MONITORING THE IMPACT ON POND PRODUCTIVITY FROM LEARNING AT THE COASTAL FIELD SCHOOL 2016-2019

First Annual Report for the Project "BUILDING with Nature-DEMAK"

SK REKTOR NO : 1040/UN7.P/HK/2-16

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REPORT ON FIRST YEAR (2016)

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ABSTRACT

The monitoring of aquaculture farmers by the UNDIP/WUR-team aims to assess the progress towards reaching the goals set by the project Building with Nature – Demak. As planned in this first year the sample was taken in one village: Tambakbulusan. As farmers implemented the learning from the Coastal Field Schools during the same season as the training was given, no baseline for this sample was measured. In the village six ponds were monitored during one cropping season; we report on five ponds as one of the ponds was the demonstration pond on which Blue Forest will report.

Before stocking the ponds were dried for at least 5 days and composted goat manure was mixed to the sediment. Thereafter an good dosage of home-made organic fertilizer was added to improve water quality; during the culture period a smaller dose was added weekly to maintain the plankton growth in the pond. The farmers prepared the organic fertilizer (compost), called MOL, from fermented rotten fruits, vegetables and household waste. One farmer used an industrial compost and another fed manufactured pellets; thus the five farmers implemented partly the promoted LEISA technology.

Several of the cropping cycles couldn't be completed due to heavy rains or flooding. The ponds were restocked. Some ponds were harvested early to avoid risk of mortality due to increase of salinity of shrimp showing disease symptoms. Other water quality parameters were within the limits for recommended limits for shrimp culture.

For one production cycle only from five ponds in one village, the shrimp produced per ha was three times higher for the three LEISA farmers and for the other two 20 times higher than the average found in the Demak baseline for one full year, The average gross margin (income) was IDR 46 million/cycle, i.e. 4.5 times higher, but for the three LEISA farmers this was IDR 14 million/cycle, i.e. 40% higher than the average found in the Demak baseline for one full year. From the limited sample we conclude preliminary that the technology trained by the CFS allows to reach the goals set by BwN regarding pond productivity and income from aquaculture.

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1. INTRODUCTION

Erosion along the northern coast of Java, Indonesia, after the destruction of mangrove forest for brackish water ponds is causing the loss of land and livelihoods. This environmental issue worsened due to ground-water extraction and climate change impacts. Demak District, Central Java, is one of the areas where brackish water pond production, i.e. shrimp and milk fish, provided a source of wealth for the local community, after an era of prosperity from irrigated rice cultivation. Furthermore, the improper management of intensive shrimp culture in the brackish water ponds resulted in decreasing quality of the ponds and thus decreasing yields in the last decade. In 2015, the average production from extensive aquaculture is only 200 kg/ha/year of milkfish and 43 kg/ha/year of white leg, tiger and local shrimps. The sustainable development of brackish water pond culture is threatened as these yields are insufficient to invest in coastal protection. The project Building with Nature (BwN) Demak aims to restore coastal protection and sustainable livelihoods supporting this protection. The target is to increase the yield and net income generated from aquaculture with more than 50%.

One of the reasons of the decreasing aquaculture production in Demak, according to previous assessments, was the limited application of aquaculture technology. In the framework of a collaborative project BwN-Demak the NGO Blue Forest trains farmers through the farmer field school approach in so-called Coastal Field Schools (CFS) on good management practice in aquaculture, and a team of UNDIP-FPIK is in charge of monitoring the achievements targeted by the project. Under guidance of the teams the farmers compared three low cost improvements in their culture practice, with their customary practice. After having recovered some capital the farmers can experiment more intensive aquaculture technologies.

The main objective of the monitoring by the Aquaculture Department of the Faculty of Fisheries and Marine Sciences of Diponegoro University is to assess the accomplishment of income generating activities, and ensure that the sustainability criteria are fulfilled. The monitoring will also facilitate to align project activities with the local circumstances and to solve unexpected problems which may occur during the farming activities. On technical matters, monitoring and evaluation are required to judge whether adjustments are required in response to the field conditions (e.g. using new material for the main pole of semi-permeable dam due to human destruction by shipworms).

2. METHOD

The CFS was carried out in five villages; due to budget restrictions the monitoring in the first year will be done for one village only. A purposive random sampling method was applied to select 5 ponds belonging to farmers who had been learning at the CFS at Tambak Bulusan village. A sixth ponds was monitored but this one was used as the demonstration pond for the CFS and was not included in the calculations (the collected data are given in Annex D).

Water quality monitoring and discussion with fish farmers at Tambak Bulusan village were carried out 12 times. During each visit the team did sampling and measurements, verified the monitoring sheet filled out by the farmers, and discussed the results with the farmers.

Table 1. The schedule of UNDIP monitoring team at the first cycle of cultivation at Tambakbulusan Village

Dates	Location	Venue
16 /8-2016	House of Pak Ghofur, the pond farmers team leader	Coordination of Undip monitoring team on first stage of water quality monitoring
18/8- 2016	Head of the village office hall	- Socialization of water quality monitoring at Tambakbulusan pond farmers group. Five pond farmers who joined the CFS were chosen. One of the pond was used as the CFS demonstration pond. - The chosen pond farmers were given Water quality equipment: salino refractometer, sechi disc, water color chart, thermometer and DO table.
30/8- 2016	5 farmer's pond	- Water quality monitoring and discussion
22/9-2016	5 farmer's pond	- Water quality monitoring and discussion
08/10-2016	5 farmer's house	- Water quality monitoring and discussion
14/10-2016	5 farmer's pond	- Water quality monitoring and discussion
20/10-2016	5 farmer's pond	- Water quality monitoring and discussion
15/11-2016	5 farmer's pond	- Water quality monitoring and discussion
06/12-2016	5 farmer's house	- Water quality monitoring and discussion

The farmers were requested to observe, monitor and take notes three times a day: early morning, noon and afternoon, on several water quality variables (Table 2). Dissolved oxygen (DO) was measured weekly by the UNDIP team, when taking samples to analyse TAN, Phosphate and Nitrate. The monitoring was done at the first cycle of farming from July to November 2016.

Table 2. Water quality parameters measuring methods, equipment, locations and frequencies used for the monitoring.

Parameter	Method	Location	Frequency	Responsible	Database
- Water transparency	- Sechi disk	- Ponds	- Daily	- Farmer*	Researchers will review these monthly with farmers and then transcribe in a database. During the monthly visits they may collect water samples for further analysis, and (perhaps) sample products (e.g. fish, shrimp) for analysis.
- Water colour	- Visual observation using colour cart	- Ponds	- Weekly	- Farmer	
- pH	- Indicator stick	- Inlet, Ponds	- Weekly, at noon	- Farmer	
- Ammonia	- Test kit	- Inlet, Ponds	- Weekly	- Farmer	
- Oxygen	- Oxygen meter	- Inlet, Ponds	- Daily at dawn	- Farmer	
- Alkalinity	- Test kit	- Ponds	- Weekly	- Farmer	
- Salinity	- Refract meter	- Inlet, Ponds	- Weekly	- Farmer	
- Temperature	- Thermometer	- Ponds	- Weekly	- Farmer	
- N-components, P, aquatic organisms	- laboratory	- Inlet, Ponds	- Monthly	- Researcher	

* Farmers will be given a ledger with forms and carbons. The UNDIP team will assist in stocking and harvest to improve data quality whenever possible.

DO in the water is a water quality parameter that should be monitored by the pond farmer daily. However, a DO meter is too expensive for most small pond farmers. Therefore, the UNDIP team provided the DO table from which the farmers can read the DO at different water salinity and temperature at the air pressure of 760 mmHg (Stirling, 1985; Annexe A).

The water colour chart is a method to indicate the fertility of the pond water (Annex B). This monitoring is needed to recognise the development of algae's that favour disease out- break.

Data on Operational cost, yield and revenue were collected. The Gross margins was calculated using the following formula:

Gross margin = Income from sales – Operational cost.

The calculation of the net margin would require the accounting of the investment cost, i,e, the value of the pond. The benefit cost ratio (B/C) was calculated as the ratio:

B/C = Gross margin / Operational cost.

3. MATERIAL

The monitoring was done in five pond belonging to four famers of the fish farmer group participating at the CFS. The four farmers who owned and managed these ponds were: Pak H. Shokipin, Pak Ghofur, Pak Kasmudi, and Pak Musafak.

These four pond farmers confirmed to practice their knowledge from the CFS to make probiotic (organic fertilizer) and to manage the pond as follows:

1. Probiotic made of fermented vegetables and fruits wastes. The local name of probiotic produce by the pond farmers is "MOL". The MOL ingredient is:
   - 20 kg of rotten fruits , 5 kg of rice bran bran,
   - 5 kg of banana stalk, 3 liter of sugar cane water,
   - 7 pieces (approximately 50 gram). All ingredients were put in the in a barrel submerged with water and kept for 2-3 weeks.
   - Once white foam emerged then the liquid fertilizer is ready. Application depends on the quantitity needed. The MOL was applied to the pond prior the cultivation.

2. Stocking
   - The stocking of the shrimp post larvae was done at least of pond management when the natural food or phytoplankton starts growing.
   - To promote sustainable growth of the natural feed, additional MOL application 30 liter per week for at least 1 month, afterwards 5 L of MOL was added every 5 days depends on the water color condition. If water are clear, it indicate that natural feed supply is decreasing, which means that liquid fertilizer is needed. Entering the second month, fertilizer are given 20 L every 3 days.

The monitored ponds have different sizes (Table 3); the average area was slighty more than 0.6 ha. All ponds are too shallow for optimal shrimp culture. The farmer's management practices are presented in Tables 4 to 8. Pond B and C are owned by the same farmer in Tambakbulusan. Not all farmers stocked milkfish but all stocked shrimp, either tiger shrimp (*P. monodon*) or white leg shrimp (*L. vannamei*).

Table 3. The dimensions of the five ponds monitored in 2016.

	Unit	A	B	C	D	E	Mean
ha	ha	0.06	0.5	0.5	2	0.06	0.624
Dyke height	m	0.7 -0.8	0.7 -0.8	0.6 -0.7	-	-	
Water depth	cm	50	50	50	50	50	

Table 4: The management practices of Pond A.

- Production management system	- Extensive
- Water circulation system	- Only one gate for water inlet and outlet
- Number of water gate	- 1
- Water supply	- Canal
- Pond Management	- Pond bottom drying for 5 days - 250 kg goat manure - 20 L of MOL / week for 1 months - Afterwards 2,5 L of MOL every 3 days depended on the water colour
- Cultivated organisms	- Vannamei shrimp
- The stocking density of the shrimp	- 30.000 of PL 15
- Date of stocking	- 25 July 2016

Table 5. The management practices of Pond B.

- Production management system	- Extensive with pelleted feed when needed
- Water circulation system	- Separated water inlet and outlet
- Number of water gate	- 2
- Water supply	- Canal
- Pond Management	- Pond bottom drying for 5 days - 350 kg goat manure and fermented rice straw - 20 L of MOL for 1 months - Afterwards 5L of MOL every 2 days depended on the water colour
- Cultivated organisms	- Tiger (monodon) shrimp
- The stocking density of the shrimp	- 20.000 of juvenile
- Date of stocking	- 7 August 2016

Table 6: The management practices of pond C.

- Production management system	- Extensive
- Water circulation system	- Only one gate for water inlet and outlet
- Number of water gate	- 1
- Water supply	- canal
- Pond Management	- Pond bottom drying for 5 days - Fermented rice bran - 20 L of MOL for 1 months - Afterwards 5L of MOL every 2 days depended on the water colour
- Cultivated organisms	- Vannamei shrimp
- Stocking density of the shrimp	- 20.000 of post larva (PL) 10
- Date of stocking	- 30 July 2016

Table 7 The management practices of pond D.

- Production management system	- Extensive, IMTA
- Water circulation system	- Separated water inlet and outlet but next each other (located in one dyke)
- Number of water gate	- 2
- Water supply	- Tangking stream
- Pond Management	- Pond bottom drying for 5 days - 30 kg of cattle rumen content, 350 kg goat manure and fermented rice straw - 20 L of MOL for 1 months - Afterwards 5 L approximately of MOL was given every 3 days during cultivation depended on the water colour
- Cultivated organisms	- Tiger (monodon) shrimp, milk fish and Gracilaria
- The stocking density	- 5.000 juvenile of monodon - 4.000 fry of milk fish at 4 cm length size
- Date of stocking	- 7 August 2016

Table 8. The management practices of pond E.

- Production management system	- Semi-intensive culture with pelleted feeding
- Water circulation system	- Only one gate for water inlet and outlet
- Number of water gate	- 1
- Water supply	- Canal
- Pond Management	- Pond bottom drying for 5 days - goat manure
- Cultivated organisms	- Vannamei shrimp
- Date of stocking	- 25 June 2016 (this 1st stocking was lost) - First week of September (Second stocking)
- The stocking density	First stocking: - 4.000 PL15 of vannamei shrimp - 4.000 fry of milk fish at 4 cm length size Second stocking: 30.000 PL 15 of vannamei shrimp

Figure 1: A dish with harvested *monodon* and *vannamei*, size 40 and 80 per kg, respectively, after three month of grow-out.

4. RESULT

In this chapter, first we present the results for all five ponds. Thereafter we summarize and compare, before concluding.

The ammonia concentration in all ponds remained below 0.5 mg/L.

4.1. Pond A

Pond A was chosen because the owner was an alumni of CFS. He confirmed to be eager to improve his pond production.

The shrimp was harvested on 2 September, the yield was 150 kg / 600m^{2,} approximately 2,500 kg/ha at average individual body weight of 12.5 gram approximately The mortality rate was ± 20%.. The price of the shrimp yield was Rp60.000/kg, Actually, the harvesting time was too early because at that time the heavy raining lead to flood and decreased the salinity sharply. Therefore, the farmer harvested the shrimp immediately to prevent total lost.

The results of the daily monitoring done by the farmer are shown in **Annex C-1**. The weekly monitoring confirmed that the water quality parameters were good until 15 November (Table 9). The dark green water color on 16-18 August 2017 indicated that the phytoplankton grew adequately, yet, addition of fertilizer was needed. At the end of August the water color changed to brownish green. This indicated that phytoplankton, especially *Chaetoceros spp* grew well. On 13 September, the abundancy of phytoplankton and zooplankton were 2,9 x 10^4 and 2,4 x 10^3, respectively; The first would indicate an eutrophic water condition, while the second indicated a mesotrophic water condition. On 20 November, both the phytoplankton and the zooplankton abundancy were slightly lower, but the ratio was favorable (Table 9)

Table 9. The measured water quality, including the plankton abundancy, of Pond A.

Date	Clarity (cm)	Tempe-rature (^{0}C)	DO (ppm)	pH		Salinity (ppt)	TAN (ppm)	N (ppm)	P (ppm)	Water Color	Phytoplankton / Zooplankton (*10^3 ind/L)
				Water	Soil						
16/8	45	28	6,6	7,0	5	25	0,5			Dark green	
18/8	45	28	6,6	7,5	5	25	0,5			Dark green	
30/8	45	30	6,4	8,0	5	27	0,5	0,61	0,021	Brownish green	
13/9	45	35	6,0	8,3	5	30	0,5			Brownish green	29 / 2.4
22/9	45	40	5,6	8,5	5	25	0,5			Brownish green	
8/10	45	37	5,6	8,5	5	32	0,5			Brownish green	
14/10	45	40	5,5	8,0	5	35	0,5	0,45	0,022	Brownish green	
20/10	45	30	6,4	8,3	5	30	0,5			Brownish green	23 / 1.6
15/11	45	30	6,4	8,0	5	25	0,5			Brownish green	

The labour accounted in the operational cost was mostly for pond preparation and dyke maintenance (Table 10). The harvest was mostly done with a broadcast and trap net, and can be done by one person. The yield for the 0.06 ha pond was 150 kg (Table 11) The gross margin for one cycle was IDR 5.696.320, and the B/C ratio was 379 %.

Table 10. The operational cost of pond A (0.06 ha) per cycle (*1,000 IDR).

Item. description	Units	Unit price	Total cost	Notes
Vannamei PL	30.000 PL	0.015	450	
Net	2 m	3	6	For gates: inlet and outlet
Bamboo	1	12	12	
Nail	0.5 kg	10	5	
Wooden plank	1	15	15	
Waterpump hire	1	100	100	
Fuel	6 liter	7	42	For water pump
Goat manure	250 kg	0.8	200	
MOL	12 liter	0.14	1.68	
Net	4 m	3	12	For harvesting
Container hire	14	5	70	For packing the harvest
Ice	14	10	140	To preserve the harvest
Labour	6 person	75	450	Wage
Total operational cost			1.504	

Table 11 The mortality, yield and revenue from sales (*1,000 IDR) of pond A for one cycle.

Product	Mortality (%)	Yield (kg)	Weight (gr/pcs)	Approximate numbers harvested	Price / Unit	Revenue from sales
Vannamei		150	12.5	12,000	0.6	7,200
Total						7,200

4.2. Pond B.

The farmer owning pond B is the team leader of the farmers group in this village. He has long experience in shrimp farming, however, so far the yield was very low.

Prior to stocking, 350 kg of compost was added to the pond. This organic fertilizer was produced from fermented goat manure with hay and rice bran. Fertilizing continued by giving 3 liter of MOL everyday. The colour of water was brownish green (Table 12), which indicated that the pond was quite fertile and abundant of plankton, especially *Chaetoceros* sppas, which is a natural feed. The water color changed to brown from 14 October to 15 November indicating that phytoplankton reduced and thus fertilizer was needed.

On 8 September, an early harvest of the shrimp was done because the water salinity increased up 40 ppt (Annex C-2), and the possibility to increase water exchange was limited at the end of the dry season. Another problem was the large difference between the water temperature within the pond; the upper layer was warmer than in the lower layer of the water column.

Table 12. The water quality parameters, including the plankton abundancy, of pond B.

Date	Clarity (cm)	Tempe-rature (^{0}C)	DO (ppm)	pH		Salinity (ppt)	TAN (ppm)	N (ppm)	P (ppm)	Color	Phytoplankton / Zooplankton (*10^3 ind/L)
				Water	Soil						
16/8	40	32	6,1	7,0	5,5	30	0,5			Brownish green	
18/8	40	32	6,0	7,5	5,5	32	0,5			Brownish green	
30/8	40	33	6,0	8,0	5,5	32	0,5	0,55	0,018	Brownish green	
13/9	40	36	5,5								
22/9	40	34	6,4	8,45	5,5	20	0,7			Brownish green	36 / 1.5
8/10	40	32	5,5	8,5	5,5	40	0,7			Brownish green	
10/10	Early harvest of shrimp due to increased salinity up to 40ppt										
14/10	40	30	6,1	8,0	5,5	35	0,5			Brown	
20/10	40	30	6,4	8,0	5,5	30	0,5	0,68	0,027	Brown	
15/11	40	31	6,0	7,5	5,5	25	0,5			Brown	34 / 2.4

The early harvest resulted in a low operational cost (Table 13) and yielded a harvest of 150 kg of well-sized shrimp (Table 14). The gross margin for one cycle was Rp 15.312.300 and the B/C ratio was 775%.

Table 13. The operational cost of Pond B (0.5 ha) for one cycle (*1,000 IDR)

Item description	**Units**	**Unit price**	**Total cost**	**Notes**
Monodon post larvae	20.000 pl	17	340	
Milkfish fry	200 fries	100	20	
Net	2 meter	3	6	For water inlet and Outlet
Bamboo	1	12	12	
Nails	0,5 kg	10	5	
Wooden plank	1	15	15	
Water pump hire	1 set	100	100	
Fuel	50 liter	7	350	For water pump
Goat manure	350 kg	0.8	280	
MOL	105 liter	0.14	14.7	
Net	30 meter	3	90	For harvesting
Container hire	13	5	65	For packing the yield
Ice block	13 cubes	10	130	To preserve the harvest
Workers	6 persons	100	600	Wages
Total operational cost			2,028	

Table 14. The mortality, yield and revenue from sales (*1,000 IDR) of pond B for one cycle.

Product	Mortality (%)	Yield (kg)	Weight (gr/pcs)	Approx. numbers harvested	Price / Unit	Revenue from sales
Tiger shrimp	50	312,5	32	10,000	1.7	17,000
Milkfish	50	26	260	100	3.4	340
Total						**17,340**

4.3. Pond C.

The daily monitoring done by the farmer is shown in Annex C-3. The condition of pond's water quality shown in Table. 16 . The clarity of the pond water was quite good, however, the salinity increased drastically up to 40 ppt. The brown water color indicate that the phytoplankton abundancy was reduced. The shrimp mortality was very high (70%) due to the drastic increase of salinity as well as the reduced growth of phytoplankton.

Table 15. Water quality parameters, including the plankton abundancy, of pond C

Date	Clarity (cm)	Tempe-rature (^{0}C)	DO (ppm)	pH		Salinity (ppt)	TAN (ppm)	N (ppm)	P (ppm)	Pond Water Color	Phytoplankton / Zooplankton abundancy (*10^3 ind/L)
				Water	Soil						
16/8	40	32	5,9	7	5	35	0,5			Brown	
18/8	40	33	5,9	7,9	5	35	0,5			Brown	
30/8	40	34	5,5	7,5	5	37	0,5	0,53	0,016	Brown	32 / 2.5
13/9	40	36	5,5	8,0	5	40	0,5			Brown	
22/9	40	32	5,9	8,2	5	35	0,5			Brown	
8/10	40	32	6,1	8,0	5	30	0,5			Brown	
10/19	Early harvesting due to increased water salinity up to 40 ppt										
14/10	40	32	6,0	8,5	5	32	0,5	0,55	0,023	Brown	22 / 1.3
20/10	40	30	6,4	8,0	5	30	0,5			Brown	
15/11	40	30	6,4	7,5	5	30	0,5			Brown	

The yield was about 200 kg/ha (Table 16). Due to the low operational cost (Table 17), the farmer had a benefit of about 2.881.600 IDR. To cost-benefit ratio was about 280%.

Table 16. The operational cost of pond C (0.5ha) for *vannamei* shrimp (*1,000 IDR).

Item description	Units	Unit price	Total cost	Notes
Vannamei PL	20.000 PL	0.015	300	
Milkfish fry	200 fries	0.1	20	
Net	2 meter	3	6	For inlet and outlet
Bamboo	1	12	12	
Nail	0,5 kg	10	5	
Wooden plank	1	15	15	
Water pump hire	1 set	100	100	
Fuel	5 liter	7	35	For water pump
MOL	10 liter	0.14	1.4	
Net	3 meter	3	9	For harvesting
Container	7	5	35	For packing the yield
Ice block	7 blocks	10	70	To preserve the harvest
Workers	6 persons	75	450	Wages
	Total operational cost		**1,058**	

Table 17. The mortality, yield and income from sales (*1,000 IDR) of pond C for one cycle.

	Mortality (%)	Yield (kg)	Approx. weight (gr/pcs)	Approx. numbers harvested	Price / Unit	Income from sales
Vannamei shrimp	70	100	16	6,000	0.6	3,600
Milkfish	50	31	330	100	3.4	340
TOTAL						**3,940**

4.4. Pond D

The farmer of pond D stocked 5,000 PL of tiger shrimp and 4,000 milk fish fry at the size of 4 cm. This farmer cultures seaweed *Gracilaria* in his pond to maintain the water quality; this is an example of an integrated multi tropic aquaculture (IMTA) system,

The pond was cured once a year by drying the pond bottom for 5 days. This time the pond bottom sediment was mixed with 30 kg of cattle rumen, 350 kg goat manure and fermented rice straw. Afterwards the pond was fertilized further using 20 L of MOL for a month; thereafter about 5 L of MOL was given every 3 days during the remaining cultivation period. The results of the daily monitoring done by the farmer is shown in Annex C-4. The nitrate content of the pond water was quite high in the beginning but decreased later, which could be the effect of the *Gracilaria* (Table 18).

Table 18. Water quality parameters, including the plankton abundancy, of pond D

Date	Clarity (cm)	Tempe-rature (^{0}C)	DO (ppm)	pH		Salinity (ppt)	TAN (ppm)	N (ppm)	P (ppm)	Color	Phytoplankton / Zooplankton (*10^3 ind/L)
				Water	Soil						
16/8	40	30	6,4	7,5	5,5	27	0,5			Green	
18/8	40	32	6,1	7,9	5,5	27	0,5			Green	
30/8	40	32	6,1	8,2	5,5	29	0,5	1,05	0,053	Brownish green	
13/9	40	34	6,0	8,0	5,5	25	0,5			Brown	32 / 3.5
22/9	40	32	6,1	8,3	5,5	30	0,5			Brownish green	
8/10	40	31	6,1	8,0	5,5	30	0,5			Brownish green	
14/10	40	30	6,4	8,3	5,5	28	0,5	0,72	0,026	Brownish green	
20/10	40	31	6,1	8,4	5,5	26	0,5			Brown	29 / 2.8
15/11	40	31	6,1	8,0	5,5	26	0,5			Brown	

Early October, after 3,5 months cultivation, the milkfish was harvested because the farmer started the harvest of the shrimp. The milkfish had an average individual body weight of 150 g approximately (Table 20). The survival rate of the milk fish was quite good,

Table 19. The operational cost of Pond D (2 ha) for one cycle (*1,000 IDR).

Item description	**Units**	**Unit price**	**Total cost**	**Notes**
Monodon juvenile	5.000 PL	0.045	225	
Milkfish	800 fries	0.1	80	
Net	2 meter	3	6	For Inlet and Outlet
Bamboo	1	12	12	
Paku Kayu	0,5 kg	10	5	
Wooden plank	1	15	15	
Water pump hire	2 set	100	200	
Fuel	60 liter	7	420	For water pump
MOL	25 liter	0.14	3.5	
Net	20 meter	3	60	For harvesting
Container	4	5	20	For packing the harvest
Ice block	4 blocks	10	40	To preserve the harvest
Worker	2 persons	75	150	Wages
		TOTAL	**1,237**	

The tiger shrimp were harvested in three times between early October and 30 November 2016. The average yield was 45 kg at size 30 (30 shrimp/kg) and price of Rp. 130.000/kg (Table 20). The survival rate of the shrimp was 90%, the highest among the five ponds.

Compared to the other four ponds, the operational cost of this 2 ha pond are low (Table 19), and the income from the sales for one cycle was large (Table 20). This was reflected in the high gross margin (IDR 13,624,000) and a B/C ratio of more than 1100%.

Table 20: The mortality, yield and revenue from sales (*1,000 IDR) of pond D for one cycle.

Product	Mortality (%)	Yield (kg)	Approx. weight (gr/pcs)	Approx. numbers harvested	Price / Unit	Revenue from sales
Tiger shrimp	10	135	30	42,500	0.6	13,500
Milkfish	50	100	250	. 400	3.4	1,360
TOTAL						**14,860**

4.5. Pond E

This traditional pond has only 1 sluice-gate for inlet and outlet of water (Table 9). The pond was first stocked with milkfish and *vannamei* shrimp, but this first stocking was lost due to the flood that ruined his pond dyke. Soon after the reconstruct the dyke, he stocked again. The second stocking was only *vannamei* shrimp in the first week of September.

The farmers fed rice bran and pellets, and added fertilizer to enhance the growth of lab-lab on which the milkfish feeds. The results of the daily monitoring done by the farmer can be found in Annex B-5. The DO of the pond water was good, but the pH was high (Table 21). The second half of the culture period the water color demonstrated that the availability of natural feed in the water was good, while the zoo-plankton abundancy remained relatively low.

Table 21. The water quality parameters, including the plankton abundancy, of pond E.

Date	Clarity (cm)	Tempe-rature (^{0}C)	DO (ppm)	pH		Salinity (ppt)	TAN (ppm)	N (ppm)	P (ppm)	Pond Water Color	Phytoplankton / Zooplankton (*10^3 ind/L)
				Water	Soil						
16/8	40	28	6,5	7,5	5	27	0,5			Brown	
18/8	40	29	6,6	8,0	5	26	0,5			Brown	
30/8	40	29	6,6	8,2	5	28	0,5	0,46	0,018	Brown	
13/9	40	31	6,4	7,5	5	30	0,5			Brown	26 / 2.8
22/9	40	32	6,0	8,2	5	34	0,5			Brown	
8/10	40	30	6,2	8,3	5	32	0,5			Brownish green	
14/10	40	31	6,4	8,2	5	25	0,5	0,34	0,026	Brownish green	
20/10	40	30	6,4							Brownish green	35 / 2.9
15/11	40	28	6,6							Brownish green	

The operational cost presented included both the first and the second stocking (Table 22). The gross margin was close to Rp 6 million and the B/C ratio about 350 %.

Table 22. The operational cost of pond E (0.06 ha) for one cycle (*1000 IDR)

Item description	Units	Unit price	Total cost	Notes
Vannamei shrimp	4.000 PL	0.15	60	1st stocking (lost)
Milkfish fry	4,000	0.1	400	1st stocking (lost)
Vannamei shrimp	30.000 PL	0.15	450	2nd stocking
Net	2 meter	3	6	For Inlet and Outlet
Bamboo	1	12	12	
Paku Kayu	0,5 kg	10	5	
Wooden plank	1	15	15	
Water pump hire	1 set	100	100	
Fuel	6 liter	7	42	For water pump
Goat manure	250 kg	0.8	200	
MOL	12 liter	0.14	1.68	
Net	4 meter	3	12	For harvesting
Container	14	5	70	For packing the harvest
Ice block	14 blocks	10	140	To preserve the harvest
Worker	2 persons	75	150	Wages
	TOTAL OPERATIONAL COST		**1,464**	

Table 23: The mortality, yield and revenue from sales (*1,000 IDR) for one cycle of pond E.

Product	Mortality (%)	Yield (kg)	Approx. weight (gr/pcs)	Approx. numbers harvested	Price / Unit	Revenue from sales
Vannamei	60	200	16	12,000	0.3	3,600
TOTAL						**3,600**

5. Comparison of the results with baseline and project goals.

All monitored farmers used the MOL (Table 24). While four ponds were given the organic fertilizer recommended by the CFS, one got an industrial compost. Four of the five cultivated *vannamei,* the other farmed *monodon*. In one /two ponds milkfish was cultured.

Table 24. The dosage of fertilizer and feed used, and products and yield of the five ponds.

Farmer	Fertilizer/feed applied	Dosage of MOL	Cultivated Organism	Yield (kg//ha)
A	Industrial compost	- 3 L week^{-1} during the first month of cultivation	Milkfish *Vannamei*	5,000 670
B	Composted goat manure and rice straw	- 20 L at early stage - 3 L weekly until harvest	*Vannamei*	200
C	Composted goat manure and rice straw	- 20 L at early stage - 3L twice a week until harvest	*Monodon*	120
D	Goat manure, rice straw and cattle rumen content	- 20 L at early stage - 3 L twice a week until harvest	Milkfish *Vannamei*	125 68
E	Goat manure compost Rice bran and pellets	- 20 L at early stage - 3 L twice a week until harvest	*Vannamei*	3,330

The shrimp yield varied widely and was highest in pond E, where *vannamei* had been stocked at a high density and shrimp were fed industrial pellets. The baseline had found average yields of shrimp and milkfish of 43 and 192 kg/ha/yr, respectively. The lowest milkfish yield was 125 kg/ha and the best 5,000 kg/ha, while the average shrimp yield for the five ponds was close to 880 kg/ha for one cycle. For the three LEISA farmers the shrimp yield per ha was three times higher and for the other two 20 times higher for one cycle than the average found in the Demak baseline for one full year.

Figure 1: A harvested *monodon* after three month of grow-out.

The sales from shrimp provided by far the largest part of the revenues (Table 25). The average B/C ratio was about 570%. The farmers with the smallest ponds, who did add commercial fertilizer or feed and stocked a higher density of shrimp, reached the highest gross margin per ha. The average gross margin (income) was IDR 46 million/cycle, i.e. 4.5 times higher, but for the three LEISA farmers this was IDR 14 million/cycle, i.e. 40% higher than the average found in the Demak baseline for one full year (10 million IDR/ha per year).

In principle farmers can do at least two cycles per year. Thus their income can more than double when implementing the LEISA system learned during the CFS. When complementing the MOL with industrial compost (pond A) or feed (pond B) the income can increase dramatically.

Table 25: Overview and average of the operational cost and the revenue (*1,000 IDR) of the five ponds (A to E) monitored.

		A	B	C	D	E	Average / ha
	ha	0.06	0.5	0.5	2	0.06	
Operational cost	PL	450	340	300	225	450	**3,271**
	Fry	0	20	20	80	0	**40**
	Equipment	50	128	47	98	50	**413**
	Fuel & rent	142	450	135	620	242	**1,576**
	MOL & Manure	202	295	1.4	3.5	202	**1,466**
	Harvest	210	195	105	60	210	**1,526**
	Labour	450	600	450	150	150	**3,435**
	Total	1,504	2,028	1,058	1,237	1,304	**11,711**
Income	Shrimp	7,200	17,000	3,600	13,500	3,600	**57,590**
	Milkfish		340	340	1,360		**680**
	Total	7,200	17,340	3,940	14,860	3,600	**58,000**
Gross margin / pond		5,696	15,312	2,882	13,624	2,296	
Gross margin / ha		**94,933**	**30,624**	**5,763**	**6,812**	**38,260**	**46,280**

6. Conclusion

The UNDIP team monitored five ponds of four shrimp farmers in Tambakbulusan during the year they followed the Coastal Field school curriculum. The four implemented fully or partly the promoted LEISA technology already. The concurrent implementation means that team will have to collect historical information on the performance of all sampled farmers before their training.

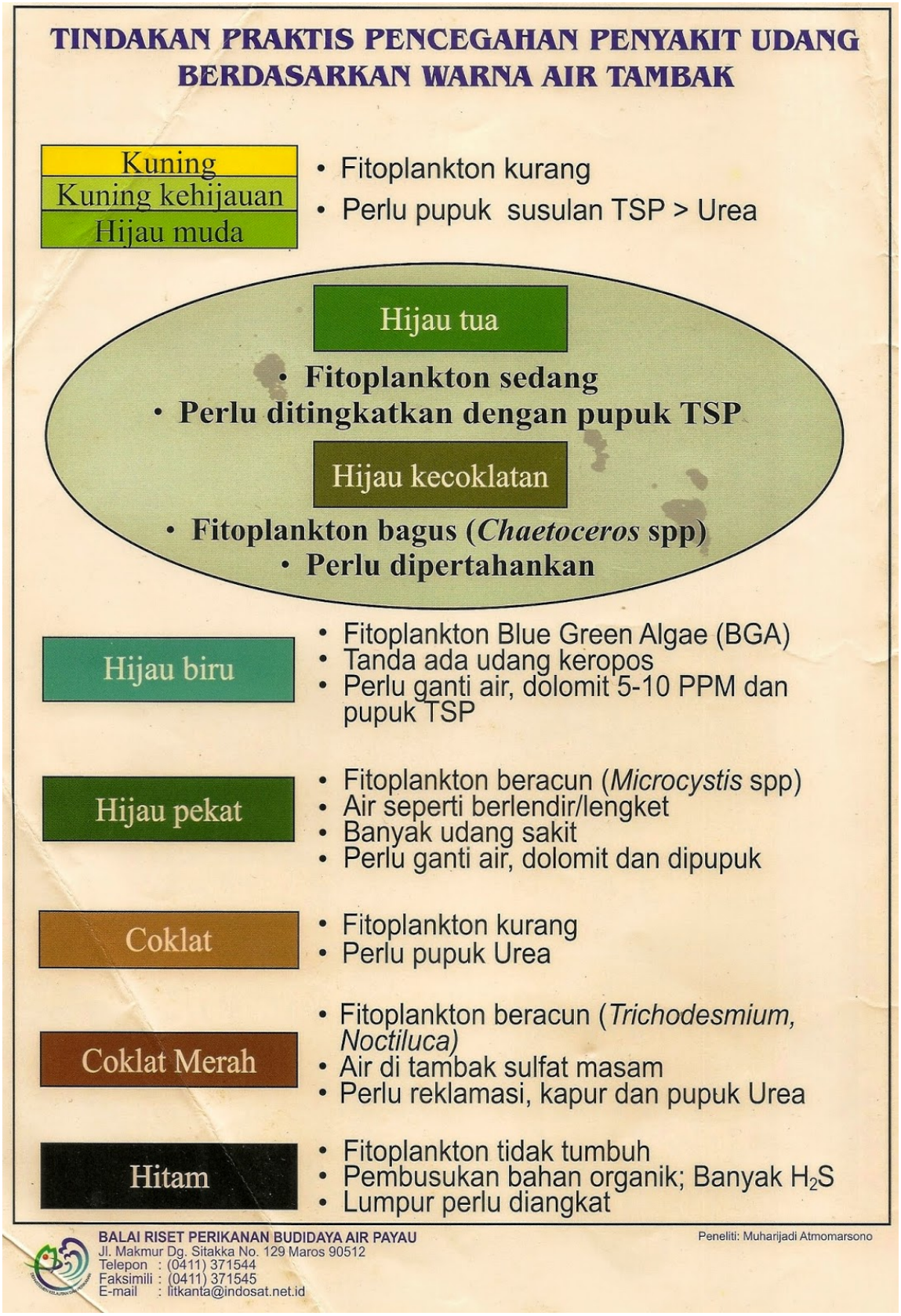
For one production cycle only, the shrimp production was three times higher for the three LEISA farmers and for the two farmers who added industrial manure or feed this was 20 times higher than the average found in the Demak baseline for one full year. The average gross margin (income) was IDR 46 million/cycle, i.e. 4.5 times higher, but for the three LEISA farmers this was IDR 14 million/cycle, i.e. 40% higher than the average found in the Demak baseline for one full year. The average ratio gross margin / operational cost was about 570%.

The application of MOL and organic fertilizer seems an appropriate first step into low cost recovery of the aquaculture production. Preliminary, based on a limited sample, in one “coast 0” village, we conclude that the implementation of the technology trained by the CFS allows thus to reach the goals set by BwN on pond productivity and income from aquaculture.

Annex A. The Dissolved oxygen in the water at different eater salinity and temperature at 760 mmHg air pressure (Stirling *et al.,* 1985)

Temperature ^{0}C	**Salinity (ppt)**							
	0	**5**	**10**	**15**	**20**	**25**	**30**	**3**
4	13,1	12,7	12,2	11,8	11,5	10,7	10,7	10,3
6	12,5	12,1	11,6	12,25	10,9	10,2	10,2	9,8
8	11,8	11,45	11,1	10,7	10,4	9,7	9,7	9,4
10	11,3	10,9	10,6	10,2	9,9	9,3	9,2	9,0
12	10,8	10,45	10,1	9,8	9,5	8,9	8,8	8,6
14	10,3	9,95	9,7	9,4	9,1	8,6	8,5	8,2
16	9,9	9,55	9,3	9,0	8,7	8,2	8,1	7,9
18	9,5	9,15	8,9	8,6	8,4	7,9	7,8	7,6
20	9,1	8,8	8,6	8,3	8,1	7,6	7,7	7,3
22	8,7	8,6	8,3	8,1	7,9	7,5	7,4	7,2
24	8,4	8,3	8,1	7,8	7,6	7,1	7,1	6,9
26	8,1	8	7,7	7,5	73	6,8	6,8	6,6
28	7,8	7,7	7,5	7,3	7,0	6,6	6,6	6,4
30	7,6	7,4	7,2	7,0	6,8	6,4	6,4	6,1
32	7,3	7,2	7	6,9	6,6	6,1	6,1	5,9
34	7,1	7	6,9	6,7	6,4	6,0	6,0	5,8
36	6,9	6,8	6,7	6,5	6,2	5,9	5,9	5,7
38	6,7	6,6	6,5	6,4	6,1	5,7	5,7	5,6
40	6,5	6,5	6,3	6,3	6,0	5,6	5,6	5,5

Annex B: The Pond water Colour Chart (Brackish Water Research Centre



Annex C: The Water Quality Parameters

Table C-1 The daily monitoring water quality done by farmer A.

Day	Date	Clarity (cm)	Temperature (^{0}C)			Salinty (ppt)			pH			Water Color	Notes
			Morning	Noon	After noon	Morning	Noon	After noon	Morning	Noon	After noon		
Sun	21/08		35			37			7			Brown	Sunny
Mon	22/08		30			36			7				Sunny, morning to noon; cloudy afternoon
Tues	23/08		29			36			7				Sunny
Wends	24/08				35			37			7		Sunny
Thurs	25/08		29			37			7			Brown	Sunny
Friday	26/08			35			37			7			Sunny
Satt	27/08		30			36			7				Sunny, morning to noon; cloudy afternoon
Sun	28/08		29			36			7				Sunny
Mon	29/08				34			22			7		Cloudy
Tues	30/08		29			30			7				
Wends	31/08				32			30			7		
Thurs	01/09				30			30			7		
Friday	02/09		29			29			7			Green	
Satt	03/09		29			35			7				
Sun	04/09		35			37			7				
Mon	05/09				35			37			7		Sunny
Tues	06/09		29			37			7			Green	Sunny
Wends	07/09			35			37			7			Sunny
Thurs	08/09		30			36				7			Sunny
Friday	09/09		29			36				7			Sunny
Satt	10/09				34			22			7		Sunny
Sun	11/09		29			30				7			Raining at night
Mon	12/09				32			30			7		Sunny

Tues	13/09			30			30			7			Sunny
Wends	14/09	29			29			7					Sunny
Thurs	15/09	29			35			7					Sunny
Friday	16/09		34			30			7				Sunny
Satt	17/09		34			32			7		Brown		Sunny
Sun	18/09	30			33			7					Sunny
Mon	19/09	32			33			8					Sunny
Tues	20/09		34			32			8				
Wends	21/09			32			30			7			
Thurs	22/09	30			32			7					
Friday	23/09	35			37			7			Brown		
Satt	24/09	30			36			7					
Sun	25/09	29			36			7					
Sun	26/09			35			37			7			
Mon	27/09	29			37			7			Brown		
Tues	28/09		35			37			7				
Wends	29/09	30			36			7					
Thurs	30/09	29			36			7					
Friday	01/10			34			22			7			
Satt	02/10	29			30			7					
Sun	03/10			32			30			7			
Mon	04/10			30			30			7			
Tues	05/10	29			29			7			Green		
Wends	06/10	29			35			7					
Thurs	07/10	35			37			7					
Friday	08/10			35			37			7			
Satt	09/10	29			37			7			Green		
Sun	10/10	-	-	-	-	-	-						

Table C-2. The daily monitoring of water quality of pond B, used to culture Monodon Shrimp (to 11 October 2016)

Day	Date	Clarity (cm)	Temperature (^{0}C)			Salinty (ppt)			pH			Water Color	Notes
			Morning	Noon	After noon	Morning	Noon	After noon	Morning	Noon	After noon		
Sun	21/08	40	30	30	31	26	25	25	7	7	7	Brown	Sunny
Mon	22/08	40	25	32	28	24	27	27	7	7	7	Brown	Sunny, morning to noon; cloudy afternoon
Tues	23/08	40	26	32	31	28	27	27	7	8	7	Brown	Sunny
Wends	24/08	40	26	32	31	28	28	28	7	7	7	Brown	Sunny
Thurs	25/08	40	29	32	30	28	27	28	7	7	7	Brown	Sunny
Friday	26/08	40	26	31	32	30	29	27	7	7	8	Brown	Sunny
Satt	27/08	40	27	33	33	30	29	29	7	7	7	Brown	Sunny, morning to noon; cloudy afternoon
Sun	28/08	40	27	33	32	29	29	29	7	7	7	Brown	Sunny
Mon	29/08	40	30	34	31	30	30	30	7	8	7	Brown	Cloudy
Tues	30/08	40	29	32	33	31	30	30	7	7	7	Greenish brown	
Wends	31/08	40	28	34	33	33	30	30	7	7	7	Greenish brown	
Thurs	01/09	40	27	33	31	31	31	30	7	7	7	Greenish brown	
Friday	02/09	40	27	34	31	31	30	30	7	7	7	Greenish brown	
Satt	03/09	40	30	34	32	31	31	31	7	7	8	Greenish brown	
Sun	04/09	40	30	30	31	26	31	31		7	7	Greenish brown	
Mon	05/09	40	32	33	32	31	31	31	7	7	7	Greenish brown	
Tues	06/09	40	31	33	31	31	32	32	7	7	7	Greenish brown	
Wends	07/09	40	31	33	31	32	32	32	7	7	7	Greenish brown	
Thurs	08/09	40	32	33	33	32	31	31	7	7	7	Greenish brown	
Friday	09/09	40	33	34	33	31	31	31	7	7	7	Greenish brown	
Satt	10/09	40	32	33	33	31	31	31	7	7	7	Greenish brown	
Sun	11/09	40	31	34	32	31	31	32	7	7	7	Greenish brown	
Mon	12/09	40	32	33	32	32	31	32	7	7	7	Greenish brown	
Tues	13/09	40	35	36	35	31	32	31	7	7	7	Greenish brown	

Wends	14/09	40	35	36	33	32	32	32	7	7	7	Greenish brown
Thurs	15/09	40	35	35	35	32	33	32	7	7	7	Greenish brown
Friday	16/09	40	33	34	35	32	33	32	7	7	7	Greenish brown
Satt	17/09	40	33	34	34	32	33	33	7	7	7	Greenish brown
Sun	18/09	40	33	33	33	33	34	33	7	7	7	Greenish brown
Mon	19/09	40	33	34	33	32	33	32	7	7	7	Greenish brown
Tues	20/09	40	32	35	35	31	31	32	8	8	7	brown
Wends	21/09	40	32	34	34	31	32	32	8	8	7	brown
Thurs	22/09	40	32	35	35	33	33	33	8	8	7	brown
Friday	23/09	40	32	35	34	32	32	32	8	8	8	brown
Satt	24/09	40	32	33	32	31	32	32	8	8	8	brown
Sun	25/09	40	32	33	32	31	32	31	8	8	8	brown
Mon	26/09	40	31	33	32	31	32	32	8	8	8	brown
Tues	27/09	40	32	34	33	31	31	31	8	8	8	brown
Wends	28/09	40	31	35	32	31	31	31	8	8	8	brown
Thurs	29/09	40	32	35	33	32	32	32	8	8	8	brown
Friday	30/09	40	32	35	33	32	32	32	8	8	8	brown
Satt	01/10	40	31	34	31	32	32	32	8	8	8	brown
Sun	02/10	55	32	35	32	31	32	32	8	8	8	brown
Mon	03/10	50	31	33	33	31	32	32	7	7	7	brown
Tues	04/10	50	32	34	33	32	33	33	7	7	7	brown
Mon	05/10	50	32	33	34	34	34	34	7	7	7	
Tues	06/10	50	32	33	33	34	33	34	8	8	8	
Wends	07/10	50	33	32	33	35	35	35	7	7	7	
Thurs	08/10	50	33	33	34	40	40	40	8	8	8	
Friday	09/10	50	32	33	34	40	40	40	8	8	8	
Satt	10/10	50	32	33	33	40	40	40	7	7	7	

Annex C-3. The daily monitoring water quality done in Pond C (same farmer as B) for Vannamei Shrimp.

Day	Date	Clarity (cm)	Temperature (^{0}C)			Salinty (ppt)			pH			Water Color	Notes
			Morning	Noon	After noon	Morning	Noon	After noon	Morning	Noon	After noon		
Sun	21/08	40	32	32	32	32	33	33	7	7	7	Brown	Sunny
Mon	22/08	40	32	33	32	32	32	33	7	7	7	Brown	Sunny, morning to noon; cloudy afternoon
Tues	23/08	40	32	33	32	33	33	33	7	7	7	Brown	Sunny
Wends	24/08	40	33	33	33	32	32	33	7	7	7	Brown	Sunny
Thurs	25/08	40	32	32	32	33	33	33	7	7	7	Brown	Sunny
Friday	26/08	40	32	34	32	32	32	32	7	7	7	Brown	Sunny
Satt	27/08	40	32	33	33	34	34	34	7	7	7	Brown	Sunny, morning to noon; cloudy afternoon
Sun	28/08	40	31	32	32	33	33	33	7	7	7	Brown	Sunny
Mon	29/08	40	32	31	31	32	32	32	7	7	7	Brown	Cloudy
Tues	30/08	40	32	33	32	33	33	33	7	7	7	Brown	
Wends	31/08	40	32	33	32	33	33	33	7	7	7	Brown	
Thurs	01/09	40	32	32	32	33	34	33	7	7	7	Brown	
Friday	02/09	40	31	31	31	32	33	33	7	7	7	Brown	
Satt	03/09	40	31	32	31	33	33	34	7	7	7	Brown	
Sun	04/09	40	32	32	32	32	33	33	7	7	7	Brown	
Mon	05/09	40	31	32	32	33	33	33	7	7	7	Brown	Sunny
Tues	06/09	40	31	32	32	33	33	33	7	7	7	Brown	Sunny
Wends	07/09	40	32	33	32	33	34	34	7	7	7	Brown	Sunny
Thurs	08/09	40	32	32	32	33	33	32	7	7	7	Brown	Sunny
Friday	09/09	40	31	32	32	33	33	33	7	7	7	Brown	Sunny
Satt	10/09	40	31	33	33	36	36	36	8	8	8	Brown	Sunny
Sun	11/09	40	32	33	34	35	35	35	8	8	8	Brown	Raining at night
Mon	12/09	40	32	33	34	35	35	37	8	8	8	Brown	Sunny
Tues	13/09	40	31	32	32	37	38	38	8	8	8	Brown	Sunny

Wends	14/09	40	31	32	31	35	35	35	8	8	8	Brown	Sunny
Thurs	15/09	40	31	33	32	38	38	38	8	8	8	Brown	Sunny
Friday	16/09	40	31	32	32	39	39	39	8	8	8	Brown	Sunny
Satt	17/09	40	32	33	32	40	40	40	8	8	8	Brown	Sunny
Sun	18/09	40	31	33	32	38	38	38	8	8	8	Brown	Sunny
Mon	19/09	40	31	32	32	38	38	38	8	8	8	Brown	Sunny
Tues	20/09	40	31	32	32	35	35	36	8	8	8	Brown	
Wends	21/09	40	30	32	31	35	35	35	8	8	8	Brown	
Thurs	22/09	40	30	32	31	36	36	36	8	8	8	Brown	
Friday	23/09	40	31	32	31	36	37	37	8	8	8	Brown	
Satt	24/09	40	31	32	31	35	35	36	8	8	8	Brown	
Sun	25/09	40	31	33	31	34	35	35	8	8	8	Brown	
Sun	26/09	40	32	32	31	34	34	34	8	8	8	Brown	
Mon	27/09	40	31	33	31	32	32	32	8	8	8	Brown	
Tues	28/09	40	31	32	30	32	32	32	8	8	8	Brown	
Wends	29/09	40	31	32	31	33	33	32	8	8	8	Brown	
Thurs	30/09	40	31	32	30	33	33	33	8	8	8	Brown	
Friday	01/10	40	30	32	31	32	32	32	8	8	8	Brown	
Satt	02/10	40	32	32	31	33	33	32	8	8	8	Brown	
Sun	03/10	40	31	33	31	32	32	32	8	8	8	Brown	
Mon	04/10	40	31	33	31	32	32	32	8	8	8	Brown	
Tues	05/10	40	29	30	30	30	31	30	7	7	7	Brown	
Wends	06/10	40	30	30	30	30	31	30	7	7	7	Brown	
Thurs	07/10	40	30	31	31	30	31	30	7	7	7	Brown	
Friday	08/10	40	29	30	30	30	30	30	7	7	7	Brown	
Satt	09/10	40	29	30	30	30	30	30	7	7	7	Brown	
Sun	10/10	40	29	30	29	30	30	30	7	7	7	Brown	

Annex C-4. The data daily collected on water quality in Pond D (from 21 August to 11 October 2016)

Day	Date	Clarity (cm)	Temperature (^{0}C)			Salinty (ppt)			pH			Water Color	Notes
			Morning	Noon	After noon	Morning	Noon	After noon	Morning	Noon	After noon		
Sun	21/08	35	26	26	32	30	30	30	7	7	7		Sunny
Mon	22/08	45	26	26	26	30	30	30	7	7	7		Sunny, morning to noon; cloudy afternoon
Tues	23/08	40	27	33	33	30	30	30	7	7	7		Sunny
Wends	24/08	40	27	32	32	30	30	30	7	7	7		Sunny
Thurs	25/08	40	30	30	31	30	30	30	7	7	7		Sunny
Friday	26/08	40	28	33	33	30	30	30	7	7	7		Sunny
Satt	27/08	40	29	34	34	30	28	29	7	7	7		Sunny, morning to noon; cloudy afternoon
Sun	28/08	40	30	34	34	29	29	29	7	7	7		Sunny
Mon	29/08	40	32	32	34	29	30	30	7	7	7		Cloudy
Tues	30/08	40	29	34	31	30	30	28	7	7	7		
Wends	31/08	40	29	34	34	31	28	28	7	7	7		
Thurs	01/09	40	29	35	34	30	28	30	7	7	7		
Friday	02/09	40	31	35	34	30	30	30	7	7	7		
Satt	03/09	40	29	34	35	30	30	30	7	7	7		
Sun	04/09	40	29	34	34	30	30	30	7	7	7		
Mon	05/09	40	29	33	34	30	30	30	7	7	7		Sunny
Tues	06/09	40	28	34	33	30	29	29	7	7	7		Sunny
Wends	07/09	40	33	34	34	30	30	30	7	7	7		Sunny
Thurs	08/09	40	30	35	35	30	30	30	7	7	7		Sunny
Friday	09/09	45	27	34	34	25	20	20	7	7	7		Sunny
Satt	10/09	45	28	35	35	25	25	25	7	7	7		Sunny
Sun	11/09	45	28	33	33	25	25	25	7	7	7		Raining at night
Mon	12/09	45	28	34	34	27	25	25	7	7	7		Sunny
Tues	13/09	45	31	34	34	27	25	25	7	7	7		Sunny

Wends	14/09	45	29	34	33	27	27	27	7	7	7	Sunny
Thurs	15/09	40	29	34	34	30	30	30	7	7	7	Sunny
Friday	16/09	40	29	33	34	30	30	30	7	7	7	Sunny
Satt	17/09	40	28	34	33	30	29	29	7	7	7	Sunny
Sun	18/09	40	33	34	34	30	30	30	7	7	7	Sunny
Mon	19/09	40	33	33	33	28	25	27	7	7	7	Sunny
Tues	20/09	40	33	34	33	28	27	27	7	7	7	
Wends	21/09	40	32	33	33	28	27	27	7	7	7	
Thurs	22/09	40	32	34	33	28	27	27	7	7	7	
Friday	23/09	40	32	33	33	27	27	27	7	7	7	
Satt	24/09	40	31	33	33	27	25	25	7	7	7	
Sun	25/09	40	31	32	33	20	20	20	7	7	7	
Sun	26/09	40	29	30	30	23	22	21	7	7	7	
Mon	27/09	40	29	29	29	20	20	20	7	7	7	
Tues	28/09	40	30	30	30	20	20	20	7	7	7	
Wends	29/09	40	29	30	29	20	20	20	7	7	7	
Thurs	30/09	40	30	30	29	20	20	20	7	7	7	
Friday	01/10	40	29	30	30	20	20	20	6	6	6	
Satt	02/10	40	29	29	28	20	20	20	6	6	6	
Sun	03/10	40	29	29	28	20	20	20	6	6	6	
Mon	04/10	40	28	29	29	20	20	20	6	6	6	
Tues	05/10	40	28	29	29	20	20	20	6	6	6	
Wends	06/10	40	28	29	29	15	16	16	6	6	6	
Thurs	07/10	40	28	29	28	20	20	20	6	6	6	
Friday	08/10	40	28	29	29	10	10	10	6	6	6	
Satt	09/10	40	28	29	29	10	10	10	6	6	6	

Annex C-5. The daily monitoring water quality done in Pond E (from 21 August to 11 October 2016)

Day	Date	Clarity (cm)	Temperature (^{0}C)			Salinty (ppt)			pH			Water Color	Notes
			Morning	Noon	After noon	Morning	Noon	After noon	Morning	Noon	After noon		
Sun	21/08	40	28	30	31		25	25		7	7	Brown	Sunny
Mon	22/08	40	25	32	28	24	27	27	7	7	7	Brown	Sunny, morning to noon; cloudy afternoon
Tues	23/08	40	26	32	31	28	27	27	7	7	7	Brown	Sunny
Wends	24/08	40	26	32	31	28	28	28	7	7	7	Brown	Sunny
Thurs	25/08	40	29	32	30	28	27	28	7	7	7	Brown	Sunny
Friday	26/08	40	26	31	32	30	29	27	7	7	7	Brown	Sunny
Satt	27/08	40	27	33	33	30	29	29	7	7	7	Brown	Sunny, morning to noon; cloudy afternoon
Sun	28/08	40	27	33	32	29	29	29	7	7	7	Brown	Sunny
Mon	29/08	40	30	34	31	30	30	30	7	7	7	Brown	Cloudy
Tues	30/08	40	29	32	33	31	30	30	7	7	7	Brown	
Wends	31/08	40	28	34	33	33	30	30	7	7	7	Brown	
Thurs	01/09	40	27	33	31	31	31	30	7	7	7	Brown	
Friday	02/09	40	27	34	31	31	30	30	7	7	7	Brown	
Satt	03/09	40	30	34	32	31	31	31	7	7	7	Brown	
Sun	04/09	40	28	34	33	32	32	32	7	7	7	Brown	
Mon	05/09	40	27	32	32	33	33	32	7	7	7	Brownish green	Sunny
Tues	06/09	40	27	32	32	34	33	32	7	7	7	Brownish green	Sunny
Wends	07/09	40	28	32	32	33	34	32	7	7	7	Brownish green	Sunny
Thurs	08/09	40	28	32	32	32	33	33	7	7	7	Brownish green	Sunny
Friday	09/09	40	28	32	32	32	33	32	7	7	7	Brownish green	Sunny
Satt	10/09	40	28	32	32	33	34	32	7	7	7	Brownish green	Sunny
Sun	11/09	40	28	33	33	32	33	32	7	7	7	Brownish green	Raining at night
Mon	12/09	40	27	32	32	33	33	32	7	7	7	Brownish green	Sunny

Tues	13/09	40	27	33	33	33	32	32	7	7	7	Brownish green	Sunny
Wends	14/09	40	27	32	32	33	33	32	7	7	7	Brownish green	Sunny
Thurs	15/09	40	28	33	32	32	33	33	7	7	7	Brownish green	Sunny
Friday	16/09	40	28	32	32	32	33	33	7	7	7	Brownish green	Sunny
Satt	17/09	40	27	32	33	31	33	32	7	7	7	Brownish green	Sunny
Sun	18/09	40	28	32	32	32	32	32	7	7	7	Brownish green	Sunny
Mon	19/09	40	27	33	32	32	33	32	7	7	7	Brownish green	Sunny
Tues	20/09	40	27	32	32	33	33	32	7	7	7	Brownish green	
Wends	21/09	40	28	33	33	30	32	31	6,5	6,3	6,4	Brownish green	
Thurs	22/09	40	28	32	33	29	30	31	6,4	6,3	6,4	Brownish green	
Friday	23/09	40	28	33	33	27	29	30	6,1	6,3	6,2	Brownish green	
Satt	24/09	40	27	33	33	26	28	28	6,2	6,3	6,2	Brownish green	
Sun	25/09	40	27	33	32	26	27	27	6,3	6,4	6,4	Brownish green	
Sun	26/09	40	28	32	33	25	26	27	6,2	6,1	6,2	Brownish green	
Mon	27/09	40	28	33	33	25	26	25	6,3	6,2	6,3	Brownish green	
Tues	28/09	40	28	33	33	25	27	25	6,4	6,2	6,3	Brownish green	
Wends	29/09	40	28	34	33	25	25	25	6,3	6,2	6,3	Brownish green	
Thurs	30/09	40	28	34	32	23	24	24	6,4	6,2	6,3	Brownish green	
Friday	01/10	40	27	34	32	23	24	24	6,3	6,1	6,2	Brownish green	
Satt	02/10	40	27	34	32	22	24	23	6,3	6,1	6,1	Brownish green	
Sun	03/10	40	27	33	32	22	23	23	6,3	6,2	6,2	Brownish green	
Mon	04/10	40	27	33	32	21	22	22	6,3	6,2	6,2	Brownish green	
Tues	05/10	40	27	32	32	20	22	21	6,2	6,1	6,2	Brown	
Wends	06/10	40	27	30	31	20	23	22	6,3	6,2	6,2	Brown	
Thurs	07/10	40	27	31	30	20	22	21	6,3	6,2	6,3	Brown	
Friday	08/10	40	27	30	30	21	23	21	6,4	6,2	6,3	Brown	
Satt	09/10	40	28	30	30	20	22	21	6,3	6,2	6,3	Brown	
Sun	10/10	40	27	30	30	20	21	12	6,4	6,5	6,2	Brown	

Annex D: Results of the Demonstration plot

D.1. Demplot (Demonstration Pond)

The brackish water pond belonging to pak Bakri was chosen as the demonstration pond by the pond farmers group supported by the CFS team. This pond was chosen because its accessibility to the main road, as well as its water supply. The pond area is 4000 m^2. The knowledge from the CFS on pond management as mentioned above was applied. The characteristics of the demonstration pond is shown in Table D-1.

After the drying of the demopond the farmers applied 400 kg industrial goat compost and 20 liters of mol on the pond bottom. This was done in the evening when the wheather is cool so that the bacteria will remain active. Then the pond was gradually filled to the desire depth and left for one week before stocking.

Table D-1. The characteristics of the demonstration pond of the CFS in 2016.

- Pond area	- ± 4,000 m^2
- Water depth	- ± 1 m
- Production management system	- Extensive
- Water circulation system	- separated Inlet and outlet
- Number of water gate	- 2
- Water supply	- Canal
- Pond Management	- Pond bottom drying for 5 days - 400 kg of industrial goat compost - 20 L of MOL for 1 months - Afterwards 5 L of MOL every 3 days depended on the water colour
- Cultivated organisms	- Tiger shrimp (P monodon) and milkfish
- The stocking density of the shrimp	- 15,000 of PL 20
- The stocking density of milkfish fry	- 200 fries at the length size 3-5 cm
- Date of stocking	- 2 Augustus 2016

The pond was stocked with tiger shrimp shrimp (*P monodon*) post larva 20 (PL20) at the density of 15,000 / pond and milkfish fry 200 at individual size of 3-5 cm. The shrimp stocked on 2th August 2016. There was heavy rain upstream on October and the main river caused flooding and erosion. Since the water supply of the demonstration pond was mainly from the canal connected to the river, the flood resulted in water quality problem in the demonstration pond. Consequently therefore

was no shrimp harvest. Fortunately, the milkfish was less affected by the low water quality and its cultivation continued. However, the milkfish yield was 100 fish only, at an average body weight of 200 gram. The demplot pond was considered to have failed: 100% mortality of the shrimp and about 50% of the milkfish stocked was lost. The condition of pond's water quality shown in Table D-2 and the daily monitoring done by the farmer is shown in Table D-5.

Table D-2. Water quality parameters monitoring

Date	Clarity (cm)	Tempe-rature (^{0}C)	DO (ppm)	pH		Salinity (ppt)	TAN (ppm)	N (ppm)	P (ppm)	Pond water Color	Phytoplankton / Zooplankton (*10^3 ind/L)
				Water	Soil						
16/8	80	30	6,4	7,0	5	25	0,5			Dark green	
18/8	85	35	6,0	7,0	5	27	0,5			Dark green	
30/8	70	32	6,1	8,3	5	28	0,5			Brownish green	
13/9	75	34	6,0	8,5	5	27	0,5	0,52	0,014	Brownish green	24 / 2,0
22/9	75	31	6,3	8,6	5	25	0,5			Brownish green	
8/10	80	32	6,0	8,0	5	28	0,5			Brownish green	
14/10	85	30	6,1	8,1	5	35	0			Brown	
20/10	85	30	6,3	8,0	5	32	0	0,44	0,021	Brown	12 / 1,2
15/11	85	29	6,5	8,2	5	25	0			Brown	

The operational cost and the benefit is presented in Tables D3 and D-4. The lost was IDR 1.502.100, The C/B ratio was 82 % (82% lost)

Table D-3. Operational Cost (*1000 IDR) of demonstration pond for one cycle.

Materials	Units	Unit price	Total	Notes
Vaname shrimp PL	15.000 PL	0.15	225	
Milkfish fry	200 fries	0.1	20	
Net	2 meter	3,	6	For gates: inlet and outlet
Bamboo	1	12	12	
Nail	0,5 kg	10	5	
Wodden plang	1	15	15	
Waterpumt hire	1 set	100	100	
Fuel	30 liter	7	210	For water pump
Goat manure	800 kg	0.8	640	
MOL	65 liter	0.14	9	
Net	20 meter	3	60	For harvesting
Container hire	6	5	30	For packing the yield
Ice block	6 blocks	10	60	To preserve the harvest
Labour	6 persons	75,	450	Wage
	Total operational cost		**1.842**	

Table D-4: The Mortality, Yield, Revenues (*1000 IDR) of the demonstration pond for one cycle.

Yield	Unit	Price / Unit (Rp)	Total (Rp)	Notes
Vannamei shrimp	Failed	-	-	100%
Milkfish	100 fish	3.4	340.	The milkfish yield was 100 fish only, at an average body weight of 200 gram . The mortality was50%
		Total revenue	**340**	

Table D-5. The daily monitoring water quality done by the farmer at demonstration pond (from 21 August to 11 October 2016)

Day	Date	Clarity (cm)	Temperature (^{0}C)			Salinty (ppt)			pH			Water Color	Notes
			Morning	Noon	After noon	Morning	Noon	After noon	Morning	Noon	After noon		
Sun	21/08	45	29	30	31	25	25	25	7	7	7	Brown	Sunny
Mon	22/08	50	27	30	30	27	25	25	7	7	7	Brown	Sunny, morning to noon; cloudy afternoon
Tues	23/08	50	26	30	32	25	25	25	7	7	7	Brown	Sunny
Wends	24/08	45	26	31	31	26	25	25	7	7	7	Brown	Sunny
Thurs	25/08	45	29	31	31	25	25	25	7	7	7	Brown	Sunny
Friday	26/08	48	28	31	35	27	25	25	7	7	7	Brown	Sunny
Satt	27/08	50	29	33	33	26	25	25	7	7	7	Brown	Sunny, morning to noon; cloudy afternoon
Sun	28/08	48	27	33	33	25	25	25	7	7	7	Brown	Sunny
Mon	29/08	42	29	33	33	26	25	25	7	7	7	Brown	Cloudy
Tues	30/08	48	29	33	33	25	25	25	7	7	7	Brown	
Wends	31/08	48	30	32	33	26	25	25	7	7	7	Brown	
Thurs	01/09	48	30	33	33	25	25	25	7	7	7	Brown	
Friday	02/09	50	30	33	34	27	25	25	7	7	7	Brown	
Satt	03/09	50	31	33	33	26	25	25	7	7	7	Brown	
Sun	04/09	46	30	32	32	25	25	25	7	7	7	Brown	
Mon	05/09	60	29	34	35	30	30	30	7	7	7		Sunny
Tues	06/09	60	29	34	34	30	30	30	7	7	7		Sunny
Wends	07/09	55	29	33	34	30	30	30	7	7	7		Sunny
Thurs	08/09	55	28	34	33	30	29	29	7	7	7		Sunny
Friday	09/09	55	33	34	34	30	30	30	7	7	7		Sunny
Satt	10/09	55	30	35	35	30	30	30	7	7	7		Sunny
Sun	11/09	45	27	34	34	25	20	20	7	7	7		Raining at night

Mon	12/09	45	28	35	35	25	25	25	7	7	7	Sunny
Tues	13/09	45	28	33	33	25	25	25	7	7	7	Sunny
Wends	14/09	45	28	34	34	27	25	25	7	7	7	Sunny
Thurs	15/09	45	31	34	34	27	25	25	7	7	7	Sunny
Friday	16/09	45	29	-	-	27	-	-	7	-	-	Sunny
Satt	17/09	60	29	34	35	30	30	30	7	7	7	Sunny
Sun	18/09	60	29	34	34	30	30	30	7	7	7	Sunny
Mon	19/09	55	29	33	34	30	30	30	7	7	7	Sunny
Tues	20/09	55	33	33	34	29	29	29	7	7	7	
Wends	21/09	55	32	33	34	30	30	30	7	7	7	
Thurs	22/09	60	32	33	33	29	29	29	7	7	7	
Friday	23/09	60	32	32	32	29	29	29	7	7	7	
Satt	24/09	55	30	32	32	29	29	29	7	7	7	
Sun	25/09	60	31	32	32	29	29	29	7	7	7	
Sun	26/09	55	30	31	31	29	29	29	7	7	7	
Mon	27/09	60	32	32	32	27	27	27	7	7	7	
Tues	28/09	50	33	32	32	29	29	29	7	7	7	
Wends	29/09	55	33	32	32	27	27	27	7	7	7	
Thurs	30/09	60	31	32	32	27	27	27	7	7	7	
Friday	01/10	-	-	-	-	-	-	-	-	-	-	
Satt	02/10	55	31	31	31	28	28	28	7	7	7	
Sun	03/10	-	-	-	-	-	-	-	-	-	-	
Mon	04/10	60	31	31	31	25	26	25	8	8	8	
Tues	05/10	-	-	-	-	-	-	-				
Wends	06/10	-	-	-	-	-	-	-				
Thurs	07/10	55	30	30	29	25	25	25				
Friday	08/10	60	29	30	30	25	25	25				
Satt	09/10	-	-	-	-	-	-	-				

Sun	10/10	-	-	-	-	-	-	-