Integrated Coastal Management for Climate Change

Aquaculture and the 7:3 policy in Kien Giang province Vietnam

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List of acronyms and abbreviations:

GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit (**GIZ**) GmbH (German Society for International Cooperation)*
AusAID	*Australian Agency for International Development*
KGPC or PPC	*Kien Giang Provincial People's Committee*
FMPB	*Forest Management Protection Board*
VWU	*Vietnam Women's Union*

Foreword

This document is a component of Phase 2 (2011-2015) of the AusAID funded GIZ 'Conservation and Development of the Kien Giang Biosphere Reserve Project'.

The Kien Giang Provincial People's Committee (KGPC) recognises the need to incorporate livelihoods into mangrove forest management. As conservation of mangrove forests can conflict with the livelihood activities of people living in and near the mangrove protection zone, the KGPC requested GIZ investigate the current status and viability of aquaculture in this zone under its 2005 policy of 70% mangroves and 30% pond/production area (7:3 policy).

The KGPC proposed that assistance was needed to help landholders establish a sustainable management system for these areas through better pond design and mangrove planting regimes.

The current document outlines preliminary findings and recommendations based on field visits, discussion with stakeholders and a review of relevant literature.

For background information visit http://www.kiengiangbiosphererereserve.com.vn/

Contents

1. PROJECT

Aquaculture and the 7:3 policy in Kien Giang province Vietnam

2. PROJECT OBJECTIVES

- Evaluate the economic and environmental status of aquaculture farms in the mangrove protection zone of Kien Giang
- Provide a brief assessment of the impact of the 7:3 policy on farm viability.
- Propose strategies to assist farmers improve aquaculture productivity and profitability under the 7:3 policy.

3. INTRODUCTION

Livelihoods impacting on natural resources must be incorporated into integrated coastal management plans. This requires an understanding of their ecological and economic sustainability and of policys and regulations impacting on them. One such livelihood is aquaculture which has already had a major impact on coastal regions of Kiang Giang.

Marine and brackish water aquaculture is economically important in KG with most development concentrated in Kien Luong and Ha Tien districts. There are currently 71,484 hectares under production; 85% of this area is shrimp ponds which produced approximately 144,000 tonnes of shrimp in the first half of 2013. The remaining area of 10,722 hectares consists of crabs, algae, blood shell and fish production. There are plans to expand the production of these and other high value aquaculture species such as sweet snails, pearl oysters and arca (http://vccinews.com/news_7 August 2013).

A small percentage of this aquaculture in KG is located in the Mangrove Protection Zone (See Box 3). The mangroves in this zone are considered to be of high ecological importance for both erosion prevention and biodiversity. However people also live within this zone and the dominant livelihood is brackish water pond-based aquaculture.

To avoid the potential conflict between environmental conservation and economic development, caused by having people living within the mangrove belt, the government has implemented a national strategy (See Box 2) that promotes the planting of mangroves and restricts the livelihood production area on land tenures. The leaseholders located within the protection zone are issued with a 'Green book' and must comply with the conditions therein.

In 2005, in response to the national strategy, KG Provincial Peoples Committee (PPC) devised a 7:3 policy (Box 1) which stipulated that 70% of any leasehold within the mangrove protection zone, must be maintained (or replanted) as mangroves; the remaining 30% can be used for production and livelihood related activities.

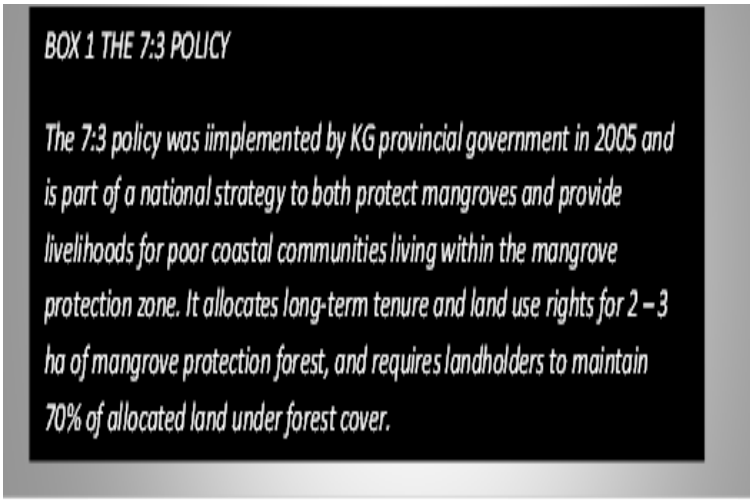
The policy has now been in place for 8 years with the phasing in period due to end in 2014. This report was commissioned by GIZ, at the request of KGPC, to assess how the 7:3 policy has impacted on the economic viability of aquaculture operations in the mangrove protection zone and, if needed, make recommendations for improving economic viability. Livelihoods need to be sustainable and viable to both relieve pressure on the mangroves and to improve living standards of marginalised communities living in remote coastal regions. ***Economic development and livelihoods must be fully integrated into any successful mangrove management strategy***.

4. METHODS

The focus of this report is to assess the viability of 'pond based aquaculture in the Mangrove Protection Zones along the 200 km coastline of mainland Kien Giang province' (See Figure 1).

The assessment is based on field observations, data provided through interviews with farmers and the Forestry Protection Management Board (FPMB) and a workshop conducted at the GIZ office in Rach Gia with input from a Fisheries extension officer and representative from the Vietnam Womens Union (VWU). Information was also obtained through meetings organised by Vnforest and the Ministry for Agriculture Rural development (MARD), as part of a formal National Forest Management review process.

Figure 1 *Map prepared by GIZ showing Kien Giang coastline*.
http://kiengiangbiosphererereserve.com.vn/project/



5. FINDINGS

5.1 Policy and Zoning

The National government has an action plan for the protection and development of Vietnam's mangrove forests (See Box 2 and 3). At the time this report was written (October 2013) this National Forestry Management strategy, which includes the 7:3 policy in KG, was under review by VNFOREST and MARD, in consultation with DARD, FPMB, other relevant local government agencies and farmers. Topics under discussion included non-compliance and viability of extensive aquaculture farming systems.

Outcomes of the formal review process are(as of Oct 2013) yet to be announced.

5.2 Types and number of aquaculture farms

There are **1076 farms now operating in the mangrove protection zone along the 200km mainland coastline of KG.** There is also the potential for a further 935 leases in the northern districts to commence production in the future; these leases currently either do not have the width of mangrove belt required to undertake production or the leaseholder has chosen to delay development (See Appendix I for details of farm numbers by district and commune).

The dominant farming activity in the mangrove protection zone of KG is brackish-water, pond based aquaculture.

In the northern districts, the farms are mostly **intensive shrimp** culture systems while farmers in the south employ

Box 2.

The National government has an action plan for the protection and development of Vietnam's mangrove forests, the ***National Programme to Restore and Develop Coastal Mangrove Forest for the Period 2008-2015*** *(MARD). This national project represents a significant State investment in mangroves.*

The overall objective of this action plan is to promote the protection, rehabilitation and wise use of Vietnam's mangrove ecosystem and also meet the needs of socio-economic development.

Two important aims are to;

- Rehabilitate mangrove forests so that by 2015, the area is equivalent to the area in 1982 (250,000 ha). Include an increase in mangroves on shrimp farms to around 40-70 percent.

- Establish a legal framework for mangrove ecosystem management and encourage community based mangrove management.

an **extensive** poly culture system growing **shrimp, crab and blood cockles (Figure 10**).

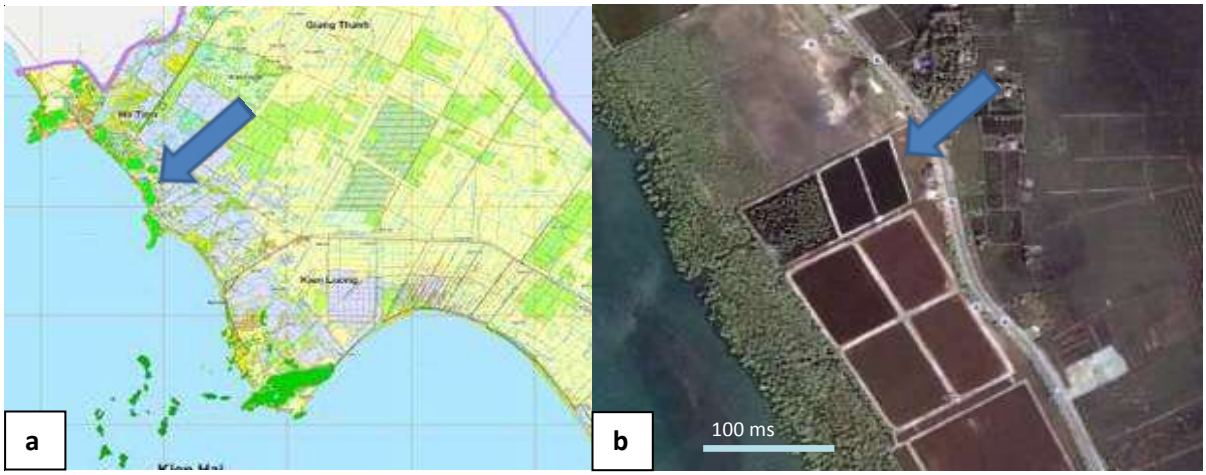


Figure: **2a**. *The **northern district of Kien Luong** showing easy access to the main highway. Farms west (seaward) of the highway are subject to the 7:3 policy. **b**. A farm with a 5:5 mangrove to pond ratio; mangrove is seaward of production ponds. The arrow indicates a leasehold with two 0.25 ha ponds*.

Intensive farms in the **northern districts** of Hon Dat and Ha Tien mostly culture *Penaeus vannamei,* commonly known as white leg shrimp. The farming system is characterised by high inputs, high stocking densities, potentially high profit and high risk. Such farms incur high capital investment and ongoing operating costs. Inputs include artificial feeds and aeration, which make transport systems and access to electricity essential. The farms in the northern districts of KG have access to such infrastructure which enables them to intensify their pond culture systems. Profits per unit area are very high relative to extensive systems.

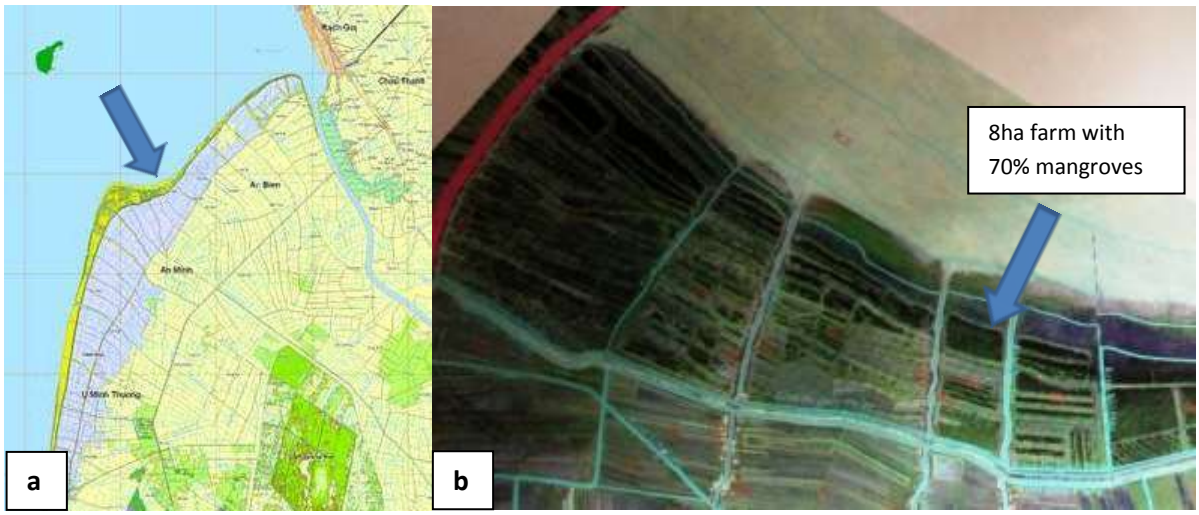


Figure 3a. *The southern district of An Bien. **b.** Aerial view showing pond orientation, absence of roads and intricate canal system. Only leaseholds seaward of the main canal (which runs parallel to coastline) are in the 'mangrove protection zone' where the 7:3 policy applies.*

Box 3

MANGROVE FOREST ZONING according to 2011 Policy/decision 25 Kien Giang

Buffer zone- erosion or deposition zone in front of mangroves. It has now been extended from 200 m to 500 m seaward from the edge of main mangrove protective belt.

Pro*tective zone*- The Protection zone is now divided into Main and Sub sections.

MAIN *section*- this is the high protection zone adjoining the buffer zone. **This zone is a minimum of 200m from the water edge.** If wider, it is classified according to the mangrove species composition; it ends where *Rhizophora* genus starts to dominate *Avicenna.*

SUB *section- Rhizophora* dominates. It extends from the main section of mangrove to the dyke or road.

IN KIEN GIANG, 7:3 AQUACULTURE IS PERMITTED IN THIS SUB ZONE

In the **southern districts** most communes are isolated with no road access or suitable source of electricity. As a result aquaculture systems are extensive or traditional, with low stocking density and little or no supplementary feeding.

5.3 Production and sustainability of farms under the 7:3 policy

5.3.1 Intensive shrimp farms

Figure 4. *Plastic lined, intensive shrimp pond. Fences around ponds are to prevent crabs entering and transferring diseases. Mangrove areas are separate (seaward) from ponds. Insert- Electric paddlewheels provide additional aeration.*

Most of the intensive farms in the northern districts are culturing white leg shrimp (*Penaeus vannamei*).

At a production level of 6 tonnes per ha, two crops per year and a market value of US$10 per kg (Oct 2013; exchange rate of US$1 =VND20,000), the gross annual income is $US 120,000 per ha. With production cost of 70 to 75% of gross income (An 2012) the annual net profit is US$30-40,000 for a 1 ha pond. If the leasehold is 3 ha, then the farm can be 7:3 compliant and remain highly profitable (**Note**: these costing's are rough estimates only and do not take into account loan repayments and crop losses due to, for example, disease outbreaks).

The environmental impact of intensive shrimp farms is a highly debated topic with potential negative impacts (after the initial construction stage) including eutrophication of local waters, and the release of chemicals and diseases into the natural environment. By restricting pond area the 7:3 policy effectively reduces the density of farms and thereby relieves pressure on the

environment, thus contributing to environment sustainability objectives.

Figure 4. *White-leg shrimp harvest at an intensive farm in Kien Luong district, Kien Giang province. The farm is adjacent to the major highway which enables rapid road transport of chilled (on ice) product to processing plants.*

5.3.2 Extensive Polyculture farms

Extensive poly-culture farming systems are practised in the more remote southern districts of An Minh and An Bien. Farmers culture shrimp, mud crabs and blood cockle in the same pond (Figure 10).

Figure 5a. *Areal map of Nam Thai commune, An Minh district, with the location of farm marked in red. (Source: Google earth 2013).* ***b.*** *Farm with approximately 20% mangrove cover.*

There has been a shift from the traditional farming method which relied on natural recruitment through tidal inflow to stock ponds, to the extensive-improved system whereby young shrimp, crabs

and cockle are purchased and artificially stocked in the ponds at a low density. Crablets and shrimp post-Larvae (PL) are purchased from local commercial hatcheries/nurseries. The blood cockle are either collected locally from the wild or are imported from elsewhere, including Thailand. The need for importation suggests the local supply is being depleted.

Stocking density of crabs and shrimp is low (1-3 m^{-2}) compared to intensive farms (>30 m^{-2}), although farmers expect mortalities and compensate by frequent pond restockings. They also do partial harvests throughout the year resulting in an unknown shrimp density. However, the maximum density is ultimately determined by the carrying capacity of the system which, with no additional aeration (source of oxygen) and minimal supplementary feeding, remains low.

Pond management consists mostly of water exchange and the periodic cleaning of pond bottoms. The timing and extent of these management strategies have a major impact on productivity and account for much of the variation in production levels between farms within a single commune.

However, the economic viability of these extensive farms is largely dependent on farm size. Land allocation in the mangrove protection zone in KG is typically less than 3 ha. Under the 7:3 policy, where mangroves are grown adjacent to ponds, this results in less than 1 ha for production ponds.

Income is determined by production volume and market price and varies between farms. Most farmers do not record farm inputs and outputs. The small (13 farmer) income survey completed during this project showed a large range of incomes within one commune (See Appendix III). The most quoted average production figure for extensive farming systems in Vietnam is 500kgs per ha per annum with incomes ranging between US$1000 and US$5000, depending on the currency exchange rate at time of publication (AIMS *et al*. 1999, Binh, *et al* 1997, Bush *et al* 2010, Clough *et al* 2001, 2002, Johnston *et al* 2000, Minh 2001, Omoto 2012).

Figure 6. *Meeting with 14 farmers in Dong Hung commune, An Minh district.*

BOX 4

CONCLUSIONS

The 7:3 policy is yet to achieve its dual goals of increasing mangroves and providing livelihoods for poor coastal communities living within the mangrove protection zone.

Non-compliance is more evident in the southern districts. This suggests issues arise when the 7:3 policy is applied to extensive production systems. Specifically:

1. ***Economic viability of 7:3 extensive aquaculture farms under 3ha, is marginal.***
2. *Most leaseholds in mangrove protection zones in KG are less than 3 ha; 64% in the south and 89% in the north (Appendix II).*
3. *Most (76%) of existing farms have more than 30% of their land under production.*
4. ***Farmers are reluctant to apply the 7:3 policy because it results in a loss of aquaculture production area and an associated loss of income and living standards; it threatens the viability of their farm.***

According to our survey (Oct 2013) farmers in Dong Hung commune (An Minh district) are currently making a gross income of between 20 and 100 M VND per annum. However farms are not yet compliant with the 7:3 policy and this income is being derived from an average pond area of 1.5 ha. A household now operating a non-compliant farm could, when compliant, see a potential income loss of 50%. For a lower earning (e.g. 20 M VND per annum) household of 4 people, this is approaching the poverty line. According *MOLISA (*2010) the poverty line for rural Vietnamese was 400 000 VND per person, per month per person.

Figure 7. *An extensive aquaculture farm in Nam Thai commune, An Bien district. The farmer purchased the adjoining leases to achieve a land area of 8 ha. The operation was approaching the 7:3 ratio and the family was deriving some income from mangroves. Total income 100 M VND.*

Income generated from mangrove timber is low relative to aquaculture (Do *et al* 2005) and requires a 6 year grow-out period before any harvesting can take place (Decision 25, 2011). There are no (short to midterm) financial incentives for replacing pond production area with mangrove trees.

The ongoing impact of the extensive farms on the natural environment is low due to the 'low input and output' nature of the culture system. Nutrient discharge is low and the active recruitment of natural crab and shrimp larvae and juveniles (potentially depleting local populations) has largely been replaced by hatchery reared stock.

5.4. Compliance with the 7:3 policy

The compliance issue is most evident in the southern districts of KG. There is about 4 times more farms operating in the 'mangrove protection zones' in the southern districts (867) than in the northern districts (209) (Figure 8 and Appendices II and III) and these farms show much more variation in 'mangrove to pond' ratios than the northern farms. About 76% (657) of farms in the southern districts are yet to reduce their production area to comply with the 7:3 policy requirements; 38 farms having no mangroves.

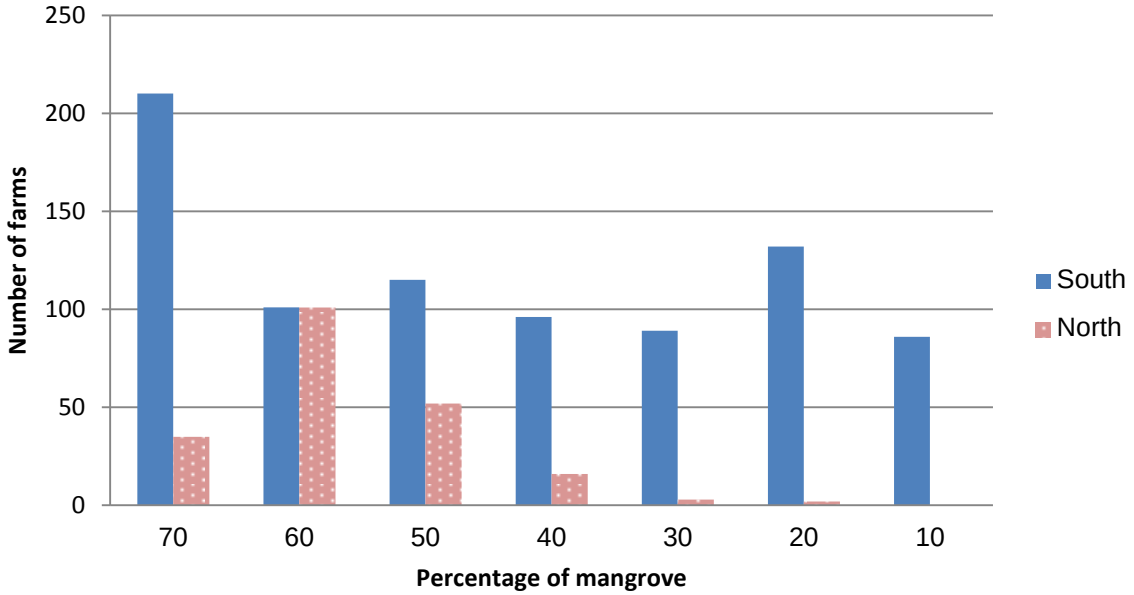


Figure 8. *The number of farms and their percentage mangroves for the northern and southern districts of Kien Giang.*

To be viable and compliant will likely require leaseholds to be greater than 3 hectares, or farmers generate an alternate/ additional income source. Thus with current farming practises and productivity levels (income generating capacity per unit area) and the small size of extensive, aquaculture in the southern districts is unlikely to remain economically viable under the 7:3 policy.

6. RECOMMENDATIONS

An increase in farmer compliance and economic viability would be best achieved through a multi-faceted approach involving technical improvements to farm management practises, education and training, innovative marketing and site specific amendments to the policy.

The following recommendations apply to the extensive polyculture farming systems of the southern districts.

Intensive farms, characteristic of the northern districts, are considered to be economically viable under the 7:3 policy, although like intensive shrimp culture farms worldwide, they are vulnerable to devastating production losses due viral disease outbreaks.

Box 5

RECOMMENDATION SUMMARY

A multi-faceted approach is recommended ***to best help extensive poly culture farms be viable*** *under the 7:3 policy.*

It should involve technical improvements to farm management practises, education and training, market exploration and site specific policy amendments.

- *Address technical issues, most notably water quality (issues related to water depth, circulation and exchange rate) and transport and acclimation of larvae and juveniles.*
- *A cooperative approach be piloted through the formation of farmer groups in KG. This initiative should include demonstration farms to facilitate training and education.*
- *Farmers continue with current species but explore new market avenues.*
- *Training be carried out 'on farm' and involve existing extension infrastructure and include the VWU.*
- *Site specific policy amendments that take into account, e.g. farm size and proximity to mangroves and coastal erosion or deposition zones.*
- *Collaboration with organisations carrying out related projects to strengthen models and expedite up scaling of outcomes.*

6.1. Policy driven changes and potential actions

The review process undertaken by VNFOREST and MARD in consultation with DARD Kien Giang, revealed a responsive government approach to the national forest management strategy. Consultants visited farms to discuss issues related to economic viability. Possible policy related options for improving extensive farming viability include:

- Reducing the 'mangrove to pond ratio' in accordance with size of land tenure. The review committee is aware 7:3 is economically marginal or unviable for extensive farms of 3ha or less. However the ratio of 7:3 is a KG provincial decision and further consultation is required with the provision of sustainability evidence.
- Site specific adjustments to the 'mangrove to pond' ratio based on whether the farm is located adjacent to a deposition or an erosion shoreline. For example, farms in deposition zones with active natural mangrove regeneration could have their ratio reduced. In return for this concession farmers become responsible for the protection and management of the mangroves seaward of their lease.
- Investigating the variables that affect the erosion prevention potential of mangroves. The quality of mangroves, as well as the quantity, needs to be considered. Changes in quality could reduce the area of mangrove required to achieve erosion prevention and biodiversity policy objectives.
- Allow specific mixtures of cash crops and mangroves. Cash crops could be included in the mangrove count (contributing to the 70%), increasing income and economic resilience through product diversity.
- **<u>New</u> operations in the mangrove protection zone to be subject to a farm design approval process prior to pond construction to ensure optimal aquaculture production and minimal environmental impact. Other 'best practise' principles should also be considered for long term sustainability.**
- An extension to the compliance deadline (currently 2014) while technical issues related to current

production models are addressed through research and technical training.

6.2. Technical issues affecting the production capacity of extensive farms

One approach to offsetting the income loss that results from the 7:3 policy limiting pond production area to 30%, is to increase productivity per unit area.

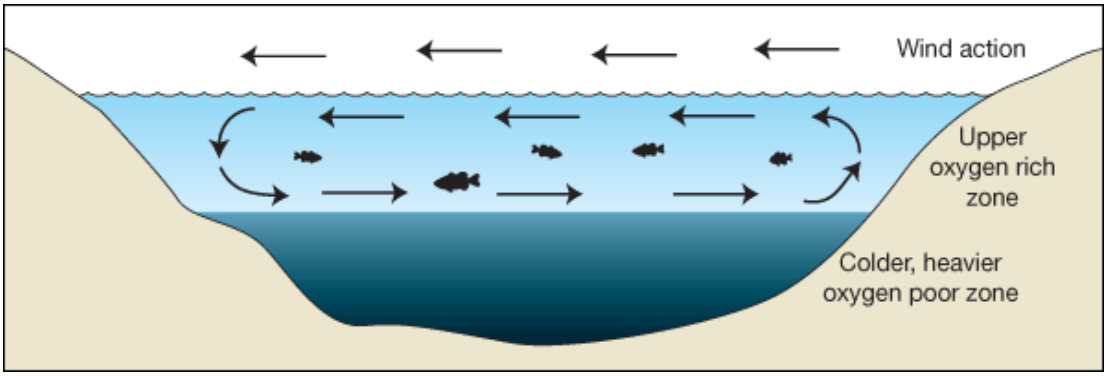
The majority of extensive farm ponds have been constructed by the farmers themselves, often with very limited knowledge, planning and resources. This has resulted in problems associated with water depth, circulation and exchange rates. In addition, sub-optimal farm management practises that are not always 'evidence based' contribute to low production.

Three of the main technical issues to be addressed are:

- *Water quality*- In aquaculture, income security is linked to water quality. Management practises that should be further investigated in An Minh and An Bien farms relate to pond depth, deposition of material excavated from pond, water exchange frequency and pond (sluice) gate operation and dimensions (Clough *et al* 2002, Johnston *et al* 1999).

Figure 8. *Sluice gates at extensive ponds in southern districts. The sluice gate design influences tidal water exchange rate and, if they leak, pond depth as the tide subsides. The size, location and number also effect water circulation and mixing patterns.*

Turbidity (levels of suspended solids and phytoplankton) and water column stratification also need to be examined for the role they may play in the slow growth of blood cockles and stock mortalities.



Source: Nov 2013 http://thelakeexperts.com/Images/Beginner/Aeration/stratification.gif

Figure 9. *Stratification in ponds resulting from poor horizontal and vertical mixing. Without sufficient movement and mixing, the water at the bottom of the pond can become low in oxygen and temperature. This will impact on the health and survival of bottom dwelling aquatic animals such as crabs, shrimp and blood cockles.*

Mangroves in or near the ponds can result in tannin toxicity and excess leaf litter (decomposition on pond bottom), contributing to poor water quality (Hai *et al* 2005). An efficient (low labour/ low cost) method of trapping leaves, for example suspending nets below trees, needs to be considered.

- Location of mangrove trees within the pond, as opposed to the common practise of planting trees on banks, could provide a valid means of increasing allowable pond production area. Water below foliage would be additional to the 30% maximum because it is between the trees. This culture method will require modifications to existing aquaculture practises and availability of suitable tree species may be an issue.

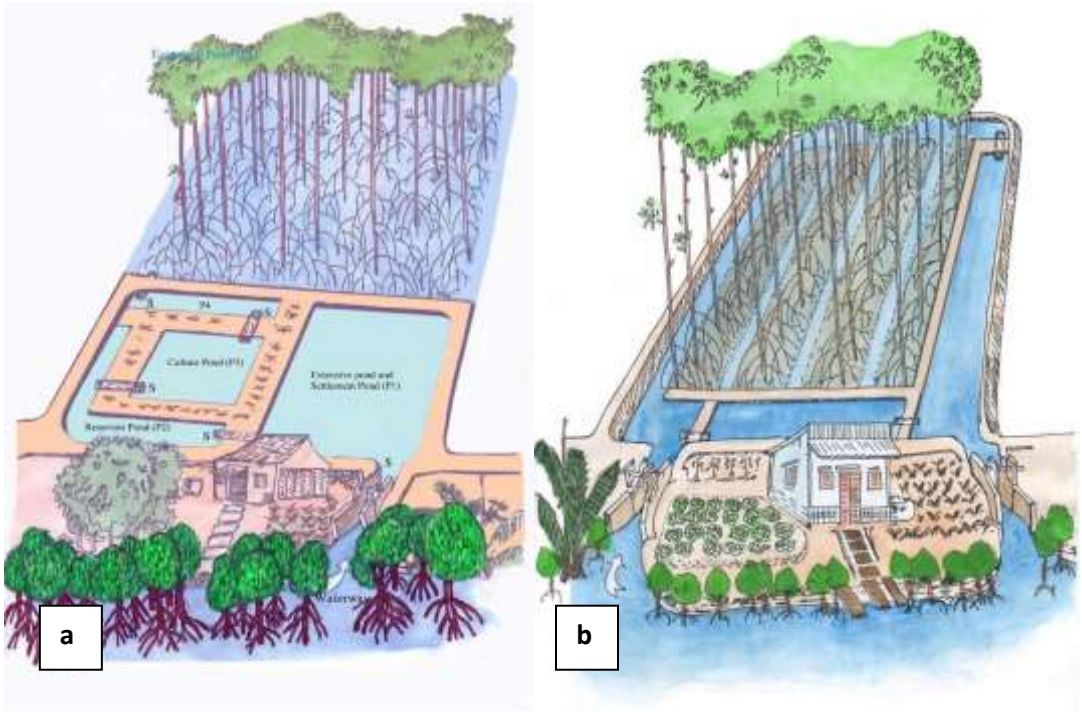


Figure 11. *Two integrated mangrove farming systems **a.** Mangrove area is separate from pond areas, **b.** Mangroves are gown in the ponds.* Source: Tuán *et al* 2005; artist Lyù Cao Taán. http://www.enaca.org/modules/library/publication.php?publication_id=111

- *Origin and quality of larvae and juveniles*- Crabs and shrimp fry are purchased from commercial nurseries that offer a range of quality and price accordingly. Farmers tend to buy batches of lower quality/ cheaper shrimp post larvae, expect mortalities and compensate with frequent restockings. It is not known whether this strategy is more effective than buying less but higher-quality larvae. The blood cockle juveniles are either collected locally from the wild or imported from elsewhere, including Thailand. The importation suggests the local supply is being depleted. The sustainability of blood cockle supply needs to be

examined. In addition, transport and acclimation of all seed stock needs to be revised as they are critical to survival in ponds.

6.3. Marketing

Another strategy to improve profit per unit area is to produce a higher value product; one that can attract premium prices and gain greater market access.

In terms of product, the species that are being cultured (Figure 10) are well suited to the culture conditions, have a ready market and are high value. Thus, in the short term, under current market conditions, it is recommended that the farmers continue to culture them. Also, having 3 species provides a buffer against market fluctuations and adds to income security. To improve the income from the sale of these **species marketing efforts should be directed towards improving quality of product and brand development**. This will require careful exploration of potential markets and associated regulatory requirements.

Eco labelling and organic certification for extensive farms; Why go organic?

- NGOs and international markets are promoting eco-farming. The interest of European buyers in 'green' products is increasing among larger retailers and consumers.
- Eco-labeling of 'Integrated mangrove fish farming' (IMFFS) products can potentially attract premium prices and increase export earnings from extensive small-scale aquaculture farming in mangrove protection zones in KG.
- The Vietnamese government aims to expand *certified organic production in integrated shrimp-mangrove farming systems* in neighbouring Ca Mau province by 2015 (Ha *et al* 2012). This expansion could include Kien Giang province.

Organic seafood products are a niche market and users currently expect to pay premiums of 30-40%.

(Ribeiro et al 2010)

Despite the potential benefits, past attempts at developing and coordinating aquaculture certification schemes in Vietnam highlighted a number of issues that, to date, have obstructed further development (Ha *et al* 2012, Tran *et al* 2013, Omoto 2012). For example issues related to connecting farmers to markets (long market chain and remoteness of farms) and to ensuring consistency in quality and quantity of product need to be addressed.

Tran *et al* (2013) suggests one impediment to the success of certification schemes is the fragmented governance system which makes chains of custody from farm to processor/exporter, difficult to establish. Omoto (2012) concluded that in order to overcome conflicts of interest and legitimate representation in organic certification, the social and economic conditions of production **require regulatory intervention from provincial and local level government**. Omoto commented that

middlemen did not always ensure that farmers received a higher price for their certified product and that there were also lengthy delays in payment; both factors resulted in farmers reluctance to continue certification.

Figure 10. *Marine/brackish water species grown in the 'extensive poly-culture pond systems' of the southern districts KG; mud crab (Scyll sp.), blood cockle (Anadara granosa) and shrimp (Penaeus monodon).*

Issues relating to certifying and coordinating many small scale farmers may be alleviated through the cooperative farming model whereby a group of farms is certified and pressure is applied from within the group to maintain certification and meet sales targets. A cooperative approach could also help with documenting production practices and establishing a chain of custody for the products.

MARD and provincial DARD institutions and staff, with donor support organisations need to promote certification as one option for ensuring sustainable aquaculture in Vietnam.

7. Implementation of aquaculture viability improvement strategies

7.1 Formation of cooperatives and demonstration farms

- *It is recommended that a cooperative approach be piloted with the formation of three farmer groups in KG.* The cooperatives should be established at the local (district and commune) administrative level with each consisting of 10-20 farmers. Benefits such as shared equipment (e.g. water quality meters), technical information exchange and increased market access should be explored.
- The management and structure of the cooperative should be carefully researched and organised to ensure participatory decision-making.
- Green/organic certification: Pilot projects should be discussed with cooperatives to test whether the group certification approach is feasible under local conditions and legislation.
- Farmer groups to participate in identifying and testing new farm management strategies and pond design changes.
- Implementation of pilot projects/trials on selected farms to assess the effect of changes in farming methods.
- Successful models to be showcased on demonstration farms and fed into national policy.

7.2 Training and education.

Improving access to technical knowledge is essential for improving farm productivity. Studies show that farmers learn mostly from their neighbours but are receptive to formal training courses if they have established a trusting relationship with the trainers (Tung 2010).

Figure 11. *On farm training; part of a 2012 GIZ funded pilot scale project evaluating the benefits of seabass fish in extensive poly-culture farms in An Minh district.*

Thus training should make use of existing aquaculture extension infrastructure (Minh *et al* 2001). Typically the government appointed extension officers work in conjunction with the DARD, to carry out training usually at the request from the district/ commune FMPB. The training should be 'in the field', where possible at the cooperative demonstration farms, and involve visits to regions where other projects show relevant technology and results.

Where possible, training should include the local Vietnam Womens Union (VWU). As a risk management strategy, training should ensure more than one household member knows the technical aspects of pond management. This strategy reduces risks associated with illness or absence of the main farm operator. It also provides women with the opportunity to diversify skills and capacity build.

VWU is one example of an existing network that could be effectively used to achieve and scale up project outputs and to ensure the long term sustainability of outcomes. Raising the capacity and knowledge of women will also help to affect gender equality.

In addition to technical training, it is recommended that an education component be included in any project that involves the 7:3 policy. The education program needs to highlight the importance of mangroves and the purpose of the 7:3 policy and should include site visits; visits to both high erosion areas where land loss (including aquaculture ponds) has been rapid due to lack of mangrove protection forests and also to farms that have successfully implemented 7:3.

7.3 Collaboration

To expedite improvements to the economic viability of 'extensive aquaculture systems' in KG mangrove protection zones, information gained and results achieved through past and ongoing related projects should be incorporated into technical and management strategies.

Two relevant, internationally funded projects are currently underway, the results of which could feed into the innovative models to be developed and tested:

1. 'Developing sustainable mangrove based Polyculture model (shrimp- mud crab and clam) in Duyen hai District, Tra Vinh Province' (2013-2015) funded by Mangroves for the future (MFF) and implemented by Research Institute of Aquaculture No. 2 (RIA 2).

2. 'Organic shrimp certification- a new approach to PES', (2013-2017) funded by the German federal Ministry of environment, nature conservation and Nuclear Safety (BMU) and implemented by IUCN and SNV (the Netherlands Development Organisation) in Ngoc Hien District, Ca Mau province.

7.4 International Donor Community

There is a pressing need to achieve a sustainable balance between economic development (livelihoods) and environmental protection (mangrove conservation). In relation to the above recommendations, donors, including bi-lateral and multi-lateral agencies, could assist with:

- Funding for relevant educational and training programmes.
- Promoting the product branding and national and international customer awareness.
- Funding for research aimed at ensuring aquaculture, as a poverty alleviating livelihood, is both economically and environmentally sustainable.

Appendix I.

District/ commune	Total households	The current ratio (forest/production land)								
		100%	7:3	6:4	5:5	4:6	3:7	2:8	1:9	No forest
An Biên district	**146**	**0**	**33**	**11**	**23**	**21**	14	**16**	**16**	**12**
Tây Yên	23		12	1	1	1	3	3	1	1
Nam Yên	19		5	3	3	2	4	1	0	1
Nam Thái	21		9	3	5	2	1	0	0	1
Nam Thái A	83		7	4	14	16	6	12	15	9
An Minh district	**721**	**0**	**177**	**90**	**92**	**75**	**75**	**116**	**70**	**26**
Thuận Hòa	299		33	27	21	35	45	78	51	9
Tân Thạnh	115		33	27	24	5	2	3	6	15
Đông Hưng A	145		6	25	41	33	19	10	9	2
Vân Khánh Đông	84		70	11	2		1			
Vân Khánh	40		35		4			1		
Vân Khánh Tây	38					2	8	24	4	
Total	867	0	210	101	115	96	89	132	86	38

Table a. The number of farms in the mangrove protection zone and their ratio of mangroves to pond area for the **southern districts** of Kien Giang, October 2013.

District/ commune	Total households	The current ratio (forest/production land)								
		100%	7:3	6:4	5:5	4:6	3:7	2:8	1:9	No forest
Kiên Lương district	**511**	**428**	**7**	**50**	**16**	**10**				
Kiên Lương town	64	55	2	4	3					
Bình An	291	237	1	36	9	8				
Dương Hòa	92	76	3	9	2	2				
Bình Trị	64	60	1	1	2					
Hòn Đất district	**588**	**472**	**25**	**45**	**35**	**6**	**3**	**2**		
Bình Giang	82	55	10	6	9	1	1			
Bình Sơn	107	75	6	9	11	2	2	2		
Lình Huỳnh	99	79	9	8	2	1				
Thổ Sơn	91	82		5	4					
Sơn Bình	76	69		6		1				
Sóc Sơn	44	40		2	2					
Mỹ Lâm	89	72		9	7	1				
Hà Tiên district	**45**	**35**	**3**	**6**	**1**					
Mỹ Đức	45	35	3	6	1					
Thuận Yên	0									
Total	**1144**	**935**	**35**	**101**	**52**	**16**	**3**	**2**		

Table b. The number of farms in the mangrove protection zone and their ratio of mangroves to pond area for the **northern districts** of Kien Giang, October 2013.

Appendix II.

District/comunue	Total number of households	Number of households in each farm size class					
		<1ha	%	>1ha,<3 ha	%	>3ha	%
An Bien district	**145**	**4**	**2.8**	**57**	**39**	**84**	**58**
Nam Yen	19	**0**		6	32	13	68
Nam Thai	21	**0**		9	43	12	57
Tay Yen	23	**3**	13.0	14	61	6	26
Nam Thai A	82	**1**	1.2	28	34	53	65
An Minh district	**720**	**10**	**1.4**	**440**	**61**	**274**	**38**
Dong Hung A	146	**0**		124	85	22	15
Van Khanh Dong	84	**0**		47	56	37	44
Van Khanh	40	**3**	7.5	23	58	14	35
Van Khanh Tay	38	**3**	7.9	34	89	1	3
Tan Thanh	115	**0**		85	74	30	26
Thuan Hoa	298	**4**	1.3	124	42	170	57
Total	**1586**	**24**	**1.5**	**934**	**59**	**632**	**40**

Table a. The number of farms (households) in each farm size class (less than 3 ha, 1 to 3 ha, more than 3 ha) in the **southern districts/communes** in the mangrove protection zone, October 2013.

District/ commune	Total households	Number of households in each size class					
		<1ha	%	1 to 3 ha	%	>3ha	%
Kiên Lương district	**447**	**229**	**51**	**172**	**38**	**46**	**10**
Kiên Lương town	64	40	63	18	28	6	9
Bình An	227	98	43	95	42	34	15
Dương Hòa	92	39	42	48	52	5	5
Binh Tri	64	52	81	11	17	1	2
Hòn Đất district	**587**	**340**	**58**	**185**	**32**	**61**	**10**
Bình Giang	82	47	57	31	38	3	4
Bình Sơn	106	81	76	20	19	5	5
Lình Huỳnh	99	24	24	60	61	15	15
Thổ Sơn	91	36	40	25	27	30	33
Sơn Bình/Kien	76	47	62	23	30	6	8
Sóc Sơn	44	32	73	10	23	2	5
Mỹ Lâm	89	73	82	16	18	0	0
Hà Tiên district	**146**	**10**	**7**	**116**	**79**	**20**	**14**
Mỹ Đức	94	6	6	73	78	15	16
Thuận Yên	52	4	8	43	83	5	10
Total	**1180**	**579**	**49**	**473**	**40**	**127**	11

Table b. The number of farms (households) in each farm size class (less than 3 ha, 1 to 3 ha, more than 3 ha) in the northern districts/communes in the mangrove protection zone, October 2013**.**

Appendix III

Farmer	Area of land (ha)	Income from aquaculture (VND per annum)	Additional income (VND per annum)
1	3.07	100 000 000	
2	2.45		
3	2.92		
4	2.84		
5	2.5	70 000 000	
6	2.9	50 000 000	
7	3.03		
8	2.72	70 000 000	20 000 000 jobs in town
9	2.93	100 000 000	
10	2.72	70 000 000	30 000 000 jobs in town
11	3.2	20 555 000	50 000 000 from business in town 30 000 000 from fruit trees
13	2.4	50 000 000	
Ave	**2.5**		

Table: Leasehold area and income in **Dong Hung commune in An Minh District.** Data collected in April 2013. At and exchange rate of US$1 =20 000 VND, 100 000 000 VND equals US$5000.

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