Value chains for sustainable Mekong fisheries: the case of *Pangasius hypopthalmus* and *Henicorhynchus/Labiobarbus* spp. in Vietnam and Cambodia

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SUMMARY

This report elaborates the function and effectiveness of domestic and regional fisheries product value-chains and identifies key policy interventions at local, national and regional scales to further improve:

1. Small-scale rural livelihoods;

2. The competitive advantages of fisheries products and their management

3. The responsible management of resources, which is important for the sustainability of the fishery and aquaculture resources.

4. Understanding of value chains of *Pangasius hypothalamus*, a high-value globally traded aquaculture species, and *Henicorhynchus* spp./*Labiobarbus* spp. (grouped as *Ca Linh* in Vietnamese and *Trey Riel* in Khmer), two low-value regionally traded capture species, in the Mekong Delta of Vietnam and Cambodia.

An interdisciplinary approach was taken to investigating value-chains and their contribution to rural livelihoods and sustainable fisheries development. First, A 'value-chain' theory from Kaplinsky & Morris (2000) was applied using mapping elements from the GTZ & M4P project 'Better Market for the Poor' were applied. Second, a livelihood analysis was carried out in parallel, focusing on various stakeholders who interact directly and indirectly with these chains. Third, a policy analysis was conducted to determine the effectiveness of government policy and the potential of value chain governance arrangements for Pangasius and *Henicorhynchus* spp./*Labiobarbus* spp. Research activities used included a survey of key chain actors, individual interviews with key informants during village visits and project workshops.

The results of the value chain analysis show the Pangasius value chain is oriented to export production with more than 90% of fish being sold internationally. Processing companies are the most powerful actors in the Pangasius chain, providing the biggest input of labour and capturing nearly three quarters of the total net value added in the chain. Support is provided by the government through VASEP, NAFIQAVED and AFA. The role of AFA is currently ambiguous and further investment is needed to increase its capacity to support small-scale farmers.

The *Henicorhynchus* and *Labiobarbus* spp. chain is smaller and more diffuse in both Cambodia and Vietnam. Retailers capture the highest proportion of value in the chain, largely because of the poor transparency around transactions with fishers and the lack of preservation technologies available. There is nearly a complete absence of support to fishers and traders in this chain from government. Instead the chain is characterized by 'informal' support networks including quasi-credit arrangements which are important in structuring the chain and limiting fisher's ability to capture a higher share of the total value in the chain. These findings extend our understanding of middlemen-as-rent-seekers to actors who also provide an important source of short-term finance to fishers who have little or no collateral to access formal credit.

Henicorhynchus/Labiobarbus spp. is widely considered a low value fish. However the results of the survey found that it has a higher price than Pangasius in domestic markets. The higher value indicates a wider trend within the Mekong Delta to *Henicorhynchus/Labiobarbus* spp. becoming a more luxury consumer item, available more readily as a speciality dish in restaurants. The growing export market for the fish is also indicative of the potential pressure the fishery may come

under in the years to come. Conversely, the rise in price means there is more potential for fishers to gain higher margins on the fish they sell. However, for this to happen they will have to improve their bargaining power *vis-à-vis* collectors and traders.

The results of the livelihoods analysis show that overall grow-out, hatchery and nursing farmers Pangasius farmers earn on average US$4751.61 per year - 14 times higher that the annual income of fishers. However, it is difficult to determine the capacity of farmers to secure these income levels on a continual basis because of the exposure of farmers to economic risk from fluctuations in export markets. The results indicate that Pangasius farmers are relatively less diversified than fishers, opting to specialise and maximise their income to overcome livelihood vulnerability. Pangasius farmers appear to deal with the higher cost of inputs and variable market prices for their fish by 'vertically' diversifying to nursing and hatchery farming. These vertical shifts are preferable to 'horizontal' diversification away from Pangasius due to their high investment in infrastructure. Vertical diversification appears to be a relatively successful strategy. Nevertheless, the movement of grow-out farmers in and out of production creates inconsistent supply to processing companies thereby affecting the economic stability of the industry.

Fishers are less exposed to these market fluctuations because traders absorb more risk in transporting the fish to market. The lower bargaining power may in fact insulate fishers from economic vulnerability. This means that they are also unable to diversify away from fishing. Fishers also appear to be far more vulnerable to environmental change given their dependency on water quality for fishery production. They are becoming more vulnerable because they are dependent on fish stocks which appear to be in decline or fully exploited. Unlike Pangasius farmers these fishers do not have as much collateral for loans, or capital to invest in other forms of production, including aquaculture. Those that attempt to shift to aquaculture are more often than not unsuccessful.

The results of the policy analysis also indicate that government intervention has not been effective in mitigating the impacts of environmental change, promoting alternative production technologies or reducing the exposure of fishers and farmers to market fluctuations. The success of the Pangasius industry has meant that policy, regulation, extension and enforcement have not been able to keep up with the innovation of farmers. The government has adopted a *laizze-faire* approach to the development of the Pangasius industry due to the lack of evidence that there are serious environmental concerns related to production, and the support this growth has given to economic reform at the national level. Fishers also regard policies as largely ineffective due to the lack of capacity of the government to monitor fishing activities and cross-border trade.

The results of the study indicate a series of challenges for extending value-chain governance to environmental and social objectives. Low compliance with international standards would mean more fish would be directed into unregulated markets, namely domestic markets. A shift to domestic markets with similar prices to export markets, means that grow out farmers may be able to cope with shifting between channels. However, the lower demand for fish in domestic markets might mean farmers are forced to diversify away from Pangasius. Farmers also note the need for improved enforcement of contracts, both in terms of providing protection for farmers who need assurance that investments made in complying with standards will be make a return. Value-chain approaches do not appear to hold much potential for governing the management of *Henicorhynchus*/*Labiobarbus* spp.

in domestic markets. However, the shift in consumer perception, the increasing export of *Henicorhynchus*/*Labiobarbus* spp to foreign markets and the growing urban consumption may lead to calls for conservation of the resource.

The study concludes that for new value chain governance arrangements to successfully support farmers' livelihoods as well as promote responsible use of resource management of fisheries resources the following should be undertaken:

- Certification schemes should focus on ensuring price premiums are paid to Pangasius farmers in order to promote further investment in compliance.
- The promotion of collective forms of control to reduce variable returns for Pangasius farmers which restrict their willingness to invest in key infrastructure.
- The government should increased regulation of contracts between chain actors for the provision of inputs, the sale of produce and compliance to private food quality and safety standards, including those related to social and environmental processes of production.
- Research should be undertaken to investigate the impact of increased domestic trade of fish and the establishment of private sustainability criteria designed for *Henicorhynchus*/*Labiobarbus* spp.
- The Vietnamese government should foster improved cooperation to share experiences in improved production practices with the emerging industry in Cambodia.
- Private and state chain actors should improve the access of farmers to sustainable production technologies and promote policies and standards which foster farmer innovation in sustainable production.

1. INTRODUCTION

The fisheries sector in Cambodia and Vietnam is undergoing a period of rapid internationalisation which has led to national economic growth and rural development (Sinh, 2005b; So and Nao, 1999). However, the expansion has also revealed a number of constraints limiting the efficiency of fishers, fish farmers, processors and traders alike. Previous research has identified three main areas of concern: 1) Fish farmers lack capacity to apply available technologies, respond to food quality standards and gain access to up-to-date market information; 2) Processing companies lack capital, remain at a small-scale and face unstable supply; 3) All market actors face a lack of timely market information, low product quality and unstable prices (Sinh, 2005b; Loc, 2006b). This report elaborates on these concerns by investigating the structure and function of the value chains of *Pangasius hypothalamus*, a high-value globally traded aquaculture species, and *Henicorhynchus* spp. and *Labiobarbus* spp, two low value regionally traded capture species in the Mekong Delta of Vietnam and Cambodia.

The importance of fisheries to livelihoods and economic growth in both countries is closely linked both in terms of fish trade. The sustainable development of the fisheries sector therefore depends on a shared understanding of how fishery resources are exploited for both domestic and regional value chains (Loc *et al.*, 2007). Faced with the poor enforcement of state legislation the Cambodian and Vietnamese governments have turned to value-chain governance mechanisms to improve efficiency and promote higher environmental performance and social equity. Given the dependency of the rural population on Mekong fisheries in both Cambodia and Vietnam, both capture (Ahmed *et al.*, 1998) and culture (Sinh, 2007), it is believed improved value-chain governance will contribute to not only efficient transfer of fish to market, but also higher margins for fishers and farmers and improved leverage for steering the industry towards sustainable production. This report offers new insights into the structure and function of local, regional and global value-chains extending from the Mekong Delta and the ability of fishers and farmers to maintain their livelihoods dependent on access to these value chains.

Cultured *P. hypopthalmus* has emerged as the most globally traded fish from the Mekong Delta with an estimated 650000 tonnes of fillets traded to international markets including the US, EU, Russia and Australia at a value of US$1.45 billion (Dung, 2008). *Henicorhynchus* spp. and *Labiobarbus* spp., grouped as *Ca Linh* in Vietnam and *Trey Riel* in Cambodia, provide a staple supply of essential protein to fishers in all of the riparian countries, as well as being traded extensively in local markets as fresh, dried or fermented products. There is also evidence that the fish are traded from Cambodia to Vietnam as fish meal for *Pangasius* spp. and *Channa striata* production (Seng, 2006). *Pangasius hypothalamus* therefore represents a high value chain that extends to international markets and *Henicorhynchus* spp./*Labiobarbus* spp. represent a low value domestic and regional value chain. Unraveling the structure and function of these international and domestic chainsand their contribution to fisher and farmer livelihoods, is essential for the development of new and effective governance arrangements.

Using *P. hypothalamus* and *Henicorhynchus* spp./*Labiobarbus* spp. as case studies, this report analyses the structure and function of domestic and international value chains in the Mekong Delta of Vietnam and Cambodia and provides recommendations for the improved environmental and social governance of fisheries production. The analysis is driven by four main questions: 1. What are the key functions of chain actors in different market channels? Where are they

located? What proportion of total value market do they receive? 2. What contribution does each value chain make to the livelihoods of fishers and farmers in both countries? 3. What policies and regulations exist in both countries to support improved fisheries value-chain governance? 4. What opportunities are there for new value chain governance arrangements to supporting farmers' livelihoods and responsible resource management of fisheries resources in the Mekong Delta? In addition, the report also discusses the development of new analytical tools and methodologies that provide concrete outcomes for improved value-chain and fisheries management.

The report is divided into six substantive sections. Section 2 provides a summary of an extensive literature review of the production, trade, governance and contribution to rural livelihoods Pangasius and *Henicorhynchus* spp./*Labiobarbus* spp. Section 3 outlines the methodology used to analyse value chains, livelihoods and policy. Sections 4 to 6 provide a summary of the key empirical findings. The final two sections discuss the contribution of the results to wider debates surrounding value chain governance for improved livelihoods and environmental management and concludes with recommendations for policy and further research.

2. LITERATURE REVIEW

2.1 Volume and value of production

2.1.1. Pangasius hypopthalmus

In Vietnam *P. hypopthalmus* is grown in the predominantly freshwater central and Northern provinces of An Giang, Dong Thap, Can Tho and Vinh Long in the Mekong Delta. In 2005 the economic growth rate for Pangasius aquaculture in the Delta was 24.9% and production reached some 850,000 tonnes in 2006, contributing to the overall growth of 19.5% for Vietnam as a whole (see Figure 1). This gave the Mekong Delta the highest overall economic growth rate in the country at 14.4%, 5.4% higher than national figure for 2005 (Loc *et al.*, 2007). Export of *P. hypopthalmus* fillets doubled in 2006 to reach 286 thousand tonnes representing a 66.5% increase in value to US$1.15 billion (VASEP, 2006 cited in World Bank, 2006). In 2008 it is estimated 650000 tonnes of fillets were exported at a value of US$1450 million (Dung, 2008). According to MOFI (2005), *P. hypopthalmus* production will reach up to about 1 million tonnes by 2010 and 1.5 million tonnes by 2020.

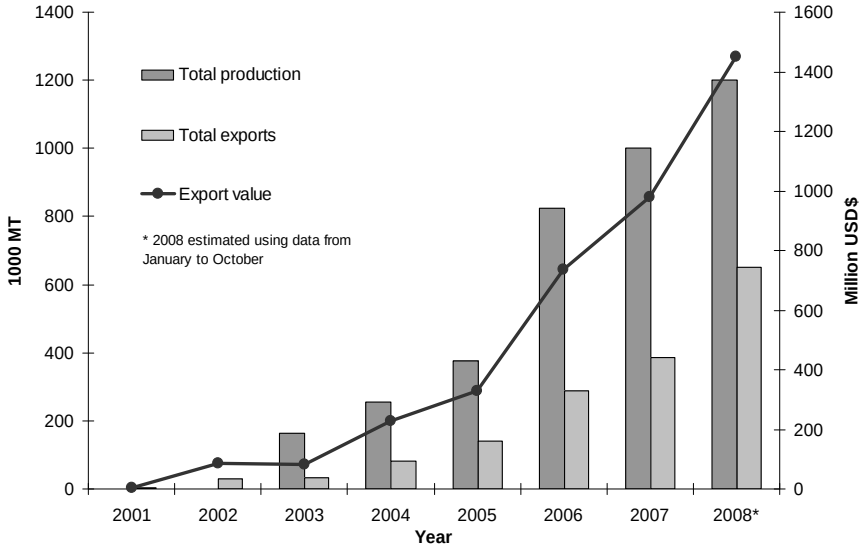
The most remarkable change in the Pangasius sector has been the shift to European markets after the US anti-dumping case in 2002. Exports to Europe were valued at US$ 374 million or 26.51% of the total export value in 2006, having increased 89.4% from 2005. The export value to EU in particular accounted for 20.86% of all exports or US$ 294.3 million, which was slightly lower than Japan (24.83%) and even higher than the US (18.43%) (MARD, 2008). This shift increased the EU share to 17% by 2005, representing a significant change from the traditional seafood export markets of Japan and the US each with a market share of 25%.

In Cambodia *P. hypopthalmus* production is predominantly from capture fisheries. Survey data indicates the high variability of catches using a range of fishing gear. The Mekong River Commission (MRC) estimates that Dai Fisheries on the Tonle Sap River account for 223 tonnes, or 1.6% of the total catch (Van Zalinge *et al.*, 2002). In addition, data from fishing lots show catches of 1,367 tonnes per year from floating and seine nets, with *P. hypopthalmus* contributing up to 6.6% of total

catch. However, this capture fishery production is being supplemented with the growing aquaculture industry. Although relatively small compared to Vietnam the production of *P. hypopthalmus* in Cambodia has increased 2.6 times from an estimated 3000 tonnes in 2004 to 8000 tonnes in 2006 (Figure 2).

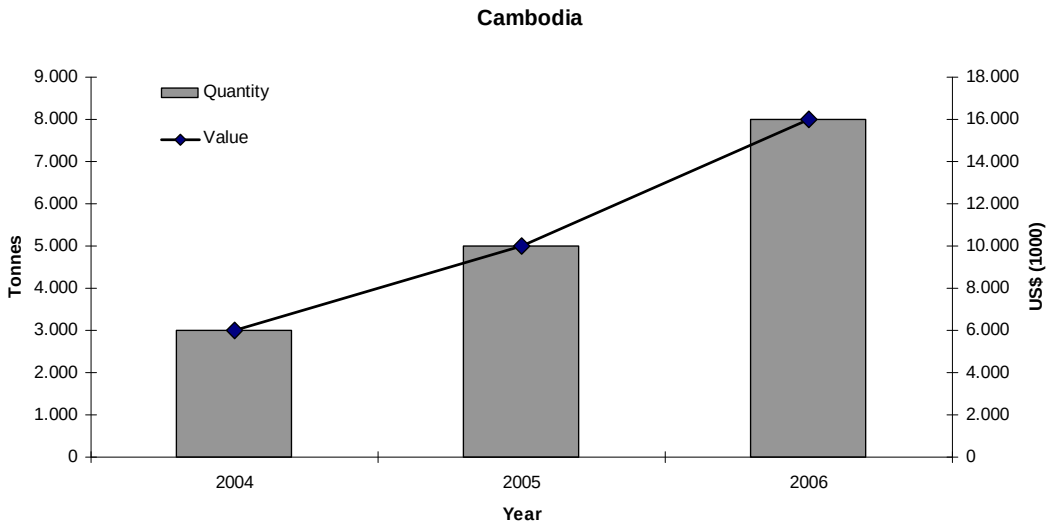
The Pangasius industry has achieved unparalleled growth in the 2000s. It is not clear if this growth can be maintained, nor is it clear what the social and environmental implications of such growth is for the Mekong Delta of both Vietnam and Cambodia. The rate of change in the industry is so high and our understanding of changes so poor that key questions remain over the structure and function of the value chain and the importance of this trade not only to national economic growth but also to local livelihoods.

Figure 1. Volume and value of Pangasius production and exports 2001-2006



Source: Hau (2008) and Dung (2008)

Figure 2. Growth of cultured Pangasius catfish (nei) in Cambodia



Source: FAO (2008)

2.1.2. *Henicorhynchus and Labiobarbus* spp.

Henicorhynchus spp. is a highly migratory group of species found throughout the Mekong River Basin. Two major fisheries for *Henicorhynchus* spp. are the Dai fisheries in Tonle Sap and the Plain of Reeds in Cambodia and the *Tone* fisheries around the Khone Falls in Southern Laos, where the fish makes up to 37 - 60% of the catch respectively (Baird et al., 2003; Baran et al., 2005; Lieng et al., 1995). As water recedes from October to March the fish migrate from Tonle Sap up and over the Khone Falls. There is evidence that high catches in the Dai fishery leads to lower catches in the Tone fishery highlighting a direct relationship between the two fisheries (Baird *et al.*, 2003) although the strength of this relationship is questioned (Baran *et al.*, 2005).

In Vietnam there is no detailed information on the marketing of *Henicorhynchus* and *Labiobarbus* spp. Evidence from Sinh (2005a) suggests that in general, households who catch more than 300 kg/year tend to sell more fish than those who captured less than 200 kg/year. By 2006, 62.7% of the total fish catch was sold while 32.7% was consumed by the households (fresh, dried and fermented or given to the ralatives) with the remaining 4.6% used as feed for snakehead (*Channa* spp.) and *P. hypopthalmus* aquaculture (Sinh *et al.*, 2007).

Information on *Henicorhynchus/Labiobarbus* spp. in Cambodia is also scarce. Based on a survey in 2003, Seng (2006) estimates that freshwater fish exports decreased by 19.4% while marine fisheries increased by 38.7%. Overall, the export market for fresh fish grew by 3% in 2003 from 52,500 to 54,160 tonnes - 17% of which is exported and processed. Seng also estimates that the trade of fish products to Vietnam through Peam Kenh decreased by 42% from 2002 to 2003 as a result of lower production in fishing lots in the Plain of Reeds due to environmental degradation.

The total expense of this trade to Vietnam was estimated by Seng as US$338.20 per tonne, including both operational costs and formal fees. The fish was sold for US$371.90 leaving a profit of US$33.70 per tonne. Informal costs accounted for 24.5% or US$19.8, leaving a profit of US$13.70 per tonne, or 3.8% return investment (Seng, 2006). The value of trade to Thailand through Poi Pet was calculated in the same study at US$38 per tonne, representing a 2.8% return on investment in 2002, and US$66 per tonne or 6.4% return on investment in 2003.

Overall very little is known about the structure or function of the *Henicorhynchus/Labiobarbus* spp. value chain. There is some indication that this value chain is undergoing enormous change as both fish become less abundant. Indeed, there is already some indication that the price of both species is increasing in large cities such as Ho Chi Minh City as a result of the decline, as well as increased demand in export markets. What implications this increased demand and falling supply holds for those households dependent on these low value fish for their livelihoods is unclear.

2.2 Livelihoods

2.2.1 Household catch and income

In Vietnam, total fish catch is divided into three groups of species by market value: 1) Low value fish, including *Henicorhynchus/Labiobarbus* spp. - contributing between 47%; 2) Medium price ‘white fish’ or migratory species such as Pangasius - contributing between 20 and 25%; and 3) Black or sedentary fish species - contributing between 25 and 29% of total catch (Sinh et al., 2000; Nha et al., 2003).

Traditionally, *Henicorhynchus/Labiobarbus* spp. has been a common source of fish for local community in flooded areas in the Mekong Delta, especially during flooding season.

In 2000 the average household catch was estimated at 1,282.2 kg/year with variations in the dry and wet seasons (Sinh *et al.*, 2000). By 2006 there was an apparent decline in the average volume of household catch to 719.9 kg/year, caught with a total of 18 types of fishing gear in the medium and shallow flooded areas (Sinh *et al.*, 2007). Gill nets were the most common, used by about 46.5% of fishers. Fishing activities were most commonly conducted in rice-fields by 74% of the fishers surveyed contributing 69% of the catch. This is followed by 37% in the rivers and public canals providing 27% of the total catch.17.4% of fishers used garden ditches, non-aquaculture ponds or small canals making up 3.4% of the total catch. Anecdotal evidence suggests that the decline in garden fisheries may be due to the increased prevalence of electricity fishing, the higher proportion of people with gardens practicing aquaculture or the degradation of wild stocks due to the indiscriminate use of chemicals for treating cash-crops.

In Cambodia there is a high dependency of rural people on inland capture fisheries for their livelihoods. Ahmed et al (1998) reported that about 39% of households in the country are involved in fishing. The fisheries of Tonle Sap alone provide employment to some 1.2 million Cambodian fishers, with an estimated 92% of households in the eight provinces around the Great Lake accessing the fishery through common property resources, such as inundated forest, rivers, lakes, flooded rice fields, irrigation canals and dikes. Based on a survey by Rab (2005), the average annual catch per household is higher in fishing villages compared to non-fishing villages around the Lake. The highest average annual household catch was in Siem Reap province at 15.4 kg, followed by Kampong Chhnang province with 8.1 kg. Overall, however, it appears provinces in the Great Lake and Tonle Sap River area where there is a high dependency on migratory fish including *P. hypopthalmus*, *Henicorhynchus/Labiobarbus* spp. than in villages in the Mekong-Bassac area of the country. Overall 75% of the total fish catch was sold and only 6% was used for the household consumption, 8% was processed and 11% used for fish feed.

Average catches per household were higher in the open season at 3,501kg than in the closed season with an average of 508kg (Rab *et al.*, 2005). Furthermore, a greater amount was consequently consumed, processed, used for fish feed and sold fresh during the open season than the closed. The average household catch was highest in fishing villages, followed by fishing cum farming and farming villages, for the open and closed seasons. In particular, the high catch amounts for fishing and fishing cum farming households in the open season reflect the lot fisheries, which are only operational during the open season. Utilization of catch also varied between different village types. Farming households consumed from 29 to 39% of their catch at home; a greater portion of the catch compared to fishing households who consumed between 11 and 25% in both the closed and open seasons. This probably reflects the fact that both fishing and farming households reserve a similar amount of the catch for household consumption and sell and/or process the remainders.

2.2.2 Aquaculture performance

No information is available in the performance of Pangasius farmers in Cambodia. In Vietnam, Phuong *et al.* (2007) outlined the performance of Pangasius farmers. The results showed that farmers are dependent on range of inputs such as feed

and seed which makes them particularly vulnerable to changes in market prices. Overall, farmers have total costs of US$107,537 per hectare, with the average size of pond of 1.03 ha. Feed is the largest expense, making up between 74% of variable costs for those farmers using home-made feed and 93% on farms using manufactured feed. Homemade feeds are approximately half the unit cost of manufactured costs which are estimated at US$0.34 per kilogram. Fingerlings are the second expense, costing 11.74% of costs in systems using home-made feed and 6.29% of cots in systems using manufactured feeds. Finally, labour makes the third costs but makes up a significantly lower proportion of costs of between 0.20 and 0.35% of total variable costs.

Gross return for Pangasius farms was on average US$126,134 hectare/crop. However, like variable costs there are significant differences between those farmers that use home-made feed with an average gross return of US$88,173 and those who use manufactured feed receiving US$158,531 hectare/crop. Average net return for all farmers is US$18,598 per hectare/year, or US$4,132 per capita/yr. Farmers using home made feed received a considerably higher net return of US$21,515 compared to only US$14,193 for those farmers using manufactured feed. These results highlight the incentive farmers have to continue to use low-value fish from either marine or freshwater sources in their homemade fish meal.

Despite the considerable return of investment that aquaculture farmers make they remain extremely vulnerable to market fluctuation. Phuong *et al.* estimate the unit break-even price at US$0.53 per kg. Given that price variation is as much as US$0.10 per kg and the cost of inputs rose between 10-20% in 2008 alone (Nam Dinh/VfP and Igel, 2008) farmers are faced with highly variable margins. Other vulnerabilities arise from the control of disease which is more prevalent among farmers using home-made feeds (because they have lower capital and less knowledge of farming) and poor market access. Other vulnerabilities are from the lack of quality seed, over stocking of fry which affects between 21 and 38% of all farmers. In response many farmers base their decision on whether to invest in Pangasius farming or shift to alternative fish production on a crop-by-crop basis (Khiem *et al.*, 2008).

2.2.3 Fish consumption

It is likely changes to fish consumption in Vietnam and Cambodia are due to a combination of factors including an overall decline in production, a greater proportion sold to market, reduced access to fishing grounds and whether there will be a change in nutrition. The threat of changing consumption patterns are perceived in both countries as contributing to poorer health particularly in women and children (Sophearith, 2005). A decline in the smaller fish species such as *Henicorhynchus* and *Labiobarbus* spp., which are usually consumed whole in fermented fish sauce, may possibly contribute to malnutrition as it is these fish that provide essential minerals and vitamins important for women and children (Mogensen, 2001).

According to Young and Son (2002), 72.4% of the Pangasius in Vietnam was processed and exported, 8.3% was sold to restaurants and the remaining 19.3% was sold in retail markets. In 2006 there was a slight shift in the proportion sold in each market channel. Exports had risen to 86.2%, restaurants had fallen to 6.2% and the retail trade had fallen to 7.6% (Son, 2007). VASEP (2007) indicates that total exports of Pangasius now account for more than 90% of the total production. This indicates a clear shift in Pangasius production to export markets, supported by recent shift of government policy to an export orientation. However, there is a

division between Pangasius as an export product and aquatic products in general in the Mekong Delta. Overall, it is estimated that 75% of aquatic products, including *Henicorhynchus/Labiobarbus* spp. are still traded and consumed domestically.

Based on data from 1998 the consumption of fishing households around Tonle Sap was 49.7 kg/yr and 39.9 kg in non-fishing households. For those not fishing an increase in market price therefore represents a higher burden on income (Ahmed *et al.*, 1998). Exports only account for 7.12% of total freshwater production, therefore it is unlikely that this represents a major impact on domestic consumption (Seng, 2006). Rises in domestic prices will have a more severe impact on the availability of fish for poorer households, especially in urban areas. What is driving the rise in price is not known, although it is speculated as being caused by a combination of increased scarcity, growing urban populations and the higher value of fish in export markets.

Finally, there is a lack of knowledge about what contribution consumers play in driving demand. There is also little known about what the shifts in demand towards quality and safe fish products, a factor that may well increase with higher rates of urbanization in both countries. Analysing market demand to livelihoods of urban consumers and rural households may provide insights into future consumption patterns.

2.3 State Policy

2.3.1 Vietnam

Before the end of 1980s Vietnam's economy was managed by a top-down policy making process aimed at multi-sectoral integration. Most of the policies and regulations relating to fishery sector were focused on fishing, conservation of aquatic resources and subsistence aquaculture. Economic renovation or *"Doi moi"* policies implemented from the end of 1980s and the beginning of the 1990s, have been important to the development of all sectors of Vietnam's economy including fisheries and aquaculture.

Despite this shift to non-state governance the Vietnamese government maintains an extensive legal and regulatory framework for the development of the fishery sector, governed primarily by the Ministry of Agriculture and Rural Development and the Prime Minister's Office. Provincial level authorities have a degree of autonomy to develop detailed regulation and legislation to fit the specific conditions. Policies and regulations are issued by both the central and provincial governments creating a legal and regulatory framework for all sub-sectors of fishery sectors: capture and protection of natural aquatic resources, aquaculture, processing, export, and the development of support services including credit, feed and chemicals. However, the framework is in principle geared to reorienting the nation's economy to higher performance in international markets.

The shift away from state to market-based governance in both Vietnam and Cambodia is most evident through private sector certification. In Vietnam the state authority NAVIQAVED, situated in the Ministry of Agriculture and Rural Development (MARD), has taken the lead in developing a 'Pangasius' brand in 2006 to better capture the market niche that the fish holds in world markets. As part of this brand the Swiss multinational Société Générale de Surveillance (SGS), a third party auditor specializing in food quality and safety systems such as Safe

Quality Food (SQF) standards based on the Hazard Analysis and Critical Control Point (HACCP) system, has provided support to improve the quality, safety and traceability of the product in the supply chain.

Capture fisheries policy and regulation on the exploitation and protection of natural aquatic resources have been in place since colonial times. However, the program for protection and development of natural aquatic resources in the inland water bodies was only approved in 2007. At present, there are no regulations on the fishing ground and fishing season for inland fisheries and destructive fishing gears, such as electricity and micro-mesh sizes are still commonly used. Similarly, standards for private sector investment and management in the fishery sector were approved in 1999 and standards for broodstock and fingerlings of *P. hypopthalmus* catfish in 2001, and grow-out farm standards in 2002. These lists were again updated in 2004 outlining prohibited and permitted chemicals and drugs for aquaculture.

2.3.2 Cambodia

In Cambodia the government plays a significant role in the development and enforcement of fisheries management regulations. Most notably, the fishery sector has undergone a series of reforms to the system of concessions that have been in place since the turn of the 19th century (Ratner, 2006). In 2002 the government passed a decree disbanding a number of large and medium fishing lots and allowing rural communities access to various fishing. The quick and unplanned nature of this transition led to what was widely perceived as a race for fish, with community fisheries around Tonle Sap eroded through the concession regime (Resurreccion, 2006). It is yet to be seen whether the Department of Fisheries maintains formal authority over the fishery, including lot owners and community fisheries groups, the long and extensive history of power-based fishing access has meant that the governance of the resource is maintained as much through informal rights, rules and patronage as it is by the rule of law (Bush, 2008). In practice, concession holders maintaining patronage and privilege over fishing areas and fishing communities are recognized as operating with little regard to either social or environmental laws, rules and regulation.

The Cambodian government is also undergoing a shift from state to value-chain governance as it builds on its membership in the WTO. While steps have been made to develop the Sanitary and Photosanitary requirements under the FAO Codex Alimentarius for veterinary and food standards, there are limitations on how widespread these standards can be applied to fisheries (Seng, 2006; CFDO-IMM, 2005). These limitations are both technical, in terms of the capacity of monitoring and testing, while others are associated with the form and function of the traditional and habitual trade networks across the country. How these regulations will be applied to capture fisheries where traceability poorly established is not clear. However, it is expected that, like Vietnam, aquaculture systems will be better able to comply with these technical standards.

A key constraint to the government is the combination of formal and tacit control over taxation by public and private institutions, as well as endemic ‘cultural’ patronism and gratuities, which hinder transparent and accountable or management either the fishery or trade. Yim and McKenney (2003b) report a total of 27 taxes, 20% paid to the Department of Fisheries and 80% paid to other departments and informal organizations. Formal fees costs US$10 per tonne to Vietnam through Nak Loeung-Bavet and US$1.2 per tonne through Poi Pet to Thailand while informal taxes are estimated to make up 24% of the total costs

related to the export of fish equivalent to US$19.8 per tonne to Vietnam and US$60 per tonne to Thailand. Operational costs total on average US$51.3 (63.5%) to Vietnam and US$90.3 to Thailand (Seng, 2006). A number of these fees have reportedly been removed, however fishers still refer to informal taxes and gratuities for access to fishing grounds and access along some roads that are still applied on an *ad hoc* basis.

With the promotion of open market development, the Cambodian government dismantled the state monopoly on export through KAMFIMEX in late 2001. Since then the government reports there are over 20 companies with export licences (Yim and McKenney, 2003a). Nevertheless, some domestic traders have expressed concern over the lack of transparency shown in the allocation of licenses. Companies registered with the Ministry of Commerce are allowed to freely trade in Cambodia after paying a fee of US$70 (Seng, 2006). No approval is needed to export goods from Cambodia, with the exception of timber products and solidified rubber. For fish, only an export declaration accompanying an invoice and packing list is required (Seng, 2006).

2.4 Value chain governance challenges

2.4.1 Food quality and safety

Value-chain governance in the fisheries sector has focused mainly on reducing the prevalence and impact of disease in production and post-harvest contamination come under increased scrutiny by regulators in the US and the EU (Loc, 2006b). Approximately 25% of the companies report products are infected by microbiological hazards, including *Escherichia coli*, Coliform and Salmonella. In addition, 15.6% report contamination by banned antibiotics such as such as Chloramphenicol. Both state regulators and private companies have gained considerable experience on the impact that food safety standards on antibiotic and chemical residues in shrimp industry and are wary of similar impacts to Pangasius.

As the intensity of Pangasius farming increases producers may be likely to use these drugs as they expect more security around their high investment in cages and ponds: especially those not selling to highly regulated markets in the EU and US. Despite little evidence to show many legal chemicals have a measurable benefit to fish growth and health and farmers.They make up to 5% of the variable costs of farmers using home-made feed 2-4% of those using processed feed (Sarter *et al.*, 2007). Reducing contamination remains difficult due to low levels of compliance by producers concerned with disease and the low logistical capacity of processing companies and government extension officers. Nevertheless, as seen with the case of the antibiotic contamination of shrimp in Thailand, auditing practices in the US and EU is raising food quality standards. The implications for producers in Vietnam are considerable, forcing improvements in supply chain management under considerably difficult production conditions.

As part of its accession to the WTO, Cambodia was required to raise the standard of its food processing sector, including fisheries. As food quality and safety measures become more stringent in export markets Pangasius farmers will be forced to adapt their practices in order to maintain market access. How farmers in both countries can adapt to these changes is dependent on the provision of timely information and also improved capability of farmers to use this information to change their farming practices. Understanding how poor small-scale farmers can improve or ‘upgrade’ their position within global value chains therefore requires an

improved understanding of their capacity to both respond and contribute to governance and control mechanisms such as food standards.

2.4.2 Cycles of boom and bust

Pond culture of *P. hypopthalmus* is expected to expand rapidly in order to meet the national target. However, because aquaculture development has been explosive without a long-term development control of government, production exceeds the capacity of processing plants and export demand (Hao, 2005). The rapid and poorly planned development of this industry in the Delta also raises considerable constraints related to seed, feeds, credits and the enforcement of legal measures. At the beginning of 2007, it was recommended that *Pangasius* spp. production should not exceed 600,000 tonnes by the year of 2010. However, the production of this species in the same year reached about 1 million tonnes. In July 2008 the Ministry of Agriculture & Rural Development estimated that if the international market will be good, the total production of P. catfish produced in Vietnam by the year of 2010 estimated at 1.5 million tonnes and the estimation for 2020 is 2 million tonnes.

In 2008 a lending crisis saw processing companies purchasing fish from farmers from US$0.88 toUS$0.92 per kg; US$0.10 to US$0.13 per kg lower than the cost price. Farmers have been unable to reduce the cost of input, particularly feed which makes up 70-80% of the cost price. In fact the cost of feed has increased between US$0.06 and US$0.09 per kg to a current average price of between US$0.48 toUS$0.54. In addition it appears the price of antibiotics and vitamins have increased between 30-40% compared to 2007. Based on these increases it appears that the purchase price for Pangasius needs to rise to US$0.98 per kg at minimum to ensure profitability.

Also driving the 2008 financial crisis was the low capacity of processing companies not able to meet production levels. News reports also indicate that An Giang province alone has an estimated 30000 tonnes of oversized fish which have not been purchased by companies, representing 16% of the provinces total production target for the year. Most processing companies have a capacity of 100-300 tonnes/day (VietNamNet Bridge, 2008). In order to meet the supply they need to upgrade this capacity, but are currently constrained by interest rates of up to 20% per annum. The State Bank of Vietnam agreed to subsidize between 50 and 100% of the interest rates, at a cost of US$61.54 million, to allow companies to cover all pending purchases of oversized fish until August 2008. At the time there was concern that a further US$257 million was needed to ensure future growth of the industry. Processing companies refused much of the money because they did not want the debt and were able to cover most of the losses by controlling the price of fish.

2.4.3 Environmental challenges

Despite on-going land use planning efforts by provincial governments, aquaculture expansion in the Mekong Delta remains spontaneous and underlined by inadequate information and a poor understanding of the ecological conditions and environmental impacts. Indeed, concern is emerging through various state and private initiatives over whether the fragile ecological system of the Delta can continue to withstand excessive level of aquaculture production considering (Boyd et al., 2005; WWF, 2007; World Bank, 2006). Key impacts include the following:

1) An estimated two million tonnes of feed is currently being supplied to Pangasius farming in the Mekong delta – 35-50% of which is estimated to be made from

small and low-value marine and freshwater fish, including *Henichorhynchus* and *Labiobarbus* spp. (Edwards and Allan, 2004; Phuong et al., 2007).

2) Approximately 300,000 tonnes of fish waste and wastewater from ponds, cages and processing factories flow directly to waterways posing the problem of destabilizing the foundations of fish farming (World Bank, 2006);

3) The misuse of antibiotics because of poor knowledge about disease management and the increased risk of chemical residues from surrounding agriculture and industry are recognized as an imminent food safety threat (Sarter *et al.*, 2007);

If the industry is not managed properly it is widely believed the continued rate of expansion will at best inhibit future growth, or at worst lead to a collapse in productivity. Either scenario will have considerable implications for the ecological functioning of the Mekong Delta and the social sustainability of rural communities in of both Vietnam and Cambodia. The rise in Pangasius aquaculture was generally recognized as a driver of high fishing pressure on both sides of the border to supply both feed and seed to Vietnamese producers.Today the prevalence of 'home-made' feed, including low value *Henicorhynchus* and *Labiobarbus* spp., is considerably lower than at the end of the 1990s when close to 100% of farms used it as a source of protein. However, at present it is estimated that this feed is still used in more than 20% of the Pangasius production, still requiring extensive cross-border trade from Cambodia (Phuong *et al.*, 2007). Given the rise in the cost of fish meal from overseas it is possible farmers will turn back to low cost, yet more variable supply of low value fish from the Mekong.

3 METHODOLOGY

In addressing the challenges set out above research was conducted using an integrative research methodology to investigate value chains and their links to rural livelihoods and sustainable fisheries management. The project was conducted in An Giang, Dong Thap and Can Tho of Vietnam and three provinces of Cambodia, Takeo, Siem Reap, and Stung Treng (see Figure 3). Each of these provinces was chosen for their high concentration of of *P. hypothalamus* and *Henicorhynchus/Labiobarbus* spp. production.

3.1 Value chain analysis

The value chain analysis is comprised of two main analyses. First, a function analysis was conducted in which the number, type and function of actors was determined. The approach focused questions on the inputs and outputs of production as well as the mechanisms by which value chain actors maintain control production. Focus not only those directly involved in the value chain, but also those within a broader network, providing economic, policy and social support to actors. The data is then presented in 'chain maps' illustrating the main export and domestic channels, proportional outputs and description of the key functions.

Second, the value chain analysis maps the material and financial flows from input suppliers to market. This approach calculates the main expenses and net profit margins of production for the actors and consolidates the expenses and margins from the rest of the chain. The analysis emphasizes the percentage value added to the fish at each transaction in the value chain, calculated as the selling price minuses buying price, not taking into account fixed or variable costs of each actor. For Pangasius grow-out farmers, total cost include the cost of buying fingerlings

and the added costs involved in the growing cycle. All the costs and added value were computed per kg of fresh fish equivalent.

The analysis also concentrates on producers, traders, processors and retailers. However, special consideration was also given to consumers given that beyond per capita consumption data in either Vietnam or Cambodia (e.g. Ahmed et al., 1998; Hortle, 2007) few studies have focused on how consumers make decisions over which fish to purchase. Furthermore, given the clear price differences between *P. hypopthalmus* and *Henicorhynchus/Labiobarbus* spp., the analysis compares the different perceptions consumers have of high and low value species related to food quality and safety, as well as price and value.

The total number of collected samples were 967 in surveys and nine PRA groups, of which 583 samples and six PRA groups came from Vietnam site along with 384 samples and three groups from Cambodia (Table 1).

Figure 3. Study sites in the Mekong Basin

Table 1. Sample design of value-chain analysis

Chain actors	Vietnam	Cambodia	Total
1. Hatchery	10	4	14
2. Pangasius farmer/producer	90	48	138
	PRA: 3 groups		3 groups
3. *Henicorhynchus/Labiobarbus* spp. Fisher	91	90	181
	PRA: 3 groups	PRA: 3 groups	6 groups
4. Trader	22	27	49
5. Processor	7	8	15
6. Consumers	194	180	374

7. Facilitators	20	6	26
8. Livelihood & policy survey	Pangasius: 100 *Henicorhynchus/ Labiobarbus* spp. : 49	Pangasius: 8 *Henicorhynchus/ Labiobarbus* spp. : 13	170
Total	583+ 6 groups	384+ 3 groups	967 + 9 groups

3.2 Livelihoods analysis

A livelihoods analysis was carried out in parallel to the value chain analysis focusing on the vulnerabilities of various stakeholders who interact directly and indirectly with these chains. The analysis focused on the diversification of household activities and their vulnerability to economic and environmental change. Diversification is seen here as a function of a households capability to cope with changing external social, political and economic circumstances and access key assets and strategies used acquiring income and nutrition (Ellis, 2000; Mitchell and Shepherd, 2006). Vulnerability is a function of the diversification of natural, financial, physical, human and social capitals. An aggregate description of these capitals was then used to determine the vulnerability context of fishers and farmers in the Mekong Delta.Defined as the external environment which farmers and fishers have limited or no control, but determines their access to key inputs. The analysis includes the abundance of resources, national/international economic and the development of governance and technology. Shocks include factors such as human health, natural disasters, economic shocks, conflict and crop/livestock. Seasonality includes prices, production, health and employment opportunities. The analysis focused on the contribution each of the value chains make to household income, as well as the degree to which farmers can make decisions over productive activities and investment strategies.

Applying the livelihoods approach to international and regional trade means moving beyond local environmental to focus on economic and political 'mediating processes' that govern production practices and access to markets (Allison and Ellis, 2001). Value chains are one such mediating process. The livelihood analysis therefore provides a description of household assets, decision making and investment strategies in light of power relations between market actors and rules that govern access to local, regional and international chains (Dorward *et al.*, 2003). In doing so comparisons are made between the institutional environmental of aquaculture and capture fisheries and the different challenges households face in competing for common resources.

Research activities included direct interviews of the chain stakeholders by using questionnaires, individual interview, key informant panel (KIP), PRA and workshops. The main field-work was carried out from September to October 2008. A total of 202 samples were collected of which, *P. hypopthalmus* included 140 samples (100 in Vietnam and 8 in Cambodia), *Henicorhynchus/Labiobarbus* spp. included 62 samples (49 in Vietnam, and 13 in Cambodia).

Table 2. Sample distribution of livelihood & policy study

Provinces	Districts	Number of samples	Ratio (%)
An Giang	Tan Chau	44	25.9
	Chau Thanh	6	3.5
	Long Xuyen	13	7.6
	Hong Ngu	35	20.6
Dong Thap	Cao Lanh	9	5.3
	Chau Thanh	13	7.6
Can Tho	Thot Not	7	4.1
	Vinh Thanh	22	12.9
Cambodia		21	12.4
Total		**170**	**100.0**

3.3 Policy analysis

The policy analysis focuses on the awareness and compliance of fishers and farmers with key state policy and legislation. The analysis proceeds in two steps. The first is a review of the current policies relevant for *P. hypopthalmus*, *Henicorhynchus* spp.and *Labiobarbus* spp. focusing specifically on the current shift from state to market based governance approaches in both Cambodia and Vietnam. Secondly, an empirical analysis of the current level of awareness that farmers and fishers have of these state and value-chain policies, regulations and their current level of compliance (see Table 2 for sampling). Questions were also asked about the opinion of producers about policies and regulation, whether they felt they had a positive or negative impact on their production and whether they though there was a net benefit for the environment. As such, the policy analysis is strongly integrated with the livelihoods analysis outlined above.

4. VALUE CHAIN ANALYSIS

4.1 Pangasius value chain analysis

4.1.1 Volume, functions and channels

The survey recorded 1,200,000 tonnes of Pangasius traded in 2007 representing an estimated 28.9% of total aquaculture production in Vietnam (50.6% in the MD). Of this 91.4% of the trade was exported, emphasising the international focus of the industry. In Cambodia the trade of 4,300kg was recorded representing 0.6% of the total aquaculture production, 2% of the Dai fishery catch. The survey found that all of this production was for domestic markets. Although this is unlikely given the trade of high value fish to Thailand described by Yim and McKenney (2003a) through Poi Pet and by Bush (2004) through Stung Treng and the Lao PDR.

The composition of market channels within Vietnam and Cambodia differ greatly, however the functions of actors within the chains were remarkably similar (see Figure 4 and

Figure 5). Six distinct functions were found including a general group of input suppliers (feed, hatchery farmers and veterinary supplies); both grow out and hatchery farmers; traders such as collectors, wholesalers and retailers; processing actors, responsible for processing fish into marketable products and trading them to retail markets. Although the functions of these actors in different market channels was similar between the two countries there was considerable variation depending on whether fish were destined for domestic or international markets.

Farmer collective organisations, similar to co-operatives are also forming in Vietnam. Sponsored by processing companies these organisations involve on large farmers which make up 20% of those supplying approximately 80% of the total volume processed by companies such as AGFISH and Viet An. The remaining 80% of farmers, which are characterised as 'small-scale', have been encouraged to create collective groups, but successful examples are yet to emerged.

The *P. hypopthalmus* chain in Cambodia is made up of a series of collectors, wholesalers, processors and retailers. The relative geographic isolation, high degree of seasonality and large volumes of many fisheries in the country, on Tonle Sap, as well in the North and Southeast means that collectors play an important role in transferring 43.8% of fish from fishers and farmers to processing companies (Bush, 2006; Seng, 2006). Processors are small, household scale operations or medium scale private businesses, none of which meet international standards. Only a relatively small amount of fish, an estimated 14.5% is sold directly by farmers to domestic markets.

The chain in Vietnam is predominantly export oriented and as a result is more streamlined and dominated by processing companies. The first channel in Vietnam is a vertically integrated international chain extends from producers to processors and export markets. The trade makes up approximately 91.3% of the total amount surveyed and extends to well established markets such as Japan, US and EU, as well as emerging markets such as Egypt and Russia and Ukraine. The results indicate that nearly all producers selling fish to export markets have a direct contract with processing companies, thereby avoiding the extra costs incurred by collectors. This is not consistent with other studies that show that collectors play an important role in trading Pangasius and providing credit to farmers (Bush, 2006; Loc, 2006a). However, the results may indicate that there is a tendency towards vertical integration by processing companies in order to maintain greater control over farming practices.

The second channel is a domestic flow of fish from producers, to traders, wholesalers and finally consumers in major urban centres such as Ho Chi Minh City. This channel accounts for 8.9% of total production, passing from producers to collectors, who then sell towholesalers, retailers or processing companies. In Vietnam, approximately one third of the fish sold in domestic markets is processed, made up of both filleted fish as well as waste material from processing companies. The domestic chain is also a secondary market for those farmers who do not meet the quality or safety requirements of the processing markets for export markets. Quality failures mainly consist of meat discolouration or fish that cannot be delivered live to processing companies, while safety failures mainly include problems with antibiotic or probiotic contamination. The survey results reveal that most fish is disqualified from export markets at the farm gate as only 1.9% of fish is traded from processing companies to domestic markets.

Figure 4. Pangasius value chain in Cambodia

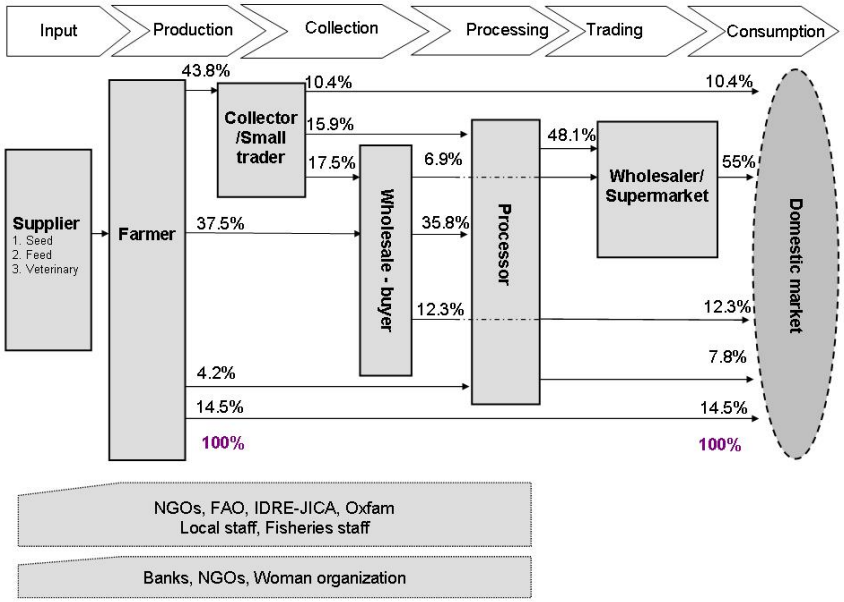
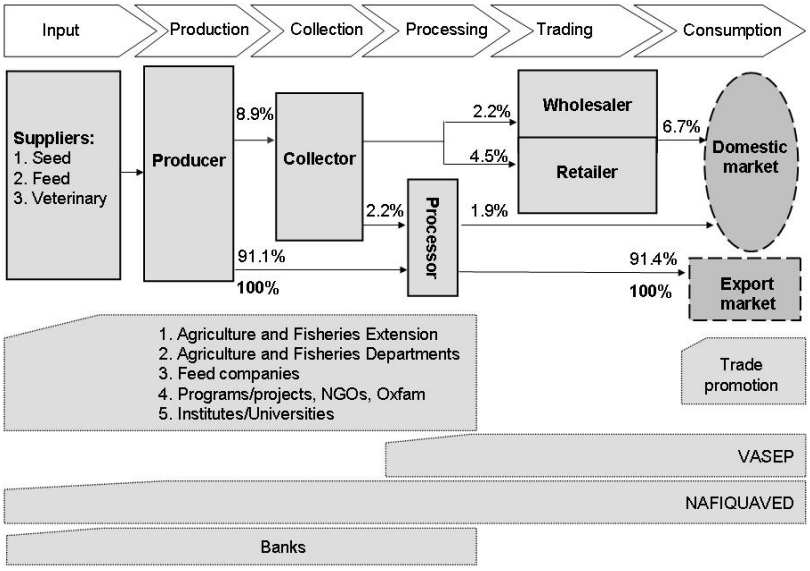


Figure 5. Pangasius value chain in Vietnam



4.1.2 Pangasius chain facilitators

There are a large number of state, private and civil society organisations who facilitate both domestic and international trade. These actors or organizations can be classified into financial, market and technical functions. One notable difference between the two countries is the absence of support organizations for Pangasius for trade and retailing in Cambodia. There have been considerable efforts to improve sanitary and photo sanitary measures for accession to the WTO by the Department of Fisheries in Cambodia. However, it appears the absence of a formal

export market for Pangasius has meant limited attention has been given to establishing coherent governance arrangements for this part of the value chain. In the absence of a strong government presence most of the support provided to producers is through NGOs such as Oxfam, the FAO and JICA.

In Vietnam market support is provided by the Vietnam Association of Seafood Exporters and Processors (VASEP) who trains and provides market information to support aqua-product processors and exporters (such as market information, international trade, and understanding quality requirements and standards). The Provincial Trade Promotion Center and National Trade Promotion Center study potential aqua-product import markets, provide information about import markets to processors and broadcasting information to promote the aquaculture industry.

VASEP has also sponsored the An Giang Fisheries Association, a member based organisation which advocates the rights of farmers. Originally set up after the U.S Anti dumping case in 2003 the role of AFA is now relatively ambiguous as it has no formal role in negotiating standards, policy or negotiate contracts. Only half of the respondents surveyed thought that AFA operated effectively by providing information on inputs and market prices, production techniques and effective disease control. The rest of the respondents thought AFA was ineffective because the association had no decisive role in negotiating contracts between members and processing companies, banks or feed companies. In total, 10% of respondents thought there was a lack of trust by members that the organisation works for the benefit of fish producers.

Financial support is provided by state and private banks who give financial support to the input suppliers, farmers and processors. In Vietnam farmers and suppliers receive private loans most commonly from the AgriBank while large processors receive loans from a range of Vietnamese and international banks. In Cambodia formal financial support is not commonly provided by the formal banking sector. The two banks that are now active in providing fishers and farmers loans are ACLEDA, AMRITH and PRASAC banks.

Technical support is provided by a range of state and civil society groups. In Vietnam the main source of technical support for farmers is the Fishery Extension officers, who are based within the District Agriculture Departments. They offer training to hatchery and grow-out farmers in new aquaculture technologies as well as instruct farmers on governmental policies to increase Pangasius hygiene and safety. In addition, there are a range of technical programmes for the improved technical performance of farms including irrigation projects for raising aqua-products, projects to upgrade breeding centres, GTZ (German Technical Assistance) and NGO programs for loans, quality standards training and relevant other supports. More specialised support regarding veterinary products is provided by the National Fisheries Quality Assurance and Veterinary Directorate (NAFIQUAVED) supports the whole chain in terms of checking, controlling as well as certifying fish products from inputs to breeding fish to finished seafood products.

4.1.3 Economic analysis of different chains

The average total net added value in the Vietnamese Pangasius chain is estimated at US$0.29 per kg. The results indicate that there is not much difference in the percentage net added value between factors in the export and domestic channels (Table 3). Traders have the lowest net added value at 17.5%. Producers and retailers/processors in both import and export channels have a similar net added value, 41.3% and 40.1% in the export channel and 46.9% - 53.1% in the domestic

channel. Overall, farmer's profit is similar in both of the channels at US$0.12 per kilogram.

The contribution of labour relative to benefits received differs between the chain actors. The results show that farmers contribute 1.2% of labour to the value chain and received 38.7% of the net added value, 48.2% of gross profit and 44.5% of gross income from the chain. By comparison, traders contributed 3.4% of labour to the value chain and only received 17.5% of net added value, 1.9% of gross profit and 4.6% of the gross value added in the chain. The rest of the labour is contributed by processing companies, representing 95.4% of the total: 79 times higher than those of farmers, and 28 times higher than those of traders. In return, processing companies receive 43.8% of the net added value, which is 1.1 times higher than farmers' and 2.5 times higher than traders'. In return for these high costs processors receive 49.9% of the gross profit, which is similar to that of farmers but 26 times higher than the profit of traders. In addition, the gross profit per farmer is only US$11,621 per year while the gross profit of processor is estimated at US$1,861,642.

In Cambodia, the Pangasius chain remains relatively non-industrial will more limited processing activities. Nevertheless, processors still dominate the labour contribution and profit margins. The results indicate that Pangasius farmers in Cambodia contributed approximately 0.6% of total labour to the value chain but receive 37.5% of net added value, 57.6% of gross profit and 38.5% of gross income from the chain (see Table 4). Traders contribute 51.8% of labour to the value chain and only received 25.0% of net added value, 17.6% of gross profit and 23.6% of gross income from the chain. Finally, processors contribute 47.6% of the total labour, receiving 37.5% of the net added value, 24.8% of gross profit and 37.9% of gross income.

The results illustrate that profit in the chain is captured by processors. Although processors employ a very large number of workers, the salary of direct workers was still lower at an average of US$127.56 per month than other types of workers. In the chain's activities, farmers have to face many risks in raising *P. hypothalamus*. The above figures were computed from information of 2007. By August 2008 costs has risen sharply, but selling price decreased leaving farmers with considerable losses of about US$0.13 per kg. This led to many farmers abandoning production. The unequal proportion in profit and income among the actors in the value chain highlights a significant vulnerability in the value chain. Consequently, the shortage of live fish supply to processing for export is looming in the near future.

Table 3. Integrated analysis of value in the *Pangasius hypopthalmus* chain in Vietnam

Actor / Analysis	Farmers	Traders	Processors	Total
1. Total working time (months)	107	81	20680	20868
2. Total labour cost (US$)	10048,68	6526,07	2873124,80	2889699,60
3. Volume traded (tonnes)	1,200,000	106,800	1,096,800	
4. Selling price (US$/kg)	0.92	1.06	1.15	
5. Profit (US$/kg)	0.12	0.05	0.14	
6. Gross profit (million US$)	144.00	5.34	153.55	302.89

7. Gross income (millionUS$)	1104.00	113.21	1261.32	2478.53
8. Labour costs (US$/kg)	0.0002	0.0007	0.0196	
9. % share of labour costs per kg	1.2	3.4	95.4	100.0
10. % share of profit per kg	38.7	17.5	43.8	100.0
11. % share of total profit	48.2	1.9	49.9	100.0
12. % share of total income	44.5	4.6	50.9	100.0

Table 4. Integrated analysis of value in the *Pangasius hypopthalmus* chain in Cambodia

Actor Analysis	Farmers	Traders	Processors	Total
1. Total working time (months)	72	40	36	148
2. Total labour cost (US$)	4.65	1.96	1.71	8.32
3. Volume traded (tonnes)	4.3	1.965	1.859	
4. Selling price (US$/kg)	1.07	1.44	2.44	
5. Profit (US$/kg)	0.27	0.18	0.27	
6. Gross profit (US$)	1161.0	353.7	501.9	2016.6
7. Gross income (US$)	4601.0	2829.6	4535.9	11784.5
8. Labour costs (US$/kg)	0.01	1.00	0.09	0.19
9. % share of labour costs per kg	0.6	51.8	47.6	100.0
10. % share of profit per kg	37.5	25.0	37.5	100.0
11. % share of total profit	57.6	17.6	24.8	100.0
12. % share of total income	38.5	23.6	37.9	100.0

4.2 *Henicorhynchus/Labiobarbus* spp. value chain analysis

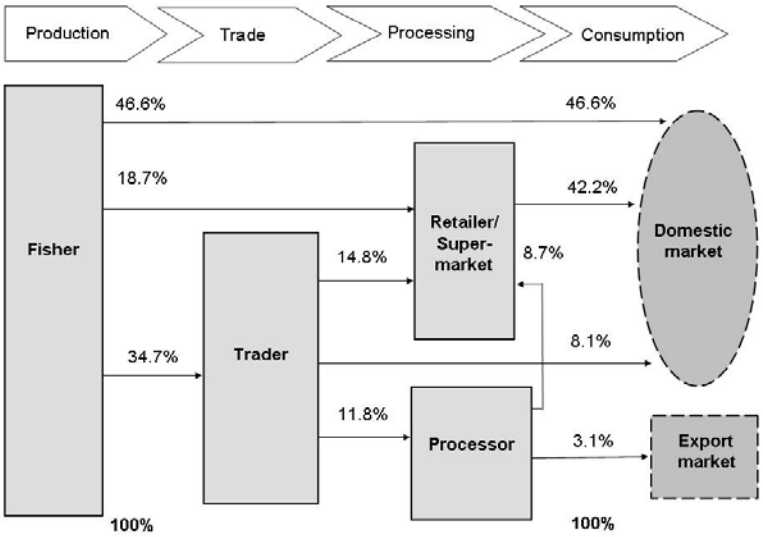
4.2.1 Value chain actors, functions and channels

The survey recorded 108,864 tonnes of *Henicorhynchus/Labiobarbus* spp. traded in both countries. In Cambodia 29,064 tonnes were recorded, representing 55% of the *Dai* fishery and in Vietnam 79,800 tonnes were recorded. Because of the lack of information on total catches it is not possible to estimate what proportion of the Vietnamese production this represents. Only 3% of *Henicorhynchus/Labiobarbus* spp. was to export markets. However, this is highly unlikely given evidence in previous studies of trade of the fish between Thailand, Vietnam, Cambodia and Laos (Yim and McKenney, 2003a; Seng, 2006).

The *Henicorhynchus/Labiobarbus* spp. value chain in the Mekong region comprises four functions. 1. Fishers who operate across a range of water bodies in both Vietnam and Cambodia using a variety of fishing gears. 2. Traders involved in colleting *Henicorhynchus/Labiobarbus* spp. from fishers to following actors. 3. Both large-scale industrial and small-scale households processing andtransforming the fish into marketable product such as salted, dried, fermented and canned fish. 4C onsumers buy the fish for their own consumption in daily meals or as feed for raising other aquaculture species.

In Vietnam the *Henicorhynchus/Labiobarbus* spp. value chain includes five main actors, operating through three channels (see Figure 7). The first of these channels passes from fishers to traders, processors before being sold to either domestic or international markets. In total this channel comprises 11.9% of the total volume traded, with 3.1% passing directly through to export markets and 8.7% passing back to retailers before being sold to domestic markets. Another sub-channel, making up 8.1% of total volume, passes from fishers to traders before being sold directly to domestic markets. The second channel passes from fishers to retailers and on to domestic markets making up 18.7% of total fish traded. Finally, a third channel is the most direct trade of fish from fishers to domestic consumers. In most cases this exchange occurs locally between households and comprises the majority of the *Henicorhynchus/Labiobarbus* spp. traded.

Figure 6. *Henicorhynchus/Labiobarbus* spp. value chain Vietnam

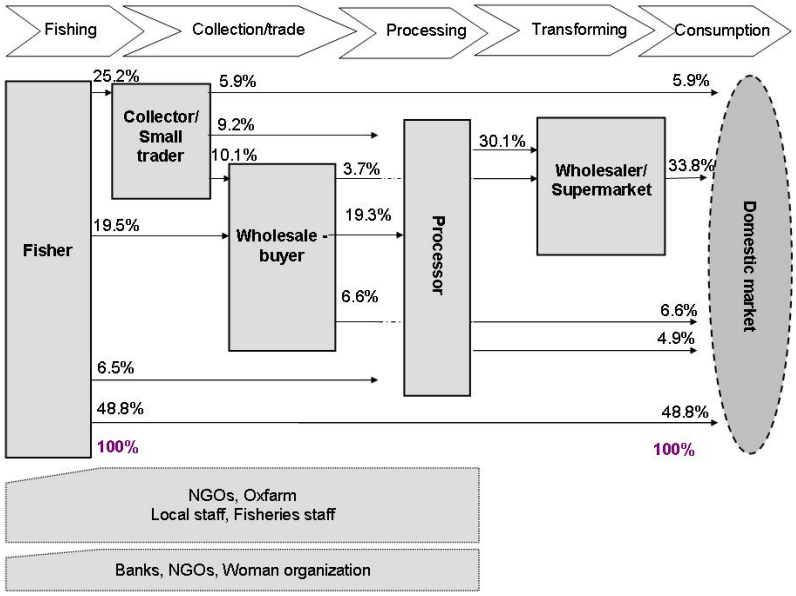


In Cambodia, the results indicate that *Henicorhynchus/Labiobarbus* spp. is only sold to domestic markets via five channels. Just less than half of the fish is sold directly by fishers to retail markets. The rest is sold via various combinations of collectors, wholesalers and processors. Similar to the *P. hypopthalmus* chain, collectors play an important role, buying one quarter of fish from fishers before selling on to wholesalers and processors. Processors handle an estimated 35% of fish in the chain. These actors are often small-scale, household level units which produce salt the fish or make fermented fish sauce (*Pra Hoc*) from the surplus catch.

No export trade was recorded in Cambodia, however it is well established that large amounts of these species are sold to Vietnam, Thailand and Laos both fresh and processed (Yim and McKenney, 2003a; Bush, 2004; Keang, 2004). There is no reliable data on the quantities of *Henicorhynchus/Labiobarbus* spp. exported, however there is anecdotal evidence that demand for the fish increases in large cities such as Ho Chi Minh City. Two companies have also begun selling canned *Ca Linh* to international markets. The Antesco company sells canned Ca Linh with sugarcane and exports 10% of its 15 tonnes/yr production and the Ba Giao Khoe 55555 Salted Fish Company exports 60% of its 150 tonnes/yr production of salted

and dried fish. Ba Giao Khoe reports that all of its fish is imported from Cambodia while the Antesco company buys from a wholesaler who probably purchases their fish in Cambodia. This international trade flow was not detected in the survey because it bypasses the main trade channels. The companies hire boats which travel directly to the Dai fishery on Tonle Sap during the main fishing season. Further information is needed on the characteristics of this trade flow.

Figure 7. *Henicorhynchus/Labiobarbus* spp. value chain Cambodia



4.2.2 Supporters and facilitators

In Vietnam there are no formal organisations or institutions supporting actors in the *Henicorhynchus/Labiobarbus* spp. value chain. The actors in the chain operated based mainly on their own experience, based on a largely migratory fishery during the wet season. In Cambodia more attention has been given to the fishery given its importance to the national economy and food security. There, supporters and facilitators include a range of NGOs who are carrying out projects to support fisheries research and development including Oxfam and WorldFish. In addition, local government and fisheries staff, banks and the Women's organization are involved in regulation and extension work as well as providing sources of credit for fishing communities to finance fishing equipment.

In both countries fishers still rely heavily on informal support services for credit and technical information. In Vietnam, 34% of respondents reported receiving informal loans predominantly for replacing fishing equipment, boat maintenance and fuel. A quarter of these respondents borrowed from private lenders with an average interest rate of 10% per month, while the other sources included relatives, with an average interest rate of 9% per month over 18 months, the women's union with an interest rate of 0.7% per month over 12 months. Respondents also reported receiving informal support from traders with preservation technologies, including ice and cool-boxes. In return these traders bought all of their fish and did not permit the fishers to sell to other buyers.

In Cambodia formal credit is available through the ACLEDA bank at 5% per month interest (Navy, 2004). Most Khmer households in floating communities on Tonle Sap cannot access this finance as they have no collateral - most commonly a land

title. Vietnamese fishers report they were not able to access ACLEDA as many are not Cambodian citizens. A such, Khmer and Vietnamese fishers see informal quasi credit arrangements as preferable because they provide flexible credit which allows them to 'repackage' their debt by balancing repayments with fish or cash, therefore ensuring they can meet their family's subsistence needs before selling of their surplus. In addition, debt-tied trade is independent of market price fluctuation. As interest rates are embedded in the price fishers are not affected by these changes. In contrast formal lending is inflexible, with repayment schedules that do not allow for seasonal variation in catch.

4.2.3 Economic analysis

The average total net added value in Vietnamese *Henicorhynchus/Labiobarbus* spp. chain is estimated at US$0.68 per kilogram (see Table 5). An analysis of labour inputs and profit shows that while fishers contribute 82.4% of total labour cost to value chain, they received only 20.4% of net added value, 40.7% total profit and 41.2% total income of the whole chain. By comparison collectors contributed 6.4% of total labour costs. And they received 4.3% profit and 2.1% total profit, and 12.3% of total income of the whole chain. Retailers contributed 11.2% of total labour cost, but received 75.3% profit: representing 3.7 times more than fishers, 17.5 times more than collectors and wholesalers. Retailers also captured half of the total profit of the chain and 46.5% of the chain's total income.

The analysis for Cambodia focuses on farmers, traders and processors (Table 6). Retailers were not included in the study because of time constraints. Similar to Vietnam fishers contributed the highest proportion of labour. However, they are able to capture a higher proportion of total net profit at 68.7%, despite contributing 78.2% of total labour costs. Despite this relatively poor performance the *Henicorhynchus/Labiobarbus* spp. fishery is the most important source of income for majority of respondents in Cambodia. Traders contributed 16.7% of labour to the value chain and only received 17.0% of net added value, 7.6% of gross profit and 18.8% of gross income from the chain. The lowest labour contribution to the value chain was processing companies, approximately 15 times lower than farmers, and 3 times lower than traders. However, they received 44.6% of the net added value and 23.7% of gross profit.

Combining the data from Vietnam and Cambodia reveals three main channels (see Table 7). In the first two market channels between 65-68% of total added value accrues to retailers and processors. However, in the third and largest channel by volume, fishers sell their fish to users directly. Comparing these three channels we see that fishers would considerably increase their share of net added value from the first to third channels - 32.6% to 34.1% and to 100% respectively. Taking the example of Vietnam fishers would receive 4.3% increase in profit if they could by-pass middlemen and sell directly to retailers and 79.6% increase if they could sell directly to final consumers, representing margins of US$0.17 and US$0.68 per kilogram respectively. However, isolation of many of these fishers, their low levels of operating capital and poor access to formal credit means they are dependent on collectors and retailers.

Unlike the Pangasius chain it appears fishers are more dependent on retailers in order to sell *Henicorhynchus/Labiobarbus* spp. to domestic retail markets. For large scale fishers this is largely because of the high volume of fish caught in migratory seasons. For small-scale fishers collectors and traders are important in providing transport for small, inconsistent amounts of catch.

Table 5. Integrated analysis of value in the *Henicorhynchus/Labiobarbus* spp. chain in Vietnam

Actor / Analysis	Fishers	Collectors/ wholesalers	Retailers	Total
1. Total working time (months/year)	30	26	10	66
2. Total labour cost (US$)	1913.40	937.57	637.80	3488.77
3. Trading volume (tonnes)	79,800	19,551	30,883	
4. Selling price (US$/kg)	0.33	0.40	0.96	
5. Profit (US$/kg)	0.14	0.03	0.51	0.68
6. Total profit (1000 US$)	11,172.0	586.5	15,750.3	27,508.8
7. Total income (1000 US$)	26,334.0	7,820.4	29,647.7	63,802.1
8. Labour costs (US$/kg)	0.01	0.00	0.00	0.01
9. % share of labour costs per kg	82.4	6.4	11.2	100.0
10. % share of profit per kg	20.4	4.3	75.3	100.0
11. % share of total profit	40.7	2.1	57.2	100.0
12. % share of total income	41.2	12.3	46.5	100.0

Table 6. Integrated analysis of value in the *Henicorhynchus/Labiobarbus* spp chain in Cambodia

Actor / Analysis	Farmers	Traders	Processors	Total
1. Total working time (months/year)	30	30	36	96
2. Total labour cost (US$)	1783.65	1473.45	1706.10	4963.2
3. Trading volume (tonnes)	29,064	7,324	8,574	
4. Selling price (US$/kg)	0.54	0.77	1.02	
5. Profit (US$/kg)	0.11	0.05	0.13	0.30
6. Gross profit (1000 US$)	3,197.04	366.20	1,114.62	4,677.86
7. Gross income (1000 US$)	15,694.56	5,639.48	8745.48	30,079.52
8. Labour cost (US$/kg)	0.71	0.15	0.05	0.90
9. % share of labour costs per kg	78.2	16.7	5.1	100.0
10. % share of profit per kg	38.4	17.0	44.6	100.0
11. % share of total profit	68.7	7.6	23.7	100.0
12. % share of total income	51.9	18.8	29.3	100.0

Table 7. Net value-added of Henicorhynchus market actors by channel

Actor / Item	Fishers	Trader	Processor	Retailer	Total
Channel 1					
Net added value (US$/kg)	0,14	0,03	0,26	-	0,42
% Net value-added (%)	32.6	7.0	60.4	-	100.0

Channel 2					
Net added value (US$/kg)	0,26	-	-	0,51	0,77
% Net value-added (%)	34.1	-	-	65.9	100.0
Channel 3					
Net added value (US$/kg)	0,70	-	-	-	0,70
% Net value-added (%)	100.0	-	-	-	100.0

4.3 The role of domestic consumers

4.3.1 Consumption quantity

In Cambodia consumers can buy many kinds of fish in two types, fresh fish and processed fish. The average household consumption of freshwater fish is 1.3 kg/week and 1.5 kg/week of each processed fish. The average size of households is five, giving an annual per capita consumption of approximately 29.1 kg/person/year, similar to the estimation of 32.3 kg/person/yr by Hortle (2007). The most common species consumed *Channa* spp. *Henicorhynchus/Labiobarbus* spp., and *Cirrhinus molitorella*. Common processed fish include smoked, salted and fermented products.

The average household consumption in Vietnam is higher than Cambodia, with each family consuming 4.61 kg/week of fresh fish and 0.77 kg/week of processed fish. Taking into account errors for converting processed products to fresh fish equivalent consumption is estimated at 62 kg/person/year.[1] Channa spp. is again the most consumed species followed by *P. hypothalamus*. The closer proximity of the Delta to marine fisheries means that marine species also make up a large proportion of the total fish consumption. Processed fish 8.89 kg/person/year. However, only 5% of the households reported consuming these products. This estimate is considerably higher than Hortle's (2007) estimate of 34.5 kg/person/year.

Table 8. Consumption quantity of fish in Vietnam

Fish products	Consumption kg/household/week		
	Minimum	Maximum	Average
Pangasius hypopthalmus	1	14	1.8
Channa spp.	1	30	2.0
Henicorhynchus/Labiobarbus spp.	0.6	4	2.2
Mud carp fish	0.6	4.0	2.2
Other fresh water fishes*	1	13	2.1
Marine species	1	10	1.5
Processed Fish	0.2	3.0	0.8

* Other freshwater fish are predominantly made up of *Anabas testudines*, *Puntioplites* spp*., Rasbora* spp*., Stoleplzorus* spp., *Clarius macrocephalus* and *Paralaubuca typus*

[1] Fresh fish equivalent conversion factors could not be applied to the Vietnamese data because respondents did not provide specific details of which products they consume.

Table 9. Consumption quantity of some fishes

Fish products	Consumption kg/household/week		
	Minimum	**Maximum**	**Average**
Fresh fish:			
Channa spp.	10.0	10.0	10.0
Cirrhinus molitorella	4.0	4.0	4.0
Labiobarbus leptochilus	2.5	2.5	2.5
Henicorhynchus/Labiobarbus spp.	0.3	10.0	2.4
Cirrhinus siamensis	1.0	4.5	2.2
Belodontichthys dinema	1.0	3.0	2.0
Typhlachirus elongatus	2.0	2.0	2.0
Osteochilus melanopleurus	1.0	3.0	2.0
Processed fish:*			
Fermented fish	1,13	1,13	1,13
Smoked fish	2,50	2,50	2,50
Fish paste	0,88	0,88	0,88
Fish eggs	0,20	3,00	0,95
Salted Fish	0,56	5,64	2,26

* The quantities of processed fish have been converted into fresh fish equivalent values using the conversion factors outlined by Hortle (2007): Fermented fish – 0.75; smoked fish - 2.5; fish paste – 0.88; Salted fish – 0.82

4.3.2 Household expenditure and fish prices

Household expenditure in both Vietnam and Cambodia is relatively similar. In Cambodia, the average expenditure for fish species for a family was estimated at US$10 per week. There was considerable variation between provinces with consumers in Siem Reap paying US$36 per week and consumers in Stung Treng spending a maximum of US$26 per week. Proportionally, fish represent 28% of total household expenditure, compared to 35% of other food items and 38% on non-food items. In Vietnam the average expenditure for food of each family was US$24 per week of which fish represented 40.1%. By comparison, US$15.37 was spent on other household items including food, electricity, water, telephone, children's schooling and health care.

Respondents in both countries indicate that the choice of species consumed was strongly dependent on price. The average price in Cambodia for fresh fish is US$1.40 per kg with the highest price for *Cirrhinus siamensis* at US$3.80 per kg, and lowest price for *Cirrhinus molitorella* at US$0.50 per kg. The average price of processed fish is considerable higher at US$3.34 per kg, with the highest price going to fish eggs at US$5.69 per kg. In Vietnam the price of freshwater fish is more expensive than Cambodia at US$1.82. In addition the price of salt-water fish is also relative high at US$1.74 but cheaper than freshwater fish. The highest price was for *Channa* spp. at US$2.71 per kg. However, given this is the most consumed fish it appears that the demand for fish elasticwith higher prices being paid in response to higher demand. The lowest value fish is *P. hypothalamus* at US$1.28 per kg, perhaps indicating the high supply of the fish on domestic

markets. The average price of processed fish in Vietnam, including smoked, fermented and salted, is US$2.99 per kg.

Fish is widely available to consumers throughout Cambodia and Vietnam indicating little price inflation due to transport and distribution. Consumers in both countries bought the majority of their fish in local markets (Table 12). In Cambodia it appears households have greater access to fish directly from fishers compared to households in Vietnam. Very little of the fish was purchased from restaurants or modern supermarkets. Approximately 21% of households caught fish themselves, highlighting the semi-subsistence nature of their livelihoods. Respondents in both countries also indicated they were satisfied with their access to fish from these markets and would not change their consumption behavior in the near future.

Although considered 'low value' *Henicorhynchus/Labiobarbus* spp. is now a higher value fish than Pangasius in domestic markets. Table 10 and 11 show that the value of this fish in the dry season when there is less abundance in the market, *Henicorhynchus/Labiobarbus* spp. is equal to or more expensive than other key species. The higher value indicates a wider trend within the Mekong Delta to *Henicorhynchus/Labiobarbus* spp. becoming a more luxury consumer item, available more readily as a speciality dish in restaurants. The growing export market for the fish is also indicative of the potential pressure the fishery may come under in the years to come. Conversely, the rise in price means there is more potential for fishers to gain higher margins on the fish they sell. However, for this to happen they will have to improve their bargaining power *vis-à-vis* collectors and traders.

Table 10. Fish prices in Vietnam

Fish products	**Price US$/kg**		
	Minimum	**Maximum**	**Average**
Fish price	Minimum	Maximum	Average
Pangasius hypopthalmus	0,51	2,55	1,28
Channa spp.	0,96	4,46	2,72
Henicorhynchus/Labiobarbus spp.	0,96	2,10	1,64
Cirrhinus microlepis	0,96	2,10	16,39
Other fresh water fishes*	0,32	5,10	1,82
Marine species	0,32	4,46	1,74
Processed Fish	0,26	6,38	2,99

* Other freshwater fish are listed in Table 66 of Appendix 2

Table 11. Fish prices in Cambodia

Fish products	**Price US$/kg**		
	Minimum	**Maximum**	**Average**
Fresh fish:			
Channa spp.	1.00	1.00	1.00
Cirrhinus molitorella	0.50	0.50	0.50
Pangasius hypopthalmus	0.62	4.14	1.00

Labiobarbus leptochilus	1.50	1.50	1.50
Henicorhynchus/Labiobarbus spp.	0.50	3.00	1.10
Cirrhinus siamensis	3.80	3.80	3.80
Belodontichthys dinema	0.30	0.90	0.60
Typhlachirus elongatus	1.00	1.00	1.00
Osteochilus melanopleurus	1.30	2.00	1.50
Processed fish:			
Fermented fish	1.50	1.50	1.50
Smoked fish	5.00	5.00	5.00
Fish paste	3.00	3.00	3.00
Fish eggs	3.00	11.25	5.69
Salted Fish	1.25	2.00	1.50

Table 12. Main market sources of fish in Vietnam and Cambodia

Market type	Vietnam		Cambodia	
	No.	(%)	No.	(%)
Supermarket	13	6.0	1	0.5
Local market	154	70.6	135	63.1
Direct from fishers	1	0.5	30	14.0
Caught	50	22.9	48	22.4
Total	**218**	**100.0**	**214**	**100.00**

4.3.3 Factors affecting the choice of fish

Price and income are the main determinants of fish consumption in both countries. In Cambodia 60% of respondents identified these two factors as having the most influence over their consumption patterns. Other factors that influenced where they purchased their fish included the distance to markets and personal trust of the trader. Consumers are also concerned about qualitative factors regarding the quality of fish. Approximately 40% of consumers indicated that they took the health of the fish into consideration at the point of sale. A further 33% of respondents also indicated that they make purchases based on what they believed to be the nutritional value of the fish. Nearly half of the respondents are aware of the dangers of Pangasius from antibiotic residues, disease and industrial feed. This follows an increasingly apparent trend of increased awareness of health and safety as a key determinant of food purchases in Vietnam (e.g. Figuie et al., 2004; Scott, 2006). In addition, these respondents placed value in fish produced with limited environmental impact due to waste drainage into the rivers.

Approximately two-thirds of consumers in Cambodian believed the current fish price was too high. However, these same respondents also acknowledged that the quality of fish was of a high quality. They recognized that fishers who caught their own fish had an important advantage in ensuring the quality of the fish they consumed. Two thirds of Vietnamese consumers also believed the price of fish in the dry season from April to May is particularly high and argued that lower value

aquaculture fish such as P. hypopthalmus could provide an alternative supply. Nevertheless, they had a preference for wild caught fish which they believed had a higher overall quality, mainly because of the abundance of flooded areas and diversified habitats for fish. Overall, only one quarter of respondents thought the quality of fish was of a medium quality.

In Cambodia about 23.3% of respondents intended to increase their consumption of fish per week. However, nearly three quarters of those interviewed believed that they would not be able to do so because of falling supply of fish, especially from capture sources. The same response was given in Vietnam, where 56% of consumers intended to increase their consumption of fish but believed they would be unable to do so because of falling supply. The only way in which consumers intended to increase their consumption was to increase their own catch in the wet season.

Respondents in both countries reasoned that the main driver of higher consumption was lower prices or rises in prices of other meat products such as beef or pork. Interestingly, the majority of consumers also argued that if their livestock had diseases and were unable to be consumed then fish is the most immediate substitute. The trend of higher fish consumption in the Delta may increase given the recent epidemics of avian influenza and the recurrent bouts of foot and mouth disease and swine fever in both Cambodia and Vietnam. There is also a much stronger confidence in the quality and safety of fish over other meats as well as the higher nutritional value of fish. In addition, fish was seen as more flexible than livestock meat as it could be processed into more kinds of dishes.

In Vietnam consumers were also nervous about a shortfall in fish supply. The primary reason was that the current amount of fish was not enough to meet demand. Respondents were also concerned their income would not raise in line with the inflation of fish prices. Overall, 44% of respondents expected fish prices to decrease while 37% expected prices to remain stable. As found in other countries fish has high income elasticity, meaning that the demand for fish increases with income (see Delgado *et al.*, 2003). Although not correlated, respondents indicated that income was the major factor affecting to consumption and the housewives would select kinds of food according to available cash.

5 LIVELIHOOD ANALYSIS

The section addresses the contribution each value chain makes to the livelihoods of fishers and farmers in Vietnam and Cambodia. The contribution of aquatic resources to the local community is also to create jobs and income, as well as providing low value fish for aquaculture systems. The results are based on a survey carried out from September to October 2008. The following section outlines the degree of livelihood diversification fishers and farmers have experienced in the last five years. The second section then provides a breakdown of the costs and income of fishers and farmers. Attention then turns to a vulnerability analysis, focusing on changing access to environmental, human, social, financial and physical capital experienced by fishers and farmers and the strategies they have adopted to cope with these changes.

5.1 Changes of the economic activities or occupations over 5 years

Fishing is a secondary occupation to agriculture and livestock, but remains an important source of income with only 30 and 37 % of households carrying out rice

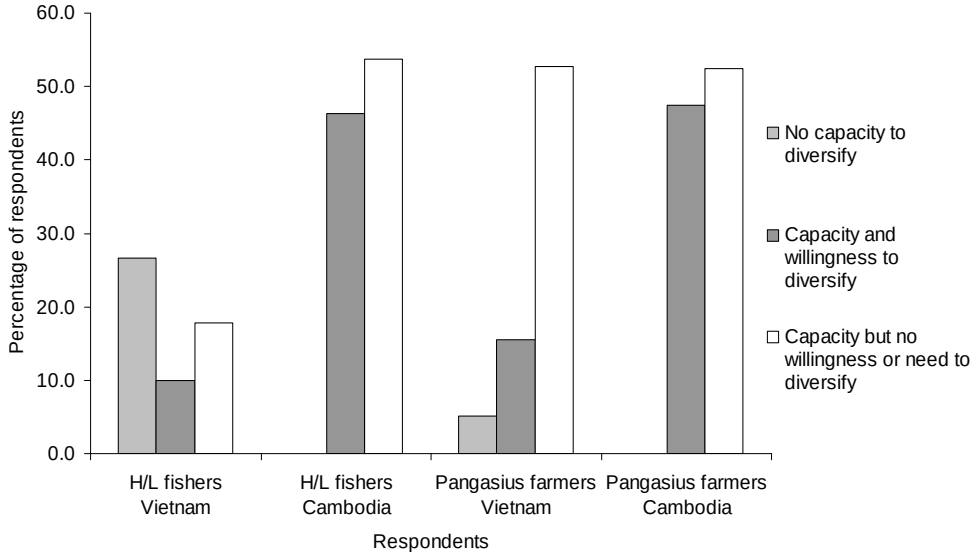
farming or livestock respectively. As indicated in Figure 8 fishers are less willing to specialise their livelihoods with very few fishing households investing in new activities such as Pangasius aquaculture. Since 2003 only 4% of respondents had invested in Pangasius farming bringing the total to 17% of all fishing households. Over the same period some 13.2% of households have taken up fishing as their primary source of income. Pangasius and other agricultural activities requires land as collateral. Therefore fishing households with little or no land are less able to borrow capital, either formally or informally, to start-up aquaculture production. The higher proportion of farmers moving towards fishing may therefore indicate a lower willingness to invest in capital intensive aquaculture production.

Across both Cambodia and Vietnam fishing for *Henicorhynchus/Labiobarbus* spp. is perceived as an undesirable livelihood activity. Respondents saw fishing as risky with its small returns, high seasonality and dependence on highly variable natural productivity. The importance of the wet season was evident across all provinces in the Mekong Delta of Vietnam, with 65% of households in An Giang, 50% in Dong Thap and 30% in Can Tho dependent on fishing as a primary income stream during these months. In Cambodia up to 70% of households in Siem Reap and 20% in Takeo are dependent on the fishery.

Fishers remain dependent on fishing because they have few alternative income opportunities due to a lack of education, capital assets and access to formal credit. As shown by the value chain analysis the weak position of fishers to bargain for higher prices means they are more vulnerable to powerful traders who, in contrast, have capital and diversified income streams. As credit is most commonly offered through these value chains fishers are locked within quasi-credit arrangements which indebt them through low prices and/or high interest rates.

In contrast to fishing, *P. hypothalamus* aquaculture is a relatively new livelihood activity to 55% of the households surveyed. Pangasius farmers are generally wealthier land owning households with access to the necessary capital to invest in ponds. Cage culture is only practiced by the wealthiest farmers due to the very high start-up costs. Figure 8 indicates that Pangasius farmers are more likely to specialize their livelihood activities given the high financial investment required. For example, capital intensive grow-out farmers are two times less likely to be involved in trading activities than hatchery and nursing households. Nevertheless, some farmers, especially in An Giang and Siem Reap indicate they are willing to change livelihood activities should opportunities present themselves. For those farmers in An Giang reflects the history of market volatility from the early 2000s and also the current rise in the cost of inputs.

Figure 8. Capacity and willingness of farmers to diversify their primary livelihood activity away from fishing or farming



5.2 Total costs and total net income of the economic activities

The results of the value chain analysis indicate that both farmers and fishers face many problems with securing input materials and access to high value markets. Pangasius grow-out farmers have high total annual average costs of US$462,728.55 (Table 13). Nursery farmers and hatcheries also have considerable costs, but only 39% and 54% that of grow-out farmers. Fishing households have considerably lower average annual costs at only US$4649.56, some 84% less than Pangasius grow-out farmers.

Fishers and fish traders received the highest return on investment of all groups surveyed of 34% and 15% respectively. However, in real terms fishing households receive a total net income of US$1581.74, or US$344 per person, approximately 10 times less than Pangasius farmers. As shown in the value chain analysis, the main constraint to this group is their lack of ability to negotiate prices as a result of the quasi-credit contracts they have with traders. The results also show that landless fishers without alternative income streams from agriculture have a per capita income, approximately US$200 per year higher than what are classified as 'poor' households (AusAID, 2004). Furthermore, only 59.9% of *Henicorhynchus/ Labiobarbus* spp. fishers and 61% of *Henicorhynchus/Labiobarbus* spp. traders had made a profit during the past five years, again indicating the variability of catches and increasing price of inputs such as petrol (Table 14).

Pangasius grow-out farmers make a return of investment of only 2.9% demonstrating their high vulnerability to price fluctuation. The high-cost of feed means farmers require readily available sources of credit. By comparison nursing farmers are the most profitable with a margin of approximately 11%. However, the nursing phase faces the highest risk of mortality through disease, water quality and temperature. Despite this nurseries succeed with 77.9% of their crops, 3% more than grow-out farmers (Table 14). The impact of a crop failure can be catastrophic for a grow-out farmer with the high costs of production. For example, if processing companies refuse to buy the fish or disease kills the fish in the last month of

production then it will take up to three years if they can maintain consistent margins for three crops per year.

Table 13. Contribution of the activities to total annual costs and total annual net income

Description	Unit	H/L spp. fishers	H/L spp. traders	Pangasius hatcheries	Pangasius nurseries	Pangasius grow out farmers
Total Costs/year	**n**	**53**	**10**	**28**	**53**	**62**
Mean	US$	4649,56	10396,14	250649,02	178717,94	462768,55
Std Deviation	US$	10593,86	9707,32	597108,36	477648,42	593893,85
Total Net Income/yr						
+ Mean	US$	1581,74	1575,37	27380,75	21072,91	13489,47
+ Std Deviation	US$	2085,61	637,80	28956,12	30384,79	42337,16
Net income per capita						
Mean	US$	344,41	408,19	6416,27	4783,50	3055,06
Std Deviation	US$	497,48	197,72	7462,26	7034,93	10561,97

Table 14. Success rate of key livelihood activities in the past five years

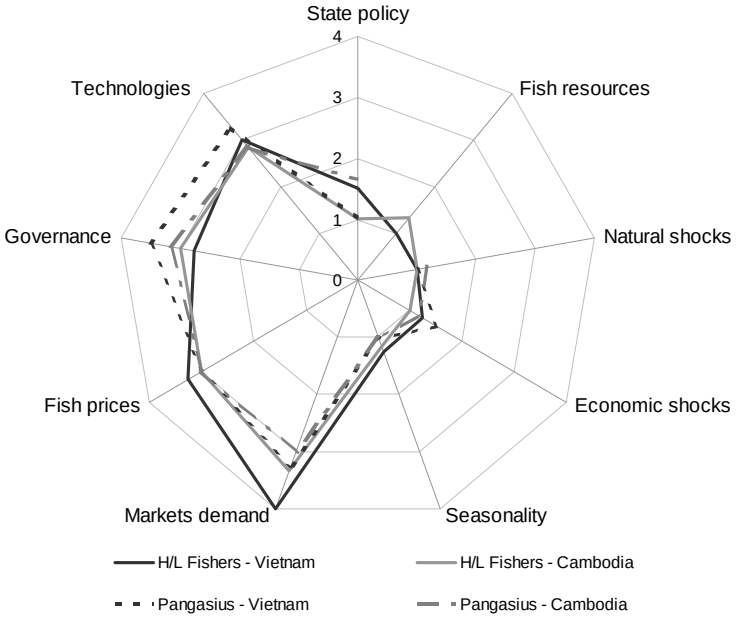
Respondents **Activities**	***Henicorhynchus / Labiobarbus* spp. fishing**	***Henicorhynchus / Labiobarbus* spp. trading**	***P. hypothalamus* hatcheries**	***P. hypothalamus nurseries***	***P. hypothalamus grow out farms***
% of the number of respondents					
Mean	59.9	61.0	96.2	77.9	74.1
Std dev.	20.1	12.0	7.5	20.3	17.9
1. Fishing *Henicorhynchus/Labiobarbus* spp.	59.9				56.7
2. Trading *Henicorhynchus/Labiobarbus* spp.		61.0			
3. Hatchery of *P. hypothalamus*			96.2	95.7	96.0
4. Nursery of *P. hypothalamus*			87.7	77.9	75.0
5. Grow-out of *P. hypothalamus*	73.3		77.0	65.0	74.1
6. Rice cultivation	79.1	70.0	69.2	89.1	90.7

5.3 Vulnerability analysis

The vulnerability of fishers and farmers is dependent on a household's ability to access the resources necessary for a sustainable livelihood. Because fishers and farmers are primary producers of raw materials in value chains their viability is a concern because reduced vulnerability of these actors benefits for the chain as a whole.

Figure **9** represents the perceptions of farmers and fishers on what vulnerabilities they will face to achieve their main livelihood activities in the future. Their main concern is over fluctuations in market demand and fish price, as well as changes in regulations. Farmers are also concerned about the limitations that technology can provide in terms of improving the efficiency of their production. Both groups place far less emphasis on economic or environmental threats that are a seen as extraneous to their control. The following sub-sections explain the current degree to which farmers can access the key capitals or assets required to ensure they can secure sustainable livelihoods.

Figure 9. Livelihood vulnerability index of *Henicorhynchus/Labiobarbus* spp. fishers and Pangasius farmers in the MRB.



Note: 1 = Low and 4 = high vulnerability

5.3.1 Natural capital

Both Pangasius farmers and *Henicorhynchus/Labiobarbus* spp. fishers confirm that changes in natural capital have had a negative impact on their activities (Figure 10). The main changes they are dealing with include weather/climate, seasonal availability of fishing habitat and resources, land suitability and accessibility due to flooding and water quality. The results indicate that, overall, Pangasius farmers are more able to deal with changing access to natural capital than fishers. The main reason for this is that the resources needed for farming are largely internalised

while the productivity of the fishery resources are more exposed to external environmental change.

Changes in seasonal weather pattern are identified as a serious negative environmental change by 55% of the respondents. The results indicate that Pangasius farmers are more than twice as successful at adapting to these changes fishers and farmers identify a range of production technologies and practices that allowed them adjust to changes in temperature and water quality. These include the application of chemical antibiotics to avoid disease and infection, the use of heating in hatcheries to adjust water temperature, better timing of feeding and release of fingerlings, and better management of water flows through the pond. Farmers are successful in 83% of the times they made adjustments to their farming practices. In comparison, only 47% of fishers were able to adapt their practices to seasonal changes including strategies to better time their activities to coincide with changing migratory patterns of fish and the use of improved fishing gears.

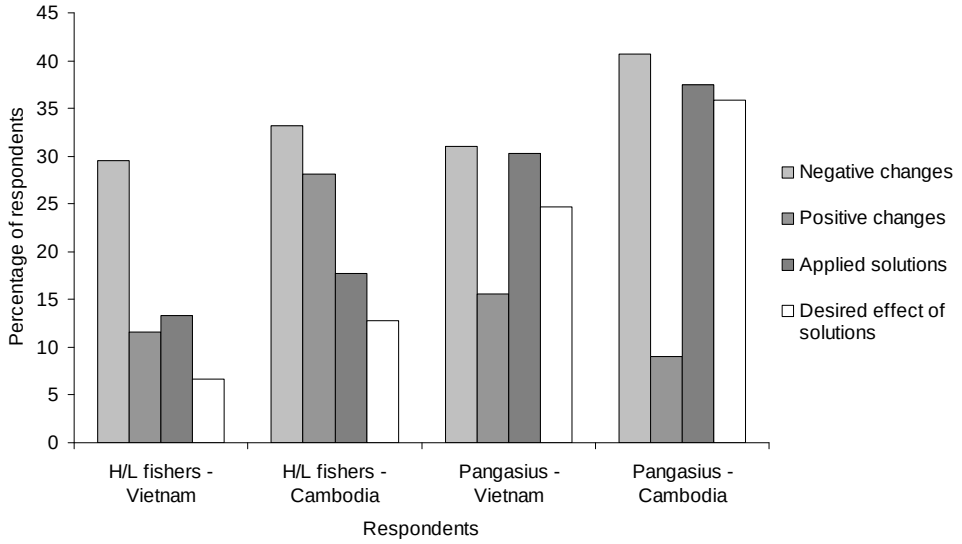
Uncertainty over changing seasonality was reported by 78.8% of 151 respondents. Between 30 and 35% of Pangasius farmers in Vietnam and Cambodia said they have been able to identify coping strategies to deal with these changes. Nursing farmers identified the rotation of ponds during the nursing phase while grow out farmers applied lower stocking densities in order to reduce stress on their fish. Nursing and grow-out farmers also apply more feed and pro-biotics to reduce stocking time or stocked larger fingerlings. Notably, farmers also seek buyers earlier in the growing phase in order to guarantee further costs involved in these solutions.

Poorer water quality from aquaculture and farming effluent was also identified as a growing concern to fishers and farmers. Approximately one fifth of respondents identify their lack of access to suitable water as a serious constraint to improving their productivity. Only 14% of Pangasius farmers stated they identified coping strategies of which roughly half were successful, including the establishment of production plans with surrounding farmers to ensure cleaner water exchange, expansion of ponds by renting land, and the early closure of ponds due to disease. The success rates of poor and wealthy farmers are not clear from the results. However, fishers, as net recipients rather than a source of effluent and pollution, thought themselves helpless in providing solutions to improve water quality.

The intensity of annual flooding over the last five years is noted as increasing by 48% of fishers, 11% of the hatcheries and 10% of the grow-out farmers. Not surprisingly fishers were more aware of the negative impacts of changes in water flows, especially to flooded habitat because of infrastructure construction. Fishers also noted that the depth of the flood offered an opportunity to adapt their fishing gears to target different species at different phases of the flood. If the flood was too severe fishers abandoned their activities to find wage labour. All of the Pangasius farmers are the most effective strategy for avoiding of their ponds was constructing embankments.

Approximately half of all respondents identified the decline of wild fish stocks as a key change in natural capital. In response fishers changed the time of fishing, the use of more and more efficient fishing gears and Pangasius farmers are increasingly purchasing processed feed. However, very few farmers and fishers could identify any positive coping strategies to deal with this decline. No solutions were offered for improving the status of fish stocks.

Figure 10. Perceptions of change to natural capital by *Henicorhynchus/ Labiobarbus* spp. fishers and Pangasius farmers in the MRB



5.3.2 Human capital

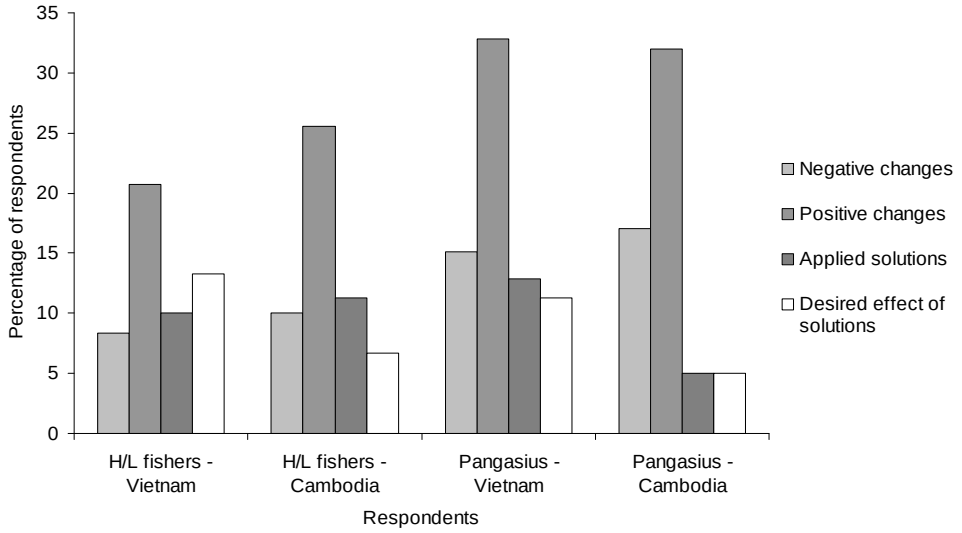
Between 20 and 35% of the respondents argued the changes in both fishing and aquaculture were very positive about changes to human capital – the range of skills and knowledge needed for livelihood specialisation or diversification (Figure 11). The positive perception of change is largely attributed to the enormous growth of the Pangasius industry in Vietnam. Nevertheless, the dynamic nature of the industry has also meant 'non-skilled' labour, such as fishers, have found it increasingly difficult to find secure employment.

Wage labour in the Pangasius sector is increasingly difficult to find due to the increasingly higher skill needed to effectively manage feed, stocking and chemical use. The respondents were concerned about the future prospects of finding consistent labour, both as employers in the case of farmers, and employees in the case of fishers. First, labour is particularly difficult to find for fishers who have on average no more than primary school education. Second, the seasonality of labour, mostly required in during the harvest of ponds also makes it difficult to find consistent labour. Both farmers and fishers were concerned about the trend in rates of pay. Farmers are concerned that higher wages for labour will put further pressure on their profit margins, while fishers are concerned that wages will remain too low to support their families. Finally, men find it easier to find work than women at the farm level. However, the respondents note that there are more opportunities for employment in the Pangasius processing sector where it is estimated 59% of the workers are women.

Pangasius farmers identified key strategies for coping with the recent shift to higher production costs including reducing the number of full time employees, shifting to part time or seasonal labour, and relying more on family labour. Larger farmers also noted the difficulties they face in finding suitable employees with technical aquaculture skills. It appears this demand for higher skill levels is in the favour of higher educated workers, notably those graduating from University degree courses.

Those farmers that are able to hire higher skilled employees said they are increasing the wages for technical positions on farms to attract these graduates.

Figure 11. Perceptions of change to human capital of *Henicorhynchus/Labiobarbus* spp. fishers and Pangasius farmers in the MRB



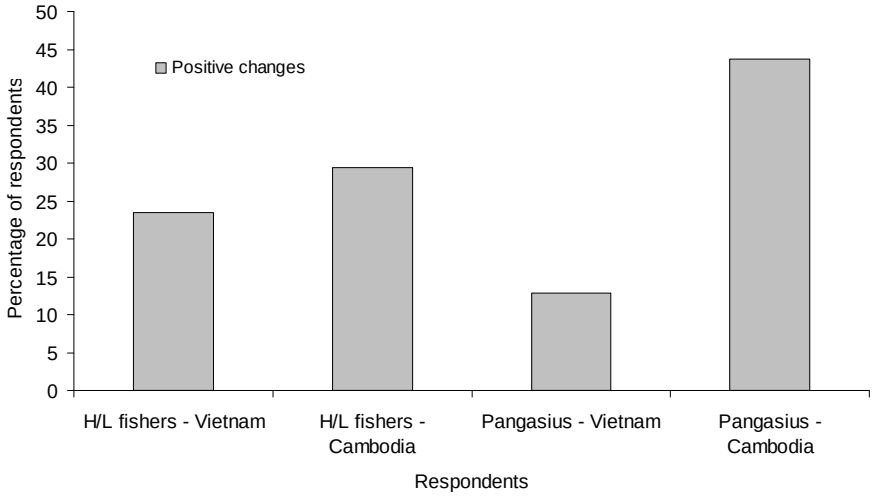
5.3.3 Social capital

Fishers and farmers have been able to improve their levels of social capital over the last five years (Figure 12). Indeed, none of the groups identified any negative changes in social capital. This result comes as a surprise given the results of the value chain analysis, where the earnings of both fishers and farmers were constrained by market poor bargaining power. The result may indicate that both groups see opportunity in these quasi-credit arrangements given they are unable to access formal credit.

Although not identified as a negative trend, respondents did identify a lack of new cooperation between value chain actors, particularly between groups of producers. Approximately 50% of respondents identified the need for improved market linkages and contractual arrangements such as the establishment of cooperatives, improved supply chain linkages between the hatcheries and nursery sites as necessary. They believe improving these relationships will reduce the economic vulnerability of chain actors to market fluctuation and production vulnerabilities caused by the poor quality of seed. However, the lack of new cooperation was not uniform across the Delta with half of the respondents in Takeo and Dong Thap reporting a positive trend in the new market linkages and collective organisations such as cooperatives.

Family networks are of primary importance in supporting farmers and fishers. Nearly two-thirds of respondents argued they were reliant on these family networks for financial and technical support when they had low production or when cash was needed for health emergencies. Smaller scale farmers with little formal training identify their lack of knowledge as a major constraint to successful Pangasius production. Instead of formal education these farmers argue they are improving their knowledge and skills through exchange with other farmers.

Figure 12. Perceptions of change to social capital of H/L fishers and Pangasius farmers in the MRB



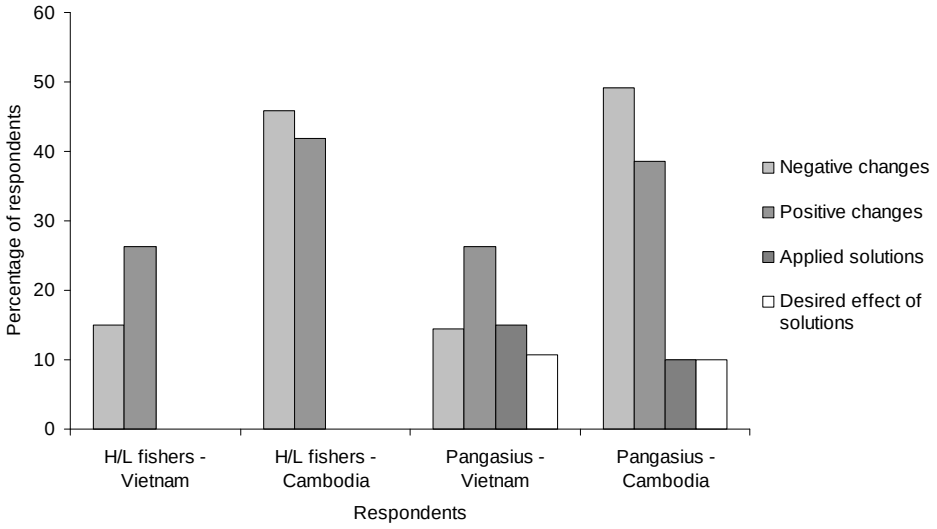
5.3.4 Physical capital

As a result of the huge investment in infrastructure throughout the Mekong Delta by government over the last five years respondents were very positive about the current level of publically funded physical capital. Transportation, markets and mobile communications were all identified as providing considerable benefits to between 40 and 74% of respondents in the various provinces.

Respondents in Cambodia were less positive about the development of physical infrastructure with nearly 50% of both fishers and farmers identifying a decline in the quality of energy and transport infrastructure. They identified a series of coping strategies for the problems they face including a shift to river transport in place of roads. To cope with the intermittent supply of electricity respondents kept fuel generators and developed more efficient use of these generators to keep costs down. Finally, to ensure that canals were kept open they organise their own initiatives to remove mud from the canal bottoms to keep the waterways open.

A smaller proportion of respondents noted positive changes to private infrastructure. The overall growth of the sector has meant approximately 55% of respondents have been able to upgrade their housing conditions, improve health care and secure better household sanitation facilities.

Figure 13. Perceptions of change to physical capital of H/L fishers and Pangasius farmers in the MRB



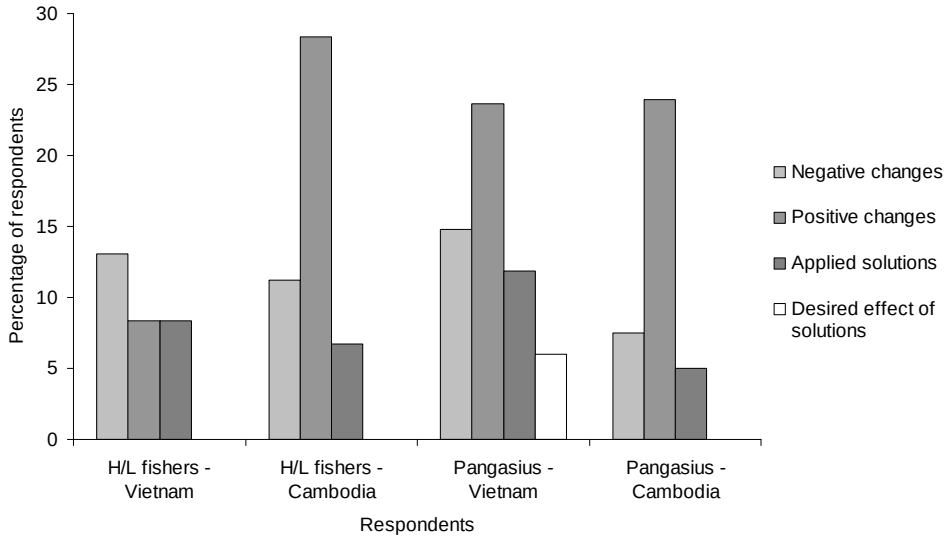
5.3.5 Financial Capital

In addition to calculating the costs and income of farmers and fishers (section 5.2) respondents were asked to comment on how they perceive their access to financial capital *vis-à-vis* external economic, political and environmental change. The results indicate that *Henicorhynchus/Labiobarbare* the only group that sees more negative than positive changes to their financial prospects. In contrast more *Henicorhynchus/Labiobarbus* spp. fishers in Cambodia identify positive changes to their financial status, and both Pangasius farmers in Vietnam and Cambodia are positive about their capacity to secure finances prospects.

Negative perceptions of financial capital are generally in response to market fluctuation. To compensate for the higher costs fishers reduce the number of people they employ to help them. Alternatively they purchase more fishing gears to increase their catches. It was not clear from the survey what extra costs such a strategy incurs, but it is assumed the cost per unit effort drops to profitable levels during these times to a level that at least covers their operating costs. Farmers employ similar strategies to compensate for higher economic risk, including diversifying to alternative livelihood activities, changing the fish they stock, reducing the area of production and stocking density.

Livelihood diversification remains a key means of reducing financial vulnerability. Overall, 44% of all respondents emphasized the important role of rice cultivation and livestock in reducing fluctuation in income from fishing and aquaculture. Just over one third of farmers and fishers both see the increased availability of wage labour in the Mekong Delta as an important source of alternative income. They argued that further investment in industrial zones in rural areas increases their ability to secure income that reduces their vulnerability to production failures.

Table 15. Perceptions of change to financial capital of *Henicorhynchus/Labiobarbus* spp. fishers and Pangasius farmers in the MRB



6 POLICY ANALYSIS

The ability of government policy to mitigate the effects of internal and external changes to Pangasius production and the *Henicorhynchus/Labiobarbus* spp. fishery remains largely unexplored. The results of the survey show the level of knowledge fishers and farmers have on various policy areas as well as their perceptions about their effective. In total 50% of Pangasius farmers were concerned about the impact that policy and regulation of their activities, especially because they have been subject to food safety regulations and are concerned about the emerging environmental and social standards. In contrast, only 37% of fishers were concerned about the impact of policy and regulation on their activities, largely because of the low level of surveillance over their activities by the government. The following focuses specifically on the current knowledge of government policy of fishers and farmers and the degree to which they believe these regulations reach their goal of environmental protection, extension of new technologies and practices and economic development.

6.1 Environmental protection

Pangasius farmers are very knowledgeable about policies and regulations related to land and water management. Between 81 and 93% of all respondents knew about these policies (Figure 14). Of these 28% acknowledged that policies related to land use had a strong impact on improving environmental protection, while 19% said the water related policies were effective. Approximately the same number of respondents stated that the policies had exacerbated environmental degradation, due to either poor enforcement or a lack of incentive for farmers to comply.

A number of solutions to increase the effectiveness of these policies were offered by the respondents. The most commonly cited solution was to discard the current taxes and fees on both land and water use for aquaculture because most farmers had an area of land smaller than what was taxable by the government. Secondly, farmers also regard water as a common resource which should not be taxed and that they would only be able to comply with water management regulations if they could increase the scale of their production. Thirdly, farmers acknowledge the

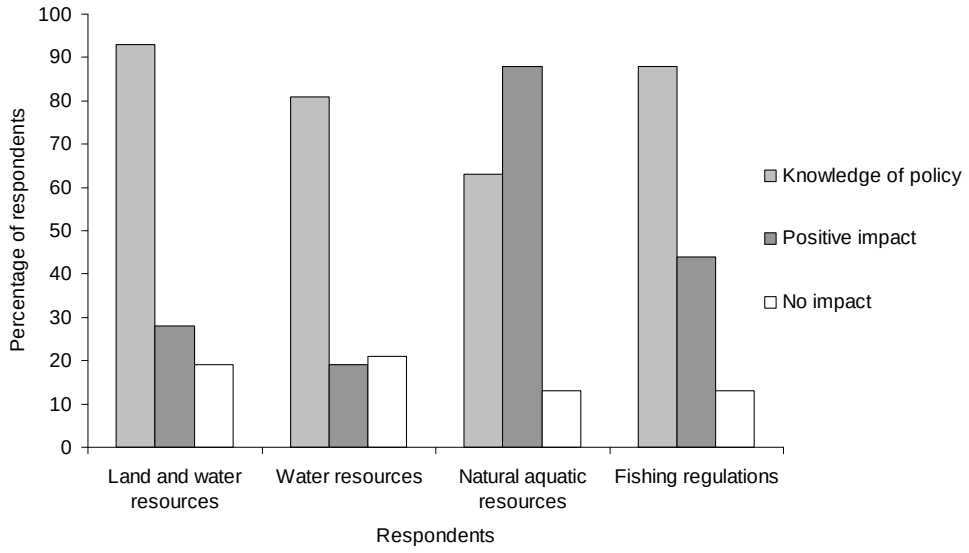
need for more meaningful participation of farmers in the planning process for Pangasius farming. Finally, farmers argued that complex administrative procedure for planning and regulation at the local level prohibits farmers from applying for permits and providing information on farming practices.

Respondents also had suggestions for improving policy and regulation on the management of water resources. Their first concern was that the policies related to the location of cage culture and discharge of water are applied inconsistently across large water bodies such as the Mekong River and major canals. They suggest that better management of these resources requires local administrations to improve their cooperation in order to apply management practices more consistently. Farmers also acknowledge the low levels of compliance related to the use of water resources regulation, especially those related to the effluent discharge. They argue that increased compliance will only be possible if the government can provide stricter fines to those violating regulations.

Fishers were also relatively knowledgeable about policies and regulation related to fishing and the use of water resources. In total 88% and 62% of fishers knew about recent changes to these respective policies. However, nearly 90% of fishers acknowledge that these policies have little or no effect on environmental protection. Fishing regulations were acknowledged as having brought about change in fishing practices by only 12.5% of respondents, while 44% argued that these regulations had no effect on fishing, largely because of “free riding” behaviour and poor enforcement.

No suggestions were offered on how to increase the compliance of fishers. However, respondents offered suggestions for improving the regulations themselves. They argue the government should invest in stricter enforcement across the Delta, acknowledging there is little if any surveillance of fishing activities currently. Close attention should be given to the use of particularly destructive fishing gears in the dry season. Finally, they recognised the need to prioritize the education and improve the financial status of poor fishers allowing them to fish with less destructive gears.

Figure 14. Knowledge and impact of policies related to environmental protection

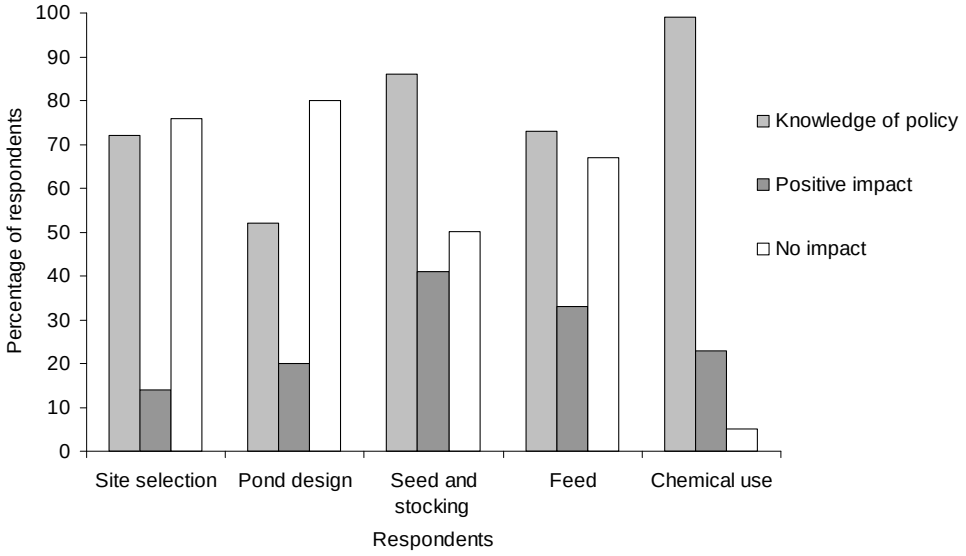


6.2 Production technologies

The practice of aquaculture in Vietnam is highly regulated with farmers subject to rules on site selection, pond design, stocking, and the use of feed and chemicals. Between 58 and 99% of farmers know about the various policies and regulations (Figure 15). However, farmers report that few of these policies successfully change farming practices, either because of a lack of enforcement or because they lack the capacity to meet the criteria.

Policies relating site selection of ponds have a strong influence over the access of farmers to water and feed. Nearly three quarters of farmers acknowledge they know about these regulations, but they all believe the policies and regulations have little or no impact on their production practices. The main reason for the ineffectiveness of the regulation is that the majority of farmers are small scale producers who are constrained in expanding their production because they are building on hereditary plots of land. Despite wanting to move their ponds to more suitable land, or extend their system to include sludge settling ponds, they are constrained by the cost of renting of buying new land. Large scale, wealthier farmers are more able to comply with site selection criteria when expanding their operations. However, low enforcement by government agencies has meant that many of these producers have been able to avoid having to comply with these regulations.

Figure 15. Knowledge and impact of policies related to production technologies



Government policy relating to the design of ponds is less well known by farmers with only 52% respondents acknowledging they know about the model farm design. Correspondingly the highest proportion of farmers acknowledge that this policy is least effective in changing farming practices. One fifth of farmers did recognise the potential of the government sponsored farm design in benefiting farmers. It is likely the lack of flexibility of most farmers due to restrictions of land and low levels of capital, especially in the case of small-scale farmers, restricts farmers capacity and willingness to comply with the policy. Because of the difficulties these farmers face less attention is also given by government extension services on ensuring a high level of compliance.

Regulations and policy related to the main production inputs of seed, feed and chemicals are all well known by farmers. Farmers are particularly knowledgeable about chemical use, however only very few(one quarter of all respondents) believe these regulations have any benefit to production. There are two main reasons farmers do not comply with these regulations. First, farmers wish to protect their investment from disease as well as wanting maximum growth in shortest length of time. Second, farmers believe they are able to apply many of the chemicals and then, by stopping the application of these chemicals in time, avoid detection in the processing companies. This finding may indicate that value-chain systems of surveillance controlled by processing companies may be more effective that state policy.

Policies relating to seed are seen by farmers as being moderately successful. More than 80% of farmers know of the policies related to the centralised control of seed quality but only half of these farmers see the policies as providing more security to their production. Half of the farmers believe that the policies make no perceivable difference to their production. Similarly, policies relating to the use of manufactured feedand the registration of farms are seen by farmers as having the most positive effect. Fewer farmers knew about these policies than of seed and drug use. Two thirds of respondents believed policies related to seed had no positive impact on their production because they rely mainly on their own experience, or advice from other famers and suppliers. Farmers suggested that in order to improve the success of these policies more research should be carried out on maximising feeding rates and volumes, as well as the environmental impacts of feed.

6.3 Economic performance

Farmers and fishers are reasonably aware of policies and regulations related to economic performance including loans, taxation, marketing and contracts, with between 44% and 58% of all respondents having some knowledge of them. However, like policies related to environmental management and production technologies, there are mixed opinions on how effective government intervention is in reducing the economic uncertainty and risk of production.

Access to credit is a major constraint to farmers who are trying to expand their production, or trying to bridge a period of poor production. Less than half of the respondents knew there were regulations related to lending, including obtaining legal documents. More than half of the respondents said that these policies had no effect in promoting or regulating the lending practices. The main reason for this may be due to the lack of access small-scale farmers have to formal credit. Banks are hesitant to lend for aquaculture many farmers obtain credit from informal lenders who, although illegal, are largely outside the control of the state. Farmers argue that for formal credit to be more effective loans should be made easier to obtain with lower interest rates. However, given the current financial crisis it is unlikely banks will loosen their lending requirements. Informal lending is therefore likely to increase in importance in the fisheries sector, especially for small-scale farmers and fishers.

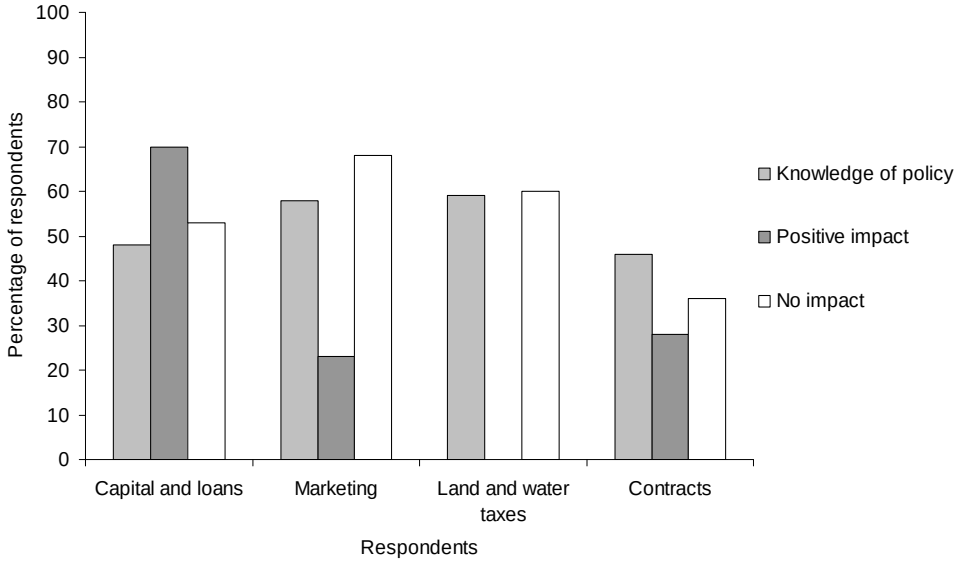
Both Vietnam and Cambodia have developed laws related to the marketing of fish products including registration of trading and quality management with the wholesalers and companies. Despite the effort to promote these laws as part of the wider push for an export driven economy only 58% of respondents know of these policies and regulations. Furthermore, approximately two thirds of respondents responded that these marketing policies have little impact on their

production and trading practices. The ambivalence of farmers and fishers to state intervention of marketing appears to highlight a paradox in government policy in Vietnam. The government is attempting to increase its intervention in markets, including stabilizing the prices, while at the same time liberalizing markets and foreign investment. Farmers are exposed to competition for their products and international standards governing their production practices while also looking to the state to provide guidance and support. How effective this guidance and support can be still remains questionable.

Land and water taxes are seen by all respondents as providing no positive impact to their activities. The reason for this is not clear, but it assumed that they see few benefits return to them in the form of support for production, from the money they pay to the government. This trend may increase as the private sector adopts monitoring, testing and extension services as part of their own market strategies or safety and quality certification systems. Not surprisingly respondents all agreed that lower taxes would be the most positive change to the current policy.

Contracts are becoming increasingly important within the fisheries sector of Vietnam. As farmers are embedded in increasingly global value chains they are being exposed to improved conditions of production and trade. Farmers throughout the Delta in particular argue that more elaborate contractualisation to processing companies signed at the start of a production cycle would decrease their vulnerability to price fluctuation. Despite these observed benefits less than half of the respondents knew of government policies designed to promote better conditions for production contracts. Nearly three quarters of those who knew about the policies believed they had no impact on their production and trading activities. The main reason for this negative assessment is that parties breaking contracts are rarely prosecuted. Farmers suggest that local government should be more involved in brokering contracts and enforcing contracts should agreements not be kept.

Figure 16. Knowledge and impact of policies related to economic performance



7 DISCUSSION

7.1 Value chains

The results confirm the export orientation of the Pangasius industry and show a new trend to export markets for *Henicorhynchus/Labiobarbus* spp. in Vietnam. Contrary to the expectations of the research no export trade was detected from Cambodia, although it is likely this is due to limitations in the research design and execution. New markets for *Henicorhynchus/Labiobarbus* spp. hold significant implications for fishers in both Vietnam and Cambodia as the overall catch of the fish declines and prices increase. The more transparent and vertically integrated export oriented chains show the potential for small-scale farmers to capture significantly higher value that fishers are able to achieve. However, the results demonstrate that overall both groups groups are the most vulnerable actors in both the *P. hypothalamus* and *Henicorhynchus/Labiobarbus* spp. chains. The main constraints faced by fishers and farmers are their poor bargaining power for inputs as well prices for the fish they produce. Both groups account for the lowest gross added value and receive the lowest income of any actor in their respective value chains. In contrast, processors and retailers capture more than two-thirds of the gross profit in the chain.

The results also show there is overall relatively little support for fishers targeting *Henicorhynchus/Labiobarbus* spp. both in Cambodia and Vietnam. Until now there have been few state, private or NGOs who have intervened in the value chains to provide technical support, regulation over quality or safety. Although the state has placed emphasis on the high volume Dai fisheries in Cambodia there has been less attention on the more dispersed fisheries. In Vietnam the fishery remains largely outside the governments regulation and control. Despite the lack of data on cross-border trade of *Henicorhynchus/Labiobarbus* spp. between Cambodia and Vietnam in the survey, there is considerable evidence that the trade is high volume. As demand for the fish increases in Vietnam, especially in domestic and export consumer markets, these illegal flows of fish will become more important.

If the fishery is to expand then structural changes are required to ensure a more equitable distribution of profits. For fishers to capture a higher share of profits then they will have to strengthen their links with retailers and by-pass collectors and wholesalers. However, there are considerable constraints in achieving such structural change to value chains. The quasi-credit schemes that underlie most of the value chains in both Vietnam and Cambodia may restrict bargaining power of fishers, but they also enable access to credit that is largely unattainable for landless and poor fishers. Even in the capital intensive Pangasius industry quasi-credit schemes are evident to cover short term cash flow issues for inputs such as feed and seed. If desirable by fishers and farmers, formal (micro) credit schemes may improve the transparency of the value chains and improve bargaining power, leading to a higher share of profit.

Demand for fish appears to be income elastic in Vietnam especially. This is again highlighted by the higher demand for *Henicorhynchus/Labiobarbus* spp. as it emerges as a higher value, specialty fish. The selection of fish is based largely on income and price, but there is also an emerging awareness of food quality and safety. Currently concerns are related more to Pangasius and not *Henicorhynchus* and *Labiobarbus* spp.. There does appear to be some potential for raising issues related to environmental concerns over both capture and culture fish. However, health concerns are currently more influential over consumer choice.

There are a range of opportunities that the fisheries sector of both Cambodia and Vietnam should further investigate. Membership to WTO will bring further market access and better regulation of international trade. This should strengthen the confidence of international investors to develop direct linkages with processing companies in the Mekong Delta. However, there are a range of new technical barriers that producers will be increasingly exposed to. First, food safety measurements are becoming more stringent, especially for lucrative European markets. Second, environmental and social standards are being developed that are also set to increase regulation of farmers and fishers. While technical barriers are assessed through the WTO environmental certification still remains outside of the discussions. How producers can cope with these standards is yet to be seen. But is almost certain there will be trade offs between livelihoods, economic expansion and improved environmental performance.

7.2 Livelihoods

The results of the livelihoods survey estimate that on average Pangasius farmers earn 14 times more per year than fishers. However, it is difficult to determine the capacity of farmers to secure these income levels on a continual basis, largely because of the exposure of farmers to economic risk from fluctuations in export markets. Instead, diversification and vulnerability of livelihoods are needed to withstand periods of economic or environmental fluctuation and uncertainty.

The results show that Pangasius farmers have annual income levels more than five times higher than the regional average of US$538 (CSO, 2007). Although these farmers cannot be considered poor they are highly vulnerable to market fluctuation. The results indicate that Pangasius farmers are relatively less diversified than fishers. This specialisation can be considered a strategy given that most farmers are financially capable of diversifying. Fishers by comparison are very willing to diversify their income streams away from fishing but are unable to do so because of a lack of financial, physical, social and human capital. Smaller farmers may have less potential for growth given restrictions in land, but they are more able to diversity to other fish species, or alternatively to downgrade from grow-out farming to nursing. If farmers do diversify they do so vertically within the industry, shifting their operations to nursing or hatching during periods when inputs for grow-out farming are too high. Overall, farmers have been able to move between these three activities relatively successfully, mainly because the return on investment is also very high, if not higher than grow out farming.

The different rates of return indicate the vulnerability of the various farmers to market and non-market forces. Pangasius grow-out farmers are highly dependent on the cost of feed which makes up nearly 90% of their total operating costs. Because their return on investment is only 0.7%, the lowest of all the groups surveyed, any change in either the price of feed or lower market prices can lead to severe losses which are difficult to make up. One of the key mechanisms farmers use to cope with poor production or poor market prices is through access to credit. However, farmers are more able to access credit through informal lenders meaning that any bridging finance comes with high interest rates if from their suppliers or traders, often implicit conditions of indebtedness. Given the variability of input prices and market demand is likely to increase in response to the global economic downturn farmers will be faced with periods of greater economic vulnerability.

The results also indicate that Pangasius farmers are not experiencing negative impacts of environmental change as predicted in many studies and reviews of the industry. Flooding is seen as a major risk by farmers but there appears to be

limited impact on their operations with most farmers building dikes in order to avoid inundation of ponds. Likewise, pens and cages are able to avoid flooding. Other external environmental factors such as changes to seasonality also appear to be relatively benign for farmers at this time as farmers are reasonably able to adjust the practices to deal with any changes. The dependency of fishers on the reproduction of fish stocks during the annual flood means they are faced with a direct trade-off. If the floods are mitigated and habitat is lost they catch less. Alternatively as flooding becomes more severe their physical capital is under risk of damage and they must seek alternative employment when flood waters become too severe. It is within this trade-off between environmental impact and access to financial capital that fishers and farmers are positioned.

There is a distinct difference in the sources of vulnerability and the capacity of farmers and fishers to cope with external impacts. Farmers may be more able to deal with environmental impacts but as they are intertwined more into global value chains they are increasingly exposed to new conditions of market entry and price fluctuation. Fishers are less exposed to these market fluctuations because traders take more risk in transporting the fish to market. The lower bargaining power may in fact insulate the fishers from economic vulnerability. However it means that they are also unable to diversify away from fishing. Fishers also appear to be far more vulnerable to environmental change given their dependency on water quality for the health of fish stocks. They are becoming more vulnerable because they are dependent on fish stocks which appear to be in decline, or fully exploited. Unlike Pangasius farmers these fishers do not have as much collateral for loans, or capital to invest in other forms of production, including aquaculture. Those that attempt to shift to aquaculture are more often than not unsuccessful.

7.3 Policy

The policy analysis indicates that government intervention has not been effective in mitigating the impacts of environmental change, promoting alternative production technologies or reducing the exposure of fishers and farmers to market fluctuations. The success of the Pangasius industry has meant that policy, regulation, extension and enforcement have not been able to keep up with the innovation of farmers. The government has had an essentially *laizze-faire* approach to the development of the Pangasius industry, largely due to the lack of evidence that there are serious environmental concerns related to production and the support this growth has given to economic reform at the national level. Fishers also regard policies as largely ineffective due to the lack of capacity of the government to monitor fishing activities, including both fishing and cross-border trade.

Pangasius farmers believe that state policy is largely ineffective in supporting more sustainable production. Farmers complain that the government is unable to disseminate information about new policies which disproportionately affects small-scale with lower levels of technical knowledge. Farmers also argue that there is very weak surveillance of state policies meaning that implementation of government programmes is *ad hoc*, with little follow-up monitoring. Despite the overly negative assessment made by farmers they offered few suggestions for improved policy intervention. Three suggestions that were made include lower taxation, improved transfer of technology and improved loan conditions. Given the already low land tax rate, of approximately US$12.00 per 1000$m^2$/yr it is unlikely reductions will be made. Extension services in Vietnam are based almost exclusively on farmer training and farming models. While there has been

enormous success in extending these general models to farmers in the Pangasius sector, fine tuning these models to individual circumstances has proven more difficult (Sinh, 2007).

For value-chain governance initiatives to succeed they will have to overcome the limitations that state policy has faced. The government has already started investing in the promotion of certification systems such as the WWF Pangasius Aquaculture Dialogue, EurepGAP and Safe Quality Foods (SQF). Questions remain over the division of responsibilities between these systems and the state: Can they provide extension and information? Can they provide technical support to farmers? Are they able to facilitate credit? Further research is needed, but it does appear that private sector actors, including processing companies, feed and chemical suppliers are key actors in extending information to farmers and better situated to respond to the needs of farmers than government extension workers. Although it appears few premiums are available in return for compliance with international standards (see for example Mantingh and Dung, 2008), value-chain governance mechanisms may still have the greatest leverage over farmers by regulating access to lucrative international markets.

Together the results of the value-chain and policy analyses indicate there may be implications for the development of value-chain governance systems. Low compliance with these standards would mean more fish would be directed into unregulated markets, namely domestic markets. As more than 90% of the volume traded goes to export markets famers are dependent on high market prices to remain profitable. A shift to domestic markets with similar prices to export markets, means that grow out farmers may be able to cope with shifting between channels. However, the lower demand for fish in domestic markets might mean farmers are forced to diversify away from Pangasius. It is more likely that these farmers will be the 80% majority of farmers that are small-scale in nature and contribute just 20% of the production. The other 20% of farmers, who are large scale and well linked to processing companies are more likely to consolidate their position in export markets with their stronger connections to the processing companies. For small-scale farmers to remain competitive they may require cooperative forms of production to improve their economy of scale in both production and the costs of compliance. The government may play an important role in this respect in collaboration with the An Giang Fisheries Association (AFA) in facilitating farmer compliance.

Farmers also note the need for improved enforcement of contacts. The rise in value-chain standards and third-party certification systems will increase the need for such enforcement. Both in terms of providing protection for farmers who need assurance that investments made in complying with standards will be make a return. If domestic markets absorb fish that does not comply with environmental or social certification the government will also play a continued role in food quality and safety governance. The results also indicate there is a growing awareness of domestic consumers of quality and safety issues related to Pangasius. What potential there is for the value-chain governance of ‘sustainable’ Pangasius production in domestic markets remains unclear given only a very small number of consumers noted environmental and social issues concern them.

For *Henicorhynchus/Labiobarbus* spp. fishers the lack of policy enforcement and policy means fishing activities will remain relatively unchanged. The difficulty in accessing flooded areas to monitor the fisheries contributes to the lack of monitoring. There are few laws which address cross-boundary nature of the

resource, or the trade. The diffuse nature of the resource and these trade networks means that the state will have to find alternative ways of regulating the resources. The government has been successful in regulating the Dai fisheries in the past, especially when there was cross border tensions in the ownership of these nets by Cambodians in Vietnam. The increased scarcity of *Henicorhynchus/Labiobarbus* spp. and the higher value of the fish in domestic urban and international markets there will be more financial incentive to monitor and regulate the fishery. As the fishery is highly migratory management efforts will remain trans-boundary. If good cross-border management can be established then opportunities may open to also establish better control over cross-border trade of *Henicorhynchus* and *Labiobarbus* spp..

Value-chain approaches do not appear to hold much potential for governing the management of *Henicorhynchus/Labiobarbus* spp. in domestic markets. However, the shift in consumer perception, the increasing export of *Henicorhynchus*/ *Labiobarbus* spp. to foreign markets and the growing urban consumption may lead to calls for conservation of the resource. There will have to be a stronger shift from human health as the primary concern to environmental issues. One possible means of increasing the conservation of the resource might be community-based approaches and the inclusion of fishers. Such approaches have been trialed successfully in the Mekong Delta of Vietnam (Sultana and Thompson, 2004) as well in other parts of the Mekong River Basin (e.g. Baird and Flaherty, 2005). Further consideration could be given to how best to adapt these community arrangements to the seasonally flooded *Henicorhynchus/Labiobarbus* spp. fisheries in both Cambodia and Vietnam.

8 CONCLUSION

This study has addressed four key questions related to form and function of value-chains, their contribution to the livelihoods of farmers and fishers, the effectiveness of government policy and the potential for value chain governance to steer towards sustainable production in the Mekong Delta. The two value chains focus on in this study, *P. hypopthalmus* and *Henichrohynchus/Labiobarbus* spp. contrast markedly in answering these questions. The main finding of the research is that actors in high value export chains have a higher potential income, but face considerably higher economic vulnerability. Alternatively, fishers are severely constrained in their ability to negotiate higher prices for their fish, but appear to be less vulnerable to economic and environmental change due to the social relations of trade. As a result value chain governance is more likely to be effective in high value export chains than domestic or regional value chains.

As expected the Pangasius value chain is meeting the export orientation of the Vietnamese government, with more than 90% of fish being sold to international markets. Processing companies are the most powerful actors in the Pangasius chain, providing the biggest input of labour and capturing nearly three quarters of the total net value added in the chain. Surprisingly there is only a small difference between the net value added of farmers and processing companies. Support is provided by the government through VASEP, NAFIQAVED and AFA. The role of AFA is currently ambiguous and further investment is needed to increase its capacity to support small-scale farmers.

The *Henicorhynchus/Labiobarbus* spp. is a considerably smaller and more diffuse value chain. Retailers are able to capture the most value in the chain because of poor transparency around transactions with fishers and the lack of preservation

technologies available. Also notable is the nearly complete absence of support to fishers and traders in this chain from government. Instead the chain is characterized by 'informal' support networks including quasi-credit arrangements which are important in structuring the chain and limiting fisher's ability to capture a higher share of the total value in the chain. This supports an alternative understanding of middlemen who provide the credit as rent seekers who also provide an important source of short-term finance to fishers who have no or little collateral to access formal credit.

Despite reports of large volumes of cross border trade from Cambodia to Vietnam this trade was not detected in the study, possibly because it is untaxed and therefore illegal. The results were also not able to determine what proportion was traded to Vietnam as fish feed and what proportion is sold for human consumption. As Vietnamese urban markets increase their demand for Henicorhynchus Cambodian fisheries will likely provide the supply. Vietnamese processing companies selling *Henicorhynchus/Labiobarbus* spp. are already looking to increase their supply from Cambodia. There is a clear opportunity for governments of both countries to ensure that this increased trade is carried out in a responsible way, with higher returns for fishers and traceable andtransparent supply chains.

The direct contribution value chains make to the livelihoods of fishers and farmers remains difficult to define. In terms of total income Pangasius related farmers make up to 18 times more than fishing households. However, because of the very low operating margin and small rate of return of Pangasius farmers - especially grow-out farmers - they are far more vulnerable to changing economic or environmental conditions. Pangasius farmers appear to deal with the higher cost of inputs and variable market prices for their fish by 'vertically' diversifying to nursing and hatchery farming. These vertical shift are preferable to 'horizontal' diversification away from Pangasius altogether due to their investment in infrastructure. Overall vertical diversification appears to be a relatively successful strategy. Nevertheless, their movement in and out of production enhances the inconsistent supply of Pangasius to processing companies thereby affecting prices.

Fishing households are willing to diversify their production away from fishing in the hope of obtaining more income and reducing their vulnerability to the variable productivity of fish stocks. This diversification may come at a cost. Although fishers receive a lower share of the total value of *Henicorhynchus/Labiobarbus* spp. they appear to be insulated from market fluctuation through their quasi-credit arrangements with traders. With demand for *Henicorhynchus/Labiobarbus* spp. is increasing in urban areas fishers are currently missing out on higher returns. However, lower prices for their fish appears to be an acceptable opportunity cost to ensure stability during periods of low demand, peak catches, and the guarantee of quick market access to these relatively distant markets at landing sites.

Government policy in Cambodia and Vietnam has been successful in promoting growth of the fisheries sector. Policy has proven less effective in supporting equitable distribution of benefits along value chains and reducing the vulnerability of fishers and farmers., The Vietnamese government has already began to outsource environmental regulation to private certification schemes. The area farmers believe the government can make the most important intervention is regulating their contracts with processing companies, as well as feed and seed suppliers. Farmers note that increased certainty over their variable costs and revenue will allow them to invest in cleaner production technologies such as water treatment. Given that contracts will shift risk to processing companies it is still

unclear what further investment they will make in strengthening provisioning arrangements with farmers.

Fishers largely operate outside government control both in terms of their fishing practices and economic activities. Fishers' knowledge about policies and regulations in most policy areas remains low and they are subject to limited monitoring and surveillance. At the behest of fishers stricter regulation and enforcement would improve violations. Any government intervention in credit and lending may prove ineffective given the flexible nature of repayments in informal and quasi-credit arrangements. The best approach to ensuring management may be through establishing or building upon community management arrangements. There may also be scope in expanding the role of such community arrangements to increase collective bargaining power in markets.

The lack of private investment in the processing and trade of *Henicorhynchus/Labiobarbus* spp. makes the task of developing sustainability criteria for the sustainable production, trade and consumption of these fish will prove only possible through concentrated state, NGO and multilateral efforts. A considerable hurdle to implementing market-based criteria for the sustainable management of both species is the complex, diffuse and power-based trade networks that exist within Cambodia, extending to Thailand, Laos and Vietnam.

The conclusions of the study suggest that for new value chain governance arrangements to successfully support farmers' livelihoods as well as promote responsible use of resource management of fisheries resources the following should be undertaken:

- Certification schemes should focus on ensuring price premiums are paid to Pangasius farmers in order to promote further investment in compliance.
- The promotion of collective forms of control to reduce variable returns for Pangasius farmers which restrict their willingness to invest in key infrastructure.
- The government should increased regulation of contracts between chain actors for the provision of inputs, the sale of produce and compliance to private food quality and safety standards, including those related to social and environmental processes of production.
- Research should be undertaken to investigate the impact of increased domestic trade of fish and the establishment of private sustainability criteria designed for *Henicorhynchus* and *Labiobarbus* spp.
- The Vietnamese government should foster improved cooperation to share experiences in improved production practices with the emerging industry Cambodia.
- Private and state chain actors should improve the access of farmers to sustainable production technologies and promote of policies and standards which foster farmer innovation in sustainable production.

This study has revealed how little is known still about *Pangasius hypopthalmus* and *Henicorhynchus*/*Labiobarbus* spp. value chains in Cambodia and Vietnam. To assist improved policy formulation future research should focus on: the elaboration of value chain strands for fingerlings, fish feed and fresh fish for human consumption; the trade offs between higher market access and human consumption; the specific importance of processed *Henicorynchus* and

Labiobarbus spp. in domestic, regional and international markets; the specific support different chain actors need to comply with emerging environmental and social regulation and standards; and finally, what new role the state should adopt to better regulate production *vis-à-vis* the growing role of private sector-led value-chain governance.

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