A SURVEY OF MARINE ORNAMENTAL FISHERS' LIVELIHOODS IN NORTH BALI

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Abstract

A study was conducted to determine the impacts and benefits of the marine ornamentals (MO) trade on fishing communities in north Bali, Indonesia. Village surveys included livelihoods mapping, activity calendars showing the degree of reliance by the communities on the MO trade for their incomes, and assessments of relative wealth from various activities within each community. Data were collected from desktop studies and from the results of questionnaires filled in by people in seven villages along the north coast in Buleleng Regency. The data collection methodology can be used in further studies of other, similar fishing communities. The impacts of destructive fishing techniques in the past (including cyanide use), and of the recent introduction by the government of marine conservation areas (and in particular, no-take zones) on the economic prospects of the fishing communities, were noted. Information was also collected about the fish buyers and trade chains. Significant impacts included a reduction in species and numbers of fish, and the need for fishers to travel much further afield to maintain their incomes. In addition, fishers were obliged to find alternative (non-MO fishing) employment. Overall, the number of fishers working for the MO trade is declining, and young people no longer wish to work as fishers, preferring further education if possible to improve their employment opportunities. Challenges and opportunities for the future are described, including the need for new fisheries management policies, stricter law enforcement for reef protection, the benefits of artificial reef structures installation and training programs, and the need for education and alternative employment opportunities, particularly for the next generation of young people in the fishing communities.

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Section 1. Introduction

1.1. Background

This field study is part of a wider study being carried out by the Durrell Institute for Conservation and Ecology at the University of Kent, on behalf of the Ornamental Aquatic Trade Association of the UK, to look at the benefits of the trade in wild-caught ornamental aquatic organisms. The overall aim of this field study is to reveal objective information about how communities and households in Indonesia benefit from the trade in ornamental aquatic organisms (MO). To date, relatively little hard evidence is available on this in peer-reviewed journals.

The scope of the study:

- Livelihoods mapping to show areas that communities rely on for various resources, and the relative importance of different resources in sustaining livelihoods.
- Household activity calendars to show how individual households rely to varying extents on the marine ornamental (MO) fish trade at different times of the year, and any alternative livelihood options adopted when the catching of ornamental fish is not possible.
- Household and community ranking will be used to determine the relative wealth of households and communities involved in the MO fish trade compared to those involved in other activities such as agriculture or food fisheries.

1.2. Objectives

The purpose of this field study was to collect and consolidate data and information about the livelihoods of MO fishers and households of the ornamental fishing communities in North Bali, and to prepare a report describing how communities and households in study sites benefit from the trade in ornamental aquatic organisms.

1.3. Methodology

Two types of data used for this study are the secondary data collected from the desktop study, and primary data gathered using the questionnaires.

The questionnaires were drawn up by DICE, University of Kent. A few changes were suggested, and these were incorporated into the final questionnaires (Appendix 1). The intention was to make the questions as relevant as possible to the requirements of the study.

The number of respondents and the fishers villages to be included in the study were agreed prior to the field study being conducted. Fishers were interviewed at the middlemen's facilities when fishers brought their catches to sell.

1.4. Data processing

There are 86 sets of data for each of the respondents. Data were entered and processed using Excel spreadsheets. The database can be used to evaluate and monitor fisheries activities for compiling time series data in the future, using a selection of indicators that can be regularly collected and monitored.

Section 2. General description of the Study Area

The survey was implemented in Bali Province. The island is situated about 600 miles south of the equator. The island's monsoonal climate has two alternating wind patterns: the southeast wind from April to September, and southwest from November to March. During the monsoon months from December to February, the sea is rough, with big waves and strong currents that cause water turbidity.

The study was conducted in seven villages (Desa). of which six are in Buleleng Regency: (Tembok, Les, Singaraja, Pemuteran, Sumberkima, Pejarakan), and Gilimanuk village in Jembrana Regency (Fig 1).

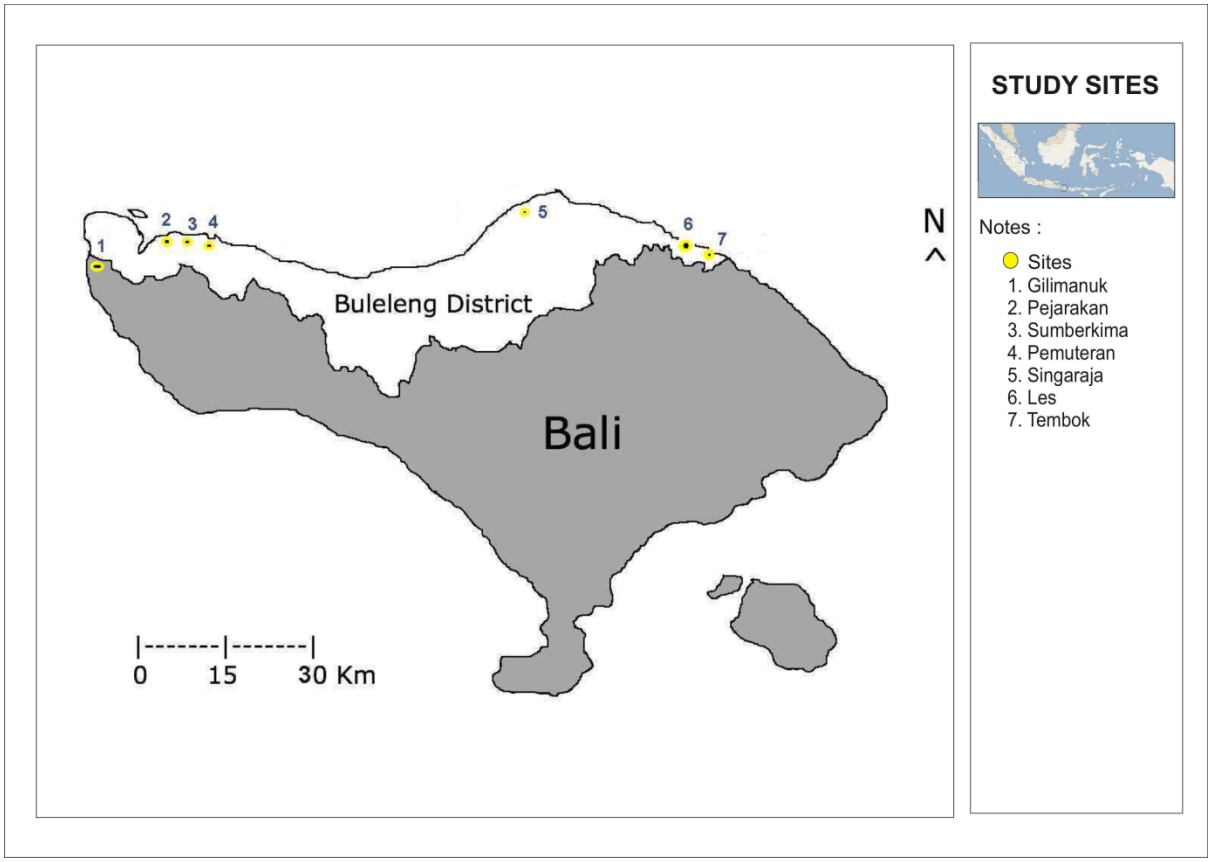

Figure 1. Study sites

The primary sites were Les in East Bali, and Pejarakan and Gilimanuk in west Bali. These were selected based on information from the middlemen, because of the high numbers of ornamental fishers in the communities there.

Desa Tembok and Les village are situated in east Bali, and are part of Tejakula sub-district, which consists of nine villages - Buleleng Regency (Table 1). The Tejakula Sub- District covers an area of 97.68 km² with the coastline 25.75 km long, and the land is made up of volcanic rock of various sizes, gravel, and greyish black volcanic sand from Mount Agung (Pemkab Buleleng, 2013).

Table 1. Villages in Tejakula sub-district

No.	Name of Village	Area (km²)	Coastal Length (km)
1.	Pacung	6.66	4.29
2.	Sembiran	17.79	1.28
3.	Julah	4.7	0.96
4.	Bondalem	6.69	2.84
5.	Tejakula	13.96	4.43
6.	Les	7.69	2.19
7.	Panuktukan	6.25	1.97
8.	Sambirenteng	9.4	2.98
9.	Tembok	10.81	4.81
	Total	**83.95**	**25.75**

Desa Sumberkima, Pejarakan and Pemuteran are part of Gerokgak sub-district, Buleleng Regency. Desa Kampung Baru is in Central Bali, and is part of Buleleng Sub-District, Buleleng Regency.

Desa Gilimanuk is part of Jembrana Sub-District. Gilimanuk is the main port for ferry crossings to East Java.
In 2011, Buleleng Regency declared three Marine Conservation Areas. These are Pemuteran waters in West Buleleng (651.24 Ha), Central Buleleng (6,727.91 Ha) and East Buleleng (6,661.68 Ha). The East Buleleng Marine Conservation Area includes the whole coastal waters of Tejakula Sub-District (Fig. 2). The blue colour in the legend represents the conservation areas.

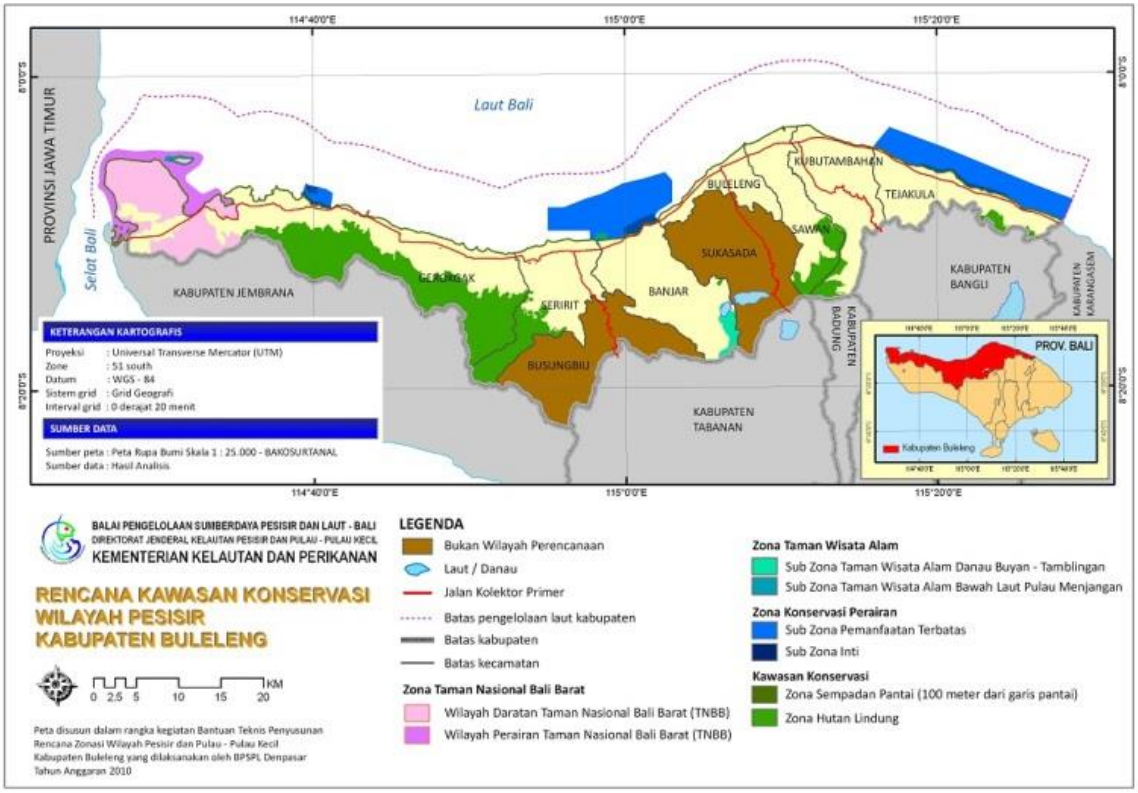

Figure 2. Buleleng Marine Conservation Areas (blue colour)

The fishery district office of Buleleng stated that there were 1.285 fishers in 2009, fishing for both ornamental and food fish. From a total human population of 786,972, the number of fishers was only 0.16%. The human population in the study sites is described in Table 2.

Table 2. Total area and human populations

	Village	Total Area	Population
1	Tembok	10.81 km²	7,196
2	Les	7,69 km²	7,562
3	Singaraja	1,51 km²	7,561
4	Pemuteran	10.81 km²	9,983
5	Sumberkima	7,54 km²	8,299
6	Pejarakan	6,7 km²	11,225

Source : Pemkab Buleleng 2013

Section 3. History of marine ornamental collection in North Bali

Fishers reported that ornamental fish collection started in the west part of Bali in the mid-1970's, and expanded to the eastern part later in the mid-1980s. The main village in west Bali where significant numbers of fishers live is Sumberkima, and in the eastern part it is Les village. In the early days, the fishers collected fish using simple equipment, such as

homemade goggles, and nets woven by the fishers themselves. Now they can buy diving masks, fins and factory-produced netting that they can adapt for fish collection of various types.

The use of potassium cyanide, referred to as *potas* by local fishermen, was introduced to them by the buyers who were also exporters of marine ornamental fish in the mid-1980s. The fishermen stopped using nets because they could collect more fish in a shorter time using cyanide.

Cyanide fishing is a method of collecting live fish for use in aquariums and also for the live reef fish trade. It involves spraying a sodium cyanide mixture to stun the fish, so they can be scooped off the reef easily.

The use of cyanide to stun the fish is widespread, but it not only kills the corals on which the cyanide is sprayed, but also many non-target fish and other marine organisms. The cyanide breaks down in the fish's tissues relatively quickly, and widespread health issues for humans after consuming fish killed with cyanide have yet to be demonstrated, but the damage to the reefs and marine life has already been done.

Many reefs areas across Indonesia have been ruined or totally lost through cyanide fishing. Cyanide concentration results in coral reefs losing colour and higher mortality levels among corals.

Until early 2000, cyanide was cheap and easy to obtain in North Bali. Cyanide use is prohibited in Indonesia, with penalties up to 6 years in jail and/or a 1.2 billion Indonesian Rupiah fine (USD 100.000). Unfortunately enforcement is weak, and only a very few cases of cyanide fishing have been brought to court. Often, the offenders are released after payment of a small fine.

Over 20 years, cyanide fishing in North Bali has contributed significantly to the loss of habitats and biodiversity on the coral reefs. It has led to reef degradation and local extinction of highly- targeted species such as the Blue Tang (*Paracanthurus hepatus*), Angelfish e.g. Emperor Angel (*Pomacanthus imperator*), and Blueface Angel (*Pomacanthus xanthometopon*). The variety and the quantity of ornamental fish in the North Bali fishing grounds have decreased significantly. The decline of local fish has obliged the marine ornamental fishers from North Bali to travel to far away reefs in their boats in search of high-value fish species, on less degraded reefs as far as Sulawesi and Maluku in eastern Indonesia. They travel in boats belonging to the middlemen, for periods of two weeks to one month at a time.

Types of fishers

There are two types of marine ornamental fishers in North Bali: free divers and hookah divers.

The majority of fishers are free divers. They dive up to a depth of 10 metres using fishing nets with a mesh size of 0.5 cm. Fish are harvested using scoop nets and barrier nets, where fish are being driven into the barrier net, then to be scooped up using the scoop nets before being transferred to holding nets on the surface.

Hookah divers are fishers who use air supply-assisted diving equipment, i.e. petrol powered compressors with air hoses attached. Compressor-assisted collectors often dive up to depths deeper than 30 metres. The fish they collect are put into decompression containers, which are then taken to the surface in gradual ascent to prevent the fish from becoming stressed and bloated. Compressor diving can be extremely dangerous for the health of the divers.

Hookah divers use boats to reach the fishing grounds, while free divers rely on public transportation or their own motorbikes to reach the fishing grounds, or they just walk to the beach, and then swim out to the reefs.

Section 4. Results

4.1.Respondents

The total number of respondents who participated in the field study was 108 fishers from seven villages (Table 3).

Table 3. Number of respondents

No.	Villages	Number of fishers interviewed
1	Tembok	10
2	Les	20
3	Singaraja	10
4	Pemuteran	12
5	Sumberkima	11
6	Pejarakan	25
7	Gilimanuk	20
	Total	108

4.2.Livelihoods

Fishers received incomes from fishing for ornamental fish of between IDR 6.000.000 (USD 500) to more that IDR 24.000.000 (USD 1,840) per year. Fishers using hookah could potentially earn significantly more than the non-hookah fishers. This is because the hookah fishers dive deeper, to areas of reef where a greater variety of reef fish can still be found. From the study, 42 % earned between IDR 6 million to IDR12 million (USD 460 to USD 920), 37 % earned between IDR 12 million to IR 24 million (USD 920 – 1,840), and 20 % earned over IDR 24 million (USD 1,840) per year (Fig 3). The exchange rate was USD = IDR 13,043 (Oanda historical exchange rate, March 1 – 31, 2015)

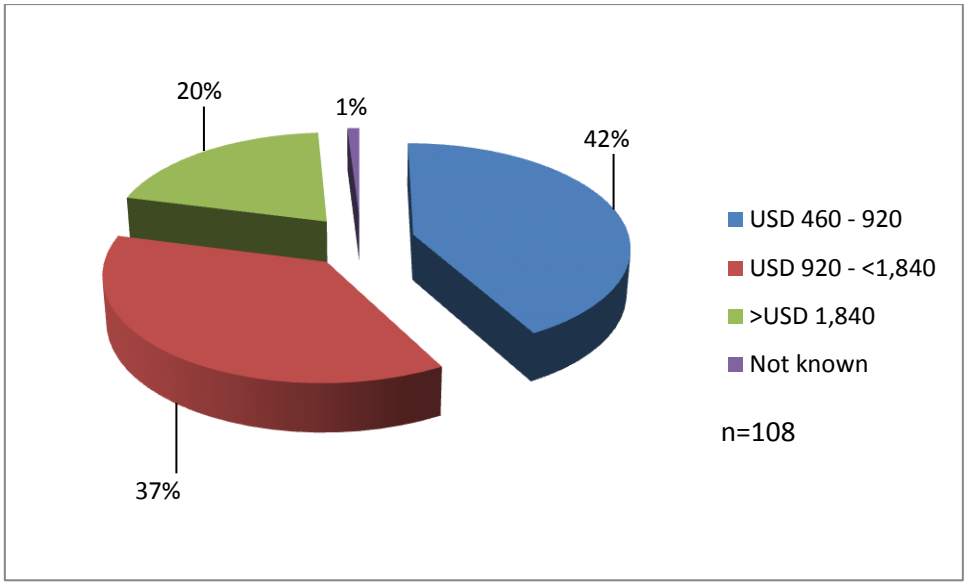

Figure 3. Fishers' earnings

Figure 4 shows that 62 % of the fishers depended entirely on ornamental fishing for their income. 28 % are both ornamental and food fishermen, 5 % are middlemen, 4 % said that most of their income came from pelagic fisheries, and only 2 % had stopped fishing for ornamental fish.

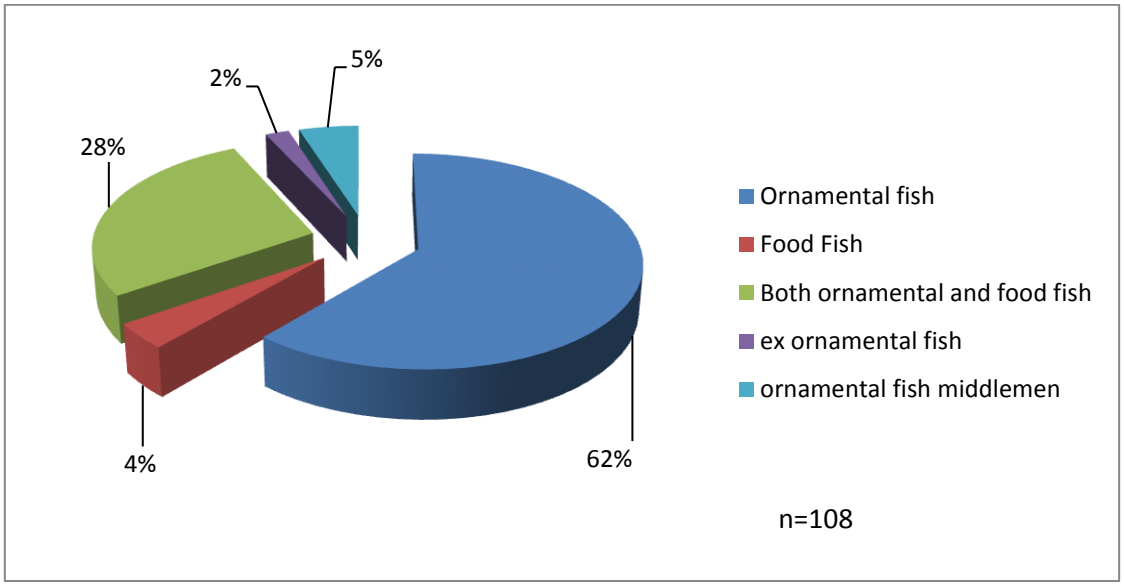

Figure 4. The percentage of livelihoods

Those fishers fishing for food fish mainly targeted pelagic fish such as tuna, mahi, and skipjack. Fishing for food usually occurred during the night, from 6 pm onwards. The highest percentage of fishers who did both ornamental and food fishing came from Gilimanuk (11%) and Les village (7%) (Fig.5). Fishers often alternated between catching food fish and ornamental fish, If they could catch enough food fish on a particular night to earn enough money, then they would not fish for ornamentals in the morning. However, when fishing for food fish did not provide enough income for the day, fishers would do both, fishing in the evening/night for food fish, and in the morning for ornamental fish.

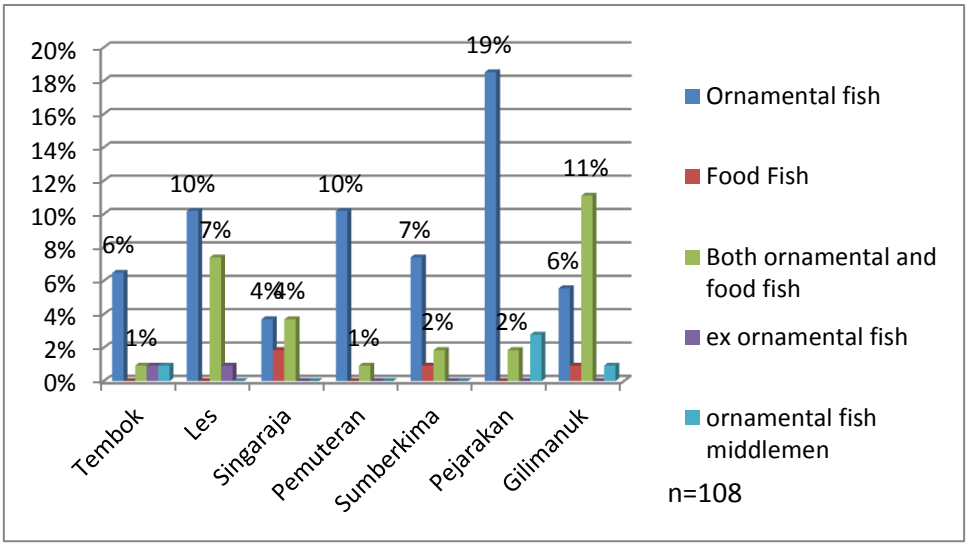

Figure 5.The percentage of livelihoods in study sites

Information on the earning from food fish was very sketchy. When answering the question of how much income they earn from fishing for food fish per day or per month, by far the majority of the respondents could not answer straight away. This is understandable, first the respondents' main income are from ornamental fishing. Secondly, the majority of catch are sold at the local market, and what they earn will be used to buy their daily need. Third, their daily income never being recorded. 21 fishers out of 108 who answered the question on their income from food fish earn the average between IDR 6 million to IDR 12 million (USD 460 – USD 920) per year from food fish.

4.3. Additional income from non-fishing activities

The Ornamental fishers do have other sources of income besides fishing. Figure 6 shows that 41 % had incomes from farming/husbandry, 19 % from general labour (this could be from casual work such as helping to pack fish; folding plastic bags), 16 % from construction work and other jobs, including labour in shrimp culture, and work in shops. Fishers take on additional work such as construction, or as general labourers during the monsoon season (December – February), when the sea is rough, and strong currents and big waves make fishing difficult. For construction work, the fishers go to the nearest town to look for work, while farming/animal husbandry can be done at home.

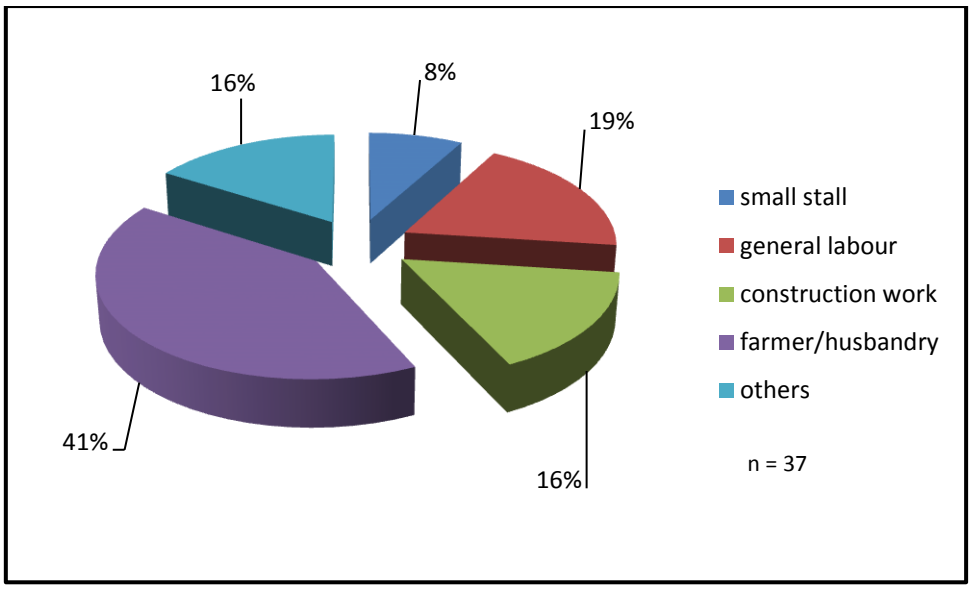

Figure 6. Types of Income from other work

Farming and animal husbandry are commonly the work of the fishers' wives. 39 % (42) of the total respondents have either chickens, pigs or cows. Farming and animal husbandry are the most common additional sources of income, particularly chickens, where 52 % of the respondents owned chickens, and 29 % owned both chickens and pigs (Fig. 7).

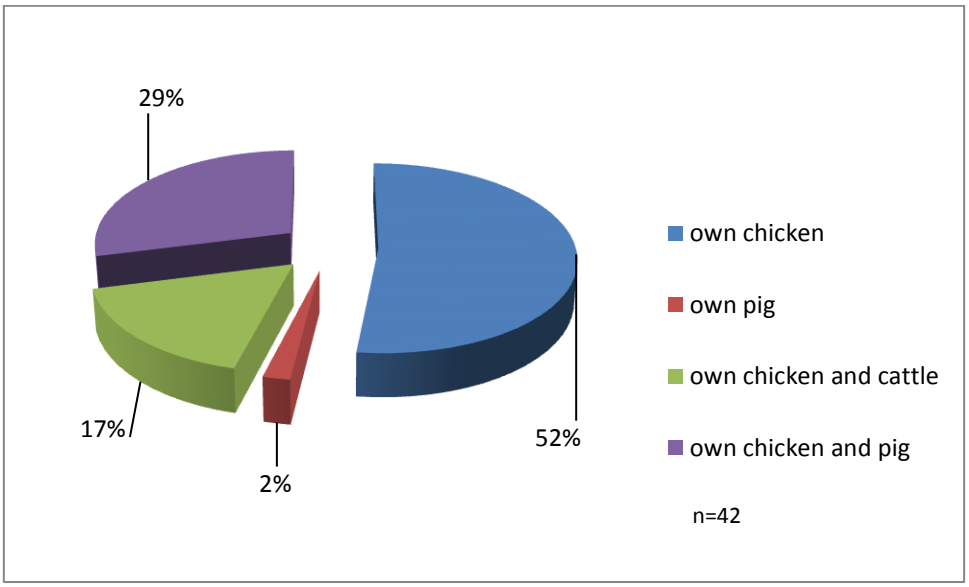

Figure 7. Percentage of the types of animals kept as sources of additional income

Table 4 shows an example of a marine ornamental fisher's earning, who also fish for food and has animal husbandry at home as an extra income. The highest percentage of income is from Marine Ornamental, which is 80% (fig.8).

To give a comparison income between ornamental fisher and food fish fishermen. The average income of food fish from Pemuteran village which only fish for food, is between IDR 820,000 – IDR 1,000,000 (USD 62.87 – USD 76.67) per month.

Table 4. Example of income from Marine Ornamental Fisher in Les

Type of Income	**Income in USD (monthly average)**
Marine Ornamental	460
Food Fish	77
Farming/Husbandry	35
TOTAL	572

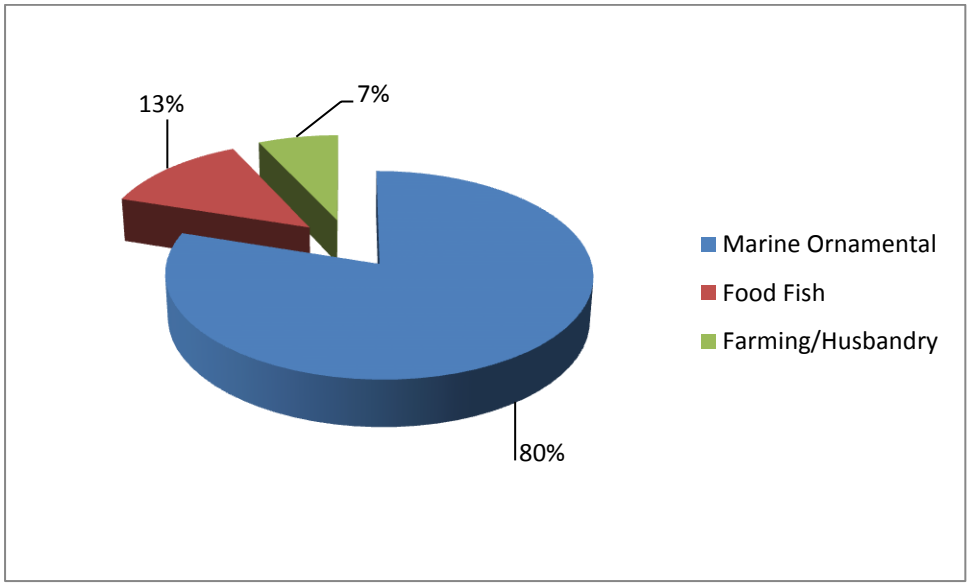

Figure 8. Percentage of incomes

4.4. Education

The average education of the fishers involved in the study was low. 58 % went to primary school, and only 10 % went to high school (fig. 9). Most of the fishers claimed that a lack of financial support and poor parents stopped them going on to higher education. Their parents did not motivate them to go to school, because schooling requires extra costs. Many of the fishers had been fishing since they were young, some as young as 14 years old.

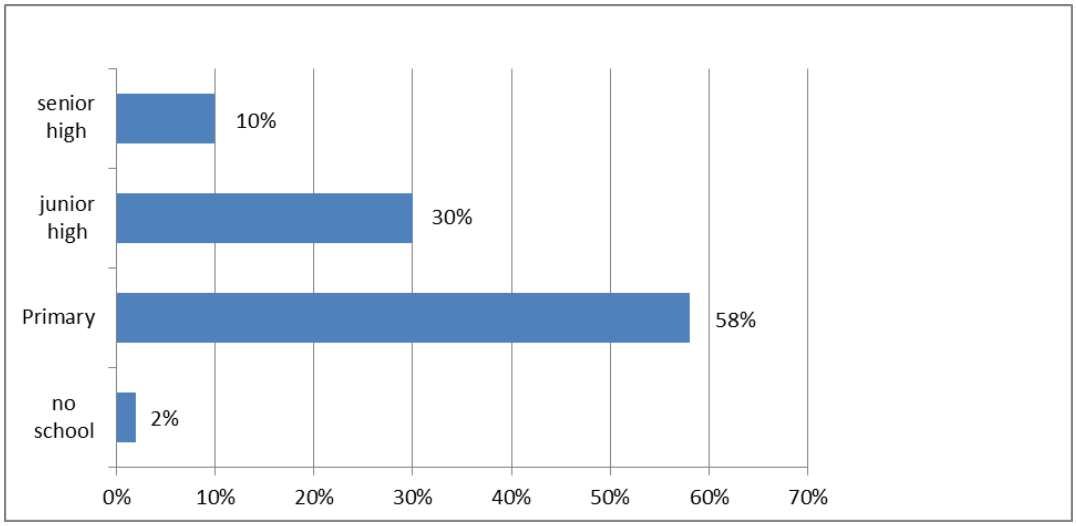

Figure 9. Fishers' education

4.5.Assets

Motorbike

From the study, 91 out of 108 ornamental fishers (84%) interviewed owned motorbikes, and 4 fishers own the car. Because of public transportation is scarce in North Bali, to own motorbike is a necessity. As ornamental fishers earn better income than food fish, it shows that more than half ornamental fishers own motorbike in each villages being surveyed (Table 5). Motorbikes are the main method used for fishers and their families to travel. Fishers who do not own a boat often use their motorbikes to reach the beaches where they fish. Fishers usually pay for their motorbikes using credit schemes.

Figure 10 shows the percentage of ornamental fishers owning a motorbike in each study sites. Which shows high percentage, and in Sumberkima all fishers interviewed owning a motorbike

Table 5. Number of fishers own motorbike in each study sites

No.	Villages	Number of fishers interviewed	Fishers own motorbike	Fishers own car
1	Tembok	10	9	1
2	Les	20	15	0
3	Singaraja	10	8	0
4	Pemuteran	12	10	2
5	Sumberkima	11	11	0
6	Pejarakan	25	21	0
7	Gilimanuk	20	17	1
	Total	108	91	4

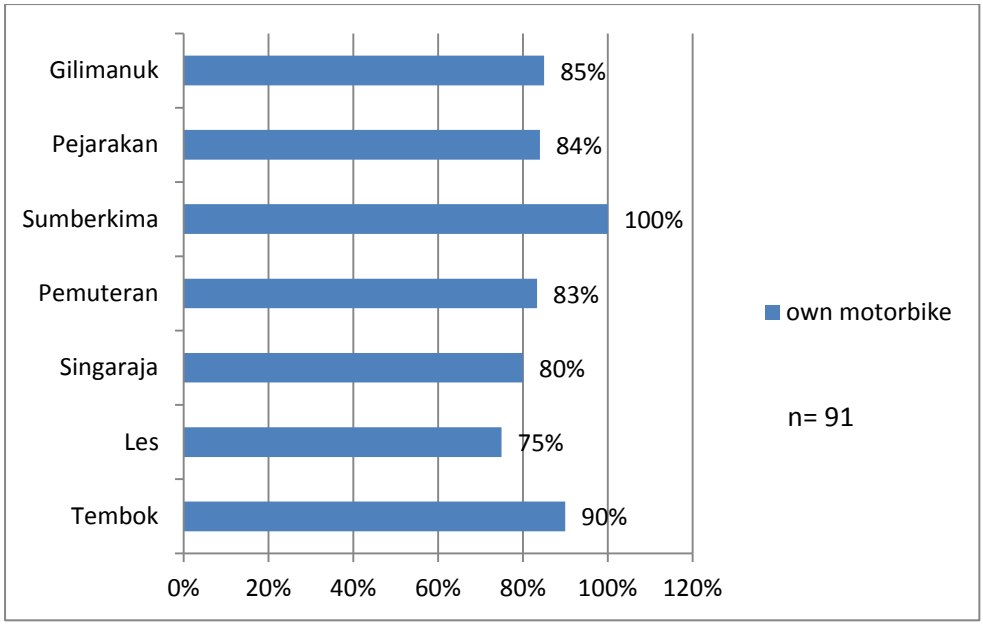

Figure 10. The percentage of fishers owning a motorbike

Land

Only 37 (34%) out of 108 fishers involved in the study owned land, with the highest number of fishers owning land coming from Les village (Table 6). The size of the land is from 0.01 ha to 1 ha. Land is passed down from the fishers' parents. The fishers do not purchase the land. Fishers from Sumberkima and Pejarakan did not own any land.

Table 6. Number of fishers own the land

No.	Villages	Number of fishers interviewed	Owning land
1	Tembok	10	7
2	Les	20	13
3	Singaraja	10	7
4	Pemuteran	12	9
5	Sumberkima	11	0
6	Pejarakan	25	0
7	Gilimanuk	20	1
	Total	108	37

Figure 11 shows the percentage of fishers owning the land in each study sites, where fishers in Pejarakan and Sumberkima do not own land. They have houses, but land is not owned. Fishers interviwed from Pejarakan and Sumberkima are not Balinese. Their parents come from Sulawesi who then settled in these villages as fishermen.

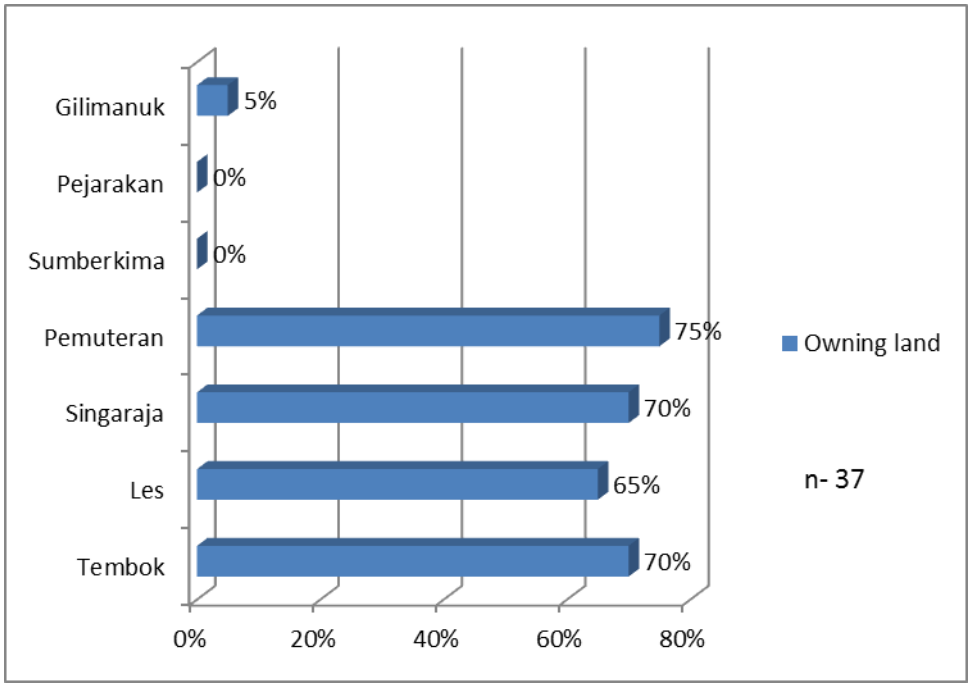

Figure 11. Land ownership

Figure 11. Land ownership

Cellular /Mobile phones

88 fishers (82%) out of 108 owned a cellular phone, and half (41 %) of them owned more than one phone (Table 7). Only 18% did not own a phone. Fishers use cellular phones for their work, as orders from the buyers are received through sms/text messages. Cellular phones are an essential asset for the fishers.

Table 7. Fishers own cellular phone

No.	**Villages**	**Number of fishers interviewed**	own 1 hp	own more than 1 hp
1	Tembok	10	5	4
2	Les	20	7	10
3	Singaraja	10	6	4
4	Pemuteran	12	3	5
5	Sumberkima	11	5	6
6	Pejarakan	25	15	4
7	Gilimanuk	20	3	11
	Total	108	44	44

Figure 12 shows that 100 % fishers interviewed from Sumberkima and Singaraja all own cellular phone

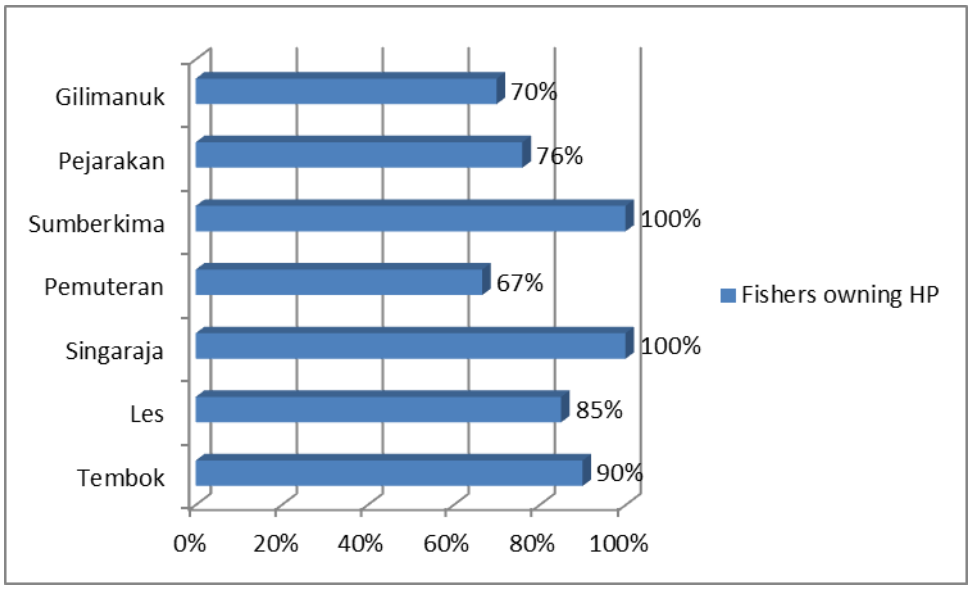

Figure 12. cellular phone ownership

Electronics

61 out of 106 involved in the study owned a TV, and only 1% owned a radio (Table 8). The traditional Balinese families to which the fishers belong live in a compound together, and the fishers live with their brothers' families and their parents. TVs are often a shared asset in the compound. It is not necessary for the fishers to own a TV, as they can go to their relatives' homes to watch TV programs. This can be seen in figure 13, where only 20 % of Les fishers have TV.

Listening to the radio is no longer a habit for many fishers, since there is generally a TV to watch. However, a few fishers still bring a radio with them during their night fishing trips.

Table 8. Fishers own TV and Radio

No.	Villages	Number of fishers interviewed	own tv	own radio
1	Tembok	10	6	1
2	Les	20	4	
3	Singaraja	10	4	
4	Pemuteran	12	4	
5	Sumberkima	11	11	
6	Pejarakan	25	14	
7	Gilimanuk	20	18	
	Total	108	61	1

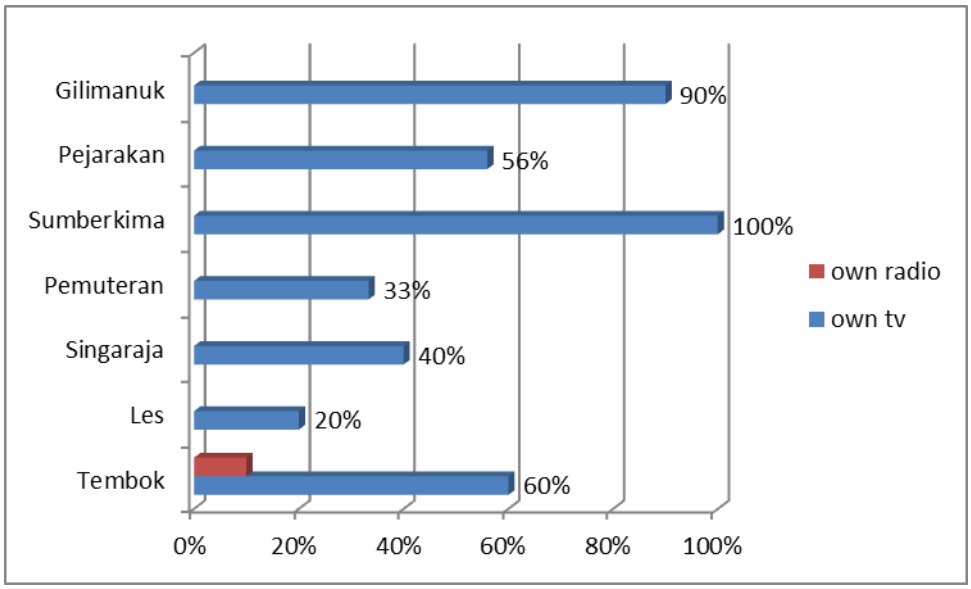

Figure 13. TV and Radio ownership

Section 5. The current situation of marine ornamental activities in North Bali

5.1. Shrinkage in the number of marine ornamental fishers in North Bali

Although official data on the number of ornamental fishers are not available, the number of fishers has declined during the last decade. According to Mina Lestari Fisher group's coordinator, a Marine Ornamental Fisher group in Les, in 2005, there were more than 80 fishers in Les village, and this has since decreased to around 40 in 2015 (Made Partiana, personal communication, February 2015). A similar situation has also occurred in Sumberkima, where there has been a significant decline in the number of ornamental fishers. There are several reasons for this reduction in the number of fishers. These include perceived low status, unpredictable income, and the work being too hard (and sometimes dangerous), requiring physical strength and stamina.

The declines in the numbers and abundance of ornamental fish species due to destruction of the reefs and overexploitation in the past have also been contributory factors leading to the decline in the numbers of fishermen. In addition, increasing developments of tourism facilities (such as hotels), in North Bali, have led to the creation of no-fishing areas, where fishers are not allowed, and therefore more reefs are now protected.

Another reason is age-related. From this study, it appears that the highest percentage of the ornamental fishers' ages is above 38 years old, and only 6% are in their mid-20's (below 27), and 12 % are in their 50's (fig. 14).

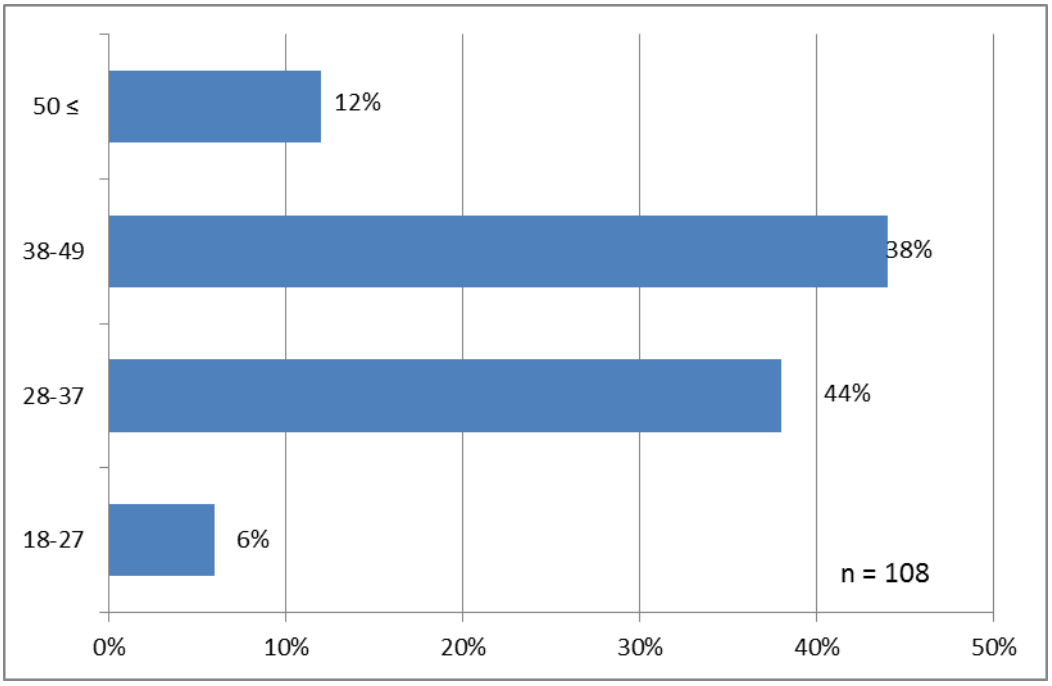

Figure 14. Age range of fishermen

Generally, young Balinese men consider being a fisherman as a low income, low status job, which is not modern. In addition, the fishers do not motivate their children to become fishermen anymore. Many of the fishers work hard to enable them to send their children to school. From figure 15, 15 % of the children were or had graduated from high school, and 34 % were still in junior high school. All of the fishers' children went to school.

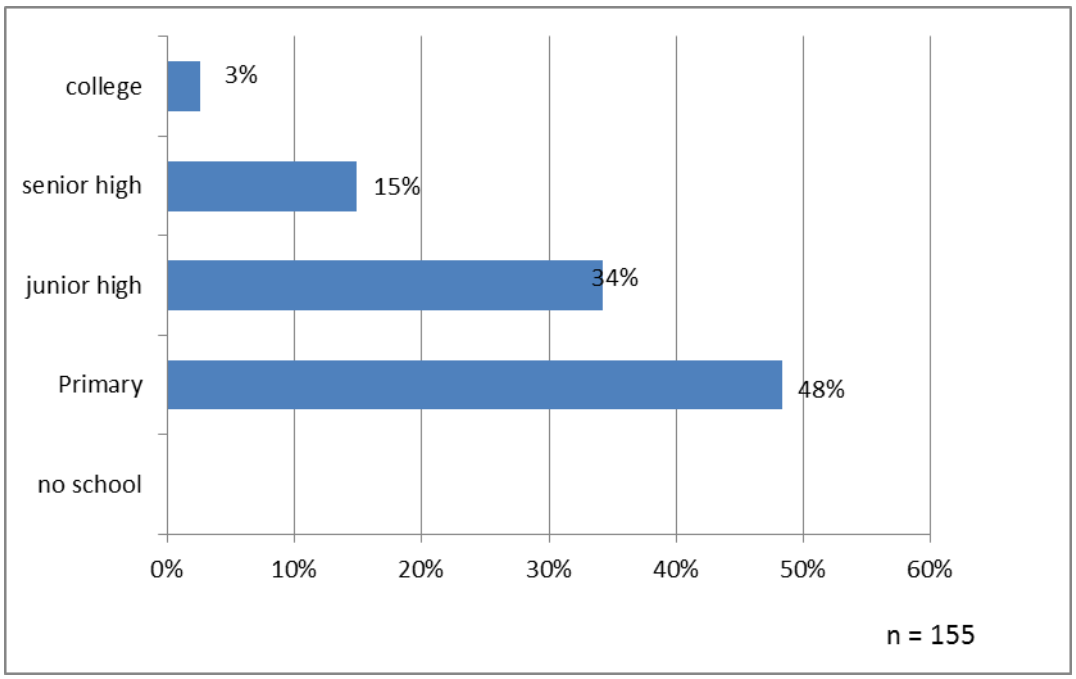

Figure 15. Children's education

5.2. Fishing in distant waters

There are at least three boats belonging to the middlemen in Sumberkima, and one boat from Les, that make regular trips to the Flores Sea, to fish for high-value species and also for those that are not of such high value, but for which demand is high (Fig. 16). 15 to 20 fishers travel on the boat from Les. Each trip lasts between 10 to 14 days, and the average earnings from each trip are between IDR 1 million to 3 million (USD 83 to USD 250). According to the Les middlemen, the operational costs for 10 to 14 days fishing trip to Flores Sea are approximately IDR 50 million (USD 4,167). The middlemen buy all of the fish collected by the fishers on board the boat.

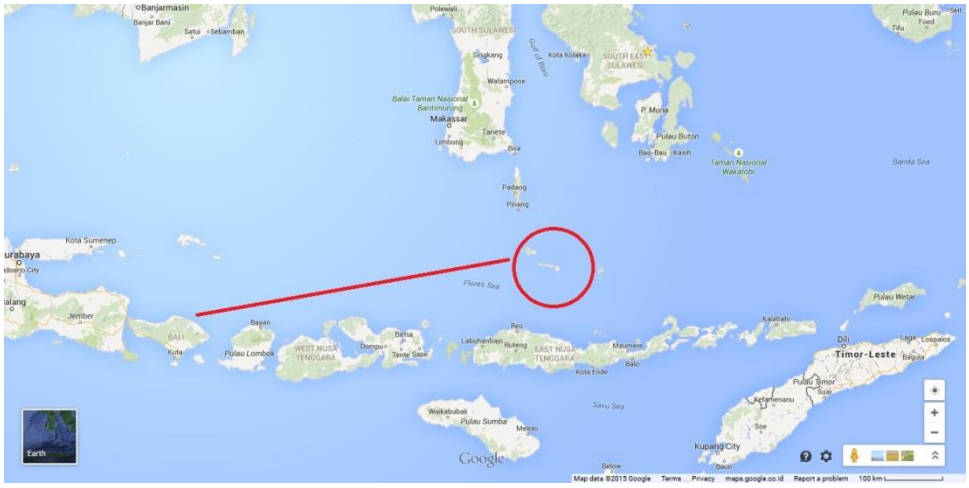

Figure 16. The circle shows the location of reefs in the Flores Sea – the fishing grounds of the Les fishers

As the costs of traveling to distant waters steadily rise due to increases in fuel prices, some exporters pay groups of fishers to be temporarily based in the eastern Indonesian Islands. For instance, seven to ten fishers from Sumberkima have been stationed on Biak Island in Papua, to specialise in collecting Blue Tang and Biak Clownfish (*Amphiprion percula*). These fishers collect and sell their catches to the exporters who support them by, for example, also paying their once - yearly return transportation costs to and from the village in Sumberkima.

5.3.Fishing times

Fishers stated that there has been a significant change in their fishing times, both in terms of the length of fishing trips and in the months of fishing. Ten years ago, the north Bali fishers could predict the best months for fishing, when the sea was calm, and visibility was good. These were from March to June, and from September to November. According to the Les fishers, during the last few years, the weather has become unpredictable, and includes storms with strong winds, big waves, strong currents and poor visibility. They experience more days when they cannot go fishing because of rough seas, and therefore have less and less time in which to earn an income from fishing.

5.4. Species collected as ornamentals and also as food fish.

Certain species of ornamental fish are also targeted as food fish. From this study, the fishers identified three fish groups which are collected both as ornamental and food fish. These are Botana (Tang, Surgeon fish), Naso (also Surgeon fish), Grouper. Large botana, Naso, and Groupers are fished using spearguns. Other species that are targeted both as ornamentals and food are lobster and octopus.
From this study only 24 % (26 fishers) responded to the question as to which species were collected both as ornamental fish and also as food fish. From the fishers who answered the questions, Grouper has the highest percentage (17%), followed by Botana (9%). These two groups are both considered good as ornamentals and as food fish (Fig. 17).

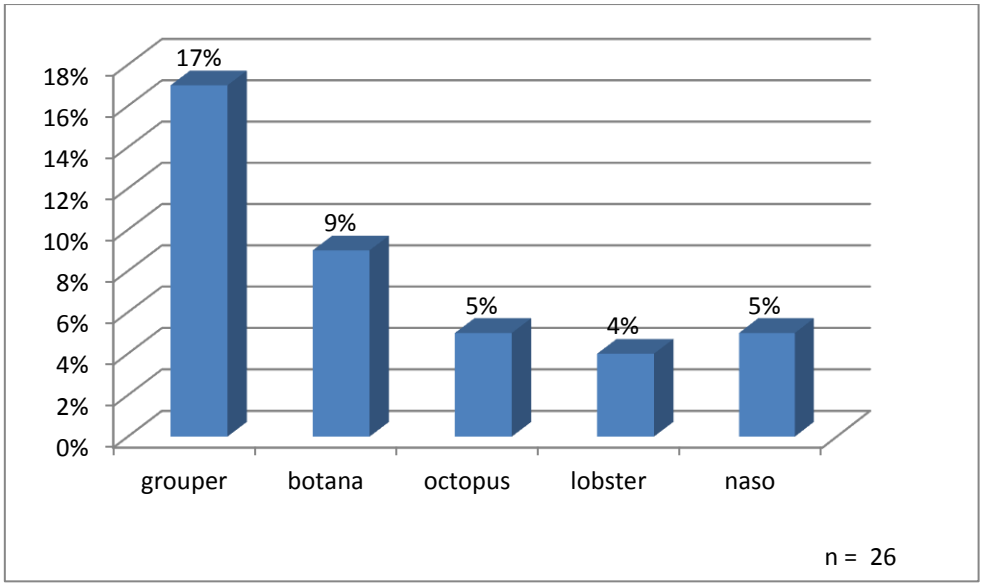

Figure 17. Percentages of species that are collected both as ornamentals and food fish

5.5. Supply chain - The role of buyers in the villages

The supply chain for ornamental fish in Bali can be short, and may involve only one or two buyers in the chain from fishers to the exporters, but trade chains are often long, and can include several buyers along the chain (Fig. 18). The length of the trade chains has implications for the health of the fish because of lengths of the holding and transportation times.

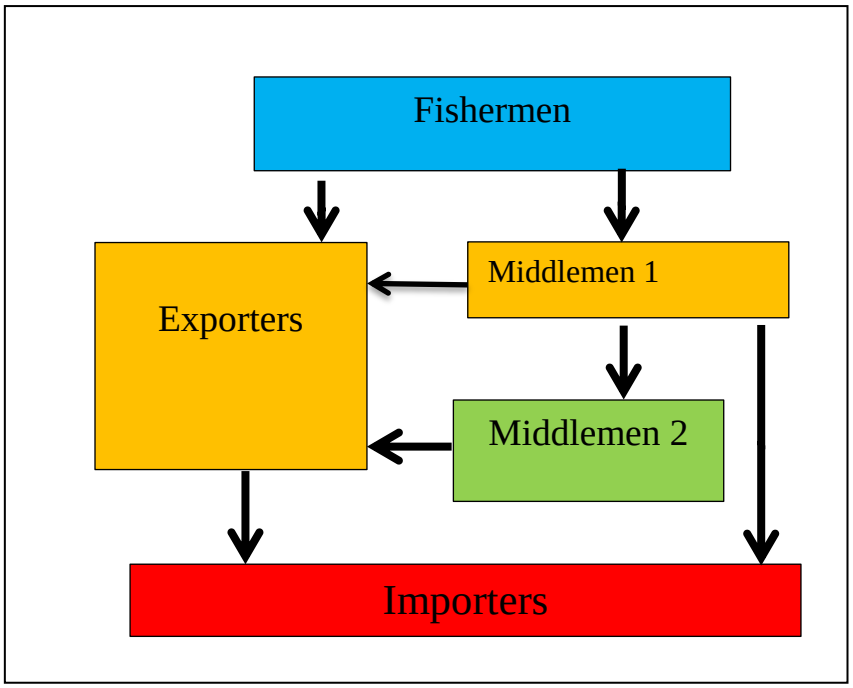

Figure 18. Supply chains

The primary buyers who purchase fish from the fishers are mostly middlemen who are also situated in the villages where the fishermen live. Fish are sold directly to the buyers on the same day as they were caught, and the buyers record the numbers of fish and quantities of each species they purchase. The purchase book could be used as the fishers' catch logbook. The middlemen normally keep the fish for a maximum of three days before sending them on to the next buyers, the exporters, who are mostly located in south Bali.

Some exporters have built holding facilities in the villages. Their facilities usually have better equipped holding systems compared to those of the middlemen. These exporters buy fish from the middlemen, and also direct from the fishers. The exporter's price is often higher than that paid by the middlemen, which makes the fishers prefer to sell directly to the exporters. Because of this, the middlemen are obliged to also increase the prices paid to the fishermen. When an exporter's facility is close to the fishing village, it helps to shorten the shipment times of the fish significantly.

Another group of buyers is the importers, who may sometimes come all the way from overseas to visit the middlemen's facilities in the village. They pick and choose their fish, then pay the exporters to pack the fish to be shipped. The importers are able to pay higher prices to the middlemen, compared to the prices paid by the exporters to the middlemen. These types of transactions upset the exporters, as they can often not compete with the prices paid to the middlemen by the importers.

Ordering the fish

The buyers (middlemen or exporters) put up a list of fish needed for the day, and the fishers will collect species and numbers of fish based on the list. However, high-value species will always be fished regardless of whether they are on the list or not, because fishers know that

high-value species will always be wanted by the buyers. Besides fish, other species collected for the marine aquarium trade include corals (hard and soft corals), molluscs, sea anemones, crustaceans, echinoderms and polychaetes.

5.6. Management of the Marine Ornamental Fishery in Indonesia

Although Indonesia is one of the major producers to the global marine ornamental trade, management of the fishery at regional and national levels is still very limited. Licenses to fish or trade are not required for fishers or middlemen at the local level. No harvest control systems have been developed so far at regional or national levels. There are no total allowable catch quotas set for any fish species, except for sea horses. The trade in sea horses has been regulated under Appendix II of the Convention on International trade in Endangered Species of Wild Fauna and Flora (CITES) due to their heavy exploitation for use in Traditional Chinese Medicine (TCM) .

Stony corale (Scleractinia) are an exception, since all species of stony coral are regulated under CITES. As a signatory to CITES, Indonesia has to comply with the resolutions issued by the CITES Secretariat. The Indonesian CITES Management Authority issues yearly harvest quotas for the allowable collection of corals in certain designated Provinces, based on recommendations from the Indonesian CITES Scientific Authority.

The Indonesian CITES Authorities have developed guidelines for better practices in coral collection and coral mariculture (MOF, 2008, 2011). The guidelines aim to help the industry and individuals who want to start coral collection or coral propagation for the marine ornamental trade. With the guidelines and regulations in place for corals, management measures for the coral fishery for trade can be implemented. In contrast, management measures for other organisms collected for the marine ornamental trade are very limited. The existing regulations (MMAF, 2009; Mukhtar, 2013) concerning the collection of marine reef fish include the prohibition of the use of cyanide, no fishing in No-take zones, and prohibition of ‘hookah’ (compressor) diving within Marine Protected Areas, but in general, these regulations are still difficult to enforce.

Recent stricter importation regulations for ornamental fish into Australia have obliged the Indonesian Quarantine Agency to issue a policy that stipulates improved biosecurity at the exporters’ facilities. The new policy requires exporters to implement biosecurity systems at their facilities that follow the Australian standard. This new policy has positively impacted and improved fish husbandry at the exporters’ facilities.

5.7. Challenges

In the 1970s, the coral reefs in Bali were subject to widespread mining and destruction for building materials. During this time, there were over 100 coral kilns operating along the north and east Bali. These were used to reduce the coral rocks to coral sand, which could then be sold to contractors and used for mixing with cement to make concrete. In 1980, the Governor of Bali issued a decree prohibiting coral mining along the coasts of Bali. Unfortunately, by

then, in many places, the damage was already so severe that large areas of marine habitats had been destroyed, and the loss of protective reefs led to erosion of the land by wave action along many parts of the Bali coastline.

Efforts to revive the condition of the coral reefs were started around the year 2000, initiated by the tourism sector, NGOs and community initiatives. In late 2000, fishers' groups in Les and Penuktukan started to deploy artificial structures to rebuild their damaged reefs next to their villages. Several local community groups have been rehabilitating their reefs, and the use of artificial structures is now being replicated in many villages in north and east Bali.

Although regulations to prohibit the use of poisonous chemicals, including cyanide ,to catch fish are in place, fish buyers (exporters) have reported that they suspect some of the fish coming to their facilities may still be being caught using cyanide. Usually, the fish arrive in good condition, but they refuse to feed, and deteriorate after a few days, often resulting in high mortalities. In the absence of cyanide testing, some buyers claim they can recognise the symptoms of fish collected with cyanide. When asked why they are still purchasing from the same suppliers who are known to use cyanide, the buyers will say that most of the suppliers sell fish that are caught using cyanide.

However, training is available for the fishers to learn to use non-destructive methods of fish collection. The first net training was offered in Bali as early as 2000. Training has been also offered by NGOs to industry members who would like to reform their supply chains and practices. However, this opportunity has not yet been generally welcomed or embraced by the industry. One reason is that they are reluctant to contribute financially towards the training. When asked, the exporters do show an interest in purchasing non-cyanide caught fish, but the exporters do not want to put pressure on their suppliers (middlemen) to not supply fish caught with cyanide because the suppliers may stop supplying the fish, and sell the fish to other exporters, who are not aware of cyanide issue. Cyanide use for fish collection therefore remains a big challenge in Indonesia.

As with other fisheries in Indonesia, data and information on fisheries, including stock status, catch data, habitat conditions and supply chains, are very limited or unavailable. Furthermore, effective reef fisheries management policies are still lacking, and no local or national legal framework exists to support or regulate the collection and trade of ornamental fish.

Section 6. Conclusions and Recommendations

Conclusions

The findings of this survey provide an understanding of the current condition of the livelihoods of the marine ornamental fishers in North Bali. It is far from complete. This survey was conducted in 7 villages, which represent typical Indonesian marine ornamental fishing communities, whose livelihoods depend on the coral reef resources.

The results of this survey indicate that the number of fishers has declined significantly in the last 10 years, for various reasons, including unpredictable income, reduced areas in which to fish, and greater work per unit efforts needed to earn enough money, as high value species are increasingly difficult to find.

Given their changing circumstances and factors affecting the amounts of fish they catch, the ornamental fishers are increasingly dependent on a combination of sources of incomes, to be able to meet their financial needs. In the past, the fishers looked for other incomes mainly during the rough weather season, where fishing was not possible. These days, fishers need to have other sources of income, many members of their families are obliged to find alternative sources of income. To achieve this, they will need further education and training. One impact of this need to find alternative employment is that there are less fishers working to supply the marine ornamentals market.

With the declaration of three Marine Protected Areas (MPAs) in Buleleng Regency in 2011, the fishers face further reductions in their catches, as fishing grounds are managed under the zonation system (Buleleng Regency Decree, 2011) . There are No-take zones within the MPAs, which function assanctuary areas for fish to recover and reproduce. Although the development of No-take zones effectively reduces the size of the fishing areas (and hence the means of income for the fishers), n the long term, the No-take zones will help to increase local fish stocks, which will ultimately benefit the local fishers financially.

With the effective management and protection of the No-take zones within MPAs, the spillover effects of the no take zones will populate the surrounding reefs and marine areas. While waiting for the positive impacts of the No-take zones to be felt, the installation of artificial reef substrates on damaged reefs, will help to increase fish biomass in the surrounding fishing grounds.

Deployment of the artificial substrates to enhance fish populations is an effective reef conservation strategy, and the visible return and increase of fish stocks in restored areas provides a credible incentive for the fishing communities to protect and more effectively manage the marine resources on which they depend.

Recommendations

- Conduct further detailed surveys of the trade to identify knowledge gaps and possible interventions to maintain sustainability in the trade while reducing the destructive impacts of the trade.
- Provide incentives and support for the fisher communities to find other sources of income, particularly during the rough weather season when they cannot collect fish.
- Provide scholarships to give more opportunities for the children in fishing communities to go on to further/higher education. Government and NGOs could provide scholarships.
- Provide environmental education to fishers communities to underline the importance of No-take zones to them for sustainability of fish stocks and income from marine resources.

MO industry and private sectors could provide funding to implement environmental education.

- Facilitate the implementation of stricter and more widespread enforcement of no-take areas, through community training with support from local government enforcement agencies NGOs can provide or facilitate training, with the support from the local Government.
- Encourage stricter enforcement of the laws relating to reef damage, and harsher penalties (particularly the use of cyanide).
- Buyers (exporters) should put pressure on their suppliers to not supplying fish, where cyanide is suspected being used to catch the fish.
- Encourage MO industry to support the installation of artificial reef structures to provide additional sources of fish, and therefore income to local communities, and to reduce their dependence on resources from natural reefs, especially in no-take zones.
- Industry could support training of fishers from other areas, particularly in the use of non-destructive fishing techniques and the establishment of artificial reef areas.

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