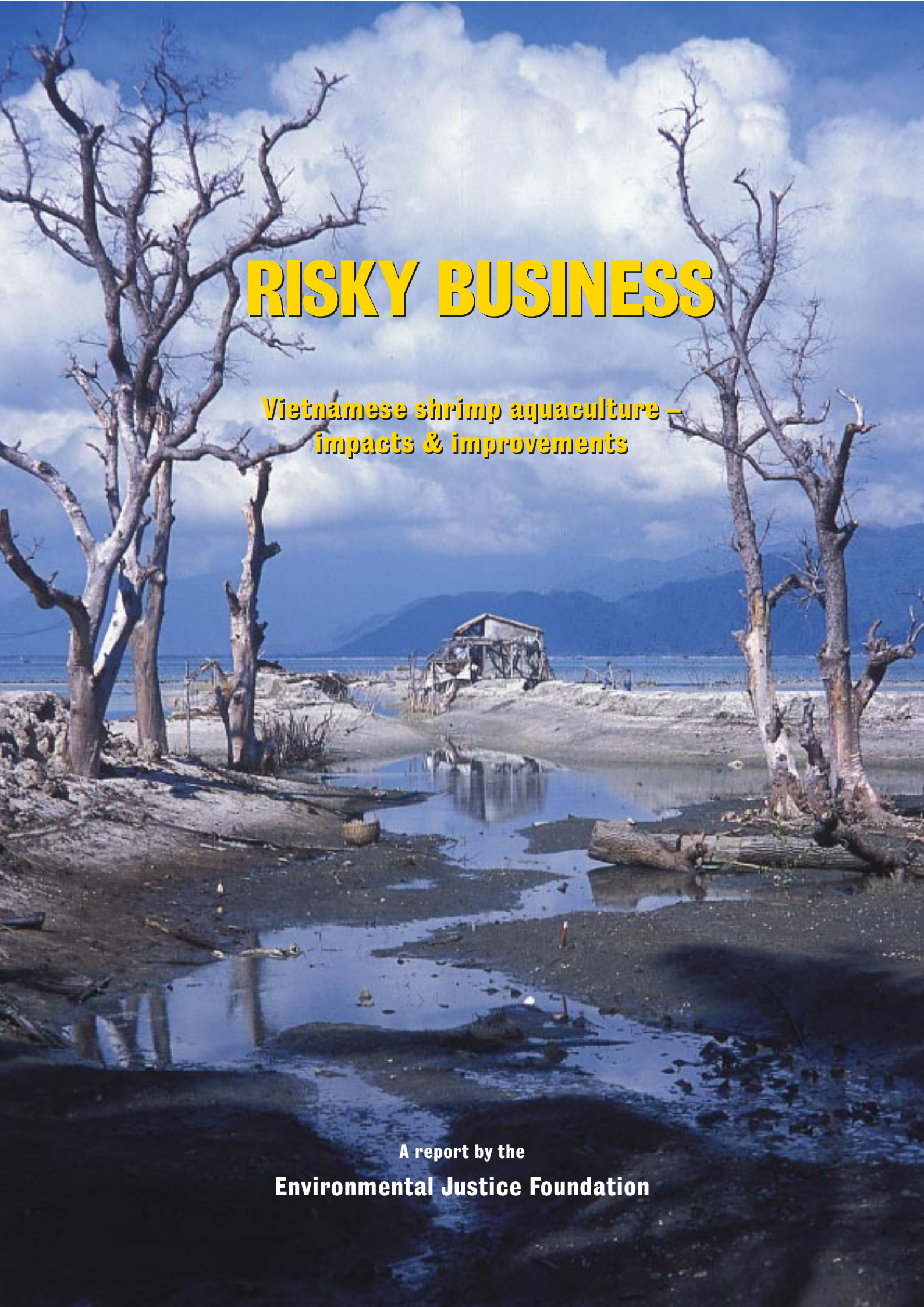

RISKY BUSINESS

Vietnamese shrimp aquaculture – impacts & improvements

A report by the

Environmental Justice Foundation

This report is one of a series documenting EJF's international investigations into the social, economic and environmental impacts resulting from shrimp production and consumption.

More information about EJF's work and pdf versions of this and other reports in the series can be found at: www.ejfoundation.org

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The Body Shop Foundation

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EXECUTIVE SUMMARY

Shrimp aquaculture is a major component of the Vietnamese economy. Foreign earnings from aquaculture are increasing annually, and the annual earnings from shrimp alone are estimated to be US$500 million.

Expansion of the industry is being encouraged as part of a government plan to raise the seafood export target to US$3 billion, and the total area of shrimp cultivation to 500,000 ha, by 2005, a plan which is intended to increase the living standards of Vietnam's rural communities.

Much of Vietnam's shrimp aquaculture has been unplanned and unregulated small-scale development, and has led to large-scale destruction of coastal environments, especially ecologically and economically important mangrove forests and other vitally important wetland habitats.

Mangroves are amongst the most important and productive ecosystems on the planet, supporting a high diversity of marine and terrestrial life through food web interactions and acting as refuges and nursery grounds for many commercially valuable species of fish, shellfish and crustaceans. Mangrove ecosystems also stabilise coastlines, in many cases promote coastal accretion, and provide a natural barrier against storms, cyclones, tidal bores and other potentially damaging natural forces.

Though the government has planned to reduce shrimp aquaculture's environmental impacts, and is implementing a 5 million ha reforestation program, aquaculture development plans are placing intense pressure on coastal areas.

Shrimp aquaculture development appears to have been important in poverty reduction and livelihood improvement for some households. However, for many rural poor, due to the activity's high risk nature, it appears also to have led to increased socio-economic differentiation through increasing landlessness and land agglomeration, and may thus have increased poverty on an individual level.

Though direct human rights abuses documented in other shrimp producing countries are not immediately evident in Vietnam, resource-use conflicts associated with shrimp aquaculture appear to be increasing, and shortages of fresh water, salt water intrusion, decreasing shrimp yields, low prices of agricultural products and pollution of estuarine water bodies are all beginning to threaten farmers' income and food security. Potential for conflict, due to resource-use disputes and exacerbated by increasingly degraded environmental conditions, should be recognised.

Many negative environmental and social impacts of shrimp aquaculture are directly related to inadequacies in current methods of production. Whilst the Vietnamese government appears aware of many of the problems associated with aquaculture development and the importance of reducing environmental impacts, financial constraints hinder attempts to rectify these problems.

ABOVE: *Shrimp farming has boomed as an industry in Vietnam, but has been poorly-planned and inadequately regulated.*

Short-term solutions include improved production techniques, greater education and technology transfer, and improved financial strategies to reduce risks to small-scale farmers. In the longer term, greater land-use planning is needed, both during shrimp production and with respect to uses after the cessation of aquaculture.

The existing aquaculture extension infrastructure, with fishery extension centres working in every commune, often in close co-operation with universities, People's Committees and local farmers, provides a potentially good basis for communication and information exchange. Additional funds and resources should be targeted to these services.

Shrimp aquaculture as currently practised in Vietnam is largely unsustainable, and widespread future productivity declines and enforced land abandonment are predicted. Vietnam's continuing development drive relies heavily on shrimp aquaculture. It is essential that this industry be conducted in an economically, environmentally and socially sustainable manner. Vietnam must seek a return to sustainable shrimp aquaculture and identify alternative means of local livelihood improvement and export revenue generation.

Without high-calibre strategic planning, Vietnam's move towards unsustainable intensification may have serious consequences in terms of increasing social disparity and landlessness, escalating resource-use conflicts, over-dependence on the shrimp export market, and problems of what to do with shrimp farms abandoned following productivity declines. Scrutiny of the future impacts of aquaculture will be impeded by the near-total lack of independent civil society organisations in Vietnam.

A small price to pay for environmental justice

£5 / $6 per month could help kids get out of the cotton fields, end pirate fishing, protect farmers from deadly pesticide exposure, guarantee a place for climate refugees

This report has been researched, written and published by the Environmental Justice Foundation (EJF), a UK Registered charity working internationally to protect the natural environment and human rights.

Our campaigns include action to resolve abuses and create ethical practice and environmental sustainability in cotton production, shrimp farming & aquaculture. We work to stop the devastating impacts of pirate fishing operators, prevent the use of unnecessary and dangerous pesticides and to secure vital international support for climate refugees.

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ENVIRONMENTAL JUSTICE FOUNDATION

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INTRODUCTION

'At the shrimp villages that I have visited, these small creatures make only strangers rich, whereas local people have earned little. In this manner they will sooner or later become tenants on their own plots of land.'

Nguyen Van Tuan, Vietnamese journalist[1]

This report describes the development, current status and future targets of shrimp aquaculture in the Socialist Republic Of Vietnam (henceforth Vietnam). We highlight the social and environmental importance of mangrove and wetland habitats and demonstrate the decline in such ecosystems due to shrimp aquaculture. We characterise the economics of shrimp aquaculture, both nationally and at the local level, and highlight the industry's key problems. Finally we describe a range of alternatives and solutions, and present recommendations to the Government of Vietnam, the international donor community, non-governmental organisations and the governments of shrimp-importing countries.

Vietnam is a densely populated South-East Asian country, bordering China in the north and Laos and Cambodia in the west, with a 3,200 km coastline stretching from the Gulf of Thailand, east to the South China Sea and north to the Gulf of Tonkin. Vietnam's largely rural population of 80 million is concentrated along the coast and heavily reliant on agriculture (67% of the labour force was in this sector in 1997)[2]. In 2000, per capita GDP was just US$1,950 and 37% of Vietnamese were estimated to be below poverty line in 1998[2].

In the years following post-war reunification in 1975, Vietnam's reconstruction was slow and heavily dependent upon socialist allies. However, the more recent *doi moi* liberalisation policy has opened Vietnam to global markets and increased Vietnam's participation in the world economy.

Population pressure, cessation of agriculture in favour of fishing, and a system of open-access fisheries have resulted in over-exploitation of near-shore resources and dwindling fisheries catches[3]. Consequently, the Vietnamese government has invested in and encouraged aquaculture to create employment and alleviate poverty. In particular, shrimp aquaculture has played an important role in Vietnam's economic development, and the country is now one of the leading exporters of farmed shrimp.

However, globally, the shrimp aquaculture industry has been associated with serious negative environmental and social impacts. Environmental problems include destruction of mangroves and other wetland habitats, and associated damage to coastal and marine ecosystems, dispersion of chemicals and nutrients into the environment, pollution and salinisation of soil and of ground and surface water supplies, depletion of ground water, and depletion and biological pollution of wild fish and shrimp populations. Social impacts associated with the industry include promotion of poverty, landlessness and food insecurity, elevation of risks from floods and typhoons, and impacts on health and education. In a number of countries, the industry has been associated with violence and serious human rights abuses; this is not evident in Vietnam, but the potential for conflict, largely based on resource use disputes and exacerbated by increasingly degraded environmental conditions, should be recognised.

For Vietnam, it is essential that lessons are learnt from other countries' experiences, that the potential for negative social and environmental impacts be reduced, and that sustainability within the industry is promoted.

OPPOSITE PAGE & ABOVE: *Shrimp farming has had major impacts on Vietnam's coastline, and has led to widespread destruction of mangrove forests and wetlands.*

DEVELOPMENT OF SHRIMP AQUACULTURE IN VIETNAM

Vietnam's entry into the global shrimp market lagged behind that of many other Asian countries[1]. However, favourable agro-climatic conditions, (particularly in the south), the opening of the economy following the economic renovation process of *doi moi*, expansion of the global shrimp market, and the spread of shrimp disease in other shrimp-producing Asian countries all led to a spectacular market entry[2].

Shrimp farming continues to expand rapidly across Vietnam. Production increased from under 200 tonnes in 1976[3] to over 100,000 tonnes in 2000[4], and 158,755 tonnes in 2001[5], with 80% of this production in the south and two-thirds of annual production processed for export[5]. In 2001, 446,208 ha of land were officially under shrimp aquaculture production, an increase of 97% from 2000[6], with an average yield of 0.36 ton/ha[5]. Today, shrimp culture is one of the most important activities in Vietnam in terms of area, production, employment and foreign exchange[3]. In 2000, Vietnam was the worlds fifth largest producer of farmed shrimp[7].

The fisheries sector in Vietnam exported US$1.76 billion in 2001, twice the amount exported in 1998, making it the country's third largest earner of export income, and seafood farms spread to cover over one million ha, a 74% increase from 1998[8]. Foreign earnings from aquaculture are increasing annually, and the annual earnings from shrimp alone are estimated to be US$500 million[9].

However, the government has estimated that Vietnam's current marine aquaculture capacity is only reaching half of its potential for development[10]. Prime Minister Phan Van Khai recently called on the fisheries industry to launch a new drive to boost quality, with a view to reaping US$2 billion in turnover in 2002, and raised the seafood export target to US$3 billion for 2005[8]. The Ministry of Agriculture and Rural Development plans to expand the total area of shrimp cultivation to 500,000 ha by 2005[11] and increase production to 300,000 tonnes[5].

Doi moi, which can be translated as 'renovation', is commonly used to describe Vietnam's economic and social transition since 1986. Three main directions of *doi moi* were a move from a centrally planned command economy to a market economy; democratisation of social relations; and opening up of doors to non-socialist countries[12].

LEFT: *Traditional extensive aquaculture. Shrimp, fish and others species are reared in net enclosures with natural water exchange.*

VIETNAMESE SHRIMP SPECIES[13]

Four species dominate Vietnamese shrimp production:

Machrobranchium rosenbergii – A freshwater species.

Metapenaeus ensis – The Greasyback Shrimp, a brackish water species, exploited from the wild rather than being farmed.

Penaeus merguiensis – Initially popular, this species, the Banana Prawn, is easy to breed but difficult to grow out after reaching 20g. Its intolerance of extreme salinity changes that occur in Vietnam has resulted in it being largely abandoned.

Penaeus monodon – The Black Tiger Shrimp has better growth rates (almost directly proportional to duration of culture) and copes better with salinity changes. This is now the species of choice for most shrimp farms. However, the high salinity (15-30 ppt) required by this species means that conditions in the Mekong Delta are not suitable for this species during the rainy season[1].

ABOVE:
Government-funded shrimp farm development on sandy land in Phu Dien commune, near Hue, central Vietnam.
© EJF / Shanahan

Shrimp Markets

Farmed shrimp realise different prices depending on their size (see table). Grade 1 and 2 shrimp are exported whilst those in Grade 3 are consumed locally. Although Grade 1 shrimp produce the greatest profits, many farmers are compelled to harvest early in order to repay loans taken out to invest in their ponds. In recent years, shrimp prices have fallen – in July 2001, Grade 2 shrimps realised about 50% of their peak price – whereas Grade 1 shrimp prices had decreased by about 30%[14]. However, even at these prices, earnings are approximately 15-50 times greater than for growing rice[15].

Black Tiger Shrimp size classes[14]:

Grade	*Shrimp/kg*
1	Max 20
2	20-30
3	30-40

Vietnam's main international export markets are the USA, Japan and EU, with some export to Africa. Although Vietnam is currently seeking new export markets[5], the October 2001 bilateral trade agreement with the USA suggests that exports to the USA are likely to dominate. Exports to the USA more than doubled between 2000 and 2002, making Vietnam the second largest exporter of shrimp to the USA[16]. The trade agreement is expected to lead to further rapid expansion of shrimp farming, delivering an export incentive while increasing competitive pressure, and with import tax levies on shrimp set to come tumbling from 20% to 5%[17]. Vietnam exported 27,200 tonnes of shrimp to the USA in 2001, worth US$317 million (43.2% of the country's total shrimp export revenue), and US$268.5 million to Japan[17]. However, seafood exports to the EU fell by 51% in value in the first five months of 2002, to just US$19 million[18], a slump likely to be linked to European detection of chloramphenicol residues in Vietnamese shrimp (see page 26).

Government policy

Aquaculture has been actively encouraged in Vietnam as a means to achieve development targets and increase exports, with official support taking the form of preferential taxation, supply of credit and investment in related infrastructure, and with national level policy encouraging growth of aquatic production[2]. For example, rice farmers in Soc Trang received capital boosts of VND 18-20 million (approximately US$ 1200-1333) per ha and unsecured loans of up to VND 50 million (US$ 3333) to encourage conversion to aquaculture[19]. Traders and exporters of aquatic products also have access to preferential taxation and financial support, through credit insurance funds, development support funds and export insurance funds[20].

Government Decision No 21, 1998:

'To quickly develop the aquatic product economy into a spearhead branch in the economy of the country, create many more jobs in order to help raise the standard of living of the people, bring about a face-lift of the rural coastal areas and contribute to living problems of the ecological environment to develop shrimp farming: to gradually move from extensive shrimp farming to improved extensive farming, semi-intensive farming to encourage the forms of inter-farming while forming areas of concentrated intensive shrimp farming'[21].

Government Decision No 67, 1999:

'To encourage family households and individuals to build aquatic products raising farms, to develop various forms of co-operative economy in the processing of aquatic product feed, in raising, exploiting and processing aquatic products for sale'[22].

LEFT: *Shrimp on sale in Can Tho market.*
© EJF / Thornton

Whilst Vietnam's government has encouraged increased production and intensification, it has also called for shrimp aquaculture development to be carefully planned, and has encouraged diversification to reduce industry risk and integrated farming to preserve ecological and agricultural balance[8]. However, it seems that the majority of Vietnamese shrimp farms are small-scale enterprises; much of this development has been unplanned and unregulated, carried out by farmers themselves with limited knowledge and resources[6,14,15], and has led to large-scale mangrove forest and wetland destruction.

Intensive or extensive?

Aquaculture methods are classified according to pond area, feed and chemical use, and stocking densities. Terminology varies between sources and countries, but it is of value to introduce the following definitions relevant in the context of Vietnam[13,23].

- Extensive/traditional: Mangroves and intertidal areas are enclosed by dykes in large ponds to allow polyculture of naturally stocked crab, shrimp and fish. Shrimp larvae densities are 1-3/m^2. Water exchange is by tidal action. Enclosed mangroves usually die after 3-5 years.
- Modified (Improved) extensive: Largely as above; stocking densities of 1-5 shrimp/m^2, with additional artificial stocking with crab, fish and shrimp. Fish and shellfish (*Abrina* cf. *declivis* and *Aloides laevis*) are used for supplementary feeding.
- Semi-intensive: Uses small (1-5 ha) ponds from which natural vegetation is cleared and in which supplementary stocking and feeding are routine. Shrimp densities are 5-8/m^2, and can occasionally reach 10-20/m^2. Ponds are often drained, dried and treated between flooding periods.
- Intensive: Small (≤ 1 ha) ponds, cleared of all natural vegetation and using artificial stocking. Feeding and aeration to maintain oxygen levels are necessary.

Conversion to aquaculture and intensification of production methods

Aquaculture has a long tradition in Vietnam. In the Red River delta, for example, aquaculture began over 100 years ago[24], and in 1996, Birdlife Vietnam reported that most aquaculture here was of the 'extensive' model[23] (see box).

However, faced with declining productivity, and encouraged by government policy to increase aquaculture production, shrimp farmers have increasingly switched to less sustainable, more intensive models. With limited annual yields of 100-200 kg/ha, improved-extensive aquaculture began to give way in the late 1990s to more intensive production. Yields increased to 3000-4000 kg/ha, with occasional Black Tiger Shrimp yields of 5000 kg/ha being recorded[25]. Most farms in central Vietnam have now adopted intensified systems, while those in northern and southern Vietnam continue to practice a variety of semi-intensive systems[26]. A recent study found that 90% of shrimp farmers in northern Vietnam, and over 50% of farmers in southern Vietnam intended to further intensify their production systems[26].

Such intensification of production requires considerable investment. The more intensive systems require inputs in the form of feed, chemicals and shrimp fry; oxygenation equipment, electricity supplies, water cycling, food (often imported from Thailand, the USA or Taiwan) and other inputs require about VND 100,000,000 (US$ 6666) per hectare[25].

The vast majority of shrimp farm development has been concentrated in south and south-central Vietnam, mainly in the Mekong Delta[3]. Although much of the delta's aquaculture, and particularly that on land governed by the forest enterprise, is a system of integrated mangrove-shrimp farming, shrimp yields from these systems have been declining[27], and aquaculture development and intensification has led to widespread mangrove and wetland destruction.

Further, government subsidies for conversion of rice land to shrimp ponds[28], and the high profit potential of shrimp farming compared to rice cultivation has led to large tracts of agricultural land being converted for shrimp aquaculture in Vietnam in recent years.

ENVIRONMENTAL IMPACTS OF SHRIMP AQUACULTURE

The principal environmental impacts of shrimp farms relate to their location, with mangroves, *Melaleuca* forests, lagoons, seasonally-inundated grasslands and other important wetland and coastal habitats increasingly impacted.

With a coastline of 3,260 km, approximately 11,000 species recorded in its marine and coastal waters, and 40 types of wetland habitat[1,2], Vietnam's coastal and marine ecosystems are of significant ecological, social and economic importance. Over 2,000 fish species, 130 of which have economic value, and 350 species of hard coral are known from Vietnamese waters[2]. A great proportion of the country's rice, fish and other food production is derived from wetland regions, particularly the Red River Delta in the north and the Mekong Delta in the south[3], and Vietnam's coastal and inland wetlands are important migratory and breeding sites for many vulnerable, near threatened and endangered bird species[4]. In the creation of shrimp farms, vast tracts of these vital habitats have been destroyed and degraded.

Other environmental problems associated with shrimp aquaculture in Vietnam include dispersion of chemicals and nutrients into the environment, pollution and salinisation of soil and water supplies, and depletion and biological pollution of wild fish and shrimp populations.

ABOVE RIGHT: *Mangrove forests provide a refuge for many vertebrate species.*

ABOVE: *Shrimp farms in Hoa Duan village, Central Vietnam .*

Degradation of wetland ecosystems

Mangroves & mudflats

'Mangrove' is a general term applied to specially-adapted, salt-tolerant tree species found between latitudes of 32º N and 38º S along tropical coasts of Africa, Asia, Australia and the Americas. Mangrove ecosystems comprise these tree species and the varied animal and plant life associated with them, and are usually characterised by conditions of high salinity, extreme tides, strong winds, high temperatures and muddy, anaerobic soils[5]. Closely associated with mangrove habitats are inter-tidal mudflats.

Vietnam has 38 true mangrove species and 45-50 associated species distributed in four discrete zones: North-East, Red River Delta, South Central, and South (divided into subzones); the majority are in the southern parts of the country, concentrated in the Ca Mau peninsular of the Mekong Delta[6,7].

Productivity and biodiversity

Mangrove forests are among the planet's most productive ecosystems[8,9,10], providing the basis for complex and extensive ecosystems at the interface of terrestrial, freshwater and marine habitats[11]. They are also among the most threatened habitats in the world today, and are declining at an alarming rate. The forests support a great variety of marine life and food web interactions, and act as refuges and nursery grounds for many species of fish, shellfish and crustacean, many of which are of commercial or subsistence value.

ABOVE: *Mangroves are among the most productive ecosystems in the world, providing the basis for complex ecosystems at the interface of terrestrial, marine and freshwater habitats.*

Mangrove ecosystems are also important habitats for a great diversity of reptiles, mammals and birds, many of which are threatened, and are increasingly under threat from habitat loss. Reptiles of conservation significance found in Vietnam's mangroves include the Monitor Lizard (*Varanus salvator*) and Estuarine Crocodile (*Crocodylus porosus*). Aquatic mammals include Dugong (*Dugong dugon*) and a number of dolphin species (including Irrawaddy Dolphin [*Orcaella brevirostris*], Chinese White Dolphin [*Sotalia chinensis*], and Black Finless Porpoise [*Neophocaena phocanoides*]), while terrestrial mammals include gibbons (*Hylobates* sp.), Crab-eating Macaque (*Macaca fascicularis*), Smooth-coated Otter (*Lutra perspicillata*), Fishing Cat (*Felis viverrina*), and the Clouded Leopard (*Neofelis nebulosa*)[3,9].

Vietnam's coastal wetlands are of considerable importance for many bird species, particularly migratory waterbirds. For example, Vietnam's Red River delta is an important staging post and over-wintering site for a number of globally threatened bird species, including Black-faced Spoonbill (*Platalea minor*) and Saunders' Gull (*Larus saundersi*)[3,12]. At the other end of the country, the Mekong Delta's 280,000 ha of mangrove and *Melaleuca* forests[3] support over 200 bird species, including large numbers of herons, egrets, storks and ibises (see box opposite).

Mangroves prevent shoreline erosion by acting as buffers and binding soft sediments, and through retention of nutrients, chemicals and fixation of heavy metals[13] they may act as efficient barriers to the transfer of pollutants, preventing contamination of near-shore waters. Mangrove root systems retard water flow, dissipating the energy of flood water[11], and this, together with the physical barrier mangroves provide, reduces the impacts of storms and typhoons. In addition to these important regulatory ecological values, many of which indirectly support economic activities, mangroves also provide many direct uses to communities, for example through provision of fuelwood, food, medicine and construction materials. Such mangrove products are vital to subsistence economies, and provide a commercial base to local and national economies[14].

WETLANDS OF THE MEKONG DELTA

The Mekong Delta is one of the largest and most complex wetland systems in South-east Asia, and is one of Vietnam's most productive and densely populated land areas, supporting over 14 million people[15]. With 736 km of coastline, 320,000 ha of brackish water bodies[16], and wetland covering 3.9 million ha, the Mekong Delta fulfils an important role in regional and global biodiversity conservation. Over 386 species and subspecies of birds and 260 species of fish are known from the delta, together with hundreds of other vertebrate species, including five species of dolphin and the vulnerable Dugong (*Dugong dugon*)[3,17]. It is an important breeding area and migration route for waterbirds, including many globally threatened and near-threatened species[1], such as the Chinese Egret (*Egretta eulophotes*), Asian Dowitcher (*Limnodromus semipalmatus*), and Painted Stork (*Mycteria leucocephala*)[4]. The eastern race of the Sarus Crane (*Grus antigone sharpii*), once thought to be on the verge of extinction, has been discovered wintering in large numbers here[3,18]. Socially and economically, this is a vitally important region, accounting for approximately 52% of national rice production, 70% of fruit production and 56% of sugar production[16]. The delta includes some of the most productive agricultural land in South-east Asia, with average rice yields estimated at 2.3 tonnes/ha, and supports one of the largest inland fisheries in the world, with an average yield from the Vietnamese portion of the delta of about 400,000 metric tonnes of fish. However, yield has been reported to be declining in recent years, partly attributed to overexploitation and destruction of wetlands[3].

RIGHT: *The Mekong Delta is one of the largest and most complex wetland systems in South-east Asia, and provides an important habitat for many threatened and near threatened bird species, such as the Painted Stork.*

Globally threatened and near threatened bird species recorded in coastal and inland wetlands of the Mekong Delta[4]

Wetland	Common Name	Scientific Name	Threat Category[19]
Inland Wetlands	Bengal Florican	*Houbaropsis bengalensis*	Endangered
	Sarus Crane	*Grus antigone*	Vulnerable
	Oriental Dancer	*Anhinga melanogaster*	Near-threatened
	Black-headed Ibis	*Threskiornis melanocephalus*	Near-threatened
	White-shouldered Ibis	*Pseudibis davisoni*	Critically Endangered
	Spot-billed Pelican	*Pelecanus philippensis*	Vulnerable
	Painted Stork	*Mycteria leucocephala*	Near-threatened
	Lesser Adjutant	*Leptoptilos javanicus*	Vulnerable
	Asian Golden Weaver	*Ploceus hypoxanthus*	Near-threatened
Coastal Wetlands	Eastern Curlew	*Numenius madagascariensis*	Near-threatened
	Asian Dowitcher	*Limnodromus semipalmatus*	Near-threatened
	Chinese Egret	*Egretta eulophotes*	Vulnerable
	Black-headed Ibis	*Threskiornis melanocephalus*	Near-threatened
	Spot-billed Pelican	*Pelecanus philippensis*	Vulnerable
	Painted Stork	*Mycteria leucocephala*	Near-threatened

IUCN Threat Categories:

Critically Endangered	A taxon is considered to be facing an extremely high risk of extinction in the wild
Endangered	Facing a very high risk of extinction in the wild
Vulnerable	Facing a high risk of extinction in the wild
Near Threatened	A taxon is close to qualifying for, or is likely to qualify for, a threatened category in the near future.

THE VALUE OF MANGROVES TO HUMANS

Fisheries: Mangrove habitats support large inshore fisheries in the Mekong[3] and Red River deltas, the forests providing refuges, feeding and nursery sites for many species of major economic importance (fish, shellfish, crabs and shrimp)[12]. A positive correlation exists between extent of mangrove and marine production[12], and it has been estimated that one ha of mangrove forest supports a marine catch of about 450 kg/yr in the Mekong Delta[20]. Mangroves are closely linked to the habitat conditions of coral reefs and seagrass beds; nearly 2/3 of all fish harvested globally depend on the health of wetlands, seagrasses and coral reefs at some stage in their life cycle[21].

Shellfish and other foods: Crabs (*Ostrea*), fishes and molluscs (e.g. *Cyclina sinensis*) are collected for consumption or sale[9]. In the northern districts of Nghia Hung, Xuan Thuy and Tien Hia, an estimated 330 to 730 kg/ha of shellfish are collected from intertidal areas each year[12]. Honey is produced from hives in mangroves, with a single hive yielding up to 18 kg per year[12]. The *Melaleuca* forests of the Mekong Delta account for about half of the honey brought to the market in the country[22].

Traditional uses of mangroves[9]: These include the supply of: fish poison from *Derris trifoliata* and *Aegicera corniculatum* roots, latex from *Excoecaria agallocha*; fodder for grazing animals from leaves of numerous species; cork from *Sonneratia* pneumatophores or *Excoecaria agallocha* lateral roots; organic fertilizer from *Avicennia* leaves; decorative carvings from roots and wood of *Rhizophora* and *Bruguiera*; and tannins for leather, inks, and fishing nets from the bark of a range of species, especially *Ceriops* and *Rhizophora*. Construction materials, firewood and charcoal are also produced from mangrove trees. Nypa Palm (*Nypa fruticans*) has many uses – fronds are woven into wall or roof shingles and used to wrap sticky rice cakes, leaf stalks are used as floats for fishing nets, leaf ribs are used to make brooms, immature seeds are eaten, and the palm is planted to protect land from erosion. Some mangrove species used in traditional medicine in Vietnam are shown on the right.

Coastal protection: On average, about five to seven typhoons strike Vietnam each year, raising sea levels many metres and sending storm surges up rivers. Already swollen by monsoon rains, the rivers flood surrounding areas, devastating property, infrastructure and crops[23]. Protecting vulnerable coastal areas from typhoon impacts is of very high social and economic importance. Vietnam has a system of more than 8,000 kilometres of river, sea and estuary dykes[23], essential for protection of the country's infrastructure and rice farming, which the government spends millions of dong repairing and maintaining[24]. In 2001, natural disasters claimed 560 lives and caused material losses of over VND 3.3 trillion (US$ 220 million); and in 2002, the government announced plans to pour VND 207 billion (US$ 13.6 million) into repairing roads and other infrastructure, and dyke embankments to reduce the damage caused by flood and other natural disasters[25]. In general terms, the greater the area of mangrove, the greater the benefit in terms of avoidance of maintenance costs for sea dykes[26]. In 2001, storm #4 hit Ha Tinh – in areas with mangroves, the dykes were safe, whilst in those without dykes eroded away[24]. In another commune in Hai Phong, dykes failed before the Vietnamese Red Cross Society implemented its project there. Now, there are 500 ha of mangroves and the dykes are secure. When Typhoon Linda hit the Mekong delta in 1997, the damage was less in mangrove areas than in those without mangroves[27].

ABOVE: *Nypa palms have many values to coastal communities.*
© EJF / Shanahan

Mangrove species with medicinal uses in Xuan Thuy protected Ramsar Site[7]

Acanthus ebracteatus
Boiled bark and root for colds, skin allergies. Bark in malaria treatment and back pain.

Acanthus ilicifolius
Leaves for relief of swelling, rheumatic pain, neuralgia

Acrostichum aureum
Leaves as poison antidote and applied to boils

Avicennia marina
Bark in contraceptives, leaves on abcesses

Clerodendron inerme
Leaves for treatment of jaundice, dried roots for wounds and cold

Crinum asiaticum
Tonic, laxative and expectorant

Derris trifoliata
Leaves as laxative, roots used in treatment of malnutrition

Excoecaria agallocha
Bark for leprosy, leaves for ulcers and epilepsy

Pluchea pteropoda
Treatment of scalds and burns

Rhizophora stylosa
Bark as astringent, anti-diarrhoea, for scalds and burns

Thespesia populnea
Scabies treatment

'For the last decade, the greatest threat to mangroves in Vietnam has been shrimp aquaculture'
Professor Phan Nguyen Hong, Vietnam National University, Hanoi[6]

The Impact of Aquaculture

The rapid development of shrimp aquaculture has had a very serious impact on Vietnam's mangrove forests. Over the last 50 years, Vietnam has lost at least 220,000 ha of mangrove forests[28] – more than 80% of original cover has been deforested[29]. In 2000, just 110,680 ha of mangrove were thought to remain[30]. Although agriculture, salt pan development and the war-time use of chemicals were previously the most important threats to mangroves (see box), for the last decade the greatest threat has been shrimp aquaculture[6].

In the Mekong Delta's Ca Mau province, the area under shrimp farming trebled in the 12 months to mid-2001[31], and is now reported to cover over 202,000 ha[32]. It has been estimated that mangrove cover in this area has dropped from over 200,000 ha prior to 1975 to 60,000 – 70,000 ha, and that almost all of this destruction has been from shrimp aquaculture[33].

Effects of mangrove loss are well documented. Mangrove destruction leaves coastal areas exposed to erosion and flooding, alters natural drainage patterns, increases salt intrusion and removes critical habitats for many aquatic species, with serious implications for both biodiversity conservation and food security.

Following widespread deforestation of mangrove areas during the American-Vietnamese war, there was a resultant crash in fishery production and shrimp catches[34], forest soil became more acidic due to loss of protective vegetation cover, and severe coastal and riverbank erosion occurred[35]. The impacts of current mangrove destruction are increasingly severe, and recently shrimp aquaculture has been suggested to be the cause of local extinctions in Vietnam, of milkfish, mullet and starfish species[2].

Globally, loss of mangroves in many areas has lead to reduced biodiversity, reduced fish catches, coastal erosion, acidification, loss of detrital foods, and loss of forestry products[36]. In Thailand, it has been estimated that for every kg of shrimp produced, 434g of fisheries are lost due to habitat conversion alone[37]. In Malaysia, fishermen reported a drop in income to 1/6 of its prior level within 2-3 years of large-scale mangrove clearance[38], while in the Chokoria region of Bangladesh, fishermen have reported 80% declines in catches since mangrove destruction and creation of dykes for shrimp farming[39]. Similar declines in fisheries catches have been reported in a number of other countries following destruction of mangroves for shrimp aquaculture development; these are discussed in more detail in EJF's companion reports on shrimp aquaculture[40].

BELOW:
Mangrove forest degraded by shrimp pond construction, Khanh Hoa.
© EJF / Shanahan

'Analyses of the characteristics and changes of the soil and water, the behaviour of creatures in the ponds, as well as on the tidal flats have shown that the construction of chain embankments for shrimp ponds has led to severe degradation of the environment and a decrease in the natural resources of the entire Ca Mau Cape'
Professor Phan Nguyen Hong[41]

In a country prone to typhoons and severe floods, mangroves play a crucial role in coastal protection (see page 10), and the costs of mangrove loss, both financial and in terms of human life and livelihoods, can be devastating.

While the government's mangrove protection efforts, and their involvement in and promotion of mangrove replanting schemes and integrated mangrove-shrimp farming systems should be welcomed, aquaculture development plans are placing considerable pressure on mangrove areas, and there is some concern over the exact models of integrated farming being used. In addition, it should be noted that integrated mangrove-shrimp farming systems do alter the suitability of the area for mangrove growth, and accelerate the succession from mangrove to terrestrial/inland species (see page 26)[42].

In 1997, Typhoon Linda claimed 3000 lives along Vietnam's southern coast, and in 1999 floods in the central provinces left 800 dead and caused US$350 million in damage. During the past two years, hundreds more people, mostly children, have been killed in Mekong River Delta floods that have caused more than $500 million damage[23].

In recent years, the forest enterprise has become more economically independent, and this may have encouraged the development of shrimp aquaculture on forest enterprise owned land[43]. The decreasing value of wood products and the regional Asian financial crisis have resulted in shrimp farming becoming a vital base for viable management of the forest enterprise, and in some areas the fact that the forest enterprise has to finance itself has led it to allocate land in order to protect the forest[44]. Without shrimp farming, there would be little incentive for the households with forest leases to protect the forest, a job that the forest enterprise itself cannot afford to do effectively[44].

OTHER THREATS TO VIETNAM'S MANGROVES

Agriculture: Historically, large tracts of mangrove have been cleared for agriculture.

War: From 1945-1975, Vietnam witnessed almost uninterrupted warfare, with severe damage to natural resources[3]. The use of napalm, herbicides and defoliant (Agents Orange, White and Blue) by the USA in the American-Vietnamese War devastated Vietnam's mangrove forests[9]. In total, it is estimated that 124,000 ha of true mangrove and 27,000 ha of back mangrove (dominated by *Melaleuca*) were destroyed[9]. The spraying was particularly intense in the south, where around 36% of mangrove forest was destroyed; much of this mangrove was dense or mature[9]. Ca Mau Cape received over 1,300 kg of Agents Orange and White between 1966 and 1970[45], and lost 52% of its mangrove as a consequence[9]. A significant proportion of the area degraded by herbicides was subsequently replanted, but large tracts all along the coast of Vietnam have now been converted again for use in aquaculture.

Cutting for fuel: Cutting of mangrove trees for firewood is now illegal but the law is reportedly circumvented by allowing logs to dry *in situ*[12].

Salt pan construction: Traditionally, mangroves were destroyed and salt ponds formed behind dykes. These produce an average 25 tons of salt/ha[9].

LEFT: *The vulnerable Dugong feeds almost exclusively on seagrasses. Seagrass beds and coral reefs are threatened by increased terrestrial run-off and siltation that can follow intense mangrove destruction and aquaculture development. Effluent from shrimp farms has led to serious seagrass losses in the Gulf of Thailand*[48].

BELOW: *Sarus Crane (Grus antigone). The Ha Tien – Kien Luong wetlands, one of the remaining strongholds of the SE Asian population of the Sarus Crane (Grus antigone sharpii) are under threat from shrimp aquaculture development.*

Coral reefs and sea grasses

Coral reef ecosystems host a considerable diversity of marine species essential to the sea's ecological integrity, and act to protect the shoreline by acting as a self-repairing breakwater. Sea grasses are the only exclusively marine flowering plants and often grow in dense, extensive beds which fringe sandy and muddy tropical and temperate coasts. Seagrass beds bind soft sediments, and create a productive and diverse habitat that provides shelter, food and vital nursery grounds for many other plant and animal species, including many species of crustaceans, fish, threatened sea turtles (such as the Green Turtle *Chelonia mydas*) and Dugong (*Dugong dugon*). Both coral reefs and seagrass beds are highly productive ecosystems. The net annual economic benefit of South-East Asian coral reef fisheries is estimated to be US$2.4 billion[46], and revenue generated through tourism can be very high. Though mangroves, seagrasses and coral reefs can all occur in isolation, research has shown substantial physical and biological interaction where they exist together[46], and both seagrasses and coral reefs are threatened by increased terrestrial runoff and siltation that can follow intense mangrove destruction and aquaculture development[47,48].

Over 95% of Vietnam's coral reefs are threatened, largely by human activities – half of the reefs are at risk of sedimentation[45].

Melaleuca forest & freshwater wetlands

Melaleuca species are generally associated with freshwater wetlands, and in Vietnam are found on the seasonally inundated alluvial and peaty soils behind mangroves[49]. The *Melaleuca* forests of the Mekong Delta, which have traditionally been a major source of fuel for the local population[50], were formerly very rich in wildlife, supporting a great diversity of mammals, birds, reptiles and amphibians, and providing nesting sites for considerable numbers of waterbirds[3]. However, the area of forest dominated by *Melaleuca* in the delta has been reduced from an estimated 700,000-800,000 ha in 1940, to 140,000 ha in 1992[51]. In the Ha Tien-Kien Luong region of the delta, *Melaleuca* forests have been rapidly reduced in recent years by the expansion of shrimp farming[18]. Indeed, the 2,200 ha Melaleuca reforestation project near Hon Chong mountain in this area (an important habitat for many endangered birds) is being encroached upon by shrimp farms at a very fast pace, a process likely to wipe out the whole project area if no protection measures are put into effect[18] (see box).

Seasonally-inundated grasslands of Ha Tien-Kien Luong

Though shrimp farm development is a serious cause for concern throughout Vietnam, one area that highlights the urgent need for action is the wetlands of Ha Tien-Kien Luong region, Kien Giang Province. The region, next to the Cambodian border and the Gulf of Thailand, harbours the last extensive remnants of seasonally-inundated grassland in the Mekong Delta, with patches of *Melaleuca* forest[18]. The biodiversity here is exceptional, with plant communities that are not present in any protected area, and many rare and endangered animal species such as the critically endangered White-shouldered Ibis *(Pseudibis davisoni)*[52]. The area is thought to be the only breeding site for the endangered Bengal Florican *(Houbaropsis bengalensis)* in Vietnam, and flocks of up to 100 of the endangered Southeast Asian population of Sarus Crane *(Grus antigone sharpii)* have been reported[52]. These wetlands are vitally important, and the seasonally-inundated grassland of the Ha Tien Plain was ranked the highest priority for wetland conservation in a 1999 Birdlife International assessment of key wetland sites. However, the area remains under tremendous threat from human activities. Of an estimated 25,000 hectares of grassland and forest on the plain in 1997[52], it was estimated that only 3,000 hectares of grassland remained in early 2001[53]. Conversion of the remaining wetlands is happening extremely rapidly[18]. Illegal shrimp ponds are being established and the use of flood canals to fill them is causing salinisation of the land. Much of this area is true freshwater habitat and its loss due to shrimp farm development is likely to be irreversible.

ABOVE & BELOW: *Tam Giang lagoon, with an area of 22,000 ha, is one of the largest lagoons in Southeast Asia.*
© EJF / Thornton

Lagoonal aquaculture – Tam Giang lagoon

Shrimp farm development is now increasing rapidly in Central Vietnam, where it is fast becoming a major source of income. 70 km long and with an area of 22,000 ha, Tam Giang is the one of the largest lagoons in Southeast Asia. It is an important aquatic environment, supporting a rich fish and invertebrate fauna, is a major staging and wintering area for migratory waterfowl, and an important source of natural resources for human utilisation. 300,000 people have settled around the lagoon and earn their livelihood by directly or indirectly exploiting its resources[54], which include molluscs, crustaceans and over 100 fish species. Annual finfish production alone was estimated to be 3,600 metric tonnes in 1997[3]. Disease has ravaged large areas under aquaculture development, and many shrimp ponds are now polluted and abandoned[54].

Legal aspects of habitat protection

Vietnam is a signatory to two international conventions with relevance to wetland conservation, the Convention on Biological Diversity (CBD) and the Convention on Wetlands of International Importance (Ramsar Convention)[1].

In many ways, Vietnam's government has been progressive in their protection of mangrove and other important wetland habitats, and it has called for the expansion of aquaculture to be carefully planned to protect the environment. It has encouraged diversification and integrated farming to reduce risk and preserve ecological and agricultural balance[55], promoted the development of sandy-land aquaculture[56], and supported mangrove replanting programmes) and projects focussed on defining sustainable land-uses in the brackish zone. There have also been public warnings about the risks of excessively intensive shrimp aquaculture and the fight against mangrove loss[57].

However, whilst these projects and the government's awareness of the environmental issues should be highlighted and welcomed, it appears that government plans for significant aquaculture expansion are placing incredible pressure on coastal areas, and there may be conflict between reforestation and shrimp cultivation expansion programs[51].

LEFT: *Supplementary feeding and the use of chemicals is common practice in Vietnamese shrimp aquaculture.*
© EJF / Thornton

In some areas shrimp farming on protected areas is being 'allowed' to continue, and even freshwater inland wetlands are now being developed. A senior academic, who asked to remain anonymous, stated that there are now many areas of small isolated patches (around 100 ha) of wetland left where, because they are considered to be too small to be of conservation value, the government has effectively turned a blind eye to aquaculture development. It was evident, both from observation and from our meetings in Vietnam, that though the government does seem to be aware of the environmental impacts of aquaculture, in particular wetland degradation, 'illegal' shrimp farm development in areas of ecological importance is continuing at a rapid rate.

Further, there seems to be a general lack of awareness of potential benefits that can be gained from environmental resources, particularly from mangrove forests. Many farmers view mangrove forests as problematic, believing leaves falling into ponds lead to pollution and disease, and that trees take up land that could be used for profitable shrimp ponds; collection of fuel-wood during thinning is not viewed as having any monetary value, and therefore is not viewed as important[42]. It seems vital that these attitudes are changed if mangroves and other vital wetlands are to be successfully protected.

Pollution

As shrimp production is a capital-intensive industry, post-larval survival rates are crucial to a farm's economic viability, and the high stocking densities that can maximise profits often lead to high levels of feeds, pesticides and antibiotics being used.

Many shrimp farms release effluent directly into the natural environment, and the water exchange necessary in more intensive shrimp aquaculture means that chemical inputs (disinfectants, antibiotics, fertilizers, pesticides, hormones) and waste (uneaten food, faeces, ammonia, phosphorous and carbon dioxide) may reach and contaminate groundwater supplies, rivers and coastal habitats. Shrimp pond effluents high in organic matter have a high biological oxygen demand (BOD), and can cause oxygen depletion in receiving waters.

Concerns surrounding pollutants include: persistence in aquatic environments; the possibility of residues in non-cultured organisms and seafood; toxicity to non-target species; possible effects on sediment bio-geochemistry; problems associated with nutrient enrichment; and possible effects on the health of farm workers[58]. There are growing concerns that the chemicals used in shrimp production may promote antibiotic resistance among micro-organisms, some of which are harmful to humans or their interests. Other chemicals used in aquaculture are known or suspected to induce cancer growth, mutations or developmental abnormalities. Wild species, as well as humans living in the vicinity of shrimp farms, may be exposed to dangerous levels of these chemicals.

SOCIAL & ECONOMIC IMPACTS OF SHRIMP AQUACULTURE

''In many coastal areas the spread of shrimp farming, resulting from clear government support, has resulted in a major upheaval in social structure. The subsequent failure of the shrimp harvest to reach initial profit levels has caused high levels of indebtedness, shifts in livelihood structure and an increased reliance on open access resources''

Dr Cecilia Luttrell[4]

Shrimp aquaculture has been encouraged by the Government of Vietnam as a method of improving the living standards of rural communities. Obvious direct benefits of the industry can include: job creation during construction; employment and income generation for shrimp farmers; local infrastructure improvements; and valuable foreign exchange inputs to the national economy through exports.

However, although shrimp farming appears to have led to general improvements in lifestyle in some areas (e.g. upgraded infrastructure, community health care and education[1]), the activity is characterised by extraordinarily high levels of risk, which exposes poor farmers to financial ruin and promotes increased socio-economic disparity.

Shrimp aquaculture may also have led to the promotion of poverty in some areas of rural Vietnam through reduction of access to coastal resources. This may be exacerbated by the uncertainty of property rights in wetland areas, (where most shrimp aquaculture takes place), resulting in loss of livelihoods for those who have used the land under de-facto or customary law[2]. These issues are discussed in more detail in further Environmental Justice Foundation reports[3] (see http://www.ejfoundation.org).

RIGHT: *Shrimp aquaculture is characterised by very high levels of risk, exposing poor farmers to financial ruin if harvests fail.*

'Shrimp have small mouths but they can eat my house and my motorbike – if they are lost, I lose everything.'

Shrimp farmer, Mr Huynh Tuyet, Xuan Tu village, Van Ninh District, Khanh Hoa[18]

Economics of aquaculture

Whilst the poorest farmers might use the relatively low cost – low return extensive system, in order to conduct more intensive aquaculture, considerable capital is required to excavate and manage a pond (see table).

The vast majority of shrimp farmers in Vietnam must borrow money to set up or intensify their ponds. Most loans are directly from a bank; the Vietnam Bank for Agriculture and Rural Development (VBA) is the major formal sector credit institution in the rural south and provides 80-90% of all loans to the countryside[6]. This money funds construction of dykes, sluice gates, and shelters as well as any inputs, such as post-larvae, feed and cleaning chemicals.

When aquaculture succeeds profits can be high, allowing farmers to pay off their debts, improve their living conditions and even buy more land. However, shrimp farming is an extremely high-risk undertaking. In 1999, Oxfam GB estimated that the risk of failure from shrimp farming in Duyen Hai was 50%, though in 1994-5 100% of shrimp harvests here failed[6]. In Tra Vinh, an estimated 80% of rich people are shrimp farmers, but 80% of poor shrimp farmers lose their investment[7]; Le Quang Binh (Oxfam GB) estimated that in 2001, 40% of shrimp harvests in Tra Vinh failed, with failure rates in some districts (such as Tra Cu) as high as 70%[8]. In Dam Doi district of Ca Mau, it has been estimated that 80% of shrimp farmers are currently losing money[9], and in Tuan Le Village, Khanh Hoa, 70-80% of shrimp harvests failed in 2001[10].

Defaulting on loan repayments is a common outcome when harvests fail, or yields begin to decline. Having already invested in pond construction, and perceiving a lack of alternatives, many shrimp farmers feel compelled to continue with the gamble, and if they can no longer get credit from the bank, may resort to private moneylenders' 'hot loans'. These can reportedly incur monthly interest rates as high as 10-20%[6,7], greatly increasing the risk of indebtedness. Should subsequent harvests fail, farmers can find themselves unable to make loan repayments and, unable to take out further loans, their last option is often to sell their land in order to cover their debts.

Consequently, shrimp farming has led to increased socio-economic differentiation associated with increased landlessness and land agglomeration in shrimp producing areas. Oxfam GB reported that there are almost twice as many landless people in Duyen Hai District than in Chau Thanh District (Tra Vinh Province, Mekong Delta), and one reason for this may be that people in Duyen Hai rely primarily on shrimp aquaculture, which is riskier than rice production, the primary means of income in Chau Thanh[6]. Tra Vinh province authorities listed only 770 landless households in 1994, but 17,458 in 1997.[6] Dr Cecilia Luttrell of CSERGE at the University of East Anglia reported similar findings, stating 'many of the landless households interviewed in one commune in Ca Mau Province had once been involved in shrimp farming, suggesting that shrimp farming had only increased their vulnerability' [4]. Many farmers feel that if just one shrimp crop in three is successful, they will be able to make enough profit to repay loans, but in Tra Vinh many of the farmers have lost their last two crops; another failed harvest could mean that they are forced to sell[7].

This increase in landlessness is a serious cause for concern in rural Vietnam – it is a major factor contributing to chronic indebtedness and extreme vulnerability, and may be leading to a change in social structure. According to local people, it is one of the main reasons for poverty in Tra Vinh Province in the Mekong Delta[6].

Cost of pond construction/preparation[5]

Method	Cost per hectare VND (millions)	US$
Extensive	7	466
Improved - Extensive	7-23	466-1533
Semi-Intensive	250	16,666

'There is increasing social disparity between those who can, and those who cannot, afford to invest in shrimp farming. However, even within groups who have invested in shrimp ponds many have suffered losses and have entered the downward spiral of debt and were often being forced to sell their land … the local households who own the shrimp ponds are now, for the most part, facing very low harvests and therefore huge debts which cannot be repaid'

Dr Cecilia Luttrell[4]

Further social impacts arise when farmers lose their land – either due to abandonment or having to sell to pay back debts. Many landless families are then forced to sell labour to others (not a reliable source of income, and increasingly difficult as shrimp harvests fail), gather mangrove products (often illegally or with unofficial permission[13]) or migrate, with further impacts on social structure, and in particular children[14].

Without land, there are very few other employment opportunities in much of rural Vietnam[7]. Furthermore, although shrimp farming does create 'spin-off' activities, such as small shops and opportunities for small trading, conversion of agricultural land and mangroves for aquaculture and the move towards intensification of shrimp farming promotes a reduction in employment opportunities. In India, it has been reported that shrimp farms employ only two or three workers per hectare, compared to the 35 workers per hectare on rice paddy[15]; statistics from Ecuador are more stark – whilst a single hectare of mangrove forest provides food and livelihood for ten families, a shrimp farm of 110 ha employs just six people during preparation and a further five during the shrimp farming season[16].

When shrimp farms are successful, profits are often reinvested directly into the ponds. Thus, there is generally not enough money to put aside for savings. Even when there are excess profits, none of the farmers EJF encountered considered saving money in a bank account as a feasible option. There appears to be a general mistrust of banks and a lack of understanding of savings schemes. Members of the shrimp farmers' club in Dong Hai, Tra Vinh Province stated that any money earned from shrimp farming would bring better return if re-invested[17]. The lack of savings and direct re-investment of profits into ponds heightens the risks involved with aquaculture, as very few farmers have any security to fall back on should future shrimp crops fail.

Shrimp farmers encountered during the production of this report seemed aware and accepting of the high risks associated with aquaculture. They maintained that aquaculture remained the best choice for them and that it would bring them more money than fishing or agriculture. However, there appears to be a gender difference in the degree of risk that seemed acceptable, women preferring lower risks and returns, and men, generally the decision makers, preferring high risk-high return activities[11,14].

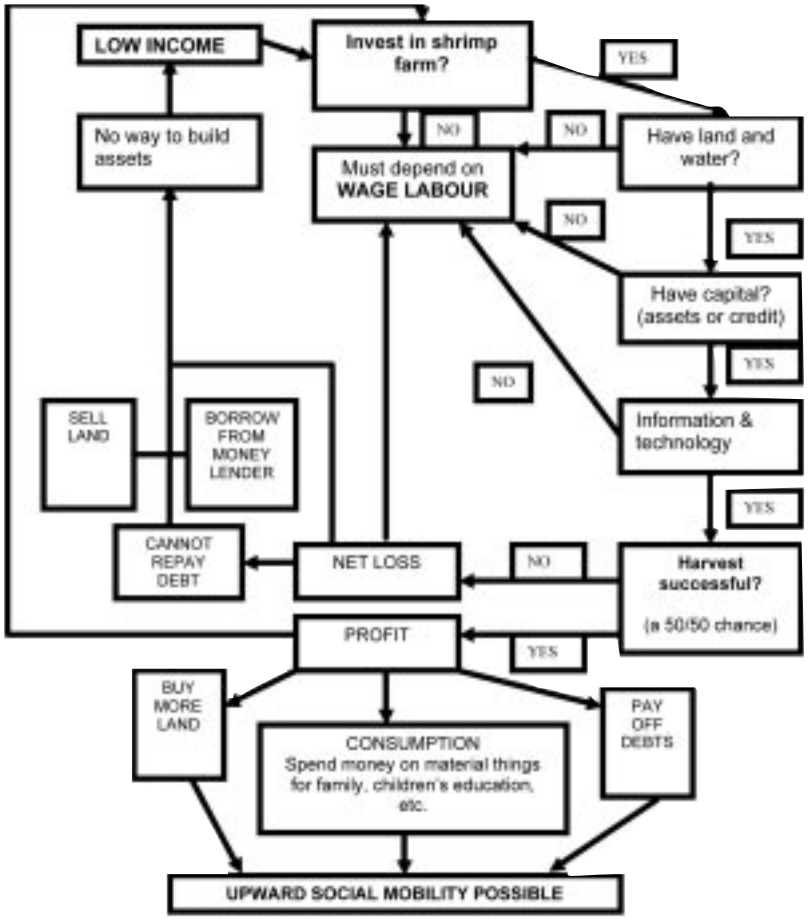
BELOW: *Salinisation of land can reduce agricultural productivity and availability of fruit and vegetables.*

'Many of the landless households interviewed in one commune in Ca Mau Province had once been involved in shrimp farming, suggesting that shrimp farming had only increased their vulnerability… The high capital investment required and the loans necessary to raise that capital are drastically lowering the security of such households'

Dr Cecilia Luttrell[4]

(Dr Luttrell reported that many households in this commune regret the conversion to shrimp, and long to convert back to rice production.)

The Road to Riches or the Path to Poverty?



Source: Oxfam GB, Hanoi.

Resource-use conflicts

In a number of other countries, serious human rights abuses including murder, rape, illegal land seizure and intimidation have arisen out of conflicts between stakeholders directly-related to shrimp aquaculture[3]. The Environmental Justice Foundation's research concludes that such extreme social impacts are not immediately obvious in Vietnam. However, conditions do exist in Vietnam that may lead to serious resource and land-use conflicts in the future. Indeed, in recent years resource-use conflicts have been escalating[19].

Rural unrest has been growing in the Mekong Delta due to lack of land and loss of rice paddies, and marginalisation of traditional rice farmers[1]. It is reported that people have been damaging dykes surrounding rice fields to flood their shrimp ponds with salt water, and approximately 120,000 ha of paddy was converted to shrimp ponds in Ca Mau in 2001[9]. Conversion of rice lands for aquaculture has serious implications for food security: Ca Mau province's rice yield is reported to have fallen by half to 460,000 tonnes in 2001[20].

Similarly, salinisation of agricultural land following dyke destruction has led to conflicts around Tam Giang lagoon[21]. Shrimp aquaculture development around the lagoon has also led to conflict over land allocation between fishers and shrimp farmers - much of the land has now been enclosed, and local fishers, especially the very poor, are unable to access resources on which many of them depend for their livelihoods[11]. This has led to intentional damage of aquaculture structures, presumably by angry fisher-folk[21].

Unequal land allocation and disputes as to rights of local people have led to land and water bodies being used illegally in Khanh Hoa. In August 2001, International MarineLife Alliance documented the death of nearly 6,000 lobsters caged off the coast of Xuan Tu, and reported that lobster culturists in the area hold the nearby black tiger shrimp farmers responsible, blaming their release of untreated wastewater into the sea as the cause[5].

'People from other provinces came here to build ponds, so they have a boundary, land and the right to exploit anything in the ponds. The problem is there is conflict between the local people and the owners … when people from Nam Ha province came they built a range of ponds that caused pollution in the local area, aquatic creatures are dying day by day'

Interview with Chairman of a Commune People's Committee in Quang Ninh Province, 1999[4]

Dr Cecilia Luttrell found during a study of one commune in Quang Ninh Province that many of the members of the commune expressed anger at appropriation of resources by outsiders. Implicit in many of her conversations about outsiders investing in shrimp ponds was the notion that stealing from their ponds was morally justified since they were viewed to have no legitimate right to make such profits from the commune's resources[4].

In Ca Mau province, much of the prime shrimp farming land is reported to have been allocated to army and police units, and provincial and district committee offices[22].

Huynh Viet Khai, director of the Ca Mau Department of Fisheries, is reported to have said that the dykes for most of the 200,000 ha of acid-free fields have been damaged, and efforts to develop plants and livestock for the area have been neutralised. Another official stated that intruding seawater is threatening rice and sugarcane crops and fruit trees[23].

ABOVE: *Rice on sale in Can Tho market. Local production of this staple crop has fallen considerably following the conversion of agricultural land to shrimp ponds producing food almost entirely for export.*

BELOW: *Much of Vietnam's coastline is being converted to shrimp ponds.*

LEFT: *Illegal shrimp ponds in Khanh Hoa Province.*

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Enclosure of open-access areas

Many of Vietnam's shrimp farms have been developed in mangrove forests and other wetland areas. Being in the tidal zone, these areas often operate as 'open-access resources' or lie at the discretion of local government for allocation to contract holders; many lack a long history of ownership, clear tenure rights or any official delineation of property rights[4]. Enclosure of such open access areas due to shrimp farming, and decreases in quantity and quality of open access resources, has in some areas resulted in households increasingly being excluded from previously available livelihood sources[4]. However, Dr Luttrell reports that although official institutional change has brought about an increasing trend towards privatisation of resources, in many coastal areas the spread and subsequent failure of shrimp farming has caused an increased reliance on open-access resources, the dependence increasing in line with poverty and vulnerability of the social group[4]. From work in one commune in Ca Mau Province Dr Luttrell reports that it is only with the advent of aquaculture that such land has had a market value attached to it capable of generating conflict[13].

Problems on the horizon

One important consideration is that in Vietnam, commercial/improved extensive shrimp farming is a relatively new development – the number of farms has increased very rapidly, but the trend really only began in the 1990s. To date, no significant tracts of land have been abandoned, and there is still very much a 'gold rush' mentality[7]. However, problems with disease and water quality are becoming increasingly common, and it seems that this will increasingly lead to landlessness, change in social structure, environmental degradation, and possibly increased conflict[7]. Shrimp aquaculture in Vietnam is on the verge of wholeheartedly adopting the intensification and industrialisation model that Thailand has struggled with for the past decade; current practices in Thailand are not ecologically sustainable, and there is concern that the consequences of such a transformation in the Mekong River Delta and along the coasts and major deltas of the north of Vietnam would be even more serious[24].

Particularly in the Mekong Delta, many of the improved extensive farms were started about ten years ago, and are now beginning to experience serious problems with pollution and disease, leading to reduced or negative profit margins. For many of the farmers, the only real option if they are to keep their land is to upgrade to semi-intensive systems (currently being encouraged by the government), though this requires major investments for improved infrastructure, food, and seed. Even if the systems are upgraded, semi-intensive systems are predicted to fail after 5-10 years[7]. Those farmers who can afford to will be forced to upgrade again, those who can't, or who are unable to obtain loans, risk losing their land. It is estimated that after approximately five years, these intensive systems will fail to be profitable[7].

Data from India and Indonesia show a similar pattern of declining productivity after 5-10 years in intensive and semi-intensive systems[15,25]. It has been estimated that over 20% of shrimp farms in former mangroves in the Gulf of Thailand are abandoned after 2-4 years[26], and shrimp aquaculture there is becoming similar to shifting cultivation, with farms moving further and further south as land is abandoned[7]. A similar situation is potential in Vietnam if production methods do not improve[7].

Whilst in Thailand some abandoned ponds have been converted for other uses such as marine mussel or sea bass culture, this may not be an option in Vietnam, and it is vital that the government begins to plan what this land will be able to be used for[7].

Health impacts

There are growing concerns about the potential for chemicals used in aquaculture to affect the health of farm workers, consumers or others in the proximity of shrimp farms. International MarineLife Alliance-Vietnam reported that chlorine has had detrimental affects on fisherwomen wading in water[5]. The United Nations Food and Agriculture Organisation states that certain chemicals used in aquaculture pose concerns since they are frequently over-used or misused and because stringent risk assessments have yet to be performed[27]. These concerns include:

- Use of antibiotics may stimulate drug resistance among micro-organisms; and may have impacts on farm workers and consumers.
- Chemical inputs include known or potential carcinogens, mutagens and teratogens.
- Organophosphate pesticides used have high neurotoxicity, potentially affecting farm workers.
- Hormones and pesticides can disrupt the human endocrine system.
- Rotenone (*Derris* root) used to kill fish in shrimp ponds can induce respiratory paralysis.
- Chemical residues in produced food may risk consumers.

ABOVE: *New hope? Antibiotic packaging in Khanh Hoa Province. Antibiotic use in shrimp farming is widespread and poorly regulated.*

Social Impacts of expansion and subsequent failure of shrimp farming[4]

Positive Impacts

- Increased foreign earnings for Vietnam
- Livelihood diversification where rice returns are low owing to salinity and problems of acid sulphate soil
- Opportunities for credit and preferential taxation for shrimp farming households
- Increased earnings for local authorities from selling contracts over previously 'unused' land and resources
- Increased trading opportunities and other multiplier effects in the area

Negative Impacts

- Rivers, ground and surface water affected by pollution from runoff, adversely affecting natural products
- Enclosure of open-access areas restricting livelihood sources for the poorest
- Increased landlessness as households which cannot afford the capital investment needed for shrimp farming are pushed off land
- Little benefit accrues to the area as many shrimp farmers who are able to profit are from outside the commune
- Increased conflict over land and resource-use rights

Impacts of the Subsequent Failure of Shrimp Farming

- High levels of debt in all shrimp farming households, restricting transfers to other income-generating activities
- Forced diversification of livelihoods
- Increased tree-planting on private land as the value of the shrimp ponds decreases
- Increased landlessness as poorer pond owners are forced to sell land to pay debts
- Falling land prices, richer households selling land

SHRIMP PRODUCTION PROBLEMS IN VIETNAM

Vietnamese shrimp farmers face various problems, and these are particularly acute for the poorest families. Many of these problems have direct economic implications and a situation therefore exists whereby shrimp aquaculture can trigger poverty spirals and promote disparities between the wealthy and poor. For many farmers, knowledge of these problems exists, but the finances required to tackle them do not[1,2]. Key problems with shrimp aquaculture in Vietnam include:

Disease

The risk of crop failure from disease outbreaks creates serious difficulties for small investors with poor access to credit, and after one failure, many farmers do not have sufficient capital to recover[3]. Shrimp viral diseases, especially White-spot disease and Yellow-head disease, are becoming increasingly prevalent in Vietnam. In 2001, in one district in Tra Vinh Province, where 60-70% of households conducted shrimp aquaculture, 40% failed in production, with the failure rate in some districts (such as Tra Cu) as high as 70%[4]. Many shrimp farmers went bankrupt in 1994 when a disease epidemic spread throughout the southern provinces covering an area of 84,858 ha and resulting in VND 294 billion (US$26.7 million) of damage[5].

There appears to be a clear link between environmental conditions and disease outbreak, with fluctuations in oxygen, temperature and salinity increasing physiological stresses and lowering the immune response of shrimp[6]. This is exacerbated where post-larvae are of poor quality, and where shrimp farms are situated in mangroves, where the soil has a high acid sulphate potential. On acid sulphate soils, anaerobic decomposition leads to the formation of iron pyrite which, when exposed to air, is oxidised to iron and sulphuric acid. Acidity stresses shrimp, can starve ponds of nutrients, release toxic ions, and precipitate iron on shrimp gills and exoskeletons[7].

BELOW: *Dead shrimp – diseases are becoming increasingly prevalent in Vietnam.*

Post-larvae quality and quantity

Major determinants of harvest success are the quality and quantity of post-larvae. Demand exists for 40 billion post-larvae annually, yet only one-third to one-half of these are produced in Vietnam, the remainder being imported largely from the USA[2,8]. In 2001, Ca Mau province could supply only two-thirds of the 12 billion breeder shrimp needed for each crop[9,10]. Prices for breeder shrimp have skyrocketed accordingly – Mr Huynh Tuyet, a shrimp farmer in Khanh Hoa stated that one mother shrimp, previously costing VND 1 million (US$66), now realises VND 10-15 million (US$ 666-1000)[11].

High demands and limited supplies have resulted in quality control systems, where present, being inadequate. Broodstock is ideally bred from only once or twice, but often seven or eight broods are raised[12]. Later broods tend to be of very poor quality (high mortality rates and increased susceptibility to disease), but prices are the same and farmers cannot tell which brood their stock is from, leading to an increased element of risk. It has recently been estimated that only 10% of breeding shrimp in the central region meet quality standards; low quality of broodstock has been blamed for recent massive shrimp deaths in the Mekong Delta, with resulting losses estimated at US$39.47 million[13].

Post-larvae quality is also affected by the distribution of hatcheries – many are in South-Central Vietnam (around Nha Trang and Da Nang). Post-larvae transported from these hatcheries to the Mekong delta are affected by the journey and have reduced survival rates[1]. However, this situation appears to be improving. For example 70 hatcheries opened in Tra Vinh province in 2002[14].

These problems particularly affect the poorest farmers, often forced to buy on credit to be settled after harvests (through middlemen at the farm-gate), and therefore unable to select post-larvae or to negotiate[1,4]. Thus the poorest farmers often buy post-larvae that cannot be sold to the more discerning wealthy ones. Being dependent upon the arrival of a middleman with post-larvae is a further problem experienced by the poor, and means that timing for stocking ponds may not be ideal, leading to further risk of failure[1].

Feed and chemicals

Feed required to produce 1kg of shrimp costs about VND 40,000[15]. Supplementary feeding is a common component of Vietnamese shrimp aquaculture. Most feed used is rudimentary (typically containing small boiled fish, shrimp, crab, rice powder and egg yolk) and produced by the farmers themselves[15]. This is because not only is commercial feed expensive but it is also limited in supply, meeting only 20% of the national requirement[2]. Home-made feed tends to be of low quality with a poor conversion rate (4kg being required to produce 1kg of shrimp) and can contribute to pollution problems[2]. Concerns about environmental and health risks associated with chemicals used in shrimp aquaculture have led to certain products being banned by shrimp importing countries (see page 26).

Quality control & antibiotic use

Quality of commercial feed may also be a problem in some areas – Charoen Pokphand Thai feed is generally recognised as the best quality in Vietnam, but is very expensive. Although other commercial feed is available, quality is not assured: unscrupulous activities reported include farmers being sold out-of-date feed (which apparently has led to shrimp deaths[16]) and allegations of feed being poisoned by rival companies – two as-yet un-named companies in Can Gio are under MOFI (Ministry of Fisheries) investigation[17]. As with post-larvae, feed and fertiliser are bought at the farm-gate so for small-scale farmers, acting alone, there is little potential for negotiation[4,18].

Officials are reportedly struggling to keep up shrimp feed certification and quarantine regulations. There are thought

BELOW: *Vietnam currently produces only one-third to one-half of the post-larvae needed to supply demand.*

to be over 120 feed varieties in use, and illegal imports are flourishing despite the government issuing more licenses; illegal feed used for shrimp breeding is not tested or quarantined before use, and represents a potential path for disease outbreaks[10]. By 2010 over one million tonnes of shrimp food will be available, but only half of this will be certified[2]. It has been estimated that about 80% of traders sell food without conducting any quality tests, at prices 3-4 times less than feeds maintaining quality standards[19]. Recently, the government has revoked the need for licenses for importing aquaculture feeds[19].

Inappropriate Feeding Regimes

Whilst many farmers correctly feed small quantities at regular intervals[15], others, especially the poorest, are unable to do so, leaving shrimp to starve when they cannot afford food and then overfeeding when funds are available[1]. For other farmers, a general lack of awareness of pond mortality rates means that they are often overfeeding all the time. For either reason, the resulting excess feed wastes money and resources[15], and can increase nutrient pollution of the ponds and receiving waters.

Pond pollution

In addition to artificial feed and antibiotic use, chemicals including chlorine and formaldehyde are widely used for pond preparation and sterilisation (some farmers actually wash shrimps in 1-2 ppm formaldehyde[20]). Pesticides and possibly heavy metals are also thought to be present in many shrimp ponds as residues from previous agricultural activity and run-off from neighbouring farms[2,20].

Excessive stocking densities and inappropriate feeding regimes can increase pollution and further impact productivity. As the shrimp grow, they need more food and produce greater quantities of excreted waste, factors that are exacerbated with high culture densities. The excessive organic matter (especially at night and early in the morning) is polluting as it blocks light and can inhibit algal oxygen production. At these times, dissolved oxygen content can be as low as 2.5 or 3 mg/l, whereas levels should be greater than 5mg/l in ponds[2]. It appears that a critical stage is reached around two months after stocking, when problems of disease often occur. By this time the farmer has invested heavily in feed, etc. and is in no position to attempt remediation.

BELOW: *As shrimp production intensifies in Vietnam, the range and quantity of chemical inputs is increasing.*

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Antibiotic use in Vietnamese shrimp production

Commercial feeds used in Vietnam do contain antibiotics, but due to problems with availability and the expense of commercial feeds, up to 80% of shrimp feed in Vietnam is thought to be home-made. Often when farmers use home-made feed they also buy antibiotics, which are widely available in shops, and add them with very little understanding of their effects or proper use, often receiving advice just from fellow farmers[15]. Prime Minister Phan Van Khai issued an instruction on 25 February 2002, demanding that the ministries of Agriculture and Rural Development and Fisheries ban the use in food of any chemicals banned by the EU and USA; to date ten antibiotics and chemicals have been banned for use in the breeding, raising and processing of seafood[21].

However, though chloramphenicol (a broad spectrum antibiotic which is used to treat bacterial meningitis and typhoid, but which has been linked to childhood leukaemia[22] and aplastic anaemia) is among those banned, it is thought that many farmers are still using their old stocks[15]. Phenicols are the only accessible potent cure for meningitis in developing countries, and so in addition to the health risks for consumers there are also impacts associated with resistance development[23]. Imports of shrimp to the US from China and Vietnam were greatly reduced in 2001 following detection of traces of chloramphenicol, and the Food and Drug Administration is reported to be refocusing its inspections on imports from these countries using upgraded testing techniques[22]. In April 2002, Canada enforced a 'hold and test' protocol to test 'every shipment' of shrimp from China, Vietnam and other Southeast Asian nations for the presence of chloramphenicol, and the EU banned Chinese shrimp in January after shipments of product tested positive[24]. In March 2002, the British Food Safety Agency demanded the exclusion of shrimp imported from a number of Asian countries, including Vietnam, due to random samples being found to contain antibiotics from the banned group nitrofurans (the nitrofurans include furazolidone and nifurpirinol, and are suspected carcinogens[24]). In the same month, the European Commission published a decision making it mandatory for Member States to test Vietnamese shrimp imports for antibiotic residues (Commission Decision 2002/250/EC). Results will be notified to the European Commission's Rapid Alert System for Food and Feed, and decisions will be reviewed in light of test results[25].

Continued use of these antibiotics may risk tighter controls and further bans on exports; in addition to the economic impacts of such controls, they risk leading to products that have failed to meet standards being released into domestic markets[26].

Pond design & technology transfer

Pond design and preparation problems result from lack of resources and poor technology transfer. Though larger scale projects appear to be well planned and well funded (e.g. the government development on sandy land in Phu Dien Commune, Hue), the majority of small scale shrimp ponds have been constructed by shrimp farmers themselves, often with very limited knowledge, planning, and resources[15].

Many of the shrimp farmers' problems stem from poor pond design, especially regarding water movement. The discharge of effluent and recruitment of water into and from the same body and through the same canal, and the exchange of water between neighbouring farms, transfers pollutants and increases the likelihood of disease transmission.

All small-scale farms visited by EJF had poor water systems and lacked water treatment facilities. In almost all of the sites, discharge of effluent and recruitment of water were from the same body, through the same canal. There was no treatment of water either prior to pond filling or before discharge, and there was exchange of water between neighbouring farms.

Although many farmers are aware that better water systems would help reduce risks[2,8,14], it appears that they do not recognise the central importance of an adequate water system. Furthermore, as most farmers have little land to use, they are not in favour of relinquishing shrimp pond area to what they perceive to be unproductive activities of water settling and cleansing, though a lack of such components exacerbates problems of overstocking and excessive chemical use discussed above. Where farmers are aware of these issues and willing to act, it seems that they are often constrained by a lack of funds.

Pond preparation is also problematic. The poorer farmers in particular cannot afford to properly prepare ponds (e.g. removal of soil, water cleansing)[1], leading to further risk of disease and failed harvests

Integrated Mangrove-Shrimp Ponds

In the Mekong Delta, the government and groups such as Oxfam GB are actively encouraging development of integrated mangrove-shrimp aquaculture, which is a positive development in many ways. However, we found that there was some concern over the actual models being used. The majority of (legal) mangrove-shrimp systems in land governed by the forest enterprise have mangrove and shrimp areas that are integrated, but it may be that it is better to use isolated mangrove and shrimp areas within these models, while still keeping the typical 30% shrimp: 70% mangrove ratio[1].

Many Mekong Delta plots are approximately 10 ha, but managing 10 ha 'ponds' only 3 ha of which actually hold shrimp and give profit can be problematic[1]. Leaf decay can lead to lack of oxygen, and predators (such as sea bass) can be difficult to control. In addition, the mangrove trees in these systems don't flourish – they are tidal trees and require water exchange, but inside the dykes water becomes stagnant. The dykes also restrict mangrove ecosystem functions such as biofiltration, acting as nursery grounds, and provision of nutrients in falling leaves.

In the integrated systems, the removal of sediment from the ponds and process of placing it on the mangrove areas rapidly accelerates the succession from mangrove to terrestrial/inland species, which out-compete the mangrove species as the area becomes higher[27]

Under-resourced extension services

Funding within the extension services is very limited – all of the centres that EJF visited were based in small run-down buildings, with limited resources for demonstration ponds or for training. In Tra Vinh, for example, extension budgets in 2001 equated to VND 5-10 per farmer (US$1 = 15,000VND); much of this goes towards salaries of extension staff and administration, and thus there is very little left for training[4].

Linked with lack of funds, a further constraint is access to education, both physical access, and accessibility of material. Though the fishery extension centre staff interviewed by EJF all stated that they travel to even the most remote areas and that everyone is welcome to attend, there are reports to the contrary[4,28], and it seems that in most provinces there are not enough staff or funds to provide adequate training or technology transfer to all. Rather, it appears that, at most, the extension services provide one training session (usually one day) per farmer per year.

In addition, even if they are able to attend, much of the training seems to be geared towards commercial or larger scale shrimp farms, and may be inappropriate for small-scale farmers. Limited funds mean that, in most cases, teaching is entirely oral, a likely impediment to transfer of knowledge.

In the south, access to extension may be more of a problem. Coastal and mangrove areas are all within the control of Government Forest Enterprises (though where they have been converted into rice paddies, they are under direct control of the Department of Rural Affairs, Agriculture and Development), and obtaining emergency advice on aquaculture can be difficult.

Frustratingly, in many cases where extension services do seem to be working, due to limited funds farmers are often unable to implement what they have learnt in training.

ABOVE: *An integrated shrimp-mangrove system in Duyen Hai, Tra Vinh province.*

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BELOW: *Shrimp farmers club in Duyen Hai. This Oxfam-led initiative encourages small-scale shrimp farmers to work together, to increase their technical knowledge and improve their negotiating power.*

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Climatic factors

Vietnam's climate contributes to problems in shrimp farming, and though the majority of shrimp farm development has been in the Mekong Delta, it seems that conditions here may be particularly unsuitable. During the dry season, increased salinity can be problematic and the weather can become too hot (with greater daily ranges), especially in the south[2]. Daily water temperature ranges of 10-12 °C can occur but a difference of just 5-6 °C can be enough to kill shrimp[2]. In the wet season, water temperature varies less, but salinity is much lower, and conditions are more suited to raising freshwater prawns[2].

Climate and water quality appear more suitable in south-central Vietnam (around Nha Trang/Khanh Hoa) and, in general, shrimp farms here do appear to have fewer problems associated with disease. Tidal range is an important factor for many of the ponds; relatively high pollution and disease in Tam Giang Lagoon may be related to the lagoon having one of the lowest tidal ranges in Vietnam – just 0.5m, resulting in inefficient water exchange[15].

In all areas that EJF visited, it appears that there is one 'safer' first harvest during the dry season, beginning just after Tet (Vietnamese New Year) with harvesting in May/June. Many farmers then attempt a second harvest before the wet season – this is often very risky – if badly-timed, the crop may be lost to floods. However, profits can be very high as there are less shrimp available on the market at this time of year.

In some areas, shrimp farmers are already being encouraged to harvest once a year – this greatly reduces risk of failure, and should be encouraged further.

Market forces

Having been encouraged by the IMF/World Bank to focus on 'cash crops' – such as coffee, tea, cotton – at the expense of subsistence food, many developing country farmers found themselves in serious financial difficulty when the value of those crops slumped because of oversupply. Vietnam's coffee industry was recently devastated by a global price slump, with prices falling from £2,800 per tonne in 1995 to £350 per tonne in 2002[29] – this was in part attributable to the relatively sudden increase in availability, much of it due to Vietnam's own rapid expansion in coffee production. Similarly, global market trends have potential to impact shrimp aquaculture and, to varying degrees, both farmers and government bodies exhibit a lack of awareness of this threat or an inability to react to it.

The trend for intensification of shrimp production both in many of Vietnam's neighbours (China, Philippines, Indonesia, Thailand) and globally (Africa, South and Central America) will have major implications for the global market (especially following China's entry into the World Trade Organisation), further exposing Vietnam to risks of over-embracing shrimp aquaculture as a central pillar of development. In light of this, it is essential that the government not only conducts relevant market analyses, but that findings are conveyed down the production chain to small-scale farmers. It is essential that Vietnam ensures environmental and social sustainability to protect its markets for shrimp.

Vietnam's main international export markets are the EU, Japan and USA, with some export to Africa. Food standards requirements in these recipient countries can also affect the trade in shrimps. For example, EU regulations restrict certain types and levels of antibiotics such as chloramphenicol. In Vietnam, chloramphenicol use is banned, but the law is difficult to enforce[2]. Trade embargoes resulting from importing countries' detection of chemicals can depress markets. Recently, the Canadian government found traces of chloramphenicol in imported shrimp, one shipment of which came from Vietnam[24], and Vietnamese Tiger prawns were among products recently recalled from sale in the UK due to presence of the carcinogenic antibiotic nitrofurans, chemicals prohibited for use in food production in the European Community[30].

As consumers become increasingly aware of social and environmental impacts of shrimp aquaculture worldwide, additional pressure can be expected to be exerted by importing countries wanting to ensure that the shrimps they consume are produced sustainably.

ABOVE: *Shrimp products for sale.*

Lack of cooperatives

In spite of a new 'Cooperative Law', there are still very few farmer's production groups in Vietnam[4]. Consequently, individual shrimp farmers lack negotiating power, which reduces their ability to secure quality feed and post-larvae.

Inefficient production chains

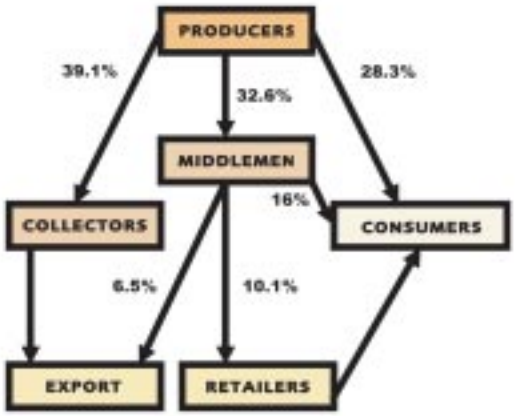
A major factor contributing to Vietnam's problems with post-larvae and feed is the structure of production chains. These comprise landowners and farm workers; suppliers of post-larvae, feed and extension services; and shrimp purchasing, processing and exporting companies. In Thailand, often one company (e.g. Charoen Pokphand) will be involved in the entire process – signing contracts with farmers for the land; supplying post-larvae, food and technical extension; and buying, processing and exporting the shrimp produced.

Conversely, in Vietnam, many farmers have use rights to their own land (though there are still many tenant farmers in some areas). Postlarvae and feed are bought from separate companies. The government provides most of the extension services, and processing and export are performed by yet more separate companies. The various companies or bodies tend not to work together, rather maximising their own profits often without thought for the final outcome or other links in the chain. For example, some hatcheries reputedly use large quantities of antibiotics so that post-larvae are healthy at sale but may die a few days later. Feed companies have reportedly acted with similar self-interest (see above). Poor farmers are often not free to decide when to stock ponds but must await the arrival of middlemen selling post-larvae[1]. The common result of this system of maximised profits at every stage in the chain is that farmers lose out.

Marketing channels

Aquaculture resource marketing channels have been studied around the Tam Giang Lagoon. There are three types of purchasers: middlemen/women who take produce to inland or city markets; those who sell to local consumers; and 'collectors' who work buy high quality produce for the local freezing company, the Song Huong Freezing Factory. This company has a monopoly, and is therefore able to dictate prices[31].

Shrimp Marketing Channels in Phu Tan[33]



Lack of recognition of mangrove importance

There appears to be a general lack of awareness of the benefits of environmental resources, particularly from mangrove forests. Many farmers believe leaves falling into ponds lead to pollution and disease, and that trees take up land that could be used for profitable shrimp ponds[32]. Farmers and landless people collect fuel-wood from dead trees in the forest, but this is not viewed as having any monetary value and therefore is not viewed as important[32]. Education about mangroves' role in improving water quality and disease reduction, and about their more direct benefits is crucial if these attitudes are to change.

Productivity declines

When extensive systems are upgraded to improved-extensive systems, production is likely to fall after about 10-20 years[33]. Many of Vietnam's improved-extensive farms were started about ten years ago, and are now beginning to experience serious problems with pollution and disease, leading to reduced or negative profit margins. Many farmers, having already invested heavily in aquaculture, feel compelled to upgrade to semi-intensive systems, though this requires further major investments for improved infrastructure, food, and seed. Even if upgraded, semi-intensive systems are predicted to fail after 5-10 years[35]. Those farmers who can afford to will be forced to upgrade again, those who can't, or who are unable to obtain loans, risk losing their land. It is estimated that after approximately five years, these intensive systems will also fail to be profitable[35]. Data from India and Indonesia show similar productivity declines after 5-10 years in intensive and semi-intensive systems[7,34]. It has been estimated that over 20% of shrimp farms in former mangroves in the Gulf of Thailand are abandoned after 2-4 years[35]; shrimp aquaculture here is becoming similar to shifting cultivation, with farms moving further and further south as land is abandoned[36]. A similar situation is envisaged for Vietnam if aquaculture development continues as it is today. Abandoned farms are difficult and expensive to convert back to agriculture because of high salinity and chemical pollution, and there remains considerable debate about the feasibility of restoring mangrove forests to their former diversity and ecological significance.

ABOVE & BELOW: *In many areas, the benefits of environmental resources, particularly of mangroves, are not recognised. Shrimp farming in Vietnam has resulted in the widespread conversion of productive and diverse mangrove forests into barren landscapes largely devoid of life.*

VIETNAMESE SHRIMP AQUACULTURE: THE WAY FORWARD

The principal problems of shrimp aquaculture in Vietnam are social, economic and environmental, and exist because of inadequacies in production techniques and poor dissemination of information. It is of prime importance that financial risks to poor farmers are reduced whilst environmental integrity is upheld and improved. Central to achieving these targets are high-calibre strategic planning, improved production standards, increased education, alternative economic approaches and reduced environmental impacts.

Improved production approaches

Improvements to integrated mangrove-shrimp systems and rotational systems

Integrated mangrove shrimp ponds should continue to be encouraged. However, careful consideration should be made of the models used and where appropriate, the government should encourage separated mangrove-shrimp systems in the typical 70:30 (or similar) ratio to replace integrated mangrove-shrimp 70:30 systems[1]. Farmers should also be encouraged to have small trial semi-extensive ponds (500-1000 m^2) within these areas. However, in general, mangrove habitats are not suitable sites for the development of shrimp aquaculture[2], and this should be taken into consideration in government policy.

Low density, mangrove-shrimp and mangrove-rice rotational systems should be encouraged. Birdlife Vietnam reported in 1996 that on 100 ha of land along the Van Uc river in Tien Lang district rice cultivation and aquaculture were conducted in ponds and between mangrove trees with rice and marine products being harvested in alternate years[3].

Water management/pollution reduction

The construction of more appropriate canal systems is necessary in many areas and the need for proper water systems should be strongly stressed during extension. Separate inflow and effluent channels will reduce the spread of disease and pollution between ponds. Better treatment of water, both before and after entering shrimp ponds, is essential, as is more informed use of inputs. Local government and donor agencies should be encouraged to provide grants or loans specifically for this purpose.

Improved Hatcheries
Post-larvae production capacity needs to be increased and an effective quality control system needs to be implemented. Apparently there are plans to upgrade hatcheries, encouraging private sector small capacity operations; to import brood stock from the USA; and to select sites along the coast that will be separated with buffer zones between them[4].

Cooperative Approaches
Oxfam GB is currently trying to encourage farmers to work in groups in their project area in Dong Hai Commune, Duyen Hai District. Such approaches increase farmers' negotiating power. Furthermore, at 'farmer clubs' like that in Duyen Hai, poorer farmers may borrow money in times of need, thus reducing the reliance on credit for the purchase of post-larvae and feed.

Sandy land aquaculture
At a number of locations, possibilities for sandy-land aquaculture are being investigated. In this system, ponds are constructed on sand lined with plastic. It is hoped that such a system may be more sustainable and have reduced environmental impacts. Research on sandy land aquaculture should be closely followed, and information exchange between the different groups working on this in different areas of Vietnam (Hue University of Agriculture and Forestry, IUCN, International MarineLife Alliance, for example) should be encouraged.

Economic improvements

Based on discussions with Participatory Poverty Assessment participants, Oxfam GB concluded that problems with government lending services include:

- Unclear policies regarding collateral limits loan accessibility for poor people.
- Unclear selection procedures and discretionary powers of local lenders disadvantage the poor.
- Subsidized government-financed lending programs are not sustainable because repayment obligations are not enforced.

Availability of loans does certainly seem to be a cause for concern. Oxfam GB recommend that credit should not be subsidised – banks and other lending institutions should charge market interest rates and then provide adequate outreach and savings facilities to the poor. In addition, more sources of credit need to be established and/or encouraged. Loan amounts and terms need to be appropriate to different kinds of production, and increased efforts need to be made to lend to remote areas. Savings should be encouraged as part of credit programs.

Grants or credit schemes for specific purposes (including water systems/treatment/pond construction) should be promoted. Conversely, loans from informal money-lenders should be discouraged, through education of the risks, formation of 'farmers clubs', and increased access to credit and saving schemes. Increased funding, from government and donor agencies, for both extension and research into environmental impacts, should be strongly encouraged. Financial incentives for conversion of agricultural land to aquaculture ponds should be reviewed.

Market analysis
The government should be encouraged to carry out very careful market analyses. Quality of shrimp and control of banned substances needs to be stressed.

ABOVE: *Post-larvae for sale at a Tra Vinh hatchery. High demand and limited supplies of post-larvae has resulted in a lack of quality control systems for hatchery-produced fry. Shrimp disease has been linked to use of low-quality post-larvae used to help meet this high demand.*
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OPPOSITE PAGE: *Vietnam's hatchery technology remains primitive*
© EJF / Thornton

BELOW: *Mrs Nguyen Ghai Bong, a demonstration shrimp farmer in Oxfam GB's project, Duyen Hai.*
© EJF / Thornton

Educational initiatives

Improved extension and technology transfer, and improved education about environmental awareness/importance and benefits of natural resources is vital. This education should be focussed at farmers, other community members, and in schools.

Aquaculture Extension Services

The need for improved shrimp farmer education is essential and is reliant upon improved teaching techniques and additional funding. Incentives need to be created in order to increase the willingness of extension staff to work in, or travel to, remote areas. Oxfam GB recommends that this can be done through increased salaries and training, and recommend a farmer-to-farmer extension methodology, organisation of farmers into groups/clubs, decentralisation of the extension system, and training of grass-roots extension staff[5]. In addition, extension materials that are appropriate for the local community need to be developed to meet educational level and language barriers. Use of TV, radio, billboards, printed material, and, very importantly, demonstration ponds, should be encouraged. Increased funding for extension services is key. The infrastructure that is already in place means that extension technology transfer could be very effective in Vietnam – fishery extension centres work in every commune, and appear to have good working relationships with local farmers, People's Committees and universities, creating a potentially excellent basis for communication and information exchange.

Staff of extension centres visited during the course of researching this document all expressed interest in the use of printed materials, video, and further demonstration ponds, but were restricted by lack of funds. Increased government funding of extension services is required, with the assistance of in international NGOs and the donor community. Oxfam GB is currently working to build capacity of training staff in Tra Vinh, and are also carrying out education/workshops of their own. The International MarineLife Alliance education programme in Khanh Hoa Province is also very encouraging.

Despite limited funds, Tra Vinh Extension Services are undertaking an enterprising education initiative. They broadcast a 15-minute weekly TV programme produced by Tra Vinh Province Television, in which they answer farmer's questions, and farmers are welcome to come down to the centre at any time for advice.

However, even when there is a high degree of awareness of aquaculture problems and solutions among shrimp farmers, a main restriction for decent pond construction is lack of capital - due to lack of land and money, there is limited ability to implement what is learnt in training. This highlights the need to develop both the extension and credit/funding systems together – developing one without the other may have limited benefit.

Extension should include education on basic feeding techniques, recommendations of good quality feed suppliers and advice on preparation of home-made feed. Simple techniques such as use of nets for feeding, allowing farmers to monitor feeding and change amounts, should be encouraged to reduce pollution risks and the waste of money and resources. Extension should include education on safe antibiotic use, but should try to discourage prophylactic use, and should stress the importance of not using banned substances even if farmers still retain stocks. Education on safe chemical use for pond preparation and sterilisation is also important. The importance of adequate water management and treatment systems for aquaculture ponds must be stressed.

Shrimp farmers also need to be taught the basics of economics and marketing, as well as be encouraged by extension staff to wisely invest any profits accrued.

Environmental Education in General

Whilst farmer education is essential, there is also, in Vietnam, a general need for improved environmental education. In relation to this report, greater education about sustainability, natural resource exploitation and values of mangrove and other coastal environments is needed. Such education should be targeted towards school children, rural people in general and shrimp farmers specifically, as well as those involved in policy determination.

It is key that attitudes towards mangroves, and other coastal ecosystems, are changed if conservation is going to be successful, and education should focus more on promoting positive benefits associated with natural resources, and mangroves and wetlands in particular. Alternative livelihoods associated with mangrove habitats (e.g. crab collection, eco-tourism potential, etc.) should be stressed, farmers should be involved in mangrove management decisions, and encouraged to harvest products from the forest on a continuous basis, giving them a continuous income. Such education should include practical ideas such as the use of wildlife and mangrove forests as environmental indicators for the health of ponds.

International MarineLife Alliance uses radio broadcasts, billboards, plays and performances by schoolchildren, and organises visits to places such as Nha Trang oceanographic centre for their education. Can Gio Biosphere Reserve also co-operate with Ho Chi Minh City TV to broadcast educational material about the mangrove forest.

LEFT: *International Marinelife Alliance uses billboards such as this, radio broadcasts, plays and performances to increase environmental awareness in Vietnam.*

Research

Considerable further research is needed to understand shrimp farming's environmental impacts and epidemiology and control strategies of shrimp viral diseases, both in general and specific to shrimp farming areas in Vietnam. Research into areas' aquaculture carrying capacity should be encouraged (e.g. of Tam Giang Lagoon).

It should be recognised that climatic conditions are an important factor. Research into the most appropriate production systems for specific areas should be encouraged, and where climatic conditions do not seem suitable, the government should be encouraged to rethink their promotion of aquaculture development.

Land restoration

Disused shrimp farms can be irrigated with fresh water to flush salts out and then cultivated with *Cyperus* until salinity is sufficiently reduced to allow rice cultivation[6]. Mangrove rehabilitation, where possible, should be encouraged (see later).

Alternative livelihoods

Alternative livelihoods need to be identified and promoted. These will vary depending on locality but might include:

- Lobster aquaculture
- Seaweed culture
- Bee-keeping
- Pearl culture
- Rotating rice-shrimp production
- Crab collection

Mangrove protection & restoration

Protection of existing mangrove forests and restoration of those deforested are important elements of maintaining the integrity of the coastal environment. Mangrove reforestation or afforestation programmes have been conducted throughout Vietnam, funded by international organisations and the Vietnamese government, which plans to replant five million ha of forest, including mangroves, by 2020[7]. In addition to ecological benefits, mangrove planting provides coastal protection to rural communities and raises marine and coastal productivity. Furthermore, in many cases, local people are paid to conduct the planting. Mangrove restoration provides immediate economic benefits to local communities, while reducing the potential for storm damage over the near and long-term[8].

Mangrove rehabilitation may result in natural levels of biodiversity[7]. The return of juvenile shrimp and crabs is especially important for the rural poor. For example, in Thai Binh Province, families can earn US$40-60 in August-September by collecting young crabs (compared to US$1-3 before mangrove restoration)[7]. In sites where the Vietnamese Red Cross Society has conducted planting, revenues have been increased; a family can earn VND 7 million (US$466) in one season collecting tiny crabs, which are sold to local consumers or aquaculturists[9].

Replanting tends to be more successful on muddy rather sandy substrates[7], but other factors also contribute to the success of regeneration. In northern Vietnam, most planting has been a monoculture of *Kandelia candel*. Monoculture plantation encourages pest attacks, thus reducing survivorship[6]. A 1984 Oxfam project lost 40% of planted mangroves to pests[7]. Increasing plantation diversity will reduce the need for pesticides, some of which used in Vietnam are known to be highly toxic to aquatic life[6]. The high densities of planting (often 0.3-0.7 m intervals) are also problematic, rapidly reducing sunlight and thereby reducing leaf decomposition rates. Mangrove afforestation or reforestation at such a high density hinders root development and reduces trees' ability to withstand strong winds or tidal action. Productivity and growth rates are also reduced in high density plantations[6].

There seems to be a great deal of variation in the success of different programmes, and little communication or exchange of information / techniques between them. There is also some concern that areas being replanted or afforested are important habitats in their own right. Birdlife International is currently working through the Forest Sector Support Programme to try to ensure that mangrove restoration

does not impact negatively on areas of high biodiversity, including mudflats, which are especially important to many bird species.

Some of the important lessons learnt from mangrove planting are summarised below.

Vietnam Red Cross (VNRC) Mangrove Planting[9]

In implementing its successful planting schemes, the VNRC mobilises locals, selecting the most vulnerable, and pays them small amounts of cash for planting (VND 400,000 (c. $27) for 1 ha = 1 week of work for 5-6 people). In addition, there is an educational element on how to plant, how to protect and why.

The annual budget for the scheme is US$700,000 (provided by Danish and Japanese Red Cross Societies).

Benefits of mangrove rehabilitation in Nam Dinh and Thai Binh provinces, Vietnam.

Benefits Valued	Valuation
Timber	Thinning (VND 180 per tree); extraction of mature trees (VND 5000)
Fish	Mean price of VND 12,500 per kg; yield estimated at 50kg per ha mangrove
Honey	Potential yield estimated at 0.21 kg / ha of mangrove
Sea dyke maintenance costs avoided	Costs avoided based on stand width, age and mean wavelength.

Mangrove rehabilitation can be desirable from an economic perspective based solely on the direct use benefits by local communities; such activities have even higher benefit cost ratios with the inclusion of the indirect benefits resulting from avoided maintenance costs for sea dyke systems which the mangrove stands protect from coastal storm surges[8,11].

Examples of mangrove reforestation and afforestation in Vietnam[12]

Agency	Area	Locality
Oxfam GB	300 ha	Ky Anh district of Ha Tinh province
Oxfam GB	600ha	Tra Vinh
Save the Children	284 ha	Thai Ha district of the same province
Vietnamese Red Cross	16,000 ha	80 communes, 24 districts, 8 provinces
(Danish Red Cross)	3000 ha	Thai Binh and Nam Dinh provinces
(Japanese Red Cross)	4000ha	6 more provinces in the north
ACTMANG	150 ha	Thai Binh
NOVIB	1000 ha	Ca Mau, Bac Lau, Soc Trang, Tra Vinh provinces
Government of Vietnam	33,000ha	Can Gio Biosphere Reserve

ABOVE: *The Vietnam Red Cross Society has successfully planted thousands of hectares of mangroves. Guards hired from local communities help ensure that the projects are protected.*

To date 45,000 rural poor have taken part in replanting. Since 1994, 16,000 ha have been planted in 24 districts of eight provinces. The replanting has been highly successful, and has led to an increase in biodiversity in planted areas – especially with respect to zoobenthos, marine species and birds.

VNRC's approach is to pay protection fees to local guards for three years after planting. These guards hail from local communities and deter clearance of the seedlings or damage due to cattle grazing. The guards are equipped with loud speakers, coats, and sirens and the regulations are posted on a noticeboards on the dykes. If rules are violated by people (or their water buffaloes), they can be stopped and must face the risk of fines from the local People's Committee

Oxfam Great Britain

In Dong Hai Commune, Duyen Hai District, Tra Vinh Province, Oxfam GB began mangrove replanting and promotion of integrated shrimp-mangrove farming in 1997. Mangrove area on the 2,230 ha site has since increased from approximately 2% to 60%[15,16]. The project has been very successful – survival rates of replanted trees are 82-97%[16], soil and water quality in the newly reforested area has improved, and local farmers estimate that crop failure rate has fallen from 60% prior to 1997 to 20% today. Farmers have been involved in every stage of the project cycle, from designing to implementing, and the project has both raised awareness about the ecological roles of mangroves and created solidarity among the farmers . At the beginning of 2002, Oxfam began a more intensive education program and group organising of farmers. Crucial in this project is the involvement of farmers in every step, including choosing species to replant. Another important lesson has been that farmers should grow seedlings themselves if possible, allowing them to generate income and reducing transfer distance for the plants[17].

'Before Oxfam GB's mangrove replanting in 1997 approximately 60% of shrimp harvests failed due to disease; failure rate today is estimated at just 20%'

Nguyen Dung Tien,
Shrimp Farmer, Duyen Hai[18]

RIGHT & BELOW RIGHT: *Almost all of the mangrove cover in Can Gio was destroyed during the American-Vietnamese war. Today, Can Gio Biosphere Reserve comprises 33,000 ha of replanted mangrove forest, with 32 true mangrove species and 42 mangrove associated reported.*

International Marinelife Alliance

In Tuan Le Village, Van Tho Commune, Van Ninh District, mangroves have been destroyed by illegal shrimp farm development. 2000 trees were replanted over 0.5 km on 22 May 2001. However, many of the original and replanted trees had already died from pollution from the shrimp ponds, and if the area is left in this condition, those remaining are unlikely to survive[19].

Conclusions

Replanting programmes need to be very carefully planned so as not to negatively impact areas that are ecologically important in their own right. Species selection and seedling density are of great importance and replanting efforts would benefit from:

- increased information exchange between the different groups planting mangroves.
- education of local communities about importance of mangrove areas and benefits they can bring, preferably prior to planting.
- local communities' involvement in decision-making (e.g. species selection) and in the actual replanting process (which, if paid, can bring employment opportunities, if unpaid may simply promote a sense of ownership and pride and possibly increase survival chances for the mangroves).
- hiring community members to protect small mangrove areas.
- incorporating local community rights to exploit forest products sustainably.
- planting at a density that won't hinder root development and reduce trees' ability to withstand strong winds or tidal action.
- avoiding monocultures.
- avoiding planting on areas (such as mud-flats) which have significant populations of shorebirds or are ecologically important in their own right.
- involving landowners and / or farmers throughout the process. Farmers can be encouraged to grow seedlings for income generation, and this can also lead to increased likelihood of survival due to reduced transfer distances.

Can Gio Biosphere Reserve[13,14]

Almost all of the original 40,000 ha of mangrove cover in Can Gio was destroyed by the American napalm and defoliant spray during the American-Vietnamese war. In 1978, aware of the significance of mangrove ecosystem rehabilitation, the People's Committee of Ho Chi Minh City invested in reforestation, undertaken by the City Forestry Service and the People's Committee of Can Gio District. The reserve now comprises 33,000 ha of replanted mangrove forest, with 32 true mangrove species and 42 mangrove associates reported. Many animal species have returned to the area, and Can Gio now provides a habitat for 127 species of fish, 30 species of reptiles, 19 species of mammals, 9 species of amphibians (including tree frogs *Rhacophorus leucomystax*), and an increasing number of waterfowl and shorebirds.In addition to the mangrove species, 95 species of inland plants dispersed by humans and animals have been found. The rehabilitated mangroves have reduced erosion of river banks, and contributed to protection from storms and reduction of salt intrusion in the agricultural production areas of Can Gio and neighbouring districts.

Prior to each replanting, the reserve management holds workshops with locals to discuss their ideas and to educate about the importance of the mangroves; they hire community members to help with the replanting, and, since 1990, they have helped poorer members of the community to build houses in the reserve and have paid them monthly salaries to protect a small area (~70ha, VND 185,000 (US$12.3) per ha per year). These families have 30-year contracts, which can be handed down as inheritance, and they are entitled to collect some of the forest products (e.g. 35% of product during thinning of the forests). Also key to the success here has been TV and radio coverage and 'propaganda', and the local people apparently now have a great sense of pride in the forest. In 2000, the Can Gio mangroves were designated for inclusion in the United Nations Educational, Scientific and Cultural Organisation's World Network of Biosphere Reserves. Ecotourism in the reserve has developed rapidly, with considerable potential socio-economic benefits for local communities (200,000 tourists visited in 2001).

CONCLUSIONS

Shrimp farming is a major factor in the Vietnamese economy, especially in rural areas, and has been important for income generation in some households. The shrimp export market is of considerable importance to Vietnam and increased production is a central component of the government's development strategy, with expansion of the industry being actively encouraged.

The government's recognition of the role mangrove forests play in coastal defence and in ameliorating disease outbreaks is important. Vietnam's legal protection of mangrove forests, coupled with an active replanting strategy, suggests that the major shrimp-mangrove conflict observed in other countries may be on the decline in Vietnam. However, at the local level, aquaculture has developed in an unplanned fashion at considerable cost to coastal habitats, and the conversion of mangroves and wetlands to ponds continues.

No evidence of serious human rights abuses of the kind associated with the development of shrimp aquaculture in other countries came to light during this research. However, aquaculture is a highly risky business, and there are no guarantees that a profit will be made from year to year. The potential to slide deeper into debt is very real for the poor small-scale farmers. Having invested heavily in shrimp ponds, they often feel compelled to play the game again rather than quit. Furthermore, land used for aquaculture rapidly becomes unusable for agriculture. Shrimp farmers are then stuck with a gamble. This has led to poverty spirals and an increasing gap between the haves and have-nots. Landlessness is a major concern – shrimp farmers unable to service loans face losing their land, and source of income. Thus, there exists a mounting potential for conflict, and economic and social disruption, alongside increasing environmental degradation.

LEFT: *Strategic planning is needed to protect the environment for future generations.*
© EJF / Shanahan.

Sustainability

Although there may be benefits to local and national economies in the short term, shrimp aquaculture as it is currently practised in Vietnam is largely not sustainable. Yields in intensified systems have been demonstrated to decline after a few years, and there exists a future threat of land being unusable on a wide scale. In Thailand, out of ~1.3 million ha used for shrimp farming, approximately 250,000 ha have been abandoned[1].

In order to make shrimp aquaculture less damaging to the environment and, at the same time, less of a gamble, the necessary changes in infrastructure, pond design, feed and post-larvae production will require considerable financial assistance. The aquaculture extension services have the potential to reach shrimp farmers the length of the country, but they are limited by funds, materials and techniques, and will become increasingly overstretched as the number of shrimp farmers increases.

Conflicting policies?

The Vietnamese government has called for the expansion of aquaculture to be carefully planned to protect the environment[2], and has promoted the development of integrated shrimp-mangrove systems and sandy land aquaculture. It is also involved in a number of large-scale water and coastal resources development projects, particularly in the Mekong Delta[3]. Many of these are positive developments, with projects focussed on defining sustainable land uses in the brackish zone and including mangrove re-planting programmes[4]. There have also been public warnings about the risks of excessively intensive shrimp aquaculture and the fight against mangrove loss[5].

However, while these projects, and the government's awareness of the environmental issues, should be highlighted and welcomed, it does seem that there is a political struggle behind the scenes as there are, at the same time, massive growth plans for the aquaculture industry and there may be conflict between reforestation programs and shrimp cultivation expansion programs.

Although some of the larger scale shrimp farm developments do seem well funded and appear to have been planned to reduce risks and environmental impacts, it appears that the majority of shrimp farms in Vietnam are small-scale enterprises, and that those most seriously affected by the industry tend to be the rural poor. Much of this small-scale development has been unregulated, and carried out by the farmers themselves with very little knowledge and very few resources[6]. This has been encouraged in many areas by government subsidies for conversion of rice land to shrimp ponds[7], and the high profit potential of shrimp farming compared to rice cultivation. The low tax on income from shrimp aquaculture may also have been influential[7].

RECOMMENDATIONS

General Recommendations

In light of the information presented in this report, the Vietnamese Government, the international donor community, United Nations agencies, non-governmental organisations, the seafood industry, consumer nations and all other concerned parties should:

- Support efforts to reduce social and environmental impacts of shrimp aquaculture and attempts to develop alternative livelihoods in Vietnam.
- Be aware of the serious social and environmental impacts shrimp farming has had in other countries, and ensure that these are not repeated in Vietnam.

The Vietnamese Government

In recognising the problems of shrimp production, the Vietnamese Government should:

- Build capacity in National, Provincial, and District Aquaculture Extension Departments; develop farmer's structure (groups / clubs) and local extension services (at commune and village levels)[8].
- Develop better quality control for seed stock (post-larvae).
- Encourage improved treatment of water and effluent and support use of dual canals systems.
- Encourage rationalisation of the production chains between shrimp farmers and exporters, hatcheries, and suppliers of feed and other inputs.
- Include mangrove and wetland ecology and importance in school curriculum, with visits to mangrove and wetland sites and practical elements.
- Clarify responsibilities of Ministry of Agriculture and Rural Development (Dept of Forestry) and Ministry of Fisheries (Department of Aquaculture) as, in mangrove-aquaculture issues, there exists considerable overlap. Greater inter-ministerial communication and coordination should be engendered.
- Avoid risk of destabilising markets with rapid development of shrimp industry.
- Promote education of all relevant partners from senior from government figures to individual shrimp farmers on what sustainability means and how it might be attained.
- Develop community-based or co-management of mangroves and wetlands.
- Explore eco-tourism potential as a sustainable alternative to shrimp aquaculture in coastal zones.
- Promote involvement of non-governmental organisations – the law on local NGOs has had 15 drafts and been mooted for 12 years[9].
- Ensure that Environmental Impact Assessments required by new developments are undertaken, are rigorous, and that findings are adhered to.
- Ensure the protection of mangroves, wetlands and other ecologically sensitive coastal areas, and encourage the rehabilitation of degraded aquaculture sites.
- Include in new shrimp production plans for what will happen after productivity declines (i.e. land restoration, alternative livelihoods).

ABOVE: *Degraded mangroves in Duyen Hai district, Tra Vinh. The land-owner now plans to farm shrimp..*

- Require foreign commercial investors to fund environmental restoration of abandoned shrimp farms, either replanting mangrove or funding the return of conditions favouring agricultural land-use (desalinisation, etc.).

- Develop and promote equally lucrative, but less risky and more sustainable, alternatives to shrimp aquaculture.

- Ensure implementation of environmental protection legislation.

- Enforce relevant legislation regarding use of chemicals in aquaculture.

- Encourage research into the social and environmental impacts of shrimp aquaculture.

- Increase the budget for aquaculture extension given the importance of aquaculture products and the high risk associated – allocation for small scale shrimp farming should have a large proportion, to better target the poor[8].

- Formulate policies specific to coastal forests, increase capability of governmental forest protection units and encourage participation of communities in forest management[8].

Aquaculture Extension Services

In recognising the problems of shrimp production, aquaculture extension services (be they governmental, academic or non-governmental institutions), and educators in general, should:

- Use demonstration ponds to teach sustainable alternatives.

- Gear training towards the farmers' frame of reference, ideally adopting the 'farmer first' principle in the mould of Farmer Field School programmes in agriculture – where field schools and farmer-to-farmer training are used.

- Encourage shrimp farmers to avoid inappropriate use of antibiotics, vitamins, etc.

- Promote poly-culture and diversification of aquaculture to protect against unfavourable market conditions and reduce risks of disease. Lobster, mussel, snail, crab and fish culture, as well as providing income can provide a greater contribution to local food security compared to the export dominated shrimp production.

- Discourage second shrimp harvests in the South, promoting alternatives instead.

LEFT & OPPOSITE PAGE: *While the Government's protection of wetlands and their active mangrove replanting strategy should be welcomed, aquaculture development plans and unregulated small-scale shrimp farm development are placing intense pressure on coastal areas.*

Non Governmental Organisations

Local and International NGOs have a major role to play in addressing some of the problems described in this report. They should:

- Conduct carefully planned mangrove afforestation, and reforestation programmes.
- Develop mangrove and aquaculture management plans.
- Provide education (both environmental awareness and aquaculture extension).
- Conduct research into sustainability of aquaculture practices.
- Research the necessity and health impacts of chemical use in aquaculture.
- Monitor species and habitats speculated to be threatened by aquaculture activities.
- Improve coordination and communication between all relevant parties.

The International Donor Community

Vietnamese shrimp aquaculture has developed rapidly, with inadequate planning and regulation. Consequently, environmental and social impacts have arisen. Donors, including bi-lateral and multi-lateral agencies, should:

- Support Vietnam in addressing the environmental and social issues arising from the rapid development of shrimp aquaculture.
- Fund relevant educational and research programmes.
- Promote the development of alternative livelihoods.
- Support habitat restoration schemes, including mangrove planting and restoration of lands polluted or salinised by aquaculture activities.
- Promote sustainability in aquaculture.

Research Institutions

Vietnamese and overseas research institutions should:

- Conduct research on sustainable approaches and amelioration of environmental damage.
- Research epidemiology, transmission and control of shrimp diseases.
- Conduct further research into the environmental impacts of shrimp farming.
- Research the carrying capacity of aquaculture sites (e.g. Tam Giang Lagoon).
- Research shrimp-mangrove integrated farming systems to determine actual comparative advantages and find the most sustainable pattern[8].
- Research and promote livelihood alternatives to shrimp aquaculture.

Donors, The Government, NGOs

In recognising the degree of financial risk to which poor farmers are exposed Vietnamese banks, donor institutions and NGOs should:

- Develop alternative credit schemes.
- Encourage savings.
- Fund and conduct relevant research.

Shrimp Consumers

In recognising the environmental and social impacts of shrimp aquaculture in Vietnam, importing companies, governments of consumer nations and consumers themselves should:

- Call for and support more sustainable and equitable approaches in shrimp aquaculture.
- Promote development of a certification and labelling system for shrimp, monitored by an independent third party and based on both environmental and social criteria.

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CONCLUSIONS & RECOMMENDATIONS

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