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MALIPUTO (*Caranx ignobilis* FOORSKAL) FISH CAGE FARMING PRACTICES AMONG SELECTED OPERATORS IN TAAL LAKE, BATANGAS, PHILIPPINES[1]

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ABSTRACT – The study was conducted among the maliputo fish cage farming operators in Barangay Banyaga, Agoncillo, Batangas and Barangay Pulang Bato, San Nicolas, Taal, Batangas. Direct observation and key informant interview were conducted to describe the maliputo fish cage farming practices of selected respondents. Results showed that maliputo fish cage farming is basically a family-based livelihood activity that involves all able-bodied members of the family in various stages of one cropping cycle. The farming practices employed in maliputo fish cage farming is almost similar with common tilapia fish cage farming. Its stages includes fish cage construction phase; acquisition and transport of fingerlings; stocking and feeding; harvesting and marketing. The major differences however were in the feeding requirement and cropping period owing to the biological difference of the two species. Maliputo fish cage farming has a longer cropping period ranging from 8 to 12 months. Maliputo has a slow growth rate particularly from 8th month onward and requires large volume of feeds over one cropping season to attain the desired weight. The study showed that maliputo fish cage farming has minimal environmental impact and not very profitable as a source of income for the family following the current practices. The operation of the fish cage supported the operator-financier relationship that also exists in the tilapia fish cage farming in the locality.
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Keywords: : maliputo fish cage farming practices, direct observation, key informant interview, Taal Lake, Batangas, trash fish.

INTRODUCTION

Caranx ignobilis or maliputo is endemic in Taal Lake. It is a catadromous fish that breeds and spawns in estuarine waters (a mixture of marine and freshwater found in river mouths and mangroves) and goes upstream to seek for freshwater to grow into adulthood. Maliputo spawns in Balayan Bay and its fingerlings migrate to Taal Lake through the Pansipit River.

Maliputo, together with muslo (C. sexfaciatus) and manipis (Caranx sp.) are the three species of Carangidae found in Taal Lake (Herre, 1927). Villadolid (1936) included maliputo as one of the eight fish species in the lake that has a high commercial value. It is also considered as one of the most delicious fishes in the Philippines and in South East Asia (Westerhagen, 1974).
Fishing methods for migratory fish species involved setting traps along the migration route. This was confirmed by Villadolid (1936) wherein he reported practices of trapping the fries and fingerlings ascending the Pansipit River as well as trapping of the sexually-matured individuals on their way to Balayan Bay. These traps were set up along the Pansipit River, the only migration route for maliputo.

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Early records on the number of maliputo harvested from the fish corrals in the Pansipit River already showed a declining trend from as high as 1,004 in 1880's, 357 in the 1920's and 311 in the 1930's (Villadolid, 1936). Other fishing methods cited in various literatures for catching maliputo in commercial quantities include beach seine (pukot) and ring net (basnig). Fish corrals (baklad), lift net and gill net (pante) were also used but in smaller quantities (Villadolid, 1936; Mutia, undated).

Maliputo remains an important part of the Taal Lake fisheries as reported by Mutia (undated). The fish is included in the top 5 commercial species of the lake. Records from San Nicolas, Batangas showed that the fish was abundant in Taal Lake until 1965 (Magistrado, 1983). This was confirmed from the result of 1996-1999 fish catch survey from eight landing sites in Taal Lake. Maliputo ranked 3rd and 4th place in terms of total annual production from 1996-2000 with 265 MT next to Atherina forskalii or guno (645 MT), Oreochromis niloticus or tilapia (943 MT) and Sardinella tawilis (3770 MT). The importance of maliputo in the food chain and its high market value motivated the Bureau of Fisheries and Aquatic Resources (BFAR) to breed maliputo in captivity.

The study was therefore conducted to describe the maliputo fish cage farming practices of some selected operators in Taal Lake and relate the impacts of these practices to environment, economic and social aspects.

MATERIALS AND METHODS

The study employed direct observation research method among the fish cage operator in Taal Lake. In the direct observation, the researcher participates with the fish cage operator in the aliputo fish farming activities. There were only four (4) active maliputo fish cage operators in Taal Lake during the conduct of this study. One of the maliputo fish cage was located in Brgy. Pulang Bato, San Nicolas Taal, Batangas and the remaining three fish cages were located in Bgry. Banyaga, Agoncillo, Batangas (Fig. 1). Key informant interview with BFAR staff and maliputo fish cage operators were conducted to gather data related to the study.

Figure 1. Map of Batangas Province showing the study sites.

The study was guided by the research framework presented in **Figure 2**. The framework shows that the local practice employed in maliputo fish cage farming was influenced by four (4) major considerations comprising of skills/knowledge, availability of resource input (labor and materials), availability of trash feeds and existing arrangement between fish cage operator and financier. The maliputo fish cage farming practices involved four (4) major phases, these include: fish cage construction phase; acquisition and transport of fingerlings; stocking and feeding; harvesting and marketing. Finally, as a livelihood activity, maliputo fish cage farming has an environmental, economic and social impact.

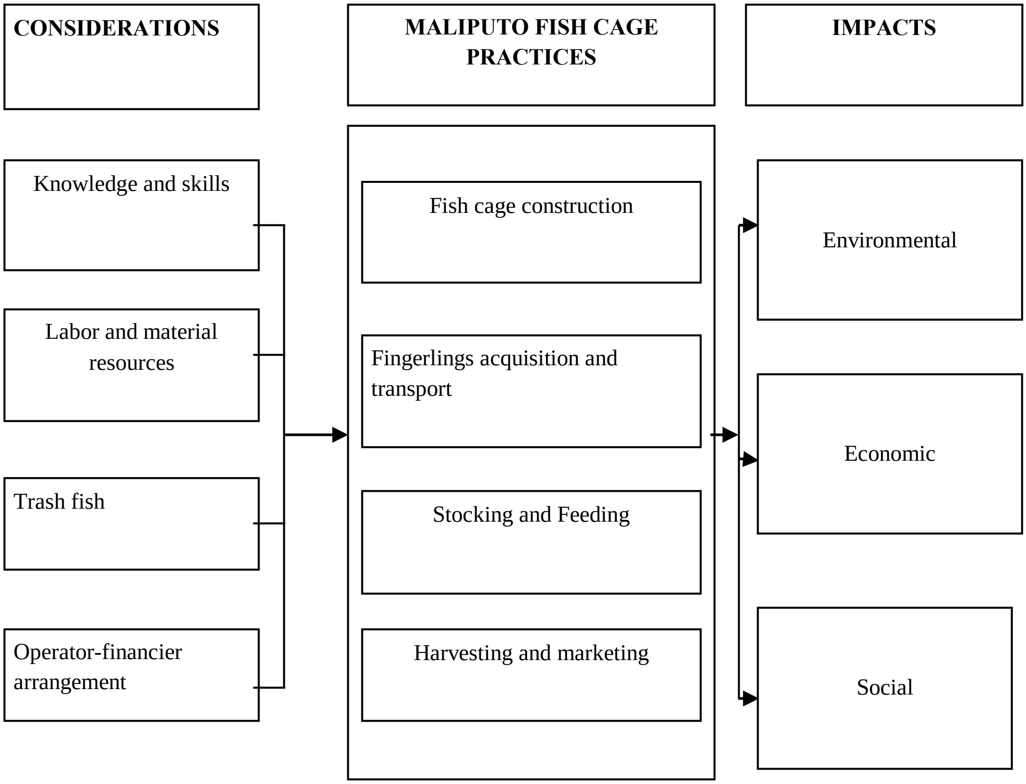

Figure 2. Framework for the maliputo fish cage farming in Taal Lake.

The source of information was limited to four (4) maliputo fish cage operators who are The source of information was limited to four (4) maliputo fish cage operators who are active at the time of the study. The information generated therefore represents only and may be true to those fish cage operators who participated in the study. The limited number of respondents could not also provide substantial information that could be used in economic sensitivity analysis to determine the economic viability of the activity. In this regard, what was described was the financial viability of the maliputo fish cage farming.

Moreover, this paper focus on the activities and considerations under the various phases of maliputo fish cage farming, including the impacts of the activities in the environment, economy and society. In addition, the social aspects of the study dealt more on the arrangements between the financier and operator hence, the study did not collect in- depth data on the roles and involvement of household members and its impact on their activities as these was not part of the study.

RESULTS AND DISCUSSIONS

The four maliputo fish cage farming operators were all males and considered as the head of the household. The average age is 49 and they have been engaged in maliputo fish cage farming for about 5-15 years. All of the maliputo fish cage operators started with tilapia fish cage farming. Hence, most of the methods employed in the operation, except for feeding, are almost similar. These include the design and structure of the floating fish cage, transport and handling of fingerlings and replacement and maintenance of fish cage nets.

Only one of the operators claimed to have undergone formal training on maliputo fish cage farming. The rest had no formal training but the skills and knowledge developed through time were based from experiences in tilapia fish cage farming.

The maliputo fish cage farming in this area was considered a family-based livelihood activity, where all able-bodied members of the household, regardless of gender and age, contribute to the activity, especially in the collection of trash fishes, during the harvesting, marketing and post- harvest activities such as repair of nets and floats.

Based on the direct observation and key informant interview, maliputo fish cage farming is divided into four major phases. These are fish cage construction phase; acquisition and transport of fingerlings; stocking and feeding; harvesting and marketing.

Fish Cage Construction Phase

Fish cage construction phase includes the construction of bamboo rafts, setting of net, towing and assembly. Construction of raft and the setting of net are done at the lakeshore. Once completed, the raft is towed to the designated location where all the parts are finally assembled. According to the operators, the main criterion used in the siting of the maliputo fish cages is its proximity to the operator's household.

The fish cages are established about 200- 300 meters from the shoreline or roughly 250 to 600 meters from the household to facilitate monitoring and feeding. It was also noted that the fish cages are established alongside the tilapia fish cages that are either owned by the maliputo fish cage operator themselves or by any member of the household. The cage is usually submerged in water more than 10 m deep to ensure that the bottom of the fish cage would not entangle with the lakebed debris during the rise and fall of the water level.

Acquisition and Transport of Fingerlings

Maliputo fish cage operators acquired fry or fingerlings from maliputo fry collectors of Sambal, Lemery, Batangas. The fry/fingerlings are captured along the shore near the estuary of Balayan

Bay while some were trapped at Pansipit River as they swam their way to Taal Lake. There are two methods used in the collection of fingerlings: beach seine or pukot made of nylon nettings, no. 200/16, 200 meshes, 22 knots and fry seine or salap made of sinamay which is 10 m long and 2 m wide. While it has been reported that maliputo spawns whole- year round, the fry/fingerlings usually peaks during the months of May to August.

Fingerlings are immediately transferred to hapas for acclimatization. Hapas or fine mesh cages are net structures with all sides suspended in floating structure. They are usually located along the Pansipit river near Balayan Bay.

Acclimatization is the process of conditioning the fingerlings to its future environment. It involves the gradual exposure of the fingerlings to the environment where it will be transferred by slowly moving the hapas containing the fries from the bay towards the lake or from an area of high salinity towards an area of low salinity. This process recognizes the salinity gradient along the Pansipit River, wherein the salinity of the water decreases as it moves closer towards the lake. Fingerlings are then conditioned under this low level of salinity for at least 2 days prior to transport to culture site. The fingerling collector will inform the operator that the fingerlings are ready for transport.

Sorting, Packing and Transport of Fingerlings

Size of the fingerlings varies and depends on the age of the fingerlings when captured. The fingerlings are sorted and separated according to sizes and placed in separate containers. This is based on the preferences of the fish cage operators.
Fingerlings are placed inside a transport plastic bags measuring 20 cm x 30 cm filled with water from the hapas where the fingerlings are acclimatized. Each plastic bag is filled with approximately 1/3 water level and is pumped with oxygen/air from a tank and then sealed to prevent gas from escaping. Each plastic bag contains approximately 30-50 fingerlings per bag depending on the sizes of the fingerlings. Recommended time to transport the fingerlings should not exceed 10-12 hours (BFAR-NFBC, undated).

For Banyaga, Agoncillo, the major mode of transport for the fingerlings is by land transport. Passenger jeep is usually hired to accommodate more number of plastic bags as well as passengers. It takes 30 minutes to reach Banyaga from Sambal Lemery.

Mortality rate during transport is very high usually reaching 40%. Only about 900 of the 1500 fingerlings survived the transport. The mortality is due to thermal shock because of rapid changes in ambient temperature and, commonly occurs during live hauling or transfer from one water body to another.

Stocking of Fingerlings

From transport bags, fingerlings are again subjected to conditioning before they are transferred to the fish cage to avoid thermal shock.
This is in consideration of the physical and chemical differences between water inside the plastic bags and lake water. To avoid trauma brought about by thermal shock and oxygen level gradient, lake water is gradually poured into the plastic bags containing the fingerlings. This is to ensure the temperature and oxygen content of the water in the plastic bag will be approximately equal to that of the lake water. This process sometimes last for only about an hour. The fingerlings are stocked at around 6-7 in the morning.

Mortality Rate

Maliputo fish cage farming suffers from a very high mortality rate. This is attributed to the tendency of the operators to cut on cost. Operators resort to packing 30-60 fingerlings inside one plastic bag. This is to reduce number of plastic bags and oxygen that will be used in the transport of fingerlings. The operator also prefers smaller sized fingerlings over much larger sized ones to accommodate more fingerlings in a plastic bag. This saves on cost of plastic bags oxygen and transportation space. During transport, the fingerlings bump with each other especially when the ride is rough. Congested packing in a plastic bag of the still young and frail fingerling contributes to fatality.

The initial stocks of a 10 m x 10 m fish cage is approximately 900 fingerlings or equivalent to the survival rate during transport. This is equivalent to a stocking density of 9 pcs m^2 which is low compared to the ideal stocking rate of 10-15 pcs m^2. About 7-10% of the remaining fingerlings die during the initial stocking caused by improper or lack of conditioning. Another 2% may also die before final harvest due to competition for food.

Feeding

Maliputo is a carnivorous species even at its juvenile stage. It is fed with trash fishes that are chopped into smaller sizes (Fig. 3). Sizes of minced trash fish depend on the size of the stocks. The most common trash fishes include species of Oreochromis niloticus (tilapia), Carassius auratus auratus (karpita) and Parachromis manaaguensis (dugong) (Table 1). Tilapia considered undersized or underweight or hibay (weak) fish does not command a good price in the market. These rejects are used as trash fishes. The fish is fed also with available Pangasius, a not so common fish as food in the community or with low consumer acceptability. Some also feed the fish with silverfish (guno), cardinal fish (dangat) and archer fish (kataba). There are also instances when good quality fishes are being used as trash fish because it is cheaper to buy them than to capture them. Trash fish can therefore be from the operators/caretakers' own fish trapping devices or bought from other fisherfolks. In extreme fish shortage in the lake, operators also resort to buying the cheapest fish in the market as trash fish.

Figure 3. Trash fishes are minced into smaller sizes prior to feeding.

Table 1. Types and amount of trash fish feed to the maliputo fish per cropping season.

Stages /Month	**Types of fish**				
	***P. hypopthalmus* (kg)**	***O.niloticus* (kg)**	***P. managuensis* (kg)**	***C. auratus auratus* (kg)**	**Total**
First month (Fry)		45			45
2 months old	3	55	5		60
3 months old		72	10	5	90
4 months old		128	18		150
5 months old		275	20	5	300
6 months old		280	15	5	300
7 months old		279	49.5	7.5	336
8 months		245.5	39.5	8	293
9 months (harvestable)		313.5	25	9	347.5
Total	3	1693	182	43.5	1921.5

The amount in kilograms of trash fish consumed monthly from seeding to time of harvest is presented in Table 2. It shows that the weight of the trash fish started from approximately 45 kilos per month or 1.5 kg per day during the first month. It is increased by 2 kg per day or 60 kg per month reaching 150 kg by the fourth month. The volume of trash fish could reached 300 kg to as high as 347 kg monthly starting from the fifth month until harvest time. The amount varies and depends on the availability of trash fish.

Table 2. Weight of trash fish consumed by maliputo fish from fry to adult stage.

Month	Weight in Kilograms
First month (Fry)	45
2 months old	60
3 months old	90
4 months old	150
5 months old	300
6 months old	300
7 months old	336
8 months	293
9 months (harvestable)	347.5
Total	1921.5

The species used as trash fish also varies monthly. Table 3 shows the types of fish and weight consumed monthly. The dominant species used as trash fish is tilapia (88%) as this is also the dominant species available from the lake. Other species include Parachromis managuensis (9%) (Jaguar guapote or dugong for local folks) and.Carassius auratus auratus (2%) (locally called Karpita) and Pangasionodon hypopthalmus (.16%) (Pangasius).

Table 3.Types of trash fishes, weight and percent consumed per cropping season.

Types of fishes	Weight (kg)	Percent Consumed
Oreochromis niloticus	1693	88
Parachromis managuensis	182	9
Carassius auratus auratus	43.5	2
Pangasionodon hypopthalmus	3	.16
Total	1921.5	100

Harvesting and Marketing

Maliputo in the wild grows relatively fast reaching sexual maturity at a length of around 60 cm (TL) in 3.5 years and a maximum weight of 80 kg. Maliputo cultured under fish cage condition is harvested from six to eight months. The cropping cycle normally starts between the months of August and September and ends in April to May. This cropping cycle has been identified and established based from the experiences of the fish cage operators. Slow growth rate and high mortality rate of the fish is observed during rainy months. They attributed this to the increased in water temperature that usually occurs during the rainy months. The operators also connected the slow growth rate and mortality of the fish to lack or insufficient oxygen in the lake water which also occurs during the onset of the rainy months. Oxygen dissolves less in higher water temperature.

The harvesting method of the fish in the cage is also similar with that of tilapia fish cages. Harvesting in fish cage is simple. Harvesting can be done by 3-4 persons. A bamboo raft is placed inside the cage. This raft serves as the platform for the 2-3 persons who will slowly pull up one corner of the net thus pushing the fishes to group together on the other corner of the cage (Fig. 4). The fishes are then scooped out of the net and transferred immediately into a pail. Maliputo has a very short lifespan when taken out of the water hence they are immediately transferred into iceboxes. The short lifespan is attributed to the absence of fish scales. Fish scales aside from the skin function as physical barrier which protect the fish against injuries. Sorting according to sizes is done at the lakeshore. The fishes are sorted according to size classes because farm gate prizes vary according to sizes. The average size of a 8-month maliputo ranges from 23 cm to 27 cm long (TL) equivalent to about 20 g (0.2 kg.) to 600 g (0.6 kg).

Figure 4. Harvesting maliputo by slowly pulling up one corner of the net towards the opposite corner.

Weight of Harvested Maliputo

Maliputo of varying sizes and weight were captured randomly from the fish cage to represent the eight-month old fish cage farm. The sample has a total of 27 individual fish with a cumulative weight of 10.2 kg. The weight, total length, total fork length, standard length and body length of each of the fish from the samples were measured. Table 4 summarizes the number of individuals, total weights, average total length, average total fork length, average standard length and average body length of the fish per class weight. It should be noted that this study adopts the weight classification used by the Taal Lake fisherfolks in sorting fish for marketing such as small (4-5 pcs), medium (3 pcs), large (1-2 pcs).

Table 4. Weight class, number of individuals, total weight and average size of maliputo.

Weight Class (g)	Number	Total weight (g)	Average total length (cm)	Average Fork length (cm)	Average Standard length (cm)	Average Body length (cm)
<299	10	2440.0	29.5	25.9	23.2	10.05
300-500	14	6050.0	63.3	58.8	52.25	23.15
> 501	3	1719.9	36.0	31.6	28.6	12.6
Total	**27**	**10210**				

The proportion of the individuals and weight per weight class were also determined and summarized in Table 5. It shows that in terms of number of fish, weight class <299 g had 37%, 300-500 g had 52% of the total samples each and about 11% belonged to weight class >501 g. On the other hand, weight class 300-500 g took 59% of the total weight and weight class <299 g took about 24% of the total weight. The weight class >501 garnered only about 17% of the total weight.

Table 5. Number and weight proportion per weight class (@10,210 g).

Weight Class (g)	**Number**	**Percent**	**Total weight(g)**	**Percent**
<299	10	37.04	2440.00	23.98
300-500	14	51.85	6050.00	59.25
> 501	3	11.11	1719.90	16.84
Total	**27**	**100**	**10210**	**100**

The figures below were blown up to obtain the proportion of individuals and total weight per weight class (Table 6). It shows that the whole population of maliputo was 794. This represent 88% survival rate from the initial stocking of 900. About 37% or 294 individuals comprised weight class <299, 52% or 412 comprised weight class 300-500 and the remaining 11% or 88 pieces comprised the >501 weight class.

About 177,750 g representing 59% of the total weight was comprised by individual fish belonging to 300-500 weight class. Weight class <299 had about 71,940 or 24% of the total weight, while weight class >501 had a total weight of 50,520 g or 17% of the total weight.

Table 6. Estimated Number and weight proportion per weight class (@300,000 g).

Weight Class (g)	Number	Percent	Total weight (g)	Percent
<299	294	37.04	71940	23.98
300-500	412	51.89	177750	59.25
> 501	88	11.11	50520	16.84
Total	794	100	300,000	100

Projected Growth Rate

Based from the information obtained from both actual measurement and interview, the growth rate for maliputo raised inside fish cage was also projected (Table 7 and Fig. 5) and compared with the growth rate of maliputo raised inside the ponds of BFAR-Butong (Fig. 6). The growth rate curve of the fish in the cage showed a sharp increase during the first three to four months but starts to taper-off from sixth month onwards. The further decline in growth rate during the last few months could be attributed to the scarcity of trash fish. It should be noted that March and April are summer and Lenten season months wherein demand for fish is high and therefore commands higher price. Fish is more valuable to market than to be used as trash fish. The months of May and June are start of the rainy months where most of the fishkill events happened.

Table 7. Projected growth rate of cultured maliputo fish (12 month).

Month	Weight in grams	Growth rate
1	5	-
2	10	100
3	50	400
4	100	100
5	200	100
6	250	25
7	300	20
8	400	33
9	500	25
10	600	20
11	650	8
12	750	15

Note. The value in the first month was based from the estimates of the weight of fingerlings when acquired from Lemery.
The value in the 8 months is the average weight based on actual measurement done.
The value in the 12th month was based from the fisherfolks estimate of the average weight in an existing 12-month C. ignobilis fish cage.
All values are averages

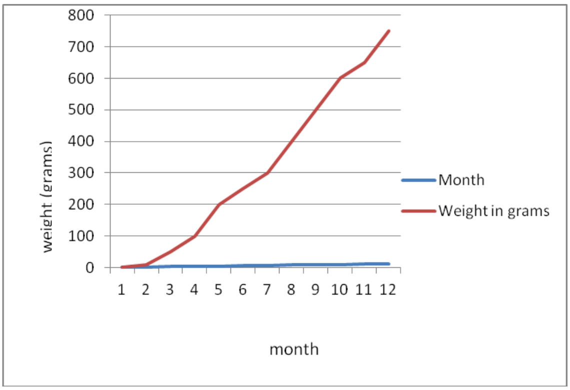

Figure 5. Weight in grams of maliputo fish in a cage culture.

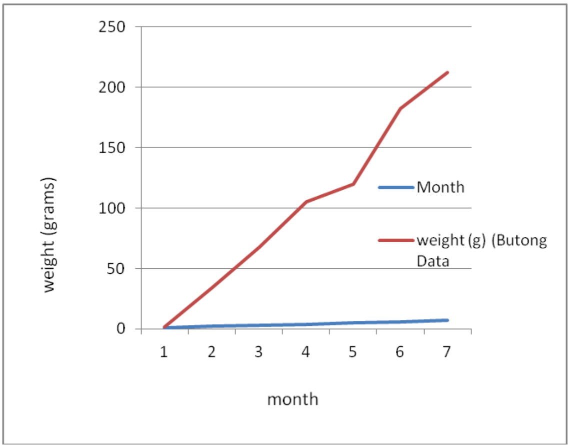

Figure 6. Weight of maliputo fish from Butong Culture.

Marketing

Considering that maliputo caters to specific market, method of sale is "by order and pick –up from production site". This means that traders will notify the fish cage operator if there are "orders" coming from Manila. Harvesting only starts after agreement on the price per kilo is settled between the traders and operator.

Selling of fish is on wholesale and cash basis only. It is also the obligation of the operator to bring the product to the buyer located in San Nicolas, Batangas.

Financing

Maliputo fish cage farming operates based on different partnership arrangements among the financier, caretaker and owner. Financiers are those individuals or corporation who invest financial inputs in the operation of the fish cage. Financers are usually not resident of the localities. Financier may enter into partnership with more than one fish cage operator/owners. Caretakers are those who provide actual labor input including, feeding and patrolling, in exchange for wages. Owners are those who financed the construction of the fish cage and the registered and/or recognized owner of the fish cage structure. Owner may operate the fish cage on his own or leased the fish cage structures to other operator or financier or enter into some form of partnership agreement with the financier.

The most common partnership arrangement is the owner- caretaker. This was practiced to reduce financial input for the fish cage farming. Under this arrangement, the recognized/registered owner of the fish cage entered into partnership with the financier. The profit sharing may vary depending on their agreement. Common practice at the time of the interview was the fix investment. In this practice, the financier shoulders the expenses for the acquisition and transport of the fries and the owner/caretaker takes care of the other related expenses including the acquisition of feeds, payment of wages and minor repairs and maintenance of the fish cage structures. The profit sharing scheme for this practice is 50/50 of the gross profit. In case of natural calamities resulting to death of the fish in the cage or total devastation of fish cage, the financier receives nothing. Other variation of this scheme may include running investment in which the owner/caretaker requests for additional cash. The additional cash advanced will be deducted from the gross income first before dividing the net profit.

Impacts of the Current Maliputo Fish Cage Farming Practice

Environmental Impact

From the current practices of the operators, activities identified that may have potential impact to the environment include the collection/extraction of raw materials and the siting of the fish cage. However, further evaluation indicated that the impact may pose significant change in the immediate environment. Bamboos are sourced from other municipalities and the volume requirement of a single fish cage may not be sufficient to result to over-extraction. The impact of siting of fish cage includes blocking of boat and wave movements. Again, as these are floating fish cages, their location can be moved to other places where they will not pose hazard or impede movement of water and boat.

Acquisition and transport of fingerlings involve the trapping and conditioning of the fingerlings prior to their transport. Trapping involves the use of fine mesh fishing nets that may also capture non-target fries or fingerlings of other species. On a larger scale, this may be detrimental to the population of the other species. However, as this involves capturing small number of fries undertaken only when there are demands, it was assessed that this will have no significant impact to the population structure of the other species. However, in the event of a sudden increase in demand for fries due to the development of a more efficient maliputo fish cage farming techniques, the need to prepare for breeding and hatchery ponds should be considered. This is to avoid undue stress to the natural population of maliputo and other non-target species.

Maliputo is a carnivorous species and a voracious feeder. An eight-month 10 m x 10 m maliputo fish cage with a stocking rate of 7-8 pcs m^2 can consume 1,920 kg of trash feeds. This is roughly between 250-300 kg of trash fish monthly equivalent to 8-10 kg of trash fish. At this feed consumption rate, the Feed Conversion Ratio (FCR) of maliputo fish cage farming could reach 6.405. This means that it will require 6.405 kg of trash fish to produce one kilogram of maliputo.

While it may appear that the volume of fish meal required for the fish in the cage will have an impact on the population of the trash fish, it should be emphasized that the preferred species are introduced comprising of Oreochromis niloticus, Carassius auratus auratus (Karpita or gold fish), Parachromis marguensis (jaguar guapote or dugong) and, in some instances, Pangasionodon hypopthalmus (pangasius). Most of the introduced species in the country have been noted for their adverse impacts to the population of local and endemic species. These introduced species compete with the local endemic species for food and habitat leading to domination, exclusion and extinction of the local and natural population of species, communities and habitat.

Trash fish is not part of the regular diets of the lakeshore households and is therefore not a threat to food security. Tilapia used as trash fishes are classified as “hibay” or those that are undersized, deformed and weak. These are not sold at the local market nor consumed by the households. Pangasius sp., an introduced fish, is not consumed by the locals because it does not suite to their taste and still unknown to them.

In general, maliputo fish cage farming has a positive impact to the ecology by regulating the population of the introduced exotic species that would otherwise posed danger to the local endemic fish population, communities and habitat.

Economic Impact

The economic impact of the Malipuo fish Cage Farming was not determined given the limited number of informants and information. However, considering that the demand for maliputo remains high despite its high price, maliputo fish cage farming may therefore be still an economically viable livelihood activity if substantial intervention is available particularly in the propagation of genetically superior maliputo fingerlings and in the development of alternative feeds.

Presently, only few operators ventured into maliputo cage farming because it is both capital and labor intensive aquaculture business. In addition to being capital and labor intensive, maliputo fish cage faming is also limited to only one long cropping cycle a year avoiding risks from typhoon that also affects the availability of trash feeds. Under this cropping cycle, the optimum weight attained by cultured maliputo is between 600 to 800 grams which is way below its optimum weight it can reach in the wild.

On the financial viability, the existing arrangements between financier and operator will still be the most beneficial arrangement as the risk involved are more nature based. In this arrangement the financial losses are shared by and between the financier and the operator.

Social Aspect

Maliputo fish cage farming being family-based activity may have some impacts on the members of the family particularly women and children. It was observed in the study that the participation of the members in the activity is not gender or age- base, it is more on the physical capacity and availability. However, there may be occasion when the participation of all members may be required especially during emergency situation such as typhoon and harvesting. Other contribution of the other members of the family particularly those children who have their own tilapia fish cages are in the form of providing trash fishes especially during the months when trash fishers are scarce.

The above may simply mean that the participation is not forced and would not over -burden the particular member. In fact, sometimes the participation is voluntary depending on the necessity of the situation.

The social impact of the financing arrangement was not determined due to the limited number of respondents as this may not be a representative of the general situation.

CONCLUSION AND RECOMMENDATIONS

The study concluded that maliputo fish cage farming in the study comprises of the following phases such as fish cage construction phase; acquisition and transport of fingerlings; stocking and feeding; harvesting and marketing. The phases are basically similar in almost all aspects of tilapia fish cage farming as it was the original livelihood activity of the operator and is also the dominant and common fish culture practice in Taal Lake. The major difference however lies in the feeding practice and cropping period that can be attributed to the less developed farming practice for maliputo, making it more labor intensive. Present practices showed that maliputo farming requires participation of all able-bodied members of the family particularly during feeding and monitoring/patrolling activities and may therefore be considered a family-based livelihood enterprise.

The findings of the study showed that a fish cage with fish stock of around 900 would require 1921 kg of trash fish over 8 months or one cropping period. These trash fishes are from various species of fishes that are considered undersized or underweight or hibay (weak) fish, hence will not command acceptable price in the market. There are however, instances where good quality fishes are being used as trash fish when the price has become so low that it would be cheaper to buy than to capture them. Trash fish can also be from the operators/caretakers' own fish trapping devices or bought from other fisherfolks. In extreme fish shortage in the lake, operators also resort to buying the cheapest fish in the market as trash fish.

The study also concluded that while maliputo in the wild grows relatively fast reaching sexual maturity at a length of around 60 cm (TL) in 3.5 years and at maximum weight of 80 kg. Maliputo cultured under fish cage condition is harvested within six to eight months with an average weight of 600 g. The short cropping cycle was identified and established based from the experience of the fish cage operators that took into consideration the high mortality rate of the maliputo stocks during some changes in the water physical and chemical attributes including salinity and temperature. These changes were attributed to changes in the weather condition. The cropping cycle normally starts between the months of August and September and ends in April to May.

The assessment of the study on the environmental impact of maliputo fish cage farming indicated that it may have insignificant impact on the quality of water, population of maliputo in the wild and population of other fish species used as trash fish. Likewise, assessment of the economic impact showed that it does not contribute significantly to the income of the family. Finally, the operation of the fish cage has also strengthened the operator-financier relationship that also exists in the tilapia fish cage farming in the locality

It would therefore be concluded that maliputo fish cage farming at this point may not be an economically viable activity unless a significant intervention in terms of technology and financial support would be provided. These would include improvement in the production and supply of high quality fingerlings, production of cheaper organic feeds and provision of technical and financial support to investors.

The concerned agencies should expand its maliputo research initiatives that would a) reduce dependency on trash fish for feeds through the development of "cheaper and ecologically friendly " organic feeds for maliputo; b) make it possible to start maliputo fish cage farming any time of the year; c) reduce mortality of maliputo fingerlings during transport identify and during its rearing period (optimum stocking rate and appropriate design and size of fish cage); and d) promote other alternative in-situ and ex-situ production.

In addition, maliputo fish cage farming may be economically viable livelihood activity if substantial intervention is available particularly in the propagation of genetically superior maliputo fingerlings and in the development of alternative feeds.

Finally, the impact of the financing arrangement which is very common in Taal Lake fishing community should be studied further to determine its social impact, who gain more or who were marginalized by the existing arrangement.

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STATEMENT OF AUTHORSHIP

The first author conducted the literature search, prepared the conceptual framework, identified thematic points, formulated recommendations, and undertook the writing up. The second author initiated the concept, identified some issues, formulated recommendations, and reviewed the paper.

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