become epizootic in the production system, especially where growing conditions or feeding regime are sub-optimal. Major problems for *P monodon* hatcheries at present are MBV and Vibrio.

Mortality in shrimp ponds remains high, with loss of one crop in three typical. This is mainly associated with viral disease, introduced in the water supply, by carriers or with post-larvae. Whitespot continues to be the major problem with at least 10% per year overall losses and much higher rates of loss locally (Mr Tao, Mr Dung). One of the reasons that poor farmers have not always been prepared to pay for high quality seed is that sources of disease are multiple, and good seed is no guarantee of disease free production (see box A2.1).

The quality and biosecurity of hatcheries in the Mekong delta has increased dramatically over the last decade, but post larvae continue to be sourced from many locations in Vietnam, so there remains great scope for further improvement. Provincial quarantine and testing is generally weak relative to the scale of stock movements. To some degree the private sector will now drive this, but there is also a major role for government.

The shortage of broodstock and the prevalence of small hatcheries exacerbates seed quality problems.

It has been suggested (Chanh, pers.comm.) that there has been excessive competition between seed producers, driving both price and quality down (although it is arguable that this is entirely driven by undiscriminating farmers buying cheap poor quality seed).

Release/supply
The shrimp industry is characterised by a few large hatcheries and many smaller. In many cases quality control is limited.

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Box A2.1. Multiple sources and causes of disease can undermine initiative
RIA2 has facilitated the development of a cluster or group of 15 shrimp farming households in a pilot project. A perimeter dyke and improved canals have been dug. Testing of PL was undertaken for the whole group – but they still suffered from disease.
*P monodon* broodstock are sourced mainly from the wild – usually Ca Mau. Some hatcheries also purchase nauplii and larvae from larger companies such as CP.

**Figure A2.4. Supply of *P. monodon* seed in 2008.**

![Diagram showing supply of P. monodon seed in 2008](image)

It is clear that there remain major problems in terms of quality control in the *P monodon* seed production sector.

Two major factors influence the likelihood of release of poor quality or infected seed:

- Effectiveness of testing/quality control by both producers and government/independent certifiers (likely to be related to scale of production);
- Awareness/knowledge of shrimp farmers and willingness to pay for higher quality/certified seed.

The large number of small scale hatcheries in itself presents challenges. Investment in quality control is limited, while regulation and traceability is both difficult and costly.

**Future prognosis**

The quality and biosecurity of hatcheries in the Mekong delta has increased significantly over the last decade, but post larvae continue to be sourced from many locations in Vietnam, and there remains great scope for further improvement. To some degree the private sector will now drive this, but there is also a major role for government.

**Exposure**

Small-scale farmers are particularly vulnerable to poor quality seed. They will be more inclined to buy cheap seed, they generally have less knowledge and
awareness of possible quality problems, and their location may make it difficult to access a high quality certified hatchery.

Many small and medium scale producers are using uncertified seed of doubtful provenance and quality.

However, despite this it is notable that in Ca Mau the percentage of lost crops was higher in intensive and extensive systems and lower in improved extensive (high productivity) (Table A2.7).

Table A2.7. Risk of crop loss in different production systems

<table>
<thead>
<tr>
<th>Type of production</th>
<th>Percentage of lost crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensive</td>
<td>15%</td>
</tr>
<tr>
<td>Improved extensive, high productivity (IEHP)</td>
<td>5%</td>
</tr>
<tr>
<td>Intensive</td>
<td>30%</td>
</tr>
</tbody>
</table>

*Estimates from Mr Chanh, Ca Mau DARD*

The reason given for this difference was that most IEHP is based on around 1ha of ponds and is therefore relatively easy to control and manage.

Our own visits to farmers suggested failure rate (total loss) of 1 crop in three typical (Thanh pers.com) in semi-intensive systems, and that failure is also common in extensive systems.

Overall it is suggested that in the wet season 80% of *L. vannamei* farmers and 20% of *P. monodon* farmers failed; while in the dry season 20% of *L. vannamei* and 30% of *P. monodon* farmers fail (Chanh pers. comm.). Changing weather patterns may also be a problem and increase susceptibility to disease or cause mortality directly. It was reported from Ca Mau DARD that shrimp stocked in 2009 in 2000 ha of farming area died 2 weeks after stocking. According to the local authorities, it was mainly due to changeable weather, especially continuous rains in the dry season and followed by blazing hot days.

**Consequence**

The consequences of stocking poor seed are very serious. Not only may farmers suffer poor growth, high FCR and high mortality; they may also harvest a product of low quality (flesh quality; yield). Poor growth and survival will encourage heavy use of chemicals to combat chronic bacterial and other diseases. This in turn may further depress growth and increase the likelihood of contamination and rejection, or offer of low price from processors/exporters.

**Mitigation**

Work is on-going to address this issue, but efforts need to be stepped up. Measures include:

- Higher investment in production and distribution of quality disease free broodstock;
- Effective monitoring and certification of hatcheries, comprehensive PCR testing;
- Centralised sales and checking of nursed post larvae (central reception facilities are being built in some provinces); and,
- Awareness raising of the importance of quality seed.
The scale and value of the industry justifies a major effort and investment in this area.

Overall risk summary assessment

<table>
<thead>
<tr>
<th>Poor quality or infected seed</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood</td>
<td>moderate</td>
<td>high</td>
<td>moderate</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>moderate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. Water quality

Character
All fish farming depends on maintaining water quality in line with species requirements. If water quality consistently or significantly falls outside these basic parameters the growth, health and survival of the aquatic species is put in jeopardy.

*Penaeus monodon* is relatively sensitive to water quality parameters, and pond water is usually maintained at a high level. *L. vannamei* is somewhat less sensitive and can be successfully grown at higher stocking densities.

Effects on the wider environment and other water resource users depend mainly on management of effluents and sediments. Since routine growout water quality is generally good, it is the release of sediments at the end of the production cycle which represent the main risk. *L. vannamei* is suited to more intensive production, so the threats to the environment are likely to be greater from this species/technology. Extensive systems pose no significant threat to water quality in the wider environment.

Throughout the delta there is increasing risk of poor water quality related to urbanisation and industrialisation. This represents a significant and increasing risk to fish farmers. However, farmers in Ca Mau said they had experienced no significant reduction in supply water quality in recent years.

There is an on-going and perhaps worsening situation with regard to rainfall. Shrimp do not respond well to sudden changes in salinity, and rainfall is reported to have become more erratic, with increased rainfall for example in dry season. Furthermore, erratic heavy rain may result in poor water quality (runoff from upstream). This represents a significant risk for producers.

Harmful blue green algae are also a problem dealt with through the use of pro-biotics and water exchange.

Release
Most intensive shrimp farmers have settling ponds to manage end of crop sediments. Increasingly this is also the case for semi-intensive producers. Farmers in Ca Mau suggested that only one or two percent do not now use settling ponds. These typically comprise 15-25% of the farm area.

Release of organic matter and toxic chemicals from industrial and urban areas is widespread.

Future prognosis
Water quality and sediment management is a major issue for more intensive producers and there is now much experience in sediment management. There are relatively simple technologies which significantly reduce risks, and standard codes of practice which address these issues. There are some pilot production activities to process pond sediment to produce fertilizers for agriculture. In the longer term it is likely that these issues will be effectively addressed. On the other hand water quality problems arising from urban/industrial activities may increase as economic development continues.
Exposure
Many household scale producers will have more limited options in terms of water supply and exchange, and may lack the means to treat influent water, or effectively remove sediments between cycles.

However, many smaller farms may be more isolated from major canal systems, and vulnerability to upstream pollution may be less. The overall extent of water quality problems in the sub-sector is unknown.

Consequence
Poor water quality may lead to loss of condition, stress, disease, low survival, and poor food conversion.

Mitigation
The use of supply water reservoirs and effluent settling ponds is widely recommended in best practice and is the key to risk reduction. More ambitious approaches to planning fish farm water supply and treatment systems may be desirable, but need to be flexible to allow for changes in species cultivated – and in some cases/periods shifts between aquaculture and agriculture to allow adaptation to shifting market conditions.

150 area committees, each comprising 10-20 households have now been established in 3 districts, and management agreed for whole group. These may also be associated with “forum support” – effectively group insurance or shared risk to support a farmer who gets disease. This may be contributed to by DARD “prevention disease fund”. In Ca Mau a more ambitious irrigation scheme has been developed for 80 families.

Individual farmers manage water more carefully – limited exchange in early grow-out, with exchange of 30-50% of water volume between 2 and 7 times per crop. This means they should be able to avoid e.g. plankton blooms, changes in salinity etc.

Overall risk summary assessment

<table>
<thead>
<tr>
<th>Water quality</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>moderate</td>
<td>moderate</td>
<td>moderate</td>
</tr>
</tbody>
</table>
10. **Excessive use of antibiotics and chemicals**

**General characteristics**

Shrimp are vulnerable to a wide range of bacterial and viral diseases. *Vibrio* is a major problem in the wet season and at other times when shrimp are stressed. *Whitespot* remains a major chronic problem throughout the Mekong delta. Severity varies from year to year – 2006 was especially bad. Antibiotics and other chemicals are used routinely in hatcheries, and commonly in grow out. It is possible however that use is in decline. Shrimp is a fairly discriminating market, and there is widespread awareness of the problems associated with banned chemical use.

A range of chemicals and probiotics is used widely to combat the threat and reduce severity of outbreaks. Table A2.8 gives an idea of some of the chemicals used – and in particular the significant use of probiotics.

**Table A2.8: Some chemicals used in shrimp farming**

<table>
<thead>
<tr>
<th>Substances used in shrimp farming</th>
<th>Batch</th>
<th>VND/batch – whole sale price</th>
<th>VND/batch – retail price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santinizer/Disinfectant</td>
<td>Blesson</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Broot 5x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mizuphor 0.5 L</td>
<td>180,000</td>
<td>200,000</td>
</tr>
<tr>
<td></td>
<td>Sanmolt-F Wolmid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed supplement/Binder</td>
<td>Trubind 1 L</td>
<td>90,000</td>
<td>95,000</td>
</tr>
<tr>
<td></td>
<td>Wokcee</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EnvoMin</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OsMin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probiotics (Feed/soil/water)</td>
<td>Environ-AC 50 kg</td>
<td>280,000</td>
<td>300,000</td>
</tr>
<tr>
<td></td>
<td>Aqualact 500 g</td>
<td>80,000</td>
<td>90,000</td>
</tr>
<tr>
<td></td>
<td>Prolid-Hq</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amnophix</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Some indication of the extent of chemical use may be gleaned from production costs presented in sections 1 and 2.

**Release**

There is significant use of antibiotics in hatcheries and nurseries during the early stages of production. Release of legal antibiotics is therefore significant and widespread. Illegal antibiotics are also used, but data is necessarily poor. However, recent government raids on chemical suppliers premises revealed that 17% of establishments were stocking illegal chemicals. False labelling is common, and illegal antibiotics may be being sold under a range of other names.

Overall trends in terms of use are unclear, although two major factors are driving increased use:

- high incidence of disease
- agents receiving commission on chemicals sales.
Set against these are several factors constraining use:

- Risks of lost reputation and market arising from contaminated product
- Government regulation and enforcement.

**Future prognosis**

The use of banned antibiotics is likely to decline as the costs of contamination are increasingly realised in the production chain. However this will take time – partly because of the lack of traceability, and partly because of the benefits of using some illegal substances in terms of shrimp growth/survival response.

**Exposure**

Smaller semi-intensive farmers with poor biosecurity, who stock cheaper seed, are more subject to disease, and are therefore more likely to use chemicals. Furthermore, their lack of knowledge makes them more vulnerable to agents mis-selling.

A huge swathe of aquatic organisms and human pathogens in the waters of the Mekong delta will be exposed to a wide range of concentrations of legal and illegal antibiotics. Human pathogens in consumers may also be exposed throughout the world.

**Consequence**

Excessive use of antibiotics, at a wide range of doses and concentrations across wide geographic areas can have serious consequences in terms of:

- shrimp pathogen resistance development;
- local resistance development in human pathogens through direct exposure;
- more widespread human pathogen resistance development as a result of exposure through contaminated product; and,
- rejection of product in increasingly discriminating markets and poor reputation of Vietnamese food export products.

**Mitigation**

A suite of coordinated measures is required to address this issue:

- High quality disease free seed;
- Promotion of best practice to maximise shrimp health through appropriate feeding, stocking density and environmental conditions in ponds;
- More widespread adoption of biosecurity measures – in terms of pond soil treatment between crops, water supply disinfection, etc;
- Vigorous enforcement of law in respect of illegal chemicals primarily through traders and agents; and,
- Improved traceability to ensure that misuse can be traced.

**Overall risk summary assessment**

<table>
<thead>
<tr>
<th>Use of antibiotics</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>high</td>
<td>high</td>
<td>low</td>
</tr>
</tbody>
</table>
11. Disease in pond sediment

Character
The organic matter which accumulates in shrimp ponds is likely to harbour some diseases, and especially parasites. Complete emptying of ponds, drying and disinfecting can get rid of most disease organisms.

Release
No data is available on the proportion of farms which effectively dry, remove sediments and disinfect ponds, or on their geographic distribution. However, limited or ineffective pond sediment management is likely to be widespread, especially amongst smaller producers, and those with less well designed ponds.

Exposure
All farmers who do not manage sediments to minimize disease are at risk, as are any farmers close to such farmers who do not disinfect intake water. Total exposure is unknown, but probably a high proportion of shrimp farmers.

Consequence
There is a widespread and well documented tendency for growth and productivity in shrimp ponds to decline through time, and this may well be related to accumulation of toxins and disease organisms in pond sediments. Chronic disease in shrimp remains a major problem, and may be in part attributable to poor sediment treatment and management.

Mitigation
- Single crop with long fallow
- Sediment drying and sterilization
- Sediment removal.

There is significant opportunity for progress here.

Overall risk summary assessment

<table>
<thead>
<tr>
<th>Poor sediment management</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>high (household scale)</td>
<td>high (household scale)</td>
<td>moderate</td>
</tr>
</tbody>
</table>

Value of further analysis
Better pond sediment management is basic good husbandry. Further survey or analysis would be costly and add little to the assessment.
12. Disease in supply water

Character
The concentration of shrimp farming means that release and exchange of pathogens in the aquatic environment is likely. A relatively small proportion of farms treat their influent or effluent water, including chlorination (although there will be a government requirement to use effluent sedimentation ponds in future).

Although bacteria and viruses may be spread through water exchange, in general bacteria can be suppressed through a combination of probiotics and antibiotics. Viral infections cannot be so controlled.

Release
Release of water carrying pathogens is normal throughout the growing areas. The actual inoculum, or concentration of pathogens in the water, and their dilution in the wider aquatic systems is unknown.

Exposure
Exposure in this case is very similar to release. Almost every farmer is releasing, and most farmers are exposed through untreated water intake. Larger more intensive farms will tend to have intake reservoirs and water sterilization, but smaller semi intensive and extensive producers will not21.

Consequence
Disease spread through contaminated water is probably the biggest contributor to disease. Disease is a massive constraint on sustained development of the industry and a major cause of debt and socio-economic problems.

Mitigation
The use of supply water reservoirs and water pre-treatment is relatively common for intensive production, but remains rare for semi-intensive and non-existent for extensive producers. It should be standard in all semi-intensive and intensive systems.

More ambitious approaches to planning fish farm water supply and treatment systems may be desirable, but need to be flexible to allow for changes in species cultivated – and in some cases/periods shifts between aquaculture and agriculture to allow adaptation to shifting market conditions.

In reality … there are 500,000ha of production (200,000 ha in Ca Mau alone) and farmers typically have diverse livelihoods. There will be major constraints to development of farm water supply infrastructure across large areas. Less ambitious farm level – or farm group level - measures will therefore be the main form of mitigation. There are interesting initiatives of this kind being undertaken (such as RIA2 facilitated cluster of 15 farm households),

Overall assessment

<table>
<thead>
<tr>
<th>Infected water supply</th>
<th>Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>high</td>
</tr>
</tbody>
</table>

21 Data on numbers of farmers with water pre-treatment and post treatment (3-5% - Mr Tao) survey
<table>
<thead>
<tr>
<th>Severity</th>
<th>high</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertainty</td>
<td>moderate</td>
</tr>
</tbody>
</table>

**Value of further information**

Further information will be costly to collect and would probably add little to the overall assessment. Action is required.
References (Annex 2)


Ravichandran, P. Litopenaeus monodon in India. Challenges and opportunities for small scale farmers, and the role of BMP programs. Central Institute for Brackishwater Aquaculture, Chennai.

