How Mariculture Operations Affect Local Communities: Insights from Seven Mariculture Areas in the Philippines

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Front cover photo: Caretakers transport feeds to the fish cages in Balingasag, Misamis Oriental. Photo by Benedict Mark Carmelita

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

HOW MARICULTURE OPERATIONS AFFECT LOCAL COMMUNITIES: INSIGHTS FROM SEVEN MARICULTURE AREAS IN THE PHILIPPINES

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EXECUTIVE SUMMARY

The Philippine government promoted the mariculture park starting in early 2000s as a strategy to increase employment and reduce poverty in coastal communities in the country. By engaging small-scale fishers as investors in the production of high-value fish species using sustainable practices, mariculture is envisioned as one of the means to address poverty by providing local employment.

This study assessed the extent to which mariculture production is providing jobs to local community members, both men and women. The income generated by local government units (LGUs) from mariculture operations was also estimated for the seven study sites. Community members' account of their fishing, gleaning, and coastal resources-based leisure activities before and after mariculture establishment was also analyzed. Data from key informant interviews, focus group discussions, and survey (among 785 randomly selected fishing and non-fishing households) conducted in January–August 2015 were used.

Results show that around 24% of the surveyed workforce, most of whom are men (92%), was engaged in mariculture activities in varying capacities. Note that very few investors in the mariculture business came from the local communities because the high cost of investment limits the capacity of local fisherfolk to engage in mariculture. The data further show that a good number of community members believed that mariculture reduced their livelihood activities, such as gleaning and fishing, by either displacing them from their fishing grounds or by polluting the coastal waters. Pollution from mariculture operations was cited as the major reason for the reduced water-based leisure activities. Mariculture operations provide additional income to the LGUs, but this represents a small percentage (0.01%–2.63%) of the LGUs internal revenue allotment.

The LGUs' ability to earn additional revenue from mariculture can be enhanced by learning from each other on what fees can be imposed. The locals, particularly the fisherfolk, must be prioritized in the provision of support to start small-scale mariculture operation, labor hiring, and in the marketing of farmed fishes. Mariculture should also be linked to processing. For the above, local legislations must be passed.

1.0 INTRODUCTION

Mariculture is the managed cultivation or production of aquatic (fish and other marine) organisms in brackish and saline water (Troell 2009). Simply, it is aquaculture in (shallow or deep) coastal waters (Lopez 2006). Mariculture usually uses cages or pens for finfishes in a monoculture or polyculture system. It has been practiced in a few areas in the country even before the government promoted the establishment of mariculture parks in the early 2000s. Mariculture development then was largely unregulated and with hardly any restriction on stocking density and feeding intensity. Operations also varied in the number and sizes of cages, which were

installed just anywhere. The situation inevitably led to environmental problems and mass fish kills in cages in some areas (Escobar et al. 2013; Rosario 2008; San Diego-McGlone et al. 2008; Sumalde, Francisco, and Peñales 2002).

When the Philippine government, through the Bureau of Fisheries and Aquatic Resources (BFAR), introduced the mariculture park as a new approach to fish farming, the objectives (BFAR 2014; Adora 2011) were: (1) to generate employment and alleviate poverty in the countryside; (2) to promote marine fish culture as an alternative source of livelihood for marginalized and sustenance fisherfolk; (3) to develop an area with appropriate equipment and infrastructure that will allow fishermen-farmers and investors to operate cost effectively and securely; and (4) to promote the use of environment-friendly inputs and farm management practices.

The mariculture park was envisioned to be implemented at the village level, in which local government (LGU) participation is needed in zoning at least 100 hectares (ha) of coastal municipal water to be declared as a mariculture reserve for the purpose. It will utilize modern floating cages designed to tolerate 2- to 3-meter waves, which would last at least five years with little maintenance. A component of the park is the establishment of a grid-type "community" storm mooring system and a cluster of marine sea cages to be managed/operated by the fisherfolk association. The cage modules shall be rented by individuals from the LGU via a user's fee. Aside from these, mariculture parks are designed to provide the necessary security from encroachment, entanglement of moorings, and navigational hazards. Furthermore, mariculture parks were designed to be participatory with the BFAR working with the LGUs, relevant national government agencies, nongovernmental organizations, and fisherfolk (Adora 2011). To attract investors, the BFAR financially supports the implementation of mariculture parks, subsidizing the grow-out operators in their initial investment. In 2010, almost a decade since the BFAR introduced the mariculture park program, there were 62 mariculture parks with a combined area of 50,150 ha, with only 273 ha (0.54%) developed by 2,199 locators/investors and the BFAR (Salayo et al. 2012).

Among the critical challenges is the low participation of fisherfolk in mariculture. Albeit late, in 2009, the BFAR came up with guidelines on the implementation of a cage-for-rent project to address the problem of none or low participation of small fishers in mariculture parks due to the high investment cost it requires. Despite this, there is still lower investment (than expected) in mariculture among fisherfolk. For example, it was reported that out of the 300 cages of local investors in Panabo City Mariculture Park, only 20 were operated by local fisherfolk families (Bui Tran 2012). This finding was supported by this research, with a significant number of community members making the same observation.

Meanwhile, there are issues of displacement of fishers from their traditional fishing grounds (now occupied by fish cages) and their gleaning area (now replaced by the mooring area). People also perceive that the environmental integrity of the resource is compromised by pollution due to the organic enrichment resulting from intensive fish culture. Consequently, recreational activities are affected. For instance, in the Bolinao mariculture area established in 1995, the uncontrolled proliferation of fish pens and cages to more than double the allowable limit of 554 units has degraded coastal resources. In over 10 years of operation, the water has become eutrophic, with ammonia increasing by 56%, nitrite by 35%, nitrate by 90%, and phosphate by 67% (CRTR 2010). This observation was also noted by study participants in some of the study sites.

In 2013, the BFAR conducted an assessment to identify mariculture sites for permanent deletion and for intensive promotion (BFAR 2014). This indicates that some mariculture parks are not functioning as expected. Out of the 67 mariculture park areas in 2013, only three (Balingasag, Panabo, and Pantukan) were identified as successful, and hence worthy of being used as models for intensive promotion.

This paper examined the nature and extent of involvement of fishing households and those not engaged in fishing in mariculture park operations. The involvement ranges from being fish pen or cage operators to becoming part of the mariculture workforce. The paper also discusses the study participants' opinion on how mariculture development in their coastal area has affected their fishing, gleaning, and recreational use. The perception of the study participants on the impact of mariculture on food security, local employment, barangay income, and pollution were also determined. The paper covers mariculture sites in seven municipalities in five provinces and three regions in the country (Figure 1): (1) Balingasag, Misamis Oriental and (2) Lopez Jaena, Misamis Occidental in Region 10 (Northern Mindanao); (3) Calape and (4) Talibon, Bohol in Region 7 (Central Visayas); (5) Sto. Tomas, La Union and (6) Bolinao and (7) Sual, Pangasinan in Region 1 (Ilocos Region).

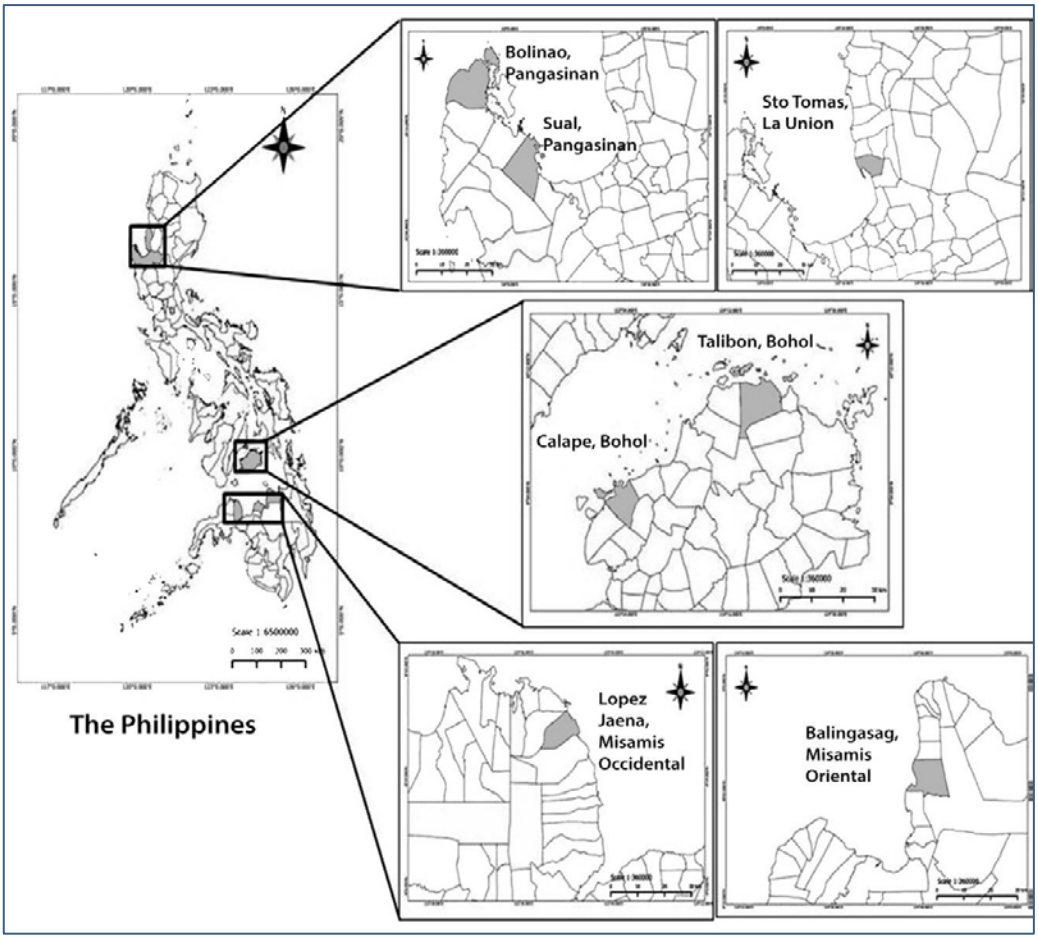

Figure 1. Location of the study sites

2.0 DATA AND METHODS OF DATA COLLECTION

The data in this paper were drawn from a larger data set that was collected from January to August 2015 using multiple field data collection methods. The data set had data from 48 focus group discussions (FGDs) with 315 participants, a household survey with 785 household participants, 138 key informant interviews (KII), secondary data collection, and observation. The household survey covered 473 fishing households and 312 non-fishing households in the 28 *barangays* (villages) selected in seven study sites (Table 1). These 28 barangays were selected based on their distance to the mariculture area. Fourteen barangays were "near the mariculture park." This means that the designated mariculture park area, particularly the fish cages or fish pens, is located in front of these barangays or relatively nearer than the barangays that are "far from the mariculture park." Given that all these barangays are in coastal areas, they share the same water body where the mariculture area is located.

The survey participants were randomly selected from a list of fishing and non-fishing households in the barangay. The participants were in their 40s, most were males who have reached at most second year high school education, and were longtime residents of the barangays. Out of the five persons in the households, 1–2 members are gainfully employed. Since they are coastal barangays, there are more households near the mariculture area and more who are engaged in fishing.

Among the 28 barangays selected in the study as mariculture barangay or non-maricuture barangay, separate FGDs were held with the men and women in the 22 barangays, a mixed group of men and women sessions were held in five barangays, while no FGD was held in one baranay. The FGD participants were residents of the barangay years prior to the establishment of the mariculture area and are familiar with the mariculture development in the locality. There were 45 key informants who were local fisheries managers (from the local government and from the regional BFAR office). Relevant secondary data from the BFAR central office and regional offices were secured.

Table 1. Profile of the participants in the household survey

Attribute	Balingasag	Lopez Jaena	Sual	Bolinao	Calape	Talibon	Sto. Tomas
	(N=105)	(N=105)	(N=120)	(N=105)	(N=105)	(N=105)	(N=140)
Age (mean)	47.29	43.88	42.00	44.03	42.41	45.39	46.67
Male (%)	50.48	50.48	50.83	53.33	69.52	60.95	76.43
Number of years in school (mean)	8.06	8.64	7.69	8.23	8.08	7.16	9.41
No. of years in the barangay (mean)	31.67	32.88	28.79	30.30	30.15	31.86	40.25
Household size (mean)	5.56	4.88	5.24	5.22	5.25	5.35	5.41
No. of household members with income (mean)	1.90	1.31	1.35	1.59	1.51	1.74	1.42
From fishing household (%)	62.86	61.90	58.33	61.90	61.90	61.90	66.43
From non-fishing households (%)	37.14	38.09	41.67	38.10	38.09	38.09	33.57
From barangay near mariculture area (%)	63.81	46.67	47.50	53.33	46.67	47.61	55.71
From barangay far from mariculture area (%)	36.19	53.33	52.50	46.67	53.33	52.38	44.29

3.0 THE MARICULTURE STUDY SITES

3.1 Classification of the Mariculture Study Areas

The mariculture sites covered by the study were grouped based on the information regarding the current management operations, which involve the private sector, the LGU, and BFAR. These categories are (1) LGU and BFAR-led, 2) private sector and LGU-led, and 3) private sector and BFAR-led (Table 2). The LGU-BFAR sites are areas that are officially declared as a mariculture park, with an active Executive Management Council chaired by the local chief executive and co-chaired by the BFAR regional director. The private sector and LGU-led sites have strong engagement by the LGU in the regulation of of privately owned fish cages and pens. The last category (private sector and BFAR-led) are officially declared mariculture areas, but most of the privately owned fish cages and pens are found outside the declared mariculture zone, and their operation is unregulated. Moreover, the BFAR has demonstration cages in the area, which can be found inside or outside of the designated mariculture zone.

Table 2. Categories of mariculture areas in the study

LGU and BFAR-led
Mariculture park in the municipality of Balingasag, Misamis Oriental province (Region 10)
Mariculture zone in the municipality of Lopez Jaena, Misamis Occidental province (Region 10)
Private sector and LGU-led
Mariculture zone in the municipality of Sual, Pangasinan province (Region 1)
Mariculture zone in the municipality of Bolinao, Pangasinan province (Region 1)
Private sector and BFAR-led
Mariculture in the municipality of Calape, Bohol province (Region 7)
Mariculture in the municipality of Talibon, Bohol province (Region 7)
Mariculture in the municipality of Sto. Tomas, La Union province (Region 1)

3.2 Operators, Technology, and Species Grown in the Study Sites

Table 3 shows information on the current operation of the mariculture areas in the study sites. The number of operators, cages, and area are based on the latest data shared by the local government or the BFAR regional office. In Balingasag, for instance, as of January 2014, there were 63 operators, with 28 in the small category, 24 of medium size, and 11 big scale operators. Many of the mariculture operators, particularly medium and big operators were from outside the municipality where the mariculture operation is located.

In terms of technologies being used, the cages and pens are either square or round, fixed, or floating, and made of bamboo, GI pipes, rope-framed cages, or high-density polyethylene (HDPE) material. HDPE is used by big fish operators and can last 10–15 years; but it is very expensive, with one cage worth PHP 1 million. The bamboo cages, which can last up to three years and have smaller capacity, are used by small and medium operators. Milkfish is the main species farmed in all sites, with very few raising other species such as pompano, siganid, and grouper. Grouper was popular in the Sto. Tomas mariculture sites.

Table 3. Operators, cages, and species grown in the study sites

Attribute	LGU and BFAR-Led		LGU and Private Sector-Led		Private Sector and BFAR-Led		
	Balingasag	Lopez Jaena	Sual	Bolinao	Calape	Talibon	Sto. Tomas
No. of operators	(as of Jan 2014) *Total:* 63 Small = 28 Medium = 24 Big = 11	(As of 2014) *Total:* 79 Small = 0 Medium = 23 Big = 10 Livelihood = 36 Conditioning* = 10	(as of May 2015) *Total:* 21	(as of Mar 2015) *Total:* 131 Fish cage = 80 Fish pen = 51	(as of Feb 2015) *Total:* 6 (inclusive of BFAR)	(as of Nov 2013) *Total:* 7 Fish cage = 3 Fish pen = 4	(as of May 2015) *Total:* 74 Inside MZ = 3 (inclusive of the BFAR demo cage) Outside MZ = 71
Total area	195.70	313.26	169.00	279.9	220.00	250.28	10.00
No. of cages/ pens	(as of Jan 2014) *Total:* 203 Small = 15 Medium = 44 Big = 144	(as of 2014) *Total:* 177 Small = 0 Medium = 41 Big = 44 Livelihood = 36 Conditioning = 48 LGU/BFAR = 2 R&D = 6	(as of May 2015) *Total:* 750	(as of Mar 2015) *Total:* 435 Fish cage = 272 Fish pen = 163	(as of Feb 2015) *Total:* 17 (inclusive of BFAR demo cage)	(as of Nov 2013) Total: 65 Fish cage = 36 Fish pen = 29	(as of May 2015) Total: 79 Inside MZ = 8 (inclusive of the BFAR demo cage) Outside MZ = 71
Residence of the operators	Big & medium: Outside of LGU Small: Within LGU	Big & medium: Almost all are from LGU Livelihood: Within LGU	Almost all are outside of the LGU	Within and outside of the LGU	Outside of the LGU	Almost all are from within LGU	Outside MZP: All within LGU Inside MZP: Outside and within LGU
Kinds of fish cages	Square, bamboo cages, HDPE	HDPE, floating circular, square bamboo cages	HDPE, square steel, circular steel	HDPE, fish pen, square fish cages, steel square cages	Floating, bamboo, square	Fish pen, floating, bamboo cages	Outside of MP: Floating, bamboo, and fish pen Inside MP: HDPE, rope-framed cage

Table 3 continued

Attribute	LGU and BFAR-Led		LGU and Private Sector-Led		Private Sector and BFAR-Led		
	Balingasag	Lopez Jaena	Sual	Bolinao	Calape	Talibon	Sto. Tomas
Species cultured	Milkfish, siganids, pompano	Milkfish, siganid, pompano	Milkfish, red snapper, green grouper, pompano, siganid	Milkfish	Milkfish	Milkfish	BFAR demo: Pompano, mangrove snapper, malaga Inside MZ: Milkfish, green grouper Outside MZ: Grouper, milkfish, malaga

Notes: (1) Data are assembled from a number of KII and secondary sources. (2) * Conditioning cages are smaller cages where fingerlings are first acclimatized before they are transferred to grow out cages.

4.0 LIVELIHOOD OPPORTUNITIES FROM MARICULTURE OPERATIONS

4.1 Participation in Mariculture Operation by Community Members

Results of the household survey show that 24% of the 785 households had members who were involved in mariculture operation in various capacities over the last few years (Table 4). The level of community engagement varies by municipality, with only 5% in Lopez Jaena to 44% in Talibon. Of those involved, 92% were men. In two municipalities, Bolinao and Calape, women did not engage in mariculture operation (ie., pen or cage farming) at all.

Table 4. Participation of households and individuals in mariculture operation

Mariculture Site	Households			Individuals with Participation in Mariculture				
				Men		Women		Total
	Total Households	With Participation	%	No.	%	No.	%	No.
Balingasag	105	31	29.52	55	96.49	2	3.51	57
Lopez Jaena	105	5	4.76	4	80.00	1	20.00	5
Sual	120	40	33.33	34	82.93	7	17.07	41
Bolinao	105	32	30.48	33	100.00	0	0.00	33
Calape	105	14	13.33	14	100.00	0	0.00	14
Talibon	105	46	43.81	47	85.45	8	14.55	55
Sto. Tomas	140	19	13.57	22	95.65	1	4.35	23
TOTAL	785	187	23.82	209	91.67	19	8.33	228

Those involved in mariculture participated in different stages of mariculture operation: input supply market, grow-out stage, harvest stage, and the marketing stage. More men (than women) were involved in the seed or feeds market and also in the grow-out stage. This is because the tasks usually require physical strength (i.e., moving seeds for stocking, carrying sacks of feeds from the storage house to the mariculture site, changing or cleaning nets), and the work condition is dangerous in the open sea.

Given that mariculture has been established in these areas for more than five years (in the case of Lopez Jaena and more than 20 years in the case of Sual and Bolinao), it was expected that the participation of the households in mariculture would be high. The low participation of the local residents as fish operators or workers can be attributed to a number of factors.

First, only those with financial capability can be operators. Even one small bamboo cage (5×5×5 m in size) can cost about PHP 120,000. Moreover, feeds are very costly. The BFAR's rent-to-own scheme, in which fisherfolk are provided with cage materials and initial seed requirement in Balingasag and Lopez Jaena, had few takers because of the high cost of feeds. Some tried only one production cycle and then stopped.

Second, in small operations, the operator can perform several roles such as that of a caretaker, watcher, and maintenance worker (clean the cage, mend the nets); and only needs hired help during harvest or when changing nets. A hired caretaker can cover three bamboo cages, although the recommendation is one caretaker for a 10×10×10 m bamboo or a circular HDPE fish cage with a 10-meter or 15-meter diameter and two caretakers for a circular HDPE fish cage with a 20-meter diameter. Similarly, a caretaker in Balingasag and Lopez Jaena also performs

several functions such as that of the feeder, net cleaner, or net mender. Smaller operations also do not hire watchers. Those with hired watchers require night duty to guard several cages. In Calape, members of the Bantay Dagat are the ones guarding the cages.

Third, there is low uptake in mariculture. In 2010, there were only 62 mariculture parks with 2,199 locators/investors, including the first mariculture park in the country established in Samal Island in 2001 (Salayao et al. 2012). In the mariculture areas covered in the study (i.e., Calape, Balingasag, and Sto. Tomas), a number of operations have already stopped because of the high cost of operation; some were not able to return to operation after being damaged by a typhoon.

4.2 Roles Performed by Men and Women in Mariculture Operation

Survey data show that the household members who participated in a mariculture operation performed different (single or multiple) roles in the production phase of mariculture operation in the seven sites. These major roles include operator, caretaker, watcher, harvester, net cleaner, net mender, and feeder. The first three roles are usually full-time jobs, while all the others are part-time engagement or on-call basis. Data show that no woman have performed the role of watcher and net mender, while all roles mentioned were performed by men (Table 5).

The performance of the different roles depended on the location of the mariculture site. For example, feeding was part of the responsibility of the caretakers in Balingasag and Lopez Jaena, while it was specialized work in Sual. Moreover, net mending was part of the work of a caretaker in Sual but not in other areas. Roles also depended on the scale of operation. For instance, in Sual where the scale of a mariculture operation by a single operator was relatively bigger, there were more roles being performed that require specialization (e.g., feeder, checker, manager, boatman, helper). In Sto. Tomas, the grouper culture operator using cages or pens outside of the designated mariculture zone performed the roles of a caretaker, watcher, feeder, and maintenance worker (for repair of cage/pen and nets).

Results of the FGDs and KIIs show that local men and women involved in the grow-out stage, ancillary industries, and marketing stage of mariculture (Table 6). Each role requires specific tasks and responsibilities. Skills and knowledge are important in the performance of these roles. For manpower pool development in mariculture parks, the BFAR provides the following: caretaker training courses, fish cage management seminars, trainings on aquaculture technologies and product development, and seminars on coastal resource management and environmental monitoring.

Operators could be owners or hired managers of the mariculture operation. As owners, they spend for the operating cost and are responsible for all management. Operators are either residents of the area where the mariculture operation is situated or from a nearby municipality or city. In big operations like in Sual, a number of operators are corporations who hire managers to oversee mariculture operations. In Sto. Tomas, the operators of grouper farming outside of the mariculture area perform most of the work needed and would only hire a few workers during harvest or for large repairs of the cage or pen.

Table 5. Roles performed by men and women in mariculture operation, from the household survey

Mariculture Site	With Participation	Operator	Caretaker	Watcher	Harvester	Net cleaner	Net mender	Feeder	Others
Balingasag									
Men	55	2	17	7	10	8	7	0	4
Women	2	0	0	0	1	1	0	0	0
Total	57	2	17	7	11	9	7	0	4
Lopez Jaena									
Men	4	0	2	0	2	0	0	0	0
Women	1	1	0	0	0	0	0	0	0
Total	5	1	2	0	2	0	0	0	0
Sual									
Men	34	0	6	3	4	2	0	13	6
Women	7	0	2	0	0	0	0	4	1
Total	41	0	8	3	4	2	0	17	7
Bolinao									
Men	33	0	9	1	5	2	1	5	10
Women	0	0	0	0	0	0	0	0	0
Total	33	0	9	1	5	2	1	5	10
Calape									
Men	14	1	5	1	3	1	0	1	2
Women	0	0	0	0	0	0	0	0	0
Total	14	1	5	1	3	1	0	1	2
Talibon									
Men	47	28	6	1	5	1	1	3	2
Women	8	6	0	0	0	0	0	0	2
Total	55	34	6	1	5	1	1	3	4
Sto. Tomas									
Men	22	8	4	2	1	1	1	3	2
Women	1	1	0	0	0	0	0	0	0
Total	23	9	4	2	1	1	1	3	2
Total	228	47	51	15	31	16	10	29	29
Men	209	39	49	15	30	15	10	25	26
%	91.67	82.98	96.08	100.00	96.77	93.75	111.11	86.21	89.66
Women	19	8	2	0	1	1	0	4	3
%	9.09	20.51	4.08	0.00	3.33	6.67	0.00	16.00	11.54

Table 6. Roles performed by men and women in mariculture operation, from the FGDs and KIIs

Input	Grow-Out	Marketing
Men		
Balingasag and Lopez Jaena		
Cage/net fabricator Feeds distributor/sales representative Seed supply operation/delivery of seed stocks to mariculture area	Operator Caretaker responsible for feeding and guarding the fish Maintenance worker (net changing/net mending) Watcher	Fish vendor
Sual and Bolinao		
Cage/pen/net fabricator Seed stock operator	Feeder Net changer Boat driver/helper Harvester	Owner of consignment area
Calape, Talibon, Sto. Tomas		
Cage/pen fabrication Seed stock supplier Feeds distributor/sales representative	Caretaker Maintenance (net changing/net mending)	
Women		
Balingasag and Lopez Jeana		
	Operator Wife who participates in the sorting of fish during harvest	Member of the fish processing association who is also a member of the women's association
Sual and Bolinao		
Feed brand sales representative	Feeder Net mender Sorter during harvest	Owner of consignment area
Calape, Talibon, Sto. Tomas		
Feeds distributor/sales lady		Fish trader/vendor

Local men were usually hired as caretakers or watchers of the fish cages. A caretaker watches the cages during the day, feeds the fish, takes charge of stocking, and cleans nets. In almost all areas, the wives helped their husbands in feeding or in stocking activities. Sometimes, the wife did the feeding while the husband fished nearby or did some other work. Although the husband's work was paid, the work of the wife was not. In Sual, there were a number of hired women who were feeders and also net menders.

Given that net change/cleaning and net mending are heavy tasks, the men were mostly involved. Harvesting is laborious and risky and usually involved the men. However, the wives or the women helped as sorters of fish. Men were mostly involved also as cage/net fabricators. They were also feeds distributors/sales representatives (also women), or involved in fingerling supply as operators of fingerling nursery in the community.

Among the goals of mariculture are to reduce employment problems in communities where they are situated and to produce a pool of manpower for mariculture operation in the area. In the case of the seven mariculture sites in the study, the goals were somewhat attained given that, on the average, 24% of households members were employed in mariculture operations at various points in their working lives. The high cost of mariculture operation, however, has prevented local fisherfolk from participating in mariculture as investor-operators. Given this, the other goal of providing an opportunity for fisherfolk to increase their income through mariculture farming has not been fully realized. The benefits often accrued to investors from other areas, who were mostly traders or financiers from the cities or influential people who were local officials.

4.3 Income Derived from Mariculture Employment in 2015

The data on participation in mariculture presented in Section 4.1 refer to households with members employed in mariculture operations in the past years. On the average, this number came out to be 24%. However, many of those members were no longer engaged in mariculture when the survey was conducted. Only 31% of those who participated remained employed in mariculture operations in 2015; this represents only 7.4% of the total household study participants (Table 7). The major reason for not remaining employed in the sector was that many of the mariculture operations had closed down for various reasons (Balingasag, Calape, and Talibon were damaged by a typhoon in December 2014; some operators in Calape and Talibon were affected by an earthquake in October 2013). Moreover, the fish kills in Bolinao resulted in the LGU having a stronger resolve in implementing zoning measures and dismantling illegal fish pens. However, note that for households who remained gainfully employed in mariculture operations, the income from this engagement represented a significant part of household income. This income source accounted for 45% of the household income of those from Sual and about 35% from those in Bolinao.

Table 7. Income derived from mariculture employment relative to total household income, 2015

Sites	Households with Current Participation in Mariculture Operation	Households with Participation in Mariculture Operation (Previous and Current)	Annual HH income (PHP, mean)	Annual Income from Involvement in Mariculture (PHP, mean)	% of Annual Income from Involvement in Mariculture to Annual Household Income
Balingasag	19	31	149,692.90	58,832.53	39.30
Lopez Jaena*	–	5	–	–	–
Sual	25	40	102,803.40	46,550.56	45.28
Bolinao	7	32	160,916.00	55,580.00	34.54
Calape*	–	14	–	–	–
Talibon	1	46	309,020.00	56,000.00	18.12
Sto. Tomas	6	19	138,943.30	38,733.33	27.88
Total	58 (31.02%)	187			
% to total number of households surveyed (N=785)	7.39				

Note: * No households with current involvement in mariculture operation were covered by the survey.

5.0 ACTIVITIES THAT MIGHT HAVE BEEN AFFECTED BY MARICULTURE OPERATIONS

The study also obtained information on whether the study participants had been engaged in fishing and gleaning before and after the establishment of the mariculture cages/pens in the study sites. Likewise, the study participants were also asked about their use of the coastal water for various recreational purposes before and after the mariculture establishment. Related studies have indicated that these activities are likely to be negatively affected by mariculture operations, mostly, by limiting the area where fishers and their family members could harvest and by polluting the water, coming mostly from intensive feed usage in mariculture.

5.1 Change in Fishing and Gleaning Activities

Results indicate that the number of study participants engaged in gleaning and fishing activities decreased after mariculture was established. The percentage of survey participants in all areas who reported gleaning was lower after mariculture was established in the area ranged between 2% and 38% (Table 8). The decline was highest in Sual (by 28%) and Bolinao (by 38%); the areas where less than half of the survey participants indicated support for mariculture operation. From the key informants' accounts, the decline in gleaning activities was largely due to the reduction in harvestable products because of pollution from mariculture farms. There could also be reduction in areas available for gleaning as these are already taken over by the mariculture operators.

Table 8. Reported gleaning and fishing activities before and after the fish cages/pens were established

Mariculture Site	Fishing Households		Non-fishing Households		Total	
LGU and BFAR-led						
Balingasag	(n= 66)	Inc/(Dec)	(n=39)	Inc/(Dec)	(N=105)	Inc/(Dec)
Gleaning (Before)	65.15	(10.60)	5.13	(2.57)	42.86	(7.62)
Gleaning (After)	54.55		2.56		35.24	
Fishing (Before)	84.85	0	5.13	(5.13)	55.24	(0.95)
Fishing (After)	84.85		0.00		54.29	
Lopez Jaena	(n= 65)	Inc/(Dec)	(n=40)	Inc/(Dec)	(N=105)	Inc/(Dec)
Gleaning (Before)	83.08	(9.23)	67.50	(27.5)	77.14	(16.19)
Gleaning (After)	73.85		40.00		60.95	
Fishing (Before)	96.92	3.08	20.00	(20.00)	67.62	(5.72)
Fishing (After)	100.00		0.00		61.90	
Private sector and LGU-led						
Sual	(n= 70)	Inc/(Dec)	(n=50)	Inc/(Dec)	(N=120)	Inc/(Dec)
Gleaning (Before)	87.14	(18.57)	68.00	(42.00)	79.17	(28.34)
Gleaning (After)	68.57		26.00		50.83	
Fishing (Before)	100.00	0	48.00	(48.00)	78.33	(20.33)
Fishing (After)	100.00		0.00		58.33	
Bolinao	(n= 65)	Inc/(Dec)	(n=40)	Inc/(Dec)	(N=105)	Inc/(Dec)
Gleaning (Before)	83.08	(32.31)	65.00	(47.50)	76.19	(38.09)
Gleaning (After)	50.77		17.50		38.10	
Fishing (Before)	98.46	1.54	17.50	(17.50)	67.62	(5.72)
Fishing (After)	100.00		0.00		61.90	
Private sector and BFAR-led						
Calape	(n=65)	Inc/(Dec)	(n=40)	Inc/(Dec)	(N=105)	Inc/(Dec)
Gleaning (Before)	61.54	(9.23)	50.00	(15.00)	57.14	(11.43)
Gleaning (After)	52.31		35.00		45.71	
Fishing (Before)	80.00	20.00	10.00	(10.00)	53.33	8.57
Fishing (After)	100.00		0.00		61.90	
Talibon	(n=65)	Inc/(Dec)	(n=40)	Inc/(Dec)	(N=105)	Inc/(Dec)
Gleaning (Before)	95.38	(13.84)	80.00	(17.50)	89.52	(15.23)
Gleaning (After)	81.54		62.50		74.29	
Fishing (Before)	95.38	1.54	37.50	(37.50)	73.33	(13.33)
Fishing (After)	96.92		0.00		60.00	
Sto. Tomas	(n=93)	Inc/(Dec)	(n=47)	Inc/(Dec)	(N=140)	Inc/(Dec)
Gleaning (Before)	65.59	0	46.81	(6.83)	59.29	(2.15)
Gleaning (After)	65.59		40.43		57.14	
Fishing (Before)	98.92	0	100.00	100.00	65.71	0
Fishing (After)	98.92		0.00		65.71	

Note: The values reflected are percentages, unless indicated as frequency.

A similar result was observed in fishing, with the greatest decline observed in Sual (by 20%) and the least in Balingasag (by 1%). In Sto. Tomas, there was no reported change in the study participants' fishing activities independent of the mariculture establishment. The reduction in fishing activities is more due to the displacement as well as the observation that the fish cages are acting as a fish aggregating device, thus, reducing the fish available to local fishers.

5.2 Change in Leisure Activities

Survey results show that leisure activities such as swimming, playing by the beach, and strolling were reduced among the survey participants or members of their households after mariculture was established. This was true in all mariculture sites (Table 9). The decline was highest in Sual and Bolinao in all the three leisure activities and the least in Calape, Talibon, and Sto. Tomas. For swimming, the decline was highest in Sual (32%) and the lowest in Sto. Tomas (0.7%). For playing by the beach and strolling, the decline was highest in Bolinao (32% and 30%, respectively) and the lowest was in Sto. Tomas (1.43% each). Generally, the decline was higher among study participants from non-fishing households compared to fishing households, except in Bolinao for all the three activities. The decline in leisurely activities was attributed largely to the water pollution that manifest through foul odor, murky water, reported skin itching upon contact with the water, and presence of solid wastes in some areas. These, in turn, are due to improper management practices such as washing of nets in coastal waters, burying dead fish in the shoreline, and improper disposal of wastes that come from both mariculture-related activities or household wastes by caretakers living in the mariculture sheds.

Table 9. Reported leisure activities in the mariculture area before and after the fish cages/pens were established

Mariculture Site	Fishing Households		Non-Fishing Households		Total	
LGU and BFAR-led						
Balingasag	(n= 66)	Inc/(Dec)	(n=39)	Inc/(Dec)	(N=105)	Inc/(Dec)
Swimming (Before)	98.48	(18.18)	94.87	(41.02)	97.14	(26.66)
Swimming (After)	80.30		53.85		70.48	
Playing by the beach (Before)	46.97	(12.12)	56.41	(35.90)	50.48	(20.96)
Playing by the beach (After)	34.85		20.51		29.52	
Strolling (Before)	59.09	(1.51)	71.79	(38.46)	63.81	(15.24)
Strolling (After)	57.58		33.33		48.57	
Lopez Jaena	(n= 65)	Inc/(Dec)	(n=40)	Inc/(Dec)	(N=105)	Inc/(Dec)
Swimming (Before)	95.38	(9.23)	87.50	(15.00)	92.38	(11.43)
Swimming (After)	86.15		72.50		80.95	
Playing by the beach (Before)	18.46	(4.61)	25.00	(12.50)	20.95	(7.62)
Playing by the beach (After)	13.85		12.50		13.33	
Strolling (Before)	47.69	(9.23)	47.50	(17.50)	47.62	(12.38)
Strolling (After)	38.46		30.00		35.24	
Private sector and LGU-led						
Sual	(n= 70)	Inc/(Dec)	(n=50)	Inc/(Dec)	(N=120)	Inc/(Dec)
Swimming (Before)	100.00	(30.00)	100.00	(34.00)	100.00	(31.67)
Swimming (After)	70.00		66.00		68.33	
Playing by the beach (Before)	88.57	(22.86)	72.00	(34.00)	81.67	(27.50)
Playing by the beach (After)	65.71		38.00		54.17	
Strolling (Before)	92.86	(24.29)	88.00	(34.00)	90.83	(28.33)
Strolling (After)	68.57		54.00		62.50	
Bolinao	(n= 65)		(n=40)		(N=105)	
Swimming (Before)	96.92	(9.23)	100.00	(22.50)	98.10	(14.29)
Swimming (After)	87.69		77.50		83.81	

Table 9 continued

Mariculture Site	Fishing Households		Non-Fishing Households		Total	
Private sector and LGU-led						
Bolinao	(n= 65)		(n=40)		(N=105)	
Playing by the beach (Before)	96.92	(38.46)	80.00	(22.50)	90.48	(32.38)
Playing by the beach (After)	58.46		57.50		58.10	
Strolling (Before)	95.38	(33.84)	80.00	(22.50)	89.52	(29.52)
Strolling (After)	61.54		57.50		60.00	
Private sector and BFAR-led						
Calape	(n=65)	Inc/(Dec)	(n=40)	Inc/(Dec)	(N=105)	Inc/(Dec)
Swimming (Before)	80.00	(9.23)	92.50	(5.00)	84.76	(7.62)
Swimming (After)	70.77		87.50		77.14	
Playing by the beach (Before)	15.38	(3.07)	20.00	(5.00)	17.14	(3.81)
Playing by the beach (After)	12.31		15.00		13.33	
Strolling (Before)	46.15	(3.07)	20.00	25.00	47.62	(3.81)
Strolling (After)	43.08		45.00		43.81	
Talibon	(n=65)	Inc/(Dec)	(n=40)	Inc/(Dec)	(N=105)	Inc/(Dec)
Swimming (Before)	96.92	(4.61)	90.00	(25.00)	94.29	(12.39)
Swimming (After)	92.31		65.00		81.90	
Playing by the beach (Before)	55.38	(10.76)	47.50	(22.50)	52.38	(15.24)
Playing by the beach (After)	44.62		25.00		37.14	
Strolling (Before)	58.46	(7.69)	47.50	(22.50)	54.29	(13.34)
Strolling (After)	50.77		25.00		40.95	
Sto. Tomas	(n=93)	Inc/(Dec)	(n=47)	Inc/(Dec)	(N=140)	Inc/(Dec)
Swimming (Before)	89.25	(1.08)	91.49	0	90.00	(0.71)
Swimming (After)	88.17		91.49		89.29	
Playing by the beach (Before)	63.44	(2.15)	46.81	0	57.86	(1.43)
Playing by the beach (After)	61.29		46.81		56.43	
Strolling (Before)	62.37	(2.15)	53.19	0	59.29	(1.43)
Strolling (After)	60.22		53.19		57.86	

Note: The values reflected are percentages, unless indicated as frequency.

6.0 PERCEIVED CHANGES IN KEY ECONOMIC AND DEVELOPMENT INDICATORS IN THE LOCALITY

6.1 On Local Employment

One of the goals of mariculture is to respond to low employment opportunities in the rural areas. In four of the seven sites (i.e., Balingasag, Sual, Bolinao, and Talibon), a higher proportion of the survey participants indicated perceived increase in local employment associated with mariculture establishment (Table 10). The results of the FGD support this, with the participants citing that the employment opportunities offered by mariculture operations is their main reason why they like having mariculture in the area. In three mariculture areas (i.e., Calape, Lopez Jaena, and Sto. Tomas), a higher proportion of the study participants indicated no change in local employment. This could be because of the relatively small number of operators in these study sites and their small operations; thus, operators often performed all the tasks required.

Table 10. Perceived changes in local employment after the establishment of mariculture

Mariculture Site	Fishing Households	Non-fishing Households	Total
LGU and BFAR-led			
Balingasag	(n= 66)	(n=39)	(N=105)
Increase	43.94	58.97	49.52
Decrease	18.18	–	11.43
The same	34.85	5.13	23.81
Do not know	3.03	35.90	15.24
Lopez Jaena	(n= 65)	(n=40)	(N=105)
Increase	16.92	30.00	21.90
Decrease	35.38	20.00	29.52
The same	44.62	42.50	43.81
Do not know	3.08	7.50	4.76
Private sector and LGU-led			
Sual	(n= 70)	(n=50)	(N=120)
Increase	57.14	76.00	65.00
Decrease	10.00	6.00	8.33
The same	32.86	14.00	25.00
Do not know	–	4.00	1.67
Bolinao	(n= 65)	(n=40)	(N=105)
Increase	69.23	52.50	62.86
Decrease	12.31	20.00	15.24
The same	18.46	25.00	20.95
Do not know	–	2.50	0.95
Private sector and BFAR-led			
Calape	(n=65)	(n=40)	(N=105)
Increase	12.31	22.50	16.19
Decrease	1.54	2.50	1.90
The same	69.23	47.50	60.95
Do not know	16.92	27.50	20.95
Talibon	(n=65)	(n=40)	(N=105)
Increase	53.85	45.00	50.48
Decrease	18.46	12.50	16.19
The same	23.08	27.50	24.76
Do not know	4.62	15.00	8.57
Sto. Tomas	(n=93)	(n=47)	(N=140)
Increase	22.58	31.91	25.71
Decrease	7.53	6.38	7.14
The same	64.52	61.70	63.57
Do not know	5.38	–	3.57

Note: The values reflected are percentages, unless indicated as frequency.

6.2 On Food Security

With increasing fish production from mariculture, it was expected that food security will be enhanced. Results show that only in Balingasag and Talibon did a higher proportion of the study participants perceive that food security in their area improved (Table 11). A higher proportion of study participants in the three municipalities of Lopez Jaena, Sual, and Bolinao perceived that the food security situation worsened after mariculture operation was established. It is difficult to connect worsened food security to mariculture, but it indicates that intensive production in these mariculture areas was not perceived to improve food security.

Table 11. Perceived changes in food security after the establishment of mariculture

Mariculture Site	Fishing Households	Non-fishing Households	Total
LGU and BFAR-led			
Balingasag	(n= 66)	(n=39)	(N=105)
Increase	25.76	35.90	29.52
Decrease	37.88	2.56	24.76
The same	33.33	5.13	22.86
Do not know	3.03	56.41	22.86
Lopez Jaena	(n= 65)	(n=40)	(N=105)
Increase	10.77	17.50	13.33
Decrease	64.62	47.50	58.10
The same	23.08	25.00	23.81
Do not know	1.54	10.00	4.76
Private sector and LGU-led			
Sual	(n=70)	(n=50)	(N=120)
Increase	25.71	40.00	31.67
Decrease	65.71	42.00	55.83
The same	7.14	10.00	8.33
Do not know	1.43	8.00	4.17
Bolinao	(n=65)	(n=40)	(N=105)
Increase	29.23	52.50	38.10
Decrease	56.92	32.50	47.62
The same	10.77	15.00	12.38
Do not know	3.08	–	1.90
Private sector and BFAR-led			
Calape	(n=65)	(n=40)	(N=105)
Increase	26.15	20.00	23.81
Decrease	18.46	–	11.43
The same	49.23	52.50	50.48
Do not know	6.16	–	14.28
Talibon	(n=65)	(n=40)	(N=105)
Increase	40.00	37.50	39.05
Decrease	26.15	32.50	28.57
The same	29.23	27.50	28.57
Do not know	4.62	2.50	3.81
Sto. Tomas	(n=93)	(n=47)	(N=140)
Increase	16.13	10.64	14.29
Decrease	17.20	36.17	23.57
The same	62.37	51.06	58.57
Do not know	4.30	2.13	3.57

Note: The values reflected are percentages, unless indicated as frequency.

Note that the FGD participants in these areas revealed that milkfish in cages were for the big market; there was no selling in small amount to local residents. Likewise, the cages and pens were well-guarded. The main problem that the survey participants in Bolinao, for instance, cited was that the episodes of fish kill have become regular, and these affect the fishing activities of small-scale fishers; they have stopped fishing because the whole water body has been affected. On the other hand, FGD participants also mentioned that during typhoons when farmed fish escape, they have high fish catch.

6.3 On Tourism Activities

Mariculture was also envisioned to increase tourism activities by attracting tourists to visit mariculture sites. Boat-for-rent businesses and tour businesses were expected to develop. However, results show that only one-third of the survey participants in Balingasag (although near the majority also answered "do not know") indicated an increase in tourism activities after mariculture operations were established (Table 12). The milkfish festival launched in 2009 in Balingasag was in support of the mariculture operation, but this did not trigger interest in the site as a tourist attraction. This is true in the other sites, where the proportion of study participants who perceived an increase in tourism activities was low, ranging between 4% (in Bolinao) and 18% (in Sual). More study participants in other sites either perceived no change or answered "I do not know." This clearly indicates that the tourism aspect of the mariculture park is hardly realized because people in general do not consider this as a tourist attraction. The mariculture park operators themselves are not keen on "selling" their farms as tourist destinations because these visits could disturb the fish or expose them to diseases.

Table 12. Perceived changes in tourism activities after the establishment of mariculture

Mariculture Site	Fishing Household	Non-fishing Household	Total
LGU and BFAR-led			
Balingasag	(n= 66)	(n=39)	(N=105)
Increase	31.82	41.03	35.24
Decrease	6.06	–	3.81
The same	22.73	–	14.29
Do not know	39.40	58.97	46.66
Lopez Jaena	(n= 65)	(n=40)	(N=105)
Increase	23.08	25.00	23.81
Decrease	10.77	12.50	11.43
The same	41.54	27.50	36.19
Do not know	24.62	35.00	28.57
Private sector and LGU-led			
Sual	(n= 70)	(n=50)	(N=120)
Increase	18.57	16.00	17.50
Decrease	12.86	8.00	10.83
The same	28.57	34.00	30.83
Do not know	40.00	42.00	40.84
Bolinao	(n= 65)	(n=40)	(N=105)
Increase	6.15	–	3.81
Decrease	15.38	20.00	17.14
The same	47.69	57.50	51.43
Do not know	30.77	22.50	27.62
Private sector and BFAR-led			
Calape	(n=65)	(n=40)	(N=105)
Increase	9.23	7.50	8.57
Decrease	1.54	2.50	1.90
The same	24.62	25.00	24.76
Do not know	64.62	65.00	64.76

Table 12 continued

	Fishing Household	Non-fishing Household	Total
Private sector and BFAR-led			
Talibon	(n=65)	(n=40)	(N=105)
Increase	12.31	25.00	17.14
Decrease	4.62	7.50	5.71
The same	50.77	27.50	41.90
Do not know	32.31	40.00	35.24
Sto. Tomas	(n=93)	(n=47)	(N=140)
Increase	6.45	8.51	7.14
Decrease	4.30	–	2.86
The same	45.16	57.45	49.29
Do not know	44.09	34.04	40.71

Note: The values reflected are percentages, unless indicated as frequency.

6.4 Pollution

It is general knowledge that fish cage culture contributes to waste in the aquatic environment due to the uneaten food, fish feces, scales, mucus, and other debris. These can accumulate beneath the cages or downstream and result in reduced dissolved oxygen and buildup of waste in the water. This leads to the formation of hydrogen sulfide, and high levels of this can cause fish mortality. Results show that more than the half of the survey participants in Balingasag (61%), Sual (59%), and Bolinao (74%) and a third in Talibon (35%) perceived that water pollution increased after mariculture establishment (Table 13). In Calape and Sto. Tomas, most of the survey participants perceived that the pollution problem did not change, due largely to small operations in these two sites.

The FGD accounts also supported the presence of water pollution in water bodies near mariculture cages/pens. The FGD participants reported foul smell near the mariculture sites and having skin problems when they come in contact with what is perceived as contaminated water. Also, the shorelines have been littered with bamboos, nets, and drums from the mariculture park. Meanwhile, mariculture in Bolinao and Sual had started long before mariculture started in other study sites, but the incidence of fish kill have become regular and more frequent. When there is a fish kill from pens and cages, the stench also affects the fishers who have to go farther to fish. Swimming was no longer viable in water areas near the mariculture sites.

Table 13. Perceived change in pollution after the establishment of mariculture

Mariculture Site	Fishing Households	Non-Fishing Households	Total
LGU and BFAR-led			
Balingasag	(n= 66)	(n=39)	(N=105)
Increase	62.12	58.97	60.95
Decrease	1.52	–	0.95
The same	33.33	10.26	24.76
Do not know	3.03	30.77	13.33
Lopez Jaena	(n= 65)	(n=40)	(N=105)
Increase	15.38	12.50	14.29
Decrease	38.46	37.50	38.10
The same	36.92	45.00	40.00
Do not know	9.23	5.00	7.62

Table 13 continued

Mariculture Site	Fishing households	Non-Fishing households	Total
Private sector and LGU-led			
Sual	(n= 70)	(n=50)	(N=120)
Increase	70.00	44.00	59.17
Decrease	7.14	40.00	4.17
The same	15.71	14.00	25.83
Do not know	7.14	2.00	10.83
Bolinao	(n= 65)	(n=40)	(N=105)
Increase	75.38	72.50	74.29
Decrease	9.23	2.50	6.67
The same	12.31	22.50	16.19
Do not know	3.08	2.50	2.86
Private sector and BFAR-Led			
Calape	(n=65)	(n=40)	(N= 105)
Increase	10.77	2.50	7.62
Decrease	20.00	10.00	16.19
The same	61.54	75.00	66.67
Do not know	7.69	12.50	9.52
Talibon	(n=65)	(n=40)	(N=105)
Increase	40.00	27.50	35.24
Decrease	13.85	27.50	19.05
The same	33.85	30.00	32.38
Do not know	12.31	15.00	13.33
Sto. Tomas	(n=93)	(n=47)	(N=140)
Increase	3.23	–	2.14
Decrease	3.23	–	2.14
The same	72.04	89.36	77.86
Do not know	21.50	10.64	17.86

Note: The values reflected are percentages, unless indicated as frequency.

7.0 INCOME OF LOCAL GOVERNMENT UNITS

Mariculture establishments are sources of new incomes for LGUs where these are situated. The amount that the LGU could collect needs to be supported by local regulations, and this is the main reason for the differences in the amounts that the seven LGUs have managed to collect. In this study, LGU income is based on estimates using information from the estimated volume of production in the study sites. Note that only one LGU agreed to provide actual data on revenues from mariculture activities.

As shown in Table 14, only the Sual and Bolinao LGUs are collecting wharfage fee, and this is the biggest source of income from mariculture operations. The Bolinao LGU earned more than PHP 2.16 million from this source in 2015 based on estimates of volume of fish produced in the mariculture cages and pens. This is the income from harvest that passes through the wharf. Sual LGU earned a relatively big amount (PHP 456,857) also from this same fee.

Table 14. Income earned by the local government unit from mariculture operations, 2015

Cost and Revenue	LGU and BFAR-Led		Private Sector and LGU-Led		Private Sector and BFAR-Led		
	Balingasag	Lopez Jaena	Sual	Bolinao	Calape	Talibon	Sto. Tomas
FIXED							
Reservation fee	63,000	38,000	–	–	–	–	–
Application fee	12,600	19,000	–	–	–	–	20
License plate	–	–	–	108,750	–	–	–
Performance bond	–	–	–	655,000	–	–	–
Total of fixed fees collected	75,600	57,000	–	763,750	–	–	20
ANNUAL							
Cage rental	90,000	–	–	–	8,000	–	–
Lease/Space rental	70,000	66,000	–	–	–	–	–
Business permit	28,500	38,000	288,000	19,650	5,000	9,000	12,000
Plate sticker	–	–	–	36,975	–	–	–
Resource/Users fee	–	–	–	–	–	–	8,045
Barangay permits/Clearances/ Certificates	22,050	–	–	–	400	300	14,200
Total of annual fees collected	210,550	104,000	288,000	56,625	13,400	9,300	34,245
OPERATIONAL							
Parking fee for feeds delivery	168,000	–	–	79,200	–	–	–
Wharfage/Auxiliary fee	–	–	456,857	1,141,714	–	–	–
Environmental fee	–	–	–	121,091	–	–	–
Total of operational fees collected	168,000	–	456,857	1,342,004	–	–	–
GRAND TOTAL	454,150	161,000	744,857	2,162,379	13,400	9,300	34,265
2015 LGU-Internal Revenue Allotment (IRA)	119,165,396	62,534,363	74,517,037	133,412,219	67,366,897	113,569,060	73,166,779
% to IRA	0.38	0.26	1.0	1.62	0.02	0.01	0.05

Only the Balingasag and Lopez Jaena LGUs collect reservation fee and application fee. In Balingasag, these amount to PHP 1,000 and PHP 200 per operator, respectively. In Lopez Jaena, the reservation fee varies by scale of operation ranging from PHP 500 to PHP 1,500 per operator, while application fee is from PHP 250 to PHP 750 per operator. The application fee in Sto. Tomas is only PHP 20 for the lone operator in the mariculture park. There are 71 other mariculture operators, but most are located outside of the park; hence, they are not obliged to make payment. Interestingly, only the Bolinao LGU imposes a one-time fee of PHP 5,000 per operator as performance bond. This is on account of the increasing occurrence of fish kills observed in Bolinao. This is on top of the environmental fee of PHP 100 per truck load of harvest that Bolinao LGU also imposes on operators. Parking fee is a major source of revenue for the Balingasag and Bolinao LGUs. This comes mainly from trucks delivering feeds in the locality.

Overall, one can see that relative to the contribution to the Internal Revenue Allotment received by the various LGU from the national government, the income from mariculture operations represents a very small percentage, with the highest estimated for Bolinao at 1.62%, followed by Sual (1.0%), Balingasag (0.38%), and Lopez Jaena (0.26%).

8.0 CONCLUSION AND RECOMMENDATIONS

Mariculture parks, and mariculture expansion in general, are expected to contribute to livelihood enhancement by engaging local fish operators and by providing employment to community members in coastal barangays where the mariculture operations are situated. This data on contribution to employment is based on the responses obtained from the survey. On the average, 24% of household members were employed in the mariculture farms at some point in their lives. However, those that have remained employed in mariculture had gone down to only 7.4% at the time of the survey, due largely to the closure of many mariculture operations as a result of typhoons, earthquakes, massive pollution, high cost of operation, or other reasons. The various FGDs, nonetheless, revealed a generally positive attitude toward mariculture by the local residents, largely on account of the perceived local employment that they provide. A small reduction in fishing and gleaning activities were reported, however, and this was attributed to the displacement of fishing areas, the pollution generated by the mariculture operations, and the reduction in fish catch because of fish that are attracted to the mariculture cages and pens. The high cost of mariculture operation has prevented local fisherfolk from participating in mariculture as investor-operators. As such, the bigger share of mariculture benefits often accrues to investors from other areas, who are mostly traders or financiers from the cities or influential people who are local officials.

There is a general perception that pollution has worsened after the establishment of mariculture. This perception is supported by the reported reduction in leisure activities, such as swimming and strolling by the beach. The decline in leisure activities was largely due to the water pollution that manifest in foul odor, murky water, reported skin itching, and presence of solid wastes in some areas. These, in turn, are due to improper management practices like washing of nets in the coastal waters, burying of dead fish in the shoreline, and wastes coming from both mariculture-related activities and household wastes disposed improperly by caretakers living in the mariculture sheds. The wastes from mariculture operations accumulate beneath the cages and result in decreased dissolved oxygen and buildup of waste in water. This leads to the formation of hydrogen sulfide, and high levels of such may cause fish mortality. Pollution manifests in foul odor near the mariculture sites and in having skin problems when people come in contact with what is perceived to be contaminated water.

In certain localities, there was high incidence of fish kill occurring more regularly and more frequent lately, as recounted by FGD participants. When there is a fish kill from pens and cages, the stench not only affects the people—fishers also have to go farther for fishing, thus, reducing their fishing income.

Mariculture was also envisioned to increase tourism activities by attracting tourists to visit mariculture sites. The boat-for-rent business and tour guide business were expected to develop. However, results show that these anticipated benefits have not been realized in the study sites. People in general do not consider a mariculture park as a tourist attraction; mariculture operators may even be wary of the potential danger that tourist boat visits may cause on their stock, mainly coming from potential exposure to diseases due to physical disturbances to the cages and pens.

Finally, although the mariculture operations provide potential sources of income of LGUs, the income remains small and the potential to exploit this benefit is not fully realized because of failure of some LGUs to pass supporting regulations to enable them to collect more taxes. In 2015, the income from mariculture operations represented a very small percentage of the LGUs' IRA, with the highest estimated in Bolinao at 1.62%, followed by Sual (1.0%), Balingasag (0.38%), and Lopez Jaena (0.26%).

Recommendations

To increase local employment and to reduce poverty in mariculture areas, the local residents, particularly the fisherfolk, must be given priority in provision of support to start small-scale mariculture operations, labor hiring, and in the marketing of farmed fishes. Local legislations must be passed for this purpose. The BFAR's livelihood program should be expanded to cover feeds required for one season of operation in order to provide small-scale operators with the experience and the funds to continue operation into the next season. Likewise, technical assistance should be strengthened and extended to fund management.

More fisher organizations or cooperatives who are willing to engage in mariculture operation should also be supported under the livelihood scheme of the BFAR. The hiring of locals could also increase if mariculture operators are local residents, since operators who are non-residents tend to bring their own workers to the area. If the operators are companies, then there should be a labor-hiring scheme that prioritizes local hiring.

In the marketing of fish, a certain percentage of the harvest should be sold directly to the local traders, particularly to retailers and to local small processors. The practice has been to sell the harvest to big traders based outside of the mariculture site, and thus the fish move outside of the mariculture site and may come back to the local market at higher prices. If mariculture operation is linked to processing, then it can contribute more to local employment. Currently, processing is not present in many mariculture areas. In Balingasag, the BFAR-funded milkfish processing plant reportedly does not source its supply from mariculture operation, but from the local market.

Lastly, the LGUs should maximize their power to generate revenues from mariculture as provided by the Local Government Code of 1991. LGUs with mariculture should learn from each other what fees, taxes, or other requirements they can impose on mariculture operation. For instance, a one-time fixed environmental fee is imposed in one LGU but not in other LGUs.

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