On behalf of:

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

of the Federal Republic of Germany

ICMP

Promotion of Best Management Practices for Silvo-Aquaculture farming in Bac Lieu province

An evaluation report

Implemented by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

GIZ in Viet Nam

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The project "Adaptation to Climate Change through the Promotion of Biodiversity in Bac Lieu Province" is funded by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and implemented by GIZ in close collaboration with the Department for Agriculture and Rural Development Bac Lieu. It´s objective is to enhance the protective effect of coastal forests through the sustainable use of resources and the promotion of biodiversity.

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Keywords: Mekong delta, wetland, forest, mangrove, shrimp, silvo-aquaculture, pilot, shrimp farming, polyculture

Implemented by:	Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
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Abstract

Coastal resilience is a very important issue in the Mekong Delta, not only does the high population density lead to overutilization and degradation of natural resources, but the region is also increasingly experiencing consequences of climate change, like rising sea levels and increased frequency of floods and storms. Additionally, coastal mangrove forest ecosystems, which provide protection against natural hazards as well as several other ecosystem services, suffer from degradation and overexploitation.

To minimize the effects and to strengthen the natural resilience, adaption strategies were developed and fostered in cooperation with local partners by the "Deutsche Gesellschaft für Internationale Zusammenarbeit" (GIZ) GmbH in the project "Adaptation to Climate Change through the Promotion of Biodiversity in Bac Lieu Province, Vietnam". By promoting Best Management Practices for silvo-aquaculture[1] and supporting Farmer Interest Groups along the coast, the objective of the project`s aquaculture component, was to increase and diversify the farmers' income, while encouraging ecological farming techniques and the integration of mangroves in shrimp ponds to take pressure off the mangrove forests and create awareness for the protection of the mangrove forest.

This study analyzes the effects of the promotion of Best Management Practices and the initiation of Farmer Interest Groups on the farmer's income, culture diversification, production risk and awareness for mangrove ecosystems. To determine trends and impacts, this study analyzed farming documentations from the trial phase, conducted individual interviews and focus group discussions amongst the targeted farmer population.

It was found that the Best Management Practices had positive effects on the income diversification and production risk. Initiated Farmer Interest Groups provided platforms for information exchange and promoted teamwork amongst the farmers. The awareness for the importance of protective mangrove forest ecosystems is present, but it was also revealed that farmers are only willing to support this goal as long as profitability of their farms is guaranteed.

[1] Silvo-Aquaculture is an aquaculture farming technique where Mangrove trees are grown in the aquaculture ponds.

Contents

Abbreviations

AESC	Agriculture and Aquaculture Extension Center
BLCAES	Bac lieu extension center
BLESA	Bac Lieu Experimental Research Station of Aquaculture
BMP	Best Management Practices
CA	Cooperative Alliance
DARD	Department of Agriculture and Rural Development
FIG	Farmer Interest Group
FPSD	Forest Protection sub Department
PPC	Provincial People's Committee Bac Lieu
SDOA	Sub-Department of Aquaculture Development

Introduction

The Mekong Delta (*Đồng bằng Sông Cửu Long*) is the region in southwestern Vietnam where the Mekong River approaches and empties into the East Sea through a network of distributaries. The combined action of river deposition and the sea has produced a coastal belt of slightly higher elevation (Le Dien, 2012). Its dynamic and vulnerable coastline is one of those expected to be most severely threatened by climate change. Not only is the area's important agriculture at stake, the changes are also putting at risk the lives of up to 100.000 people, especially of poor and marginalized groups. Short term economic interests, overuse of resources, and population growth have brought about a vicious circle of declining local incomes and increasing dependency on coastal resources. This leads to a reduction of coastal forest cover and is diminishing the natural protection function of the coast and reducing its resilience to climate change.

Costal mangrove forest ecosystems, predominantly tropical trees and shrubs growing on sheltered coastlines, mudflats and river banks, belong to a variety of plant families, which are able to absorb and disperse tidal surges. As indicated by Hirashi and Harada (2003), a mangrove stand of 30 trees per 0,01 hectare with a depth of 100 m can reduce the destructive force of a tsunami by up to 90 %. To

Figure 1: The Mekong Delta

support the maintenance and restoration of the functionality of this sensible ecosystem, the project, "Adaptation to Climate Change through the Promotion of Biodiversity in Bac Lieu Province, Vietnam" was commissioned in 2010 for a timeframe of four years. It is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). The overall project objective is to enhance the protective effect of coastal forests through the sustainable use of resources and the promotion of biodiversity.

Silvo-aquaculture is an extensive farming method practiced along the coast of Bac Lieu and other Mekong Delta Provinces and that, in

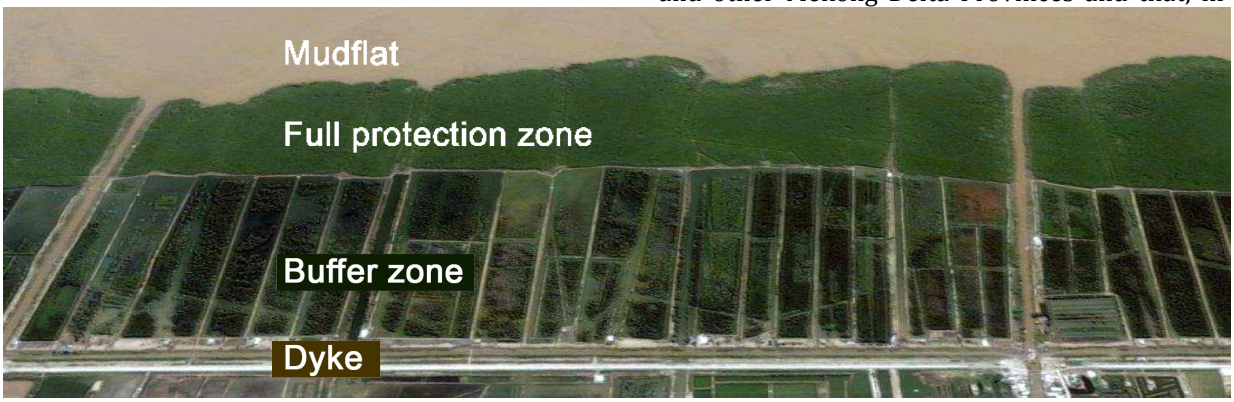


Figure 2: Spatial overview of the coastal zone

contrast to conventional aquaculture, incorporates mangrove forest in aquaculture ponds. Existing silvo-aquaculture farms are often established in the Buffer Zone of the protective mangrove belt along the coast, close to the full protection zone (see Figure 2). Due to inappropriate farming techniques, water management problems and lack of capital and mostly shrimp (*Penaeus spec.*) mono-culture it is adherent with risks and subsequent frequent loss of profit. The strategy of the GIZ project's aquaculture component is to secure the silvo-aquaculture farmer's income through the promotion of Best Management Practices (BMP), including recommendations on optimal species composition, stocking densities, nursing and feeding guidelines and as well as water management and the simultaneous establishment and support of Farmer Interest Group (FIG) pilots. This in turn is expected to reduce pressures on mangrove resources. Through the promotion of probiotics instead of antibiotics and chemicals the negative environmental impact is intended to be reduced.

In an explorative approach (first phase) existing culturing models, their potential for improvement, diversification of cultures and suitable management strategies were identified in cooperation with the Bac Lieu Experimental Station of Aquaculture (BLESA). It was found that the most successful species combination consists of a mixture of shrimp (*Penaeus spec.*), mud crab (*Scylla serrata*) and fish (especially *Mugilidae spec.*) in brackish water. These findings provided the basis for the development of best management standards, which were summarized in the *Best Management Practices* (BMP) manual. Practices and knowledge found to be successful during the first phase were applied in a second phase with a bigger group of farmers participating to prove the applicability and effect on profit of the farmers. Additionally the formation of Farmer Interest Groups (FIGs) was initiated in order to provide a platform for the exchange of experience and information as well as for the farmers to profit from the economies of scale.

Study Objectives

This study evaluates the activities of the aquaculture component's second phase which was implemented from 2011 to 2013 with the following objectives:

- To identify if the species diversification and the application of the *Best Management Practices* reduced the farmer`s risks and increased their income.
- To analyze the impact of initiated FIGs amongst the target population.
- To determine the awareness of farmers towards mangrove forests and the potential benefits of silvo-aquaculture.

The report is structured in four parts. The first part gives a review of the project development, followed by the methodology of the research and the results, by the discussion of the findings and a final conclusion.

Methods

The results of this report are based on primary and secondary data analysis as well as individual and focus group interviews. Income and profit development, the potential causes as well as comparisons of trial and control farms are based on descriptive analyses of farmer's documentation. To measure the effect of the BMP on farmer awareness for mangrove forests, the range of actual implementation of the BMP and the personal attitude of the farmers, individual interviews with all participating farmers were conducted. Researcher-administered interviews were performed using a mixed structured/semi-structured questionnaire with open and scaled questions. The questionnaire was adapted to local conditions in terms of comprehensibility and

timing. In addition focus group discussions were conducted with several FIGs to investigate the implementation and benefits for the farmers.

Hypothesis & research questions

According to the objectives of the project it is expected that all farmers that participated in the trial have a higher income-level compared to the control group and their production risks are lowered through the technical knowledge provided. The awareness for mangrove forests and their benefits is increased and farmers are willing to plant mangrove trees in their ponds. The cooperation and exchange between the farmers is optimized through the organization of the FIG and they have a better representation of their interests and a better expense-income ratio.

The following research questions will therefore be answered in this report:

Evaluation of secondary data, documented by the farmers

- What was the profit of the farms that participated in the second phase (July 2011 to November 2012)?
- Where did that profit come from?
- Were the farms "better off" than the control farms and if so, why?

Individual Interviews – Survey amongst the trial and control farms from the second phase

- Which aspects of the BMP were adopted by the farmers and which will be most likely be applied in future?
- What are the benefits of the BMP for the farmers?
- Are farmers aware of the ecological impacts of aquaculture farming and the benefit of mangrove forests?
- What do farmers expect from government and external projects? Do they have additional recommendations?
- What are the major problems farmers are facing in regard to farm management?

Focus group discussions - FIG survey

- Has something changed for the farmer by becoming a member of a FIG?
- Are there additional benefits for the farmers participating in a FIG?
- What activities do the members perform within the FIG, and where lies the focus?
- Are there recommendations in regard to improvement from the farmers?

Legal framework and Stakeholders

The legal framework for the implemented activities is given with the Vietnamese Forestry Strategy 2006-2020 of the Ministry of Agriculture and Rural Development (MARD) which states that forestry-aquaculture business activities should be organized in order to ensure the livelihoods of the people while protecting the environment. On provincial level, the approach promotes local decisions which regulate the ratio of forest cover to economic area in the Buffer Zone of the mangrove belt. For example decision 1450/QD-UB ratified on 01.12.2006 by the Bac Lieu Provincial People's Committee (PPC), the so called "60:40 law", states that at least 60% of the Buffer Zone is to be covered by forest and only 40 % to be used for economic activities, such as aquaculture and resource extraction.

The steering structure of the activity development and implementation process was led by the Project Management Unit, consisting of DARD, FPSD and GIZ staff. BLESA and the

Extension Service (AESC) are responsible for aquaculture research and information dissemination respectively and BLESA was responsible for the implementation and subsequently the achievement of the objectives in close cooperation with the Aquaculture Extension Service (AESC) and the Sub-Department of Aquaculture Development (SDOA). The Cooperative Alliance (CA) is a government held entity responsible for cooperatives and provides support to the formed Farmer Interest Groups. Ownership and commitment of the participating aquaculture farmers were most important for implementation. Traders and the processing industry were not involved in the product generation process but are affected by the outcome.

Approach

The aquaculture component, in the thematic area of livelihood improvement, is a strategy consisting of two tools: the promotion of BMP for Silvo-aquaculture and the simultaneous establishment and support of Farmer Interest Groups (FIG) pilots. The objective was to increase farmers' income while reducing negative environmental impacts on Mangrove forests. During the first phase an improved aquaculture farming model was developed which formed the basis for the development of the Best Management Practices (BMP). During the second phase the BMPs were applied at a larger number of farms and continuously monitored and improved. Simultaneously to the second phase, *Farmer Interest Groups* were established to transfer the BMPs and increase the cooperation and coordination between farmers. The process is summarized on the timeline below (Figure 3) and described in the following section.

First phase: to develop an improved Silvo-aquaculture farming model

After an initial analysis of the extensive shrimp farming sector in Bac Lieu Province, the project supported the development of sustainable management practices to set a base for future promotion of national and international certification standards, implementation of better farming and management practices by local stakeholders while exploring opportunities for partnerships with the private sector in order to up-grade the aquatic value chain (Tuan 2010 & Prein 2011). The formation of the first Farmer Interest Groups for information exchange and coordination as well as to benefit from the economies of scale was promoted. The process was carried out by BLESA in close cooperation with the Extension center.

Objectives

The objectives of the initial stage were (Tuan V. A., 2010):

- To determine barriers and establish steps to help mangrove-shrimp (*Penaeus spec.*) farmers in overcoming difficulties, and improving their livelihoods

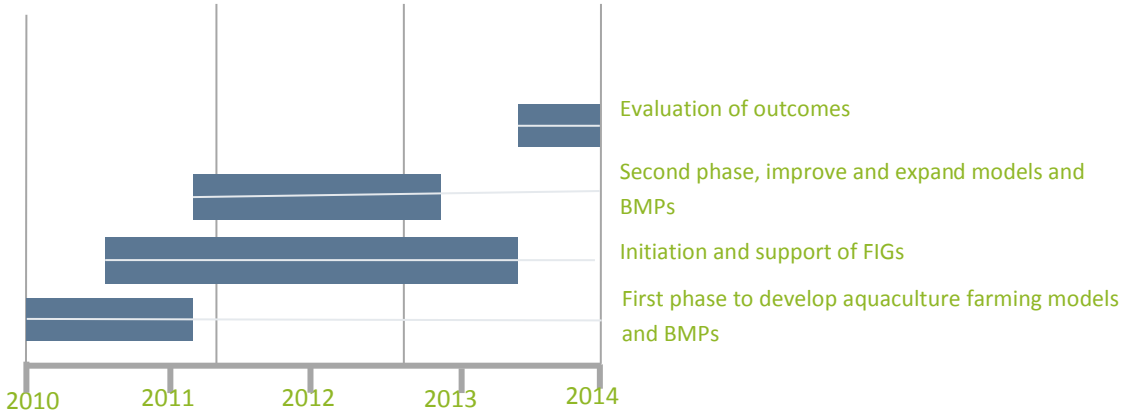


Figure 3: Timeline of project activities from 2010 to 2014

- To establish shrimp (*Penaeus spec.*) farmer groups to implement advanced sustainable shrimp (*Penaeus spec.*) farming systems
- To identify a feasible integrated farming model with diversification of cultured species thereby potentially reducing the risks for small-scale farmers

Activities and outputs

The outcome was evaluated and summarized in a written report providing information about the three pilot aquaculture models. Shortcomings and potential species were identified to provide a model for further extension. The report includes information about a suitable farming model and gives recommendations for species diversification. Based on this report, pilot sites were to be identified and further research conducted during the second phase. The first FIG was founded on the 16.11.2010.[2]

Farmer Interest Group formation/ transferring the best management practices

Through the establishment of Farmer Interest Groups (FIG) a transfer of the BMP was envisaged as well as improved coordination and cooperation between neighboring farms. Eventually these farms could also strive for group certification. The activities were carried out in close cooperation with the governmental agencies and institutions to ensure knowledge transfer. The groups themselves choose to establish a rotating loan system which is financed through yearly FIG contributions by the members and offered to the farmer most in need to be repaid at low interest.

[2] For more information see TUAN 2010 and PREIN 2011

Objectives

The Objectives of FIG initiation and BMP transfer were (Tuan V. A., 2011):

- To establish at least five FIGs
- To encourage farmers to grow mangrove trees in aquaculture areas to improve the overall environmental conditions
- To transfer the BMP to the farmers to ensure higher yields and mitigate environmental impacts
- To diversify the aquaculture production (making the production less dependent on single species) for a higher profit and lower risk of crop failure

Activities

In total, six FIGs were initiated, information material was handed out to the farmers, training classes were held regularly and basic water monitoring equipment was handed over to each FIG. All these activities were regularly monitored and discussed amongst BLESA, BLCAES and SDOA (Tuan V. A., 2011).

Second phase: to improve species composition and BMPs

Based on the results of the first phase (Tuan 2011) the developed improved Silvo-Aquaculture model needed further refinement. This was done in the second phase concentrating on the diversification of cultures and the application of the BMP targeting a broader group of farmers.

Objectives

The objectives of the 2nd pilot phase were (Tuan V. A., 2011):

- To determine barriers and establish steps to help mangrove-shrimp (*Penaeus spec.*)

farmers overcome difficulties, and improve their livelihoods

- To transfer the BMP successful via trainings and onsite support to the farmers with a long-term effect
- To improve the farmers income and profit while reducing the productions risk through diversification

Activities

A total 30 farms were included in the activities of which 3 trial and 3 control farms were selected as "key-farms". All farms were guided to record the data of their farming activity in prepared books from BLESA and the trial group was supported with trainings to transfer the BMP. The piloted species were *Ostreidae spec.*, *Mugilidae spec.*, *Scatophagidae spec.* and *Macrobrachium rosenbergii*. The seeds were provided by the project and BLESA observed and assisted the trial group. The control group remained unassisted (Tuan V. A., 2011).

Methodology

Four different sets of data were analyzed in the course of this evaluation to address the research questions. Numerical data of the second phase, recorded by the farmer themselves between July 2011 and November 2012 and the year after from December 2012 to November 2013, were summarized, analyzed and compared. Additionally 23 interviews were conducted amongst all farmers to address environmental awareness and success of the BMPs amongst the farmers. The successful implementation of the FIG was analyzed through focus group interviews.

Secondary Data evaluation

To test the applicability of the BMP the second phase was initiated. All knowledge acquired by then was actively transferred to a trial group of 15 farms. These farms were observed and supported with trainings, manuals and guidance by BLESA. A control group consisting of 15 farms that received no support or guidance was also included in the study. All farms of both groups were requested to record all farming activities, from interventions and investments to expenditures, in order to analyze the effects of the BMPs on the farmers' profits. Following the end of the second phase, farmers were asked to continue their farming documentation for another year. This data was however not yet available and is therefore not included in this study. The data was summarized by BLESA in a final report which was used as a base for the evaluation in this report. A total of 31 farms participated in this study; however the final dataset encompasses only six farms as some data was not available. These six farms are referred to as "key-farms", 3 trial farms (TF.1, TF.2, TF.3) and 3 control farms (CF18, CF.19, CF.20). These farms had reliable and continuous data and were available for interviews. These

FIGURE 4: INDIVIDUAL INTERVIEW

two groups will hereafter be referred to as "trial" and "control". After the extraction of the data, descriptive statistics were used to visualize the distribution and correlation.

Individual Farmer Interviews

To analyze the effect of the project work on the target population, in terms of behavior change, environmental awareness and their approach to the BMP, a field survey with all 30 participating farmers was to be conducted. Some farmers were not available and the time frame put a limit to the observed number of individuals. In total 23 farmers (see Table 1) were interviewed in the time from 18.12.13 to 17.01.14. A researcher-administered questionnaire with a mixed structure of open question and structured scales was selected to perform an interview with reliable data. Due to social circumstances, the reliability and authenticity of the answers is higher when open questions are applied. Simple descriptive statistics were used to describe the basic features and the categorized answers to the open questions.

Focus Group Discussions

The formation of Farmer Interest Groups was supported and farmer trainings were held amongst the group members to transfer the BMP to a wider range of the target population. To analyze the successful implementation of the groups according to the objectives and to get an

overview of the group activities, focus group discussions were conducted among four FIGs.

The focus group discussion is a type of group interview. The social, semi-public nature of the methodology shapes the data and the purposes that it serves. In a focus group session, conversations amongst participants results in data that is "talk". In this way, focus groups elicit information's that are painting a portrait of combined local perspectives. The researcher can imagine how it "all fits together". This technique is not appropriate to determine an individual's authentic point of view. The noisy social environment of focus groups makes it possible to gauge a group's overall reaction. To get a cross section of views from the diverse population, multiple sessions should be conducted with around 10-12 participants. Due to our limited time frame and resources the objective was to assess natural features of the conversations as well as focused discussion in a two-hour session. This was achieved by a well-designed interview guide and a researcher assists group which consisted of Vu Anh Tuan, Director of the Minh Hai Sub-Institute for Fisheries Research, Dang Cong Buu, GIZ Project officer and Malte Larsen, GIZ Intern. The interview guide assisted the research group members to relax, open up, think deeply, and considers alternatives of the conversations contents. The interview was audio taped and transcribed and the results featured patterns that were formed by words, so called themes or perspectives. The researchers determined the farmer's logic in addition to their subjective judgment. So this qualitative approach illuminated the local perspectives in rich detail and with high precision of reliability.

Table 1: List frame of participated farmers in the individual interviews

Tên	ID	Date
Đoàn Kết	FIG.1	14.02.2014
Thành Đạt	FIG.2	15.02.2014
Tấn Phát	FIG.3	15.02.2014
Kinh Tế	FIG.6	14.02.2014

Table 2: List frame of participated farmers in the focus group interviews

Tên	ID	Date
Trần Quốc Tuấn	TF.1	09.01.14
Trần Thị Oanh	TF.2	08.01.14
Lại Văn Quảng	TF.3	08.01.14
Đào Văn Ua	TF.4	19.12.13
Phan Thanh Vân	TF.6	08.01.14
Trần Mạnh Tính	TF.8	18.12.13
Nguyễn Văn Trường	TF.9	19.12.13
Ngô Mạnh Hiền	TF.10	19.12.13
Trần Công Khanh	TF.11	18.12.13
Lê Công Trình	TF.12	18.12.13
Nguyễn Xuân Hướng	TF.13	18.12.13
Nguyễn Xuân Phú	TF.14	16.01.14
Nguyễn Đức Tính	TF.16	08.01.14
Phạm Văn Quyền	CF.18	09.01.14
Trần Thị Huê	CF.19	16.01.14
Đỗ Xuân An	CF.20	08.01.14
Vũ Văn Vận	CF.22	17.01.14
Tran Quoc Ai	CF.23	17.01.14
Vũ Quang Ngọc	CF.26	17.01.14
Nguyễn Văn Chính	CF.27	16.01.14
Nguyễn Văn Lợi	CF.29	17.01.14
Đinh Hồng Nhung	CF.30	16.01.14
Nguyễn Văn Sĩ	CF.31	16.01.14

Results

In the following chapter, results from the farm documentation analysis, individual interviews with farmers and from focus group discussions amongst FIGs are presented.

Evaluation of secondary data from the second phase

The interpretation of the results is focused on a group of six farmers with complete data sets. All other data was incomplete or unclear. These key farms consist of 3 trial farms and 3 control farms that are compared in the following analysis.

Farm Profit

The profit varied between 14,676,471 VND/ha*year in the control group to 44,232,083 VND/ha*year in the trial group. The total income divided by cost and profit shows a better ratio in the trial group than the control group (see Figure 5). Though only three farmers were included for evaluation in each group, there appears to be a tendency that farmers who received trainings have a better cost-profit ratio than the control group. This difference is certainly owed to outstanding profits of TF.2. This exceptional value caused a higher mean profit for the trial group (see Figure 6).

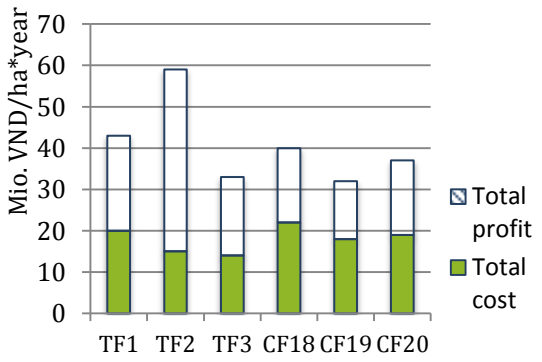


Figure 5: Income (total profit and total cost) comparison from July 2011 to November 2012 of key-farms

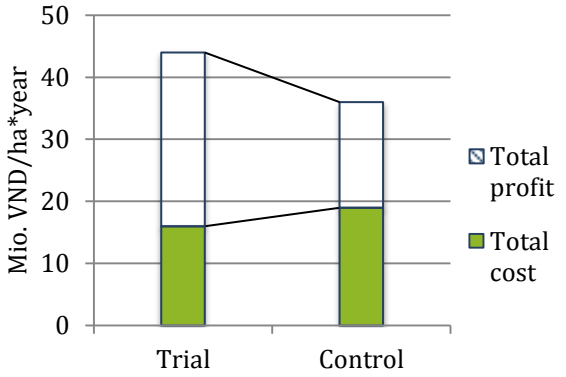


Figure 6: Mean Profit + Cost from July 2011 to November 2012 of key-farms

The trial group had a high maximum profit of 44 Mio. VND/ha*year whereas the control group`s maximum and median are equally at 18 Mio VND/ha*year and the minimum value is at 14 Mio. VND/ha*year. The control group's profit was more homogenous, while the trial group's profit differs tremendously, as seen in Figure 7.

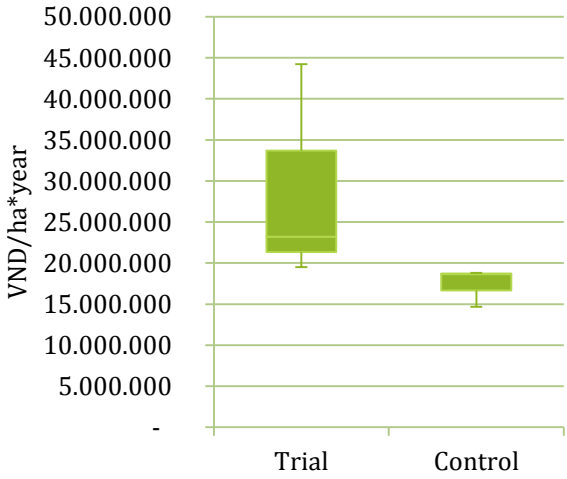


Figure 7: Profit Distribution 2nd phase July 2011 to Nov 2012

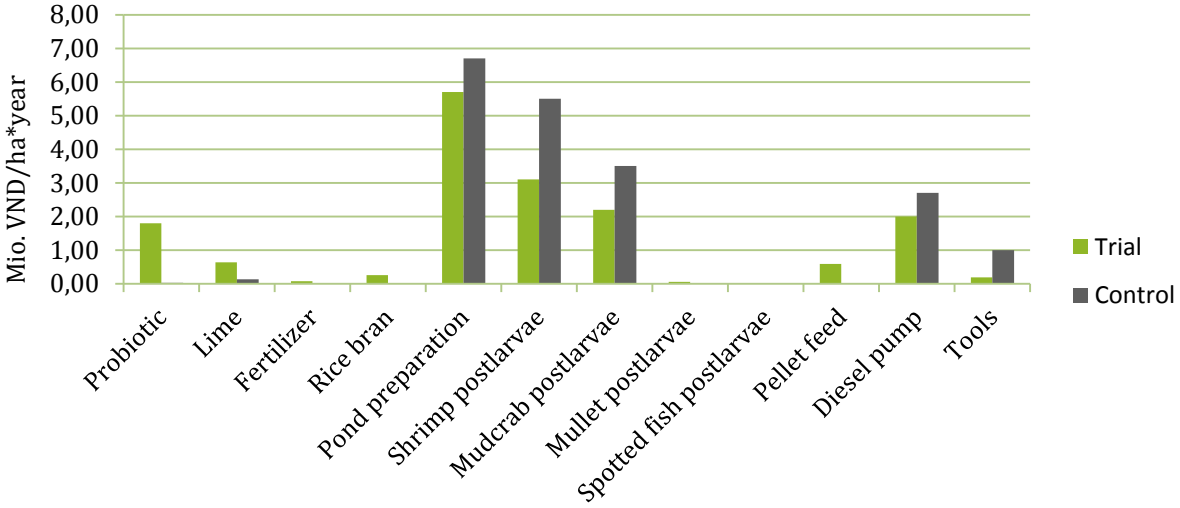
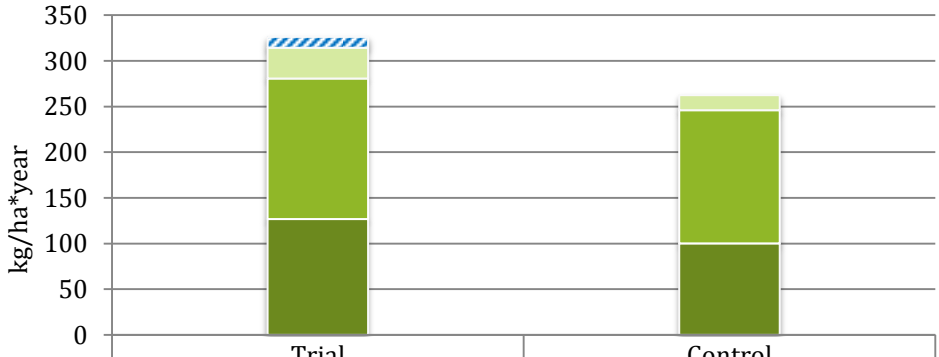


Figure 8: Mean total expenses of key farms from July 2011 to November 2012

Source of Profit

To explain the origin of the farm profits, it was necessary to review the extension costs, survival rates, yields and overall profit of both groups. Average expenses varied in composition and extent from 16 Mio VND/ha*year (Trial) to 19 Mio VND/ha*year (Control). Especially the investment in shrimp (*Penaeus spec.*) and mud crab (*Scylla serrata*) larvae are significantly higher in the control group (see Figure 8). Lower survival rates of shrimp (*Penaeus spec.*) larvae in the control group demand a higher stocking rate which results in higher expenses in larvae. Post larvae are cost intensive items with saving potential. The trial group spent 3,1 Mio VND/ha*year for shrimp (*Penaeus spec.*) and 2,2 Mio VND/ha*year for mud crab (*Scylla serrata*) larvae compared to the control groups`s 6,7 Mio VND/ha*year for shrimp (*Penaeus spec.*) and 5,5 Mio VND/ha*year for mud crab (*Scylla serrata*) larvae. There is only little variance in diesel pumping costs and pond preparation costs as seen in Figure 8. The trial group had larger additional expenses for probiotic, lime and fertilizer and smaller investments for the



	Trial	Control
Spotted fish yield	12	0
Mullet yield	34	17
Mudcrab yield	154	146
Shrimp yield	127	100

Figure 9: Total yields from July 2011 to Nov 2012 of key farms

species diversification like *Mugilidae spec.* and *Scatophagidae spec.*

On average the trial group had higher yields in all cultures than the control group. Particularly the diversification of species, like *Mugilidae spec* and *Scatophagidae spec*., contributed to the overall yield of the trial group. The high survival rates in the trial group are an indicator for the successful implementation of the BMP (see Figure 10). The trial group had mean survival rates of over 10% in the shrimp (*Penaeus spec*.) and mud crab (*Scylla serrata*) cultures. Compared to the control group, with higher stocking density, but survival rates of only 1,8 % to 6,2 %, the difference is crucial. The appropriate stocking density in the trial group led to lower investment costs for juveniles (see Figure 8). Juvenile quality control and pre-raising of juvenile increased the survival rate through a better health and fitness.

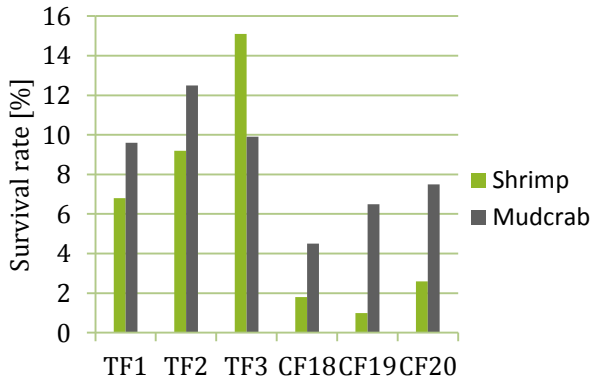


Figure 10: Survival Rate of shrimp (*Penaeus spec.*) and mud crab (*Scylla serrata*) larvae from July 2011 - November 2012

Hình 11: Cua biển (*Scylla serrata*)

Individual Interviews – Survey amongst the trial and control farms from the second pilot phase

Social data obtained in the course of the interviews revealed that mostly men make the relevant decisions in the farm, being considered as the "head of the family" (65 %), while 35 % of the farms included in this study are managed by women. Households attached to each farm comprise four or more people. 60 % of the control group is, with over 50 years of age, significantly older than the trial group population. The educational level is equal amongst both groups. Most farmers have a secondary or high school degree. A mangrove protection contract existed without exception for all farmers on the seaward side of the dyke, as is required by law. 70 % of the trial farmers were former rice farmers, whereas control farmers have a diverse background as rice farmers, students, teachers, mechanics, constructors, soldiers and merchants. The farm size at the control group is in average 3,5 ha compared to 3,0 ha in the trial group. The average water surface to pond area relation at the control group`s farms is 2,5 ha and 1,6 ha at the trial group's farms. The trial group does apparently have a smaller area available for aquaculture than the control group. This result from the area covered by mangroves, which is greater in the trial group as they follow the *60:40 law*. 80% of the control farms and 46 % of the trial farms are located landside the dyke.

Which aspects of the piloting phase were adopted by the farmers and which will most likely be applied in future?

All farms adopted ideas and elements suggested by the BMPs and even improved them to their circumstances. According to their statement the majority of farmers (100 % = trial, 70 % = control) participated in the trainings and now

use the instruction manual[3]. The number of trainings in the trial group was two to eight trainings, compared to the control group with one to five trainings by 2013. To measure the success of the elements of the BMP, a series of representative information from the instruction manual, regarding the post larvae treatment aspects of the BMP (see Table 3), were queried. Both groups answered correctly and according to the instructions. 90 - 92 % of both groups apply the quality control of post larvae, a hand-current-test and a noise-light-reaction-test. The MBV-test is more often applied by the control group. The nursery pond is used by 61 % of the trial farms and 50 % of the control farms

Table 3: Postlarvae treatment applied amongst trial and control groups

Postlarvae treatment applied	Trial [%]	Control[%]
Nursery pond applied	61	50
Postlarvey quality control	92	90
Hand-current-test	92	90
Noise-light-reaction-test	92	90
Nursery pond applied	38	90

Another question targeted the cleaning time of the ponds. According to the BMP it should be performed before new stocking takes place: for the first season in February or March and/or at the beginning of the second season from September to October. While half of the trial group farmers answered according to the recommendations in the BMP, nearly 3/4 (72 %) of the control group farmers gave different answers (see Figure 12). Consequently it can be concluded that 50% of the trial and the majority of control farmers do not manage their pond cleaning time according to the BMP.

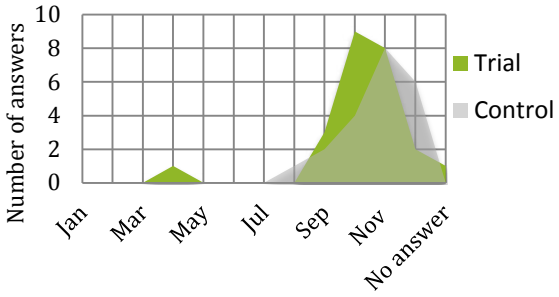


Figure 11: Statement of the farmers for the best pond cleaning time

The BMP recommend the additional production of non-aquaculture products such as vegetables, fruit and timber trees, pigs, ducks and chicken to diversify income sources. Figure 13 displays quantities of cultivation of non-aquaculture products. Overall, more trial group farmers made use of this suggestion. With the biggest difference being fruit trees (8 = trial, 5 = control) and vegetables (11 = trial, 8 = control), followed by pigs, ducks and timber trees. Only chickens are farmed by the same number of farmers in both groups while together with fruit trees and vegetables they appear to be most important products to the farmers.

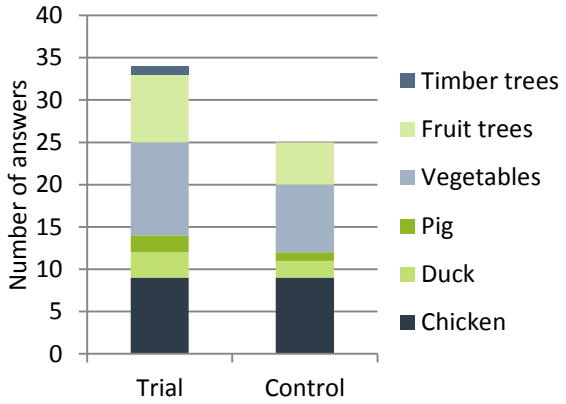


FIGURE 12: NON-AQUACULTURE PRODUCTS CULTIVATED BY THE FARMER

[3] The fact that members of the control group participated in trainings, reduces the significance of the results obtained as the baseline is/was no longer valid. The members who participated in trainings did so by joining FIGs where trainings were also offered. The trial group however got additional trainings among themselves as well as individual guidance on the implementation of the BMPs.

The groups answered homogeneously to document their farm management regularly and intent to continue it in the future, with 3 exceptions in the control group that do not document. As main reasons a better financial control in terms of income and expenditure and comparison to past years (13 = trial, 6 = control) and culture management control in terms of stocking time and stocking density adaptation (3 = trial, 6 = control) were highlighted by the farmers. A significant difference between the groups was observable in open question about the personal improvement of BMP techniques as an indicator for BMP application. The control group did not offer any improvements, whereas the trial group suggested a broad range of personal improvements:

- Application of garlic-rice barn-mix for antibiotic effect against pests
- Synchronization of stocking time with all FIG members
- Addition of water to the pond
- Shift of dredging of canals/pond from March to April
- Clean up of dead shrimp (*Penaeus spec.*) by sea bass after harvest
- Shift to mixed shrimp (*Penaeus spec.*)-pond and vegetable cultivation
- Adaptation of stocking time to weather conditions
- Flexible harvesting to match high market prices
- Invention: Fixation of some shrimp (*Penaeus spec.*)s on a small rope with a piece of Styrofoam which keeps the rope at the water surface to make the control of shrimp (*Penaeus spec.*) size for harvesting easier

Figure 13: Vegetables as non-aquaculture products

What are the benefits of the BMP for the farmers?

The trial group agreed that the implementation of the BMP stabilized their income. Controversially eight trial and five control farmer stated to be satisfied with their income while only one trial farmer stated that the he is able to make a living with his farm. Nevertheless, 60 % in both groups refused to change to an intensive culture system, even if they had the chance to. Four trial and two control farmers supplement their income with additional ponds.

The farmers groups rated which aspects of the BMP were most beneficial to them (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). Especially aspects such as water quality monitoring (6 = trial, 2 = control), mangrove management (3 = trial, 0 = control) and juvenile control (9 = trial, 4 = control) were frequently mentioned in the trial group. The control group pointed out the importance of stocking control (6 = trial, 8 = control) and natural additives (lime, rice barn and probiotics) (5 = trial, 7=control).

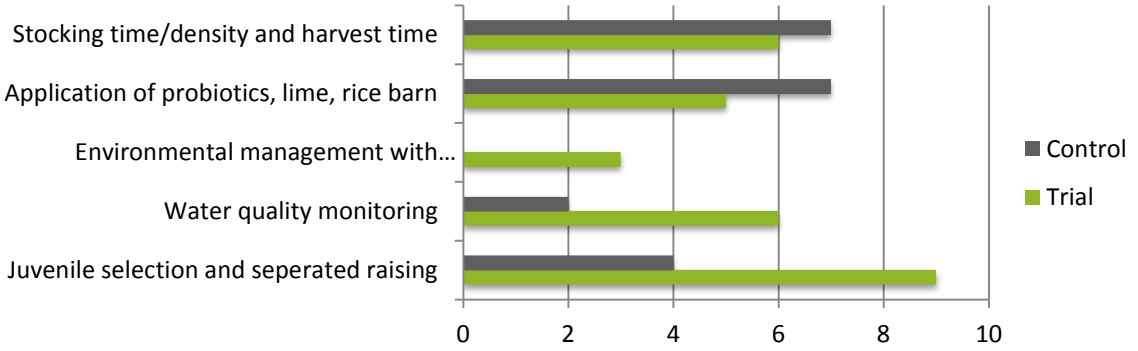


Figure 15: Best aspects of the BMP for the farmers

The advantages of mangrove forest management were highlighted by three trial farmers and one control farmer in terms of yield and growth aspects of the BMP. The benefits of a mangrove forest are known to both farmer groups, but proper densities are recommended (3 = trial, 1 = control) (see Figure 14). Furthermore monoculture with *Avicenna sp.* was mentioned among both groups to be most suitable for aquaculture (2 = trial, 5 = control). The trial group focused on better air, water and soil quality (4 = trial, 1 = control) and on temperature reduction, wind protection and provision of shade (9 = trial, 3 = control) and pollution reduction (3 = trial, 1 = control), whereas the control group pointed out the provision of shelter for juveniles and breeds (2 = trial, 8 = control) and provision of natural feed (2 = trial, 5=control).

Are farmers aware of the ecological impacts of aquaculture farming and importance of mangrove forests?

Both groups consider environmental consequences of their management decisions. To spend more money for environmental friendly methods is considered amongst both groups to be valuable and useful. The reasons are diverse, from economic income to human welfare and healthy cultures, but never to conserve nature for its own sake or for romantic reasons.

The main reasons for the farmers to support protection and reforestation of mangrove forests outside their ponds on public ground and community owned land are in priority order:

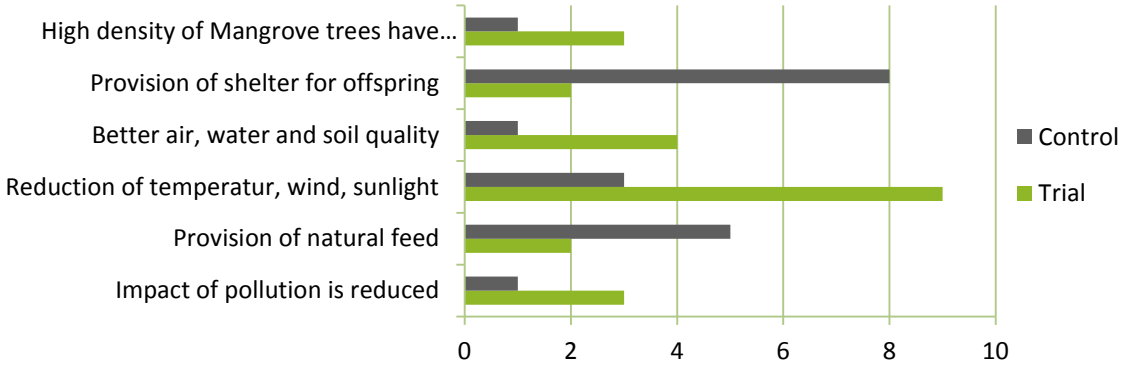


Figure 14: Advantages of mangrove forest in an aquaculture pond according to the farmers

1. Protect the natural erosion, wind & flood barrier
2. Provision of shelter for natural seeds
3. Contract with the forest department
4. Maintain biodiversity
5. Healthier environment
6. Water quality improvement

Especially the protection from wind, erosion and floods was mentioned from both groups in similar quantities (8 = trial, 7 = control). The provision of shelter for natural offspring was mentioned by the control group (0 = trial, 5 = control). The trial group mentioned the protection contract with the forest department for all farms located seaward of the dyke (2 = trial, 0 = control). The trial farmers replied that they were visually controlling the mangroves and would contact the forest department in case of any incidents.

Driving causes to consider environmental issues in farming practices are a generally higher income with healthier environment (7 = trial, 8 = control), preservation of ecological balance that supports the productivity (5 = trial, 6 = control) and mangrove forest to support health of all cultures (4 = trial, 3 = control), as shown in Figure 17. The water quality improvement was mentioned by the trial group (6 = trial, 0 = control) and human health as a direct consequence of environmental conditions (0=trial, 6=control) as well as higher yields (1 = trial, 5 = control) were recognized by the control group.

What do farmers expect from government and external projects? Do they have additional recommendations?

The farmers eagerly replied when asked about their future expectations of the government. The focus lay on the support for microcredits with low interest rates (8 = trial, 5 = control), water way improvement (5 = trial, 3 = control) and technical trainings (5 = trial, 1 = control) as visualized in Figure 18. It was also suggested to apply a governmental quality control in the hatcheries to ensure a constant supply of high quality seed (2 = trial, 2 = control).

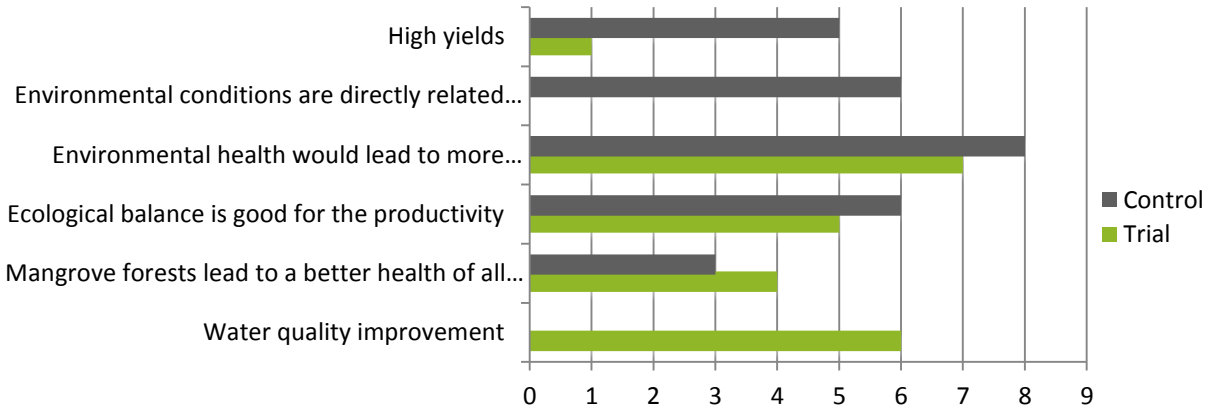


Figure 16: Reasons to consider environmental consequences in farm management

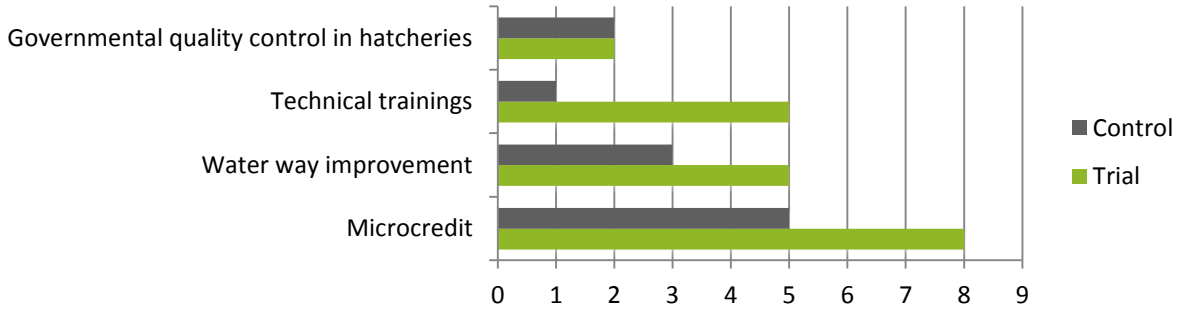


Figure 18: Expectations of the farmer from the government

Besides mangrove thinning permissions (2 = trial, 2 = control) and measures to fight the algae issue, farmers requested the improvement of the environmental legislation to prevent water way pollution (1 = trial, 0 = control) and enforcement of existing nature conservation legislation as well as prohibition of nearby shrimp (Penaeus spec.) processing factories which causes pollution of waterways and death of wild fish populations (2 = trial, 2 = control). Furthermore one control farmer suggested a better protection of natural seeds from collectors and market price control. He mentioned that the public display of the world market price and prescribed fees for middlemen would lead to a fairer distribution of revenues among the supply chain and could prevent small farmers from price dumping. The supply with free high quality seeds, probiotics and lime was requested from external organizations (11 = trial, 8 = control) by the farmers. Furthermore the idea of creating a public farms with innovative methods, new species and practical onsite training courses with technical assistance of BLESA was expressed (10 = trial, 5 = control). This model farm could serve as a platform for testing new techniques or species variants thereby decreasing the innovation risks for individual farmers. Additionally farmers suggested the establishment of a public library in FIG meeting rooms to provide up to date literature, leaflets, poster and manuals for interested farmers. Furthermore financial subsidies for FIG budget by project funding was requested by 7,6 % of the trial and 15,3 % of the control group.

What are the major problems farmers are facing?

Most farmers replied that the constantly low water quality from main water ways (2 = trial, 6 = control) and the high density of algae (2 = trial, 5 = control) are most challenging to them.

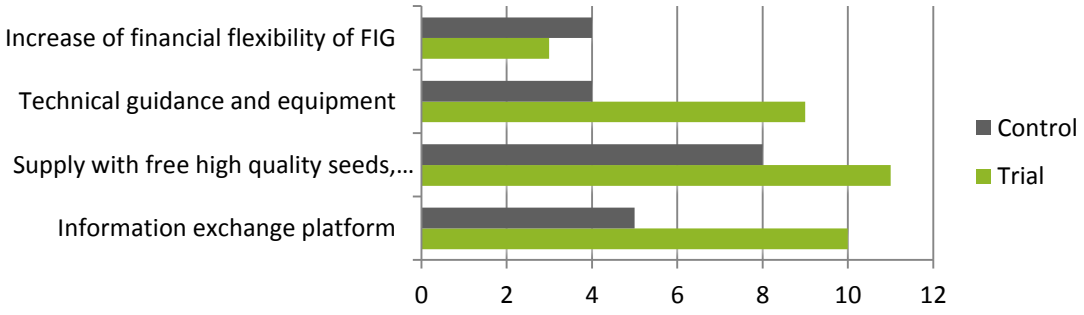


Figure 17: Expectations of the farmers to external organizations

The farmers assume that a shrimp (*Penaeus spec.*) processing facility and the intensive cultures are responsible for the pollution. It was stated that governmental restrictions for the factory and environmental legislations are not implemented. The macro algae problem was not recognized as related to the pollution. Further comments on problems are water leakage, lack of investment fund and high densities of mangrove forest.

Focus Group Discussions

Focus Group Discussions were conducted with four Farmer Interest Groups. Resulting data was analyzed for each group and the interpretation of all results is summarized in the following chapter. The results represent the current situation in the time of the interviews (see Table 2).

Do the farmer benefit from their membership in the FIG?

During the interviews, farmers named a range of benefits, listed according to their importance as stated by the farmers:

1. Improved of practices and better environmental management
2. More stable and diversified income
3. Improved growth rates
4. Of financial support via loans
5. Better neighborhoodrelationships
6. Supply with new technical equipment

With respect to improved practices, especially the separated juvenile raising was highlighted. Many groups replied to have a more diversified, stable and increase income due to the use of a bigger variety of species and the abandoning of chemicals as well as the support for the cultivation of non-aquaculture products like vegetable, fruit trees and poultry. Improved growth rates, the benefits from loans and a better neighborly relationship were also mentioned.

Are there additional benefits for the farmers participating in a FIG?

According to farmers the most relevant additional benefits are:

- Experience sharing
- Technical trainings
- Security enhancement
- Improved neighborly friendships
- Financial support
- Collective purchase and selling
- Better environmental management

Exchange of experience with respect to high quality seed sources, management methods and techniques were mentioned as most important to all groups, followed by technical trainings, financial improvement, better cohesion in the neighborhood and loans to secure farmers in case of crop failure or high seed prices. Better cooperation with the government was mentioned by two groups while improved environmental management was mentioned by only one group.

What activities do the members perform within the FIG, and where lies the focus?

The main activities in priority order as given by the farmers

1. Regular & random meetings
2. Information exchange
3. Financial/security meetings
4. Meetings of the board of directors
5. Participation in training courses
6. Development of cultivation calendar
7. Emergency meetings

The farmers quoted to have regular meetings, where they share information about high quality seed sources, farming techniques, ways to deal with the algae problem and good market places to sell the products. Furthermore, the FIGs perform meetings on purchasing, emergency and security issues, to talk and discuss about the next loan and the allocation of the loans and to talk about security threats. One group initiated a board of directors that consult before public announcements. Another group is setting up regular cultivation calendars in cooperation with non-FIG farmers to coordinate local activities. Furthermore information about water quality and pests are shared among the group, and pumping times are adapted to minimize risks.

Are there improvements recommended by the farmers?

The recommendations from the farmers summarized in priority order:

1. Increasing the financial volume for more flexibility
2. Demonstration sites for the introduction of new species, especially *Tilapia spec. spec.*
3. Decrease of mangrove cover
4. Improvement of cooperation between the groups
5. Organic product certification
6. Identification of high quality and reasonable priced seeds
7. Establishment of storage/cooling system
8. Research/ Propose solution for macro-algae problem
9. Involvement of farmers in mangrove management decisions
10. Improvement of security situation
11. Information about natural feed and how to support it

Figure 19: Focus group discussion in FIG – Welcome greetings

A wide range of improvements were mentioned by the farmers. Most emphasized was the need for higher financial flexibility of the group. Many groups are trying to buy and sell their products together, but not all farmers do have the financial resources to go along with the group. Usually this is what the loans should be used for, but their volume was said to be too low. Even for emergency loans used in case of illness, natural diseases, pests or crop failure, the loans do not have a sufficient volume. All groups proposed to establish demonstration sites to apply new techniques, methods and check out different species composition. The demonstration site should be managed in an innovative manner and provide open access to all information for interested groups or single farmers. They claim that it would be desirable for them to see proven success of new methods and having possibilities to study them before introducing innovations on their farms, especially new species introduction was mentioned, with a focus on *Tilapia spec. spec.* and *Trachinotus spec.* that are considered to have a potential to raise the income. Besides, the introduction of mangrove clam and new

cultivation methods for poultry, wild pig and other livestock were requested. It was recommended by 3 FIG to decrease the promoted mangrove density for the pond of 10.000 trees/ha to 5000 trees/ha for better farming results. A ratio of 70% water surface and 30% mangrove trees was considered to be most suitable. 3 groups brought up the further improving relationships and cooperation between the FIGs in order to build up a cooperative. They would like to receive support to establish a brand name, which would make the product recognizable allowing the product to enter a bigger and more profitable market a standardization of cultivation methods and timing with a cultivation calendar, quality control of the products as well as organic certification and labeling. A storage and cooling system that would allow synchronizing sale dates, a reliable source for supply with high quality seeds, training courses on natural feed and a solution to the macro algae problem is needed. Some farmers suggested that the algae problem possibly could even be turned into a profitable product. One matter of highest priority for the farmers is the involvement in mangrove management decisions for the forest in their pond. Currently the share of timber profits is 30% for the farmer and 70% for the government. The farmers complained that they have to take care of the forest and protect it, but do neither have a voice in the decision which timber cutter will be contracted, nor regarding the decision on where the timber is being sold. They are therefore asking for a better share of the profits and the possibility to have a voice in the decisions making process. Additionally the establishment of village police was mentioned in order to raise the security level and some farmers are requesting a general thinning allowance.

Discussion and Recommendations

This chapter consists of a review of the methods used, their reliability and possible improvements for further research. After that the objectives of the project regarding BMPs and FIGs are compared with the results of the survey to conclude the success of the actions taken. Last, all findings of the survey are reviewed and a conclusion will give an overall image about the survey findings.

Evaluation of methods

In general the analysis of the farmer documentations was appropriate get an overview of the results of the farming activities in 2011. Based on the data available up to date it was however not possible to identify trends or the hypothesized financial improvement in the data. Documentations from the time after the second phase were not available for the evaluation. Furthermore there was no initial evaluation of the farmer's income before the takeoff of the project which made data comparison difficult. Data therefore only represent the status of 2011. Another obstacle to overcome was the extraction of data from the external report prepared by BLESA which sometimes even provided contradicting information. In addition, only few farmers followed the instructions on data documentation, leaving complete datasets for just six out of 30 farms.

The personal interviews turned out to be a successful method to assess the awareness and management practices of the target population. Questionnaire design generally appeared to be appropriate and comprehensive to the majority of farmers as only few of them had problems to answer indirect and open questions according to the problem. Language barrier was an additionally hindering to intervene in the course of the interview to make sure the questions were correctly transferred to and understood by the participants. In general the length of the questionnaire of approximately 1.5 hours was too long; an appropriate time would have been 30-45 minutes. With tea and cookies the atmosphere became relaxing and supportive for honest answers. Especially the presence of BLESA staff, technical staff from the project and an introduction for the interview turned out to be very helpful for the atmosphere.

The focus group discussions amongst the FIGs were a challenging research method with excellent results. The involvement of people known to the farmers, including BLESA staff and technical project staff who guided the interviews, greatly improved the participation of farmers. Translation was a problem encountered during the discussion. An experienced translator with simultaneous translation skills and specialist vocabulary was not available for every interview, leaving the interview leader unable to interfere which resulted in drifting of the conversation in some interview. This problem highlights the importance of properly briefing and introducing the translators to the purpose of this method prior to the interviews. Additionally, in order to obtain the results desired, making use of a trained translator with specialist vocabulary or the previous training of a native speaker is advisable. It should be noted that furthermore the seating order and especially the integration of women has a strong influence on the outcome of the interviews. Mixing researchers and participants in a circular seating order, if possible on the floor to create a casual atmosphere, proved to be the best solution.

Discussion of findings

This part will discuss results of the surveys to conclude possible trends. Recommendations and comments based on the finding are given.

What was the effect of the BMP on profit and income diversification?

It was found that in the time from July 2011 to November 2012 when the second phase took place, on average trial farmers had a higher total income and less costs compared to the control farms. This could be related to higher survival rates and therefore lower stocking rates, a higher yield and diversification of cultures. The trial group also received intensive trainings at that time. Due to the survey of a small population and a single cultivation period, there is no trend identifiable. Furthermore there were trainings applied in the control group, which is influencing the results to unknown extent. The introduction of new species was of moderate success, the contribution to the total profit from the new introduced species was marginal. Recommended were *Anadara granosa*, *Tilapia spec.*, *Mugilidae spec.*, *Macrobrachium rosenbergii*, *Scatophagidae spec.* and *Ostreidae spec.*. The two successfully introduced species *Mugilidae spec.* and *Scatophagidae spec.* contributed with only 5 % to the total profit of the trial farms. And for unknown reason the control group raised *Mugilidae spec.* as well with a share of 4,3 % of total profits. Nevertheless overall the diversification and the higher yields of mud crab (*Scylla serrata*) and shrimp (*Penaeus spec.*) led to a higher total yield in the trial group. The diversification of non-aquaculture income sources contributed to the development as well. The amount of unused land surface on the farm land offers a great potential to grow vegetables and fruit trees in container or vertical gardens above salty soils which can contribute to a further diversification and income stabilization.

It is recommended to further develop the diversification potential and to promote the introduction of new aquaculture species in multi-trophic levels. The correct sizing of various populations will provide ecosystem functions, allows the biological and chemical processes involved in the pond to achieve a more stable balance of the nutrient conditions.

The recommendation to increase the density of mangroves to 10.000 trees/ha according to the BMP was constantly and tenaciously criticized by both farmer groups. The argument was, that mangroves do generally only have positive effects in much smaller densities of 5.000 trees/ha or lower. Analysis of the data derived from individual interviews on average profits and mangrove cover proves their statement. This correlation has to be carefully considered in future projects in order to find a balanced amount of cover that fit the needs of coastal protection as well as the profit of the farmer.

In summary, some of the elements of the BMPs obviously improved the situation for trial farmers in contrast to control farmers while others need to be reconsidered. Furthermore attention should be paid to farmers' documentation in order to obtain better and complete datasets.

Is the trial group "better off" than the control group?

In order to be able to draw conclusions on the effectiveness of the BMPs in the trial group, first of all a review of the range of BMP appliance amongst the groups and its influence on income development would need to be evaluated in contrast to a control group without trainings if the effect was positive, it could be assumed, that, with more trainings, the BMPs are advantageous to the trial group. Unfortunately however both groups received trainings to varying amounts and the instruction manual was used by the majority of both groups, making a comparison of the groups difficult. As thereby the control group was provided with similar know-how its function as a control or reference group without trainings was not given. This fact should be kept in mind when looking at all results in this study.

In 2011 the trial farms received intensive trainings, and one control farm (CF.22) had access to trainings and the BMP at that time. It participated in the first FIG (Doan Ket) that was founded on the 16.11.2010, and therefore received trainings seven months before it was included as a control farm into the second phase. Interestingly, its profit was highest amongst all control farms with 38 Mio. VND/ha*year in 2011; it was even higher than the average profit of the trial farms (27 Mio. VND/ha*year). Two control farms joined the FIG4 on the 02.07.2012 and two more joined FIG5 on the 14.03.13. In total 5 out of 10 control farms applied the BMP in 2013, at the time of the interviews. The profit of these 5 control farms was even higher than of the trial farms in 2013 (see Table 4). The numbers indicate a possible connection between income and trainings. Due to trainings in the control group and the appliance of BMP practices amongst both groups a conclusion of potential advantages is not possible.

Table 4: Comparison of average profit of trial and control farms in 2013

	2013 [Mio.VND/ha*year]
Trial	31
Control	39

To what extent are the BMP applied at the moment and will they be applied in the future?

The majority of farmers participated in trainings due to their involvement in the FIGs. Several factors indicate a persistent future use and development of BMP among the farmers. Exemplary questions about BMP instructions e.g. pond cleaning time, post larvae treatment, applied non-aquaculture products and documentation of farm management revealed good knowledge by both groups regarding the BMP instructions and recommendations. The individualizations and improvements of the BMP indicate a persistent use among the trial group in the future as they reflect on what is suggested to them. Based on the results it can furthermore be assumed that the documentation of farm management has a good reputation amongst both groups. It can be concluded that the integration of the farmers into FIGs will assure a permanent use and an ongoing development of the BMP practices in the future as farming experiences are shared and constantly discussed by the members

The first reason is the necessity for the farmer to be contracted by the Forest Protection Sub Department (FPSD) once mangrove trees are planted by the FPSD in the farmer`s pond. This does not apply to the farms in the buffer zone of the mangrove forest as they are required by law to keep 60% of the area covered by mangroves. But landward of the dyke, farmers can get support from the FPSD to plant mangroves in their ponds. If they do so, they have to sign a contract with the responsible ranger and are thereafter no longer allowed to cut, thin or prune the trees without permission. This limits the farmer's management possibilities for the mangroves in the pond, due to complicated applications and restrictions for permissions. The farmers are therefore afraid to lose their autonomy in managing the pond. However, if the farmers plant mangroves themselves, without the support of the FPSD, they do not have to engage in any contract with the FPSD.

The second reason is that farmers under the "Land Allocation Contract" do not have any voice in thinning decisions. They stated not to be able to choose trees, neither the logging company nor where the timber is being sold. Profit is shared with 30% for farmer and 70% for the FPSD. The farmers stated willingness to plant more trees if the contract conditions were rearranged to their advantage.

The third reason is that the farmers found only a certain density of mangrove forest cover to be useful for a productive silvo-aquaculture. According to the farmers a lower density of 5000 trees/ha or less is most appropriate. The BMP is recommending a density of 10.000 trees/ha. The argument of the farmers is that high densities of mangrove forest (above a certain level) directly decrease the profit. The results confirm the judgment of the farmers; the profit is lowered with increasing mangrove forest density. This information should be considered in future planting recommendations. The awareness of the farmer as mentioned before can only be stated for the surveyed time frame, so it was not possible to answer the question if the awareness has increased. What can be stated is that both groups currently are aware of the usefulness of mangrove forests in proper densities but it can be assumed that there will be no significant increase of mangrove forest cover under the current circumstances.

Were the FIGs successfully implemented and do they provide benefits for the farmers?

The objective to initiate farmer groups for a better organization and connection amongst the farmers, as a first steps towards the formation of a cooperative and subsequent certification, was accomplished. All groups replied to exchange information about farming practices and experiences, to have a better cooperation amongst neighbors and farmers stated to have benefits from the trainings and BMP. Furthermore the groups developed the idea of a combination of FIG to a cooperative to purchase and sell on bigger markets. The groups would like to receive a certification for organic products.

Within groups, many problems can be solved by neighborhood help and the group managed loans. But the ongoing water pollution and bad water management are hindering factors for the ongoing development and potential organic certification. The groups expressed many times that they see a need for support from the government and external organizations to achieve this goal. The FIG can therefore be considered to be implemented successful and further development within the groups will most likely take place. Greater challenges as organic product certification and cooperatives may need guidance from other institutions to develop.

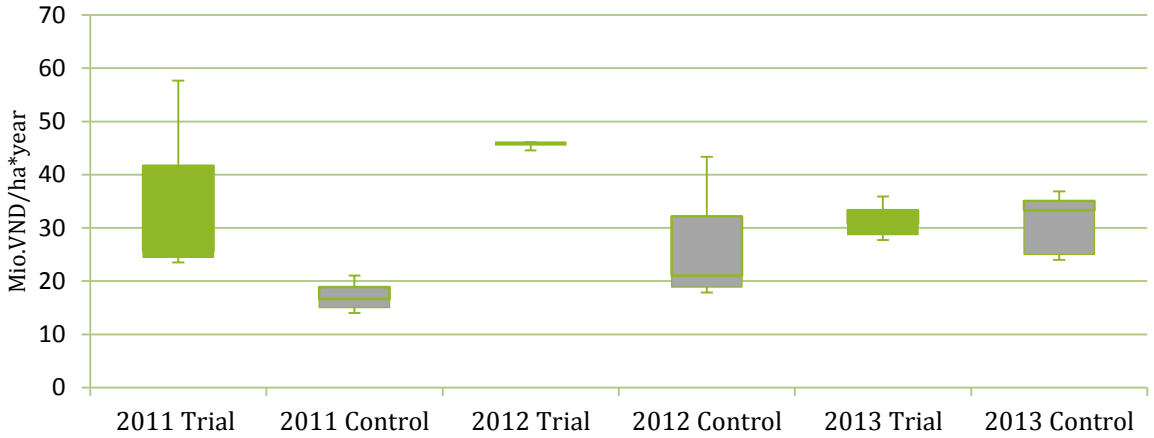


Figure 20: Total profit of the six key-farms in 2011, 2012 and 2013 (not adjusted to market price)

Profit comparison of recent years from interview data

In the interview the profits of 2011, 2012 and 2013 were assessed. The income and profits amongst the groups vary strongly in 2011 and approach similar levels in 2012 and 2013. The farmers stated their profit from the past 3 years from memory. It is not clear if they stated their profit according to the specifications "VND/ha*year" or farm wise and if they really stated the profit and not the income. It was impossible for the interviewer to interfere in the discussion to correct the answers, because of the language barrier. The results, displayed in Figure 23 should therefore be considered as not very reliable, but more as a general impression. Reasons for the increasing profit of the control farms could be the number of trainings they received by joining a FIG and through the knowledge exchange which takes place within the FIG. In comparison the profit of the trial farms did not increase significantly over the three years, as they had received in depth training before and during 2011.

Conclusion

This study investigated the impact of aquaculture component activities of the project, "Adaptation to Climate Change through the Promotion of Biodiversity in Bac Lieu Province, Vietnam" with individual interviews, focus group discussions and analysis of farming documentation of a local population of silvo-aquaculture farms for the time from 2011 to 2013. The study revealed that the farmers profit is a complex, diverse and shifting product of factors like environmental conditions, species composition, survival rate, costs and water quality. The project activities addressed these factors.

In the time from July 2011 to November 2012 the profits among the trial farms were documented to be higher than the ones of control farms, but no comparable documentation was available to draw statistically reliable conclusions. The risks of crop failure diseases were successfully reduced with the introduction of new aquaculture species and non-aquaculture product diversification, juvenile selection, separated breeding and a pest water control, self-organized from farmers of the FIGs. Farmers are aware of environmental services and willing to support their positive effects as long as they provide healthier ponds, the protection of human living conditions and especially more profits. Increase of mangrove forest cover turned out to be profitable only below certain density levels. The great majority of farmers stated to cut their mangrove trees when the opportunity would appeal to fit the mangrove density to the profitable optimum. The BMP were successfully applied and accepted in all farmer groups. They even were developed and adapted by the farmers and experiences were shared among the FIG. Risks of crop failure and tests were also here found to be reduced as well as an improvement of neighborly cooperation and farmer network according to the objectives has been established. It is assumable that in terms of profit, diversification and FIG, the project may have a long-term effect on the target population. These project activities can therefore be described as sustainable.

Potential improvements to address further income diversification and nutrient imbalances, an ecosystem based approach that includes all trophic elements can be developed; it requires further exploration of possible species in multi-trophic levels, suitable harvest and breeding techniques, identification of key markets and a FIG-based marketing approach can ensure the successful distribution of these various products.

To address the algae bloom and low oxygen content, local contaminators can be identified and solutions to avoid nutrient pollution can be worked out. More research on current algae composition, possible growing and harvest methods and processing techniques for other products, can provide new products with high potential. Non-aquaculture products like fruit trees and vegetables could be improved with containers by growing above the salty soil rainwater collection and the promotion of composts for organic waste recycling. Animal husbandry techniques and management could enrich the BMP to provide more knowledge.

The willingness to plant mangrove trees could be increased by the development of proper mangrove densities for the BMP in cooperation with the farmers, the abolition of contract related barriers and contracting on initial plantings.

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Appendix

List of farmers involved in evaluation

Table 5: List of participating farmers

			2nd Pilot Phase	After Second Pilot Phase (no data)	Farmer Awareness	
TRIAL	Tran Quoc Tuan	TF.1	1		1	Key farms
	Tran Thi Oanh	TF.2	1		1	
	Lai Van Quang	TF.3	1		1	
	Dao Van Ua	TF.4			1	
	Nguyen Van Quan	TF.5				
	Phan Tanh Van	TF.6			1	
	Ngo Van Hau	TF.7				
	Tranh Manh Tinh	TF.8			1	
	Nguyen Van Truong	TF.9			1	
	Ngo Manh Hien	TF.10			1	
	Tran Cong Khanh	TF.11			1	
	Le Cong Trinh	TF.12			1	
	Nugyen Xuan Huong	TF.13			1	
	Nugyen Xuan Phu	TF.14			1	
	Nugyen Duc Tinh	TF.16			1	
CONTROL	Pham Van Quyen	CF.18	1		1	Key farms
	Tran Thi Hue	CF.19	1		1	
	Dong Xuan An	CF.20	1		1	
	La Quoc Tuan	CF.21				
	Vu Van Van	CF.22			1	
	Tran Quoc Ai	CF.23			1	
	Nguyen Van Dang	CF.24				
	Nguyen Van Son	CF.25				
	Vu Quang Ngoc	CF.26			1	
	Nguyen Van Chinh	CF.27			1	
	Nguyen Thi Hue	CF.28				
	Ngyuen Van Loi	CF.29			1	
	Ding Hong Nhung	CF.30			1	
	Nguyen Van Si	CF.31			1	
	Sum		6	0	23	

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