IPNLF Technical Report No. 4

Farmed Milkfish as Bait for the Tuna Pole-and-line Fishing Industry in Eastern Indonesia: A Feasibility Study

Arun Padiyar P. & Agus A. Budhiman
Aquaculture Specialists
WorldFish

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AP2HI
Asosiasi Perikanan Pole and Line dan Handline Indonesia

Asosiasi Perikanan Pole and Line dan Handline Indonesia (AP2HI) are an Indonesian task force dedicated to supporting the development of coastal tuna fishing activities in Indonesia, with members including fishers, exporters, processors and producers. With representation across the value chain for both pole-and-line and hand line, AP2HI play a lead role in encouraging efficiency within industry and to align with international market requirements. AP2HI promote fair, transparent, sustainable use of Indonesia's resources and work to gain further support for their fishery. AP2HI represent a shared voice for all businesses involved in pole-and-line and hand line fisheries in Indonesia.

IPNLF
INTERNATIONAL POLE & LINE FOUNDATION

The International Pole and line Foundation (IPNLF) is an international charity working to develop and demonstrate the value of pole-and-line caught tuna to thriving coastal communities. IPNLF's ambition is to improve the wellbeing of coastal fisheries, and the people and seas connected with them, through environmentally and socially sustainable pole-and-line fishing.

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AP2HI	Asosiasi Perikanan Pole-and-line dan Handline Indonesia (Indonesian Pole-and-line and Hand Line Association)
BBAP, Situbondo	Balai Budidaya Air Payau, Situbondo (Regional Center for Brackish Water Aquaculture Development)
BBBAT, Sukabumi	Balai Besar Budidaya Air Tawar, Sukabumi (National Center for Freshwater Aquaculture Development)
BBPPBL, Gondol	Balai Besar Penelitian Dan Pengembangan Budidaya Laut (Mariculture Research and Development Center)
BPP, Konga	Balai Penyuluhan Pertanian, Konga (Agriculture Extension Unit)
CPUE	Catch Per Unit Effort
DGA	Directorate General of Aquaculture, Ministry of Marine Affairs and Fisheries, Jakarta
DPP, Larantuka	Dinas Pertanian dan Peternakan (Agriculture and Animal Husbandry Service), Larantuka
DKP	Dinas Kelautan dan Perikanan (Marine Affairs and Fisheries Service), NTT Province
IDR	Indonesian Rupaiah
IPLHLA	Indonesian Pole-and-line and Hand Line Association
IPNLF	International Pole & Line Foundation
IRR	Internal Rate of Return
KPDT	Kementerian Pembangunan Daerah Tertinggal (Ministry of Disadvantageous Region Development), Govt. of Indonesia
MoU	Memorandum of Understanding
MMAF	Ministry of Marine Affairs and Fisheries, Jakarta
mt	Metric Tonne
NTT	Nusa Tenggara Timur (East Flores Province)
Puslitbang Perikanan Budidaya	Pusat Penelitian dan Pengembangan Perikanan Budidaya (Aquaculture Research and Development Center), Pasar Minggu, Jakarta
US$	United States Dollars

Pole-and-line fishing is considered to be a sustainable method for catching tuna. However, the reliance on baitfish, which are commonly very variable in their availability, has the potential to introduce unsustainable elements to the fishery.

The efficiency of pole-and-line fishing depends on the availability of baitfish of 6-9 cm in length, which is currently caught by boat-based lift nets, in coastal areas around tuna fishing grounds. However, a trend towards reduced baitfish catches over recent years combined with conflicts with the use of baitfish for human consumption, which is a cheap source of seafood for local people, has significantly increased bait fish prices. This situation has necessitated consideration of farming baitfish to ensure a sustainable supply to pole-and-line tuna fishers.

Milkfish is one of the potential farmed fish that could be used as bait in the tuna industry, as it has been successfully trialed in the past. Milkfish farming for food fish production is already well established in Indonesia and other countries such as the Philippines, Taiwan, and Pacific island countries. It is considered to be an environmentally sound farming system due to milkfish's low food chain positioning - herbivorous or omnivorous feeding habit.

The purpose of this study, commissioned by the International Pole & Line Foundation (IPNLF) and conducted by WorldFish, is to review current experiences in the farming of milkfish and to prepare a feasibility study for development of viable milkfish bait supply for selected IPNLF priority locations in Eastern Indonesia. The study was conducted with particular focus on Larantuka, Nusa Tenggara Timur (NTT) or East Flores province of Indonesia. The fieldwork was conducted during 1 April – 12 May 2014. In detail, the study aimed to explore the possibility of milkfish fry as live bait for pole-and-line fisheries from both an economic point of view as well as technical viability, in order to overcome the problem of bait scarcity for pole-and-line fisheries throughout Indonesia.

At present, there are about 104 pole-and-line fishing boats in Larantuka. Of these, only 50 are active due to the severe scarcity of baitfish. If all the 104 boats were active and undertook 10 fishing trips per month, then they would require 5,200 baskets of bait per month (41.60 million live bait per month). There is seasonal variation in tuna catches, with tuna available only for 8 months of the year. The fishing is very low or no fishing is carried out during 4 months of the year, i.e. January-

February and July-August. Therefore, the annual bait requirement (for 8 months only) is approximately 332.80 million (41,600 baskets) for all 104 boats or 160 million (20,000 baskets) for 50 active boats. The present market price of live wild bait is IDR 300,000–425,000 per basket (IDR 37.50–53 per bait). Therefore, the estimated annual value of baitfish supply for 41,600 baskets in Larantuka at present price is about IDR 12.48 – 17.68 billion (US$ 1.45 million).

Since there is demand for additional bait for the currently inactive pole-and-line boats and a need to overcome the shortage of bait fish supply during the peak tuna fishing period (160 million baitfsh per year), it is technologically and economically viable to set up a milkfish hatchery unit in Larantuka to produce eggs and fry. Farming of milkfish from fry to bait size (6-9 cm) can be practiced in both brackish water and freshwater areas. However, there is no scope for brackish water farming due to the thick mangrove forests in the coastal area of Larantuka. Therefore, the freshwater farming was chosen; paddy-cum-milkfish farming is the most suitable and sustainable method that can be tested through trials and if feasible, promoted on commercial scale in Larantuka.

This report presents the experiences in bait milkfish farming in Larantuka, assessment of the technical and economic feasibility and business model of hatchery and farm construction and operation. The potential role of different value chain actors and actions to be taken for effective implementation of a milkfish bait farming programme at commercial scale are presented.

Photo credit: ©Arun Padiyar.

Pole-and-line fishing is widely considered to be a sustainable method for catching tuna. However, the reliance on baitfish, which are commonly very variable in their availability, has the potential to introduce unsustainable elements to the fishery.

The efficiency of pole-and-line fishing depends on the availability of baitfish of 6-9 cm in length, which are currently caught by boat-based lift nets, in coastal areas around tuna fishing grounds. Baitfish fisheries also provide a cheap source of seafood for local people. The conflict between using baitfish for pole-and-line fisheries and for human consumption, combined with a trend towards reduced baitfish catches over recent years, has significantly increased baitfish prices. This trend is expected to continue due to highly variable bait fish catches which are very dependent on the natural environment and local fishing pressures.

This situation has necessitated consideration of farming baitfish to ensure a sustainable supply to pole-and-line tuna fishers. The use of farmed bait may also be a more environmentally sound alternative to wild caught bait.

Milkfish (*Chanos chanos*) is one of the fish that has potential as livebait for pole-and-line fisheries. Milkfish farming for food fish production is already well established in Indonesia and other countries such as the Philippines, Taiwan, and Pacific island countries. It is considered to be an environmentally sound farming system due to milkfish's low food chain positioning - herbivorous or omnivorous feeding habit. In the tropical and western Pacific Ocean, there have been some attempts at culture of mlikfish and mollies as baitfish (milkfish and mollies).

Large-scale culture trials have been undertaken in Kiribati and French Polynesia, whilst smaller projects have been carried out in American Samoa, Fiji, Palau, Tonga and Western Samoa. In Hawaii, tilapia has also been raised for livebait. The culture of baitfish in the Pacific is currently halted, due to the decline in pole-and-line fleets, and there are also perceptions that fishers are reluctant to purchase baitfish at higher prices. In Indonesia, pole-and-line tuna fishermen commonly purchase wild live bait from local fishermen (bagans or lift net boat).

Previous trials on pole-and-line operations using milkfish fingerling as live bait in Larantuka have yielded encouraging results. Due to limitations in wild bait fishing areas, pole-and-line fishers are interested to use milkfish as bait. It is potentially cost effective

and environmentally sound to produce milkfish due to its low food chain positioning (herbivore or omnivore feeding habit).

In Indonesia, farming of milkfish has been carried out for food fish production for several years, therefore there are both the skills and experience available to produce live milkfish fingerling as bait. Milkfish egg production, larval rearing techniques and culturing fish in brackish water ponds as well as in freshwater cages in reservoirs have been conducted for many years. The availability of milkfish larvae from artificial propagation in a hatchery will support the production of milkfish fry for live bait.

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Source: Google map

Larantuka, Nusa Tenggara Timur (NTT) Province, Indonesia

aimed to explore the possibility of milkfish fry as live bait for pole-and-line fisheries from both an economic point of view as well as technical viability, in order to overcome the problem of bait scarcity for pole-and-line fisheries throughout Indonesia.

At present, there are about 104 pole-and-line fishing boats in Larantuka. Of these, only 50 are active due to the severe scarcity of baitfish. If all the 104 boats were active and undertake 10 fishing trips per month, then they would require 5,200 baskets of bait per month (41.60 million live bait per month). There is seasonal variation in tuna catches, with tuna available only for 8 months of the year. The fishing is very low or no fishing is carried out during 4 months of the year, i.e, January-February and July-August. Therefore, the annual bait requirement (for 8 months only) is approximately 332.80 million (41,600 baskets) for all 104 boats or 160 million (20,000 baskets) for 50 active boats. The present market price of live wild bait is IDR 300,000–425,000 per basket (IDR 37.50–53 per bait). Therefore, the estimated annual value of baitfish supply for 41,600 baskets in Larantuka at present price is about IDR 12.48 – 17.68 billion (US$ 1.45 million).

Since there is demand for additional bait for the currently inactive pole-and-line boats and a need to overcome the shortage of bait fish supply during the peak tuna fishing period (160 million baitfsh per year), it is technologically and economically viable to set up a milkfish hatchery unit in Larantuka to produce eggs and fry. Farming of milkfish from fry to bait size (6-9 cm) can be practiced in both brackish water and freshwater areas. However, there is no scope for brackish water farming due to the thick mangrove forests in the coastal area of Larantuka. Therefore, the freshwater farming was chosen; paddy-cum-milkfish farming is the most suitable and sustainable method that can be tested through trials and if feasible, promoted on commercial scale in Larantuka.

This report presents the experiences in bait milkfish farming in Larantuka, assessment of the technical and economic feasibility and business model of hatchery and farm construction and operation. The potential role of different value chain actors and actions to be taken for effective implementation of a milkfish bait farming programme at commercial scale are presented.

This study is intended to assist IPNLF in advising on the development of a farmed milkfish fry or fingerling supply for tuna bait. The detailed objectives were to:

i) Review present experiences with milkfish bait farming in selected 2-3 priority IPNLF locations
   - What has been done?
   - What are the lessons/experiences of stakeholders?

ii) Assess present and future demand/potential for baitfish and local milkfish markets within these locations
   - Define the overall demand (baitfish, and food fish).
   - Understand factors determining demand – seasonality, fish size etc
   - Assess where the demand centres are – key sites for the IPNLF project in eastern Indonesia

iii) Prepare a technical and economic/business feasibility study of meeting milkfish demand in priority sites including:
   - Hatchery production (imported eggs) – feasibility, possible sites, likely size needed
   - Pond growout – number, area, site availability
   - Feeds and management systems – imported and opportunities for locally formulated feeds
   - Overall business model and feasibility

iv) Determine human resources needs for implementation
   - Current state of knowledge, and critical gaps
   - Types of training for local farmers and local staff
   - Organisation for training course on back yard hatchery
   - Other technical assistance needed for implementation

v) Assess investment needs
   - Finance required and returns on investment.
   - Possible sources of investment (KPDT, DGF, private)

vi) Institutional involvement and responsibilities
   - Define the role of different partners/institutions in implementation of the milkfish project

- Assess/develop cooperation with the Agency for Human Resources of Marine Affairs and Fisheries and other institutions involved, such as KPDT and Directorate General of Aquaculture.
- Determine who will be the producer of egg/fry/fingerlings at the selected locations - fish farmers, local government or Association?
- Define what would be the role of local fisheries service to support the project?
- Assess whether there are any government funds to support the project?
- Determine the role of IPLHLA to back up the fish farmers?

vii) Follow up actions

- Identify necessary follow up action and recommendations for implementation.

The report format follows these points in the Terms of Reference.

Field visits were made to various stakeholders in the target study area by the consultants during 1 April – 12 May 2014 to gather the required information for the study (Annex 1). The stakeholders consulted included national and local government agencies such as under MMAF and KPDT based in Jakarta, DKP at Provincial and District level in NTT province, DPP and BPP Konga in Larantuka, aquaculture research and development centres such as BBAP Situbondo, BBPPBL Gondol and BBBAT Sukabumi. Among the private sector stakeholders, the information was gathered from IPNLF representatives in Jakarta, tuna fishing and trading companies such as PT. Ocean Mitramas, PT Prima Indo Ikan, PT Okishin, pole-and-line fishermen in Larantuka, private milkfish hatchery owners and operators in Gondol, and aquaculture farmers in Larantuka.

Primary information was obtained through direct interviews with stakeholders by seeking their opinion on important issues in the pole-and-line fishing industry. Secondary data was collected from government departments and agencies in order to back up primary data. Existing knowledge and expertise of consultants and the Indonesian milkfish farming industry was considered to develop specific intervention strategies for Larantuka. Environmental and socio-economic aspects were considered during proposal of action plans.

A major limitation of the survey was inability to observe pole-and-line vessel operation using farmed milkfish as a live bait, because milkfish fry was harvested and already used as bait on previous fishing operations and the remaining milkfish in ponds were not enough to support even one vessel for fishing operation. Secondly, because of limited time, this study was only conducted in the beginning of the skipjack season; further work should cover the whole year.

Photo credit: ©Arun Padiyar.

1. Present experiences with milkfish bait farming in Larantuka

The study focused on Larantuka, following a request from IPNLF to concentrate in this location.

PT. Ocean Mitramas has been farming milkfish for bait purposes in Larantuka since November 2012. The company has leased out 2 ha of brackish water land near Larantuka airport, which belongs to the Department of Fisheries and Marine Affairs (DKP), NTT Province. KPDT has financially supported the project to construct the farm, which has eight ponds of each about 800-1000 m^2 water spread area. Another three ponds of 3500 m^2 each are under construction. The farm has a 1 m high outer bund for protection from tides and is fenced by 50 cm high of fine mesh net to prevent entry of predator animals such as lizards, snakes etc. Each pond has a water gate, which acts both as inlet and outlet, to ensure a maximum of 0.5 m water depth is maintained. Next to the farm, there is a piggery and the dry pig manure is used as fertilizer in the ponds at 100 kg per pond per cycle.

At the time of publication, they had completed 3 cycles of bait production using milkfish fry purchased from commercial hatcheries in Gondol, Bali. The standard farming process can be summarised as:

1. Pond preparation by drying the bottom for a week

2. Filling the pond with the filtered water to maintain 10 cm of initial water depth

3. Application of insecticide to control pests and weed fish

4. Application of dry pig manure at 100 kg per pond (or 800-1000 kg/ha) to develop benthic algae within 5-7 days

5. Stocking with 20 days old milkfish fry at a density of 50,000-60,000 fish per pond (or 50-75 fish per m^2)

6. Gradually increasing the water depth at a rate of 10 cm per week

7. Use of supplementary feed: rice powder for first two weeks, followed by rice bran. After 2 weeks the benthic algae should be fully eaten by fish

The fish were grown to bait size (6-9 cm) within 30-40 days and then harvested. The detailed economics of each crop is given in Annex 4.

During the first production cycle in November 2012, only one pond was stocked with 50,000 fry, with only 2,500 fingerlings harvested - 5% survival rate. The cost of fry at this time, including transportation up to Maumere airport, was IDR 50/fry. However, the farm has not maintained the management and expenditure records for this crop, making the cost of production difficult to calculate. The failure of the crop was mainly due to staff inexperience in milkfish production.

During the second production cycle in July 2013, the company hired an experienced farm manager from Java (Mr. Rasum) and repeated the crop in two ponds with a total of 100,000 fry. The cost of fry at this time, including transportation up to Maumere airport, was still IDR 50/fry. Fry was small in size without complete development of bones (15 days after hatching) and during the transportation from Gondol to Larantuka there was 32% mortality. However, the survival rate in the pond was better than that during the previous cycle, reaching 81%. The survival rate from fry purchase to harvest was 55%. In total, 55,000 baitfish were harvested in 58 days. The growth rate was slower than expected and the fish size at harvest was 7 cm. The baitfish was sold to pole-and-line fishers for IDR 300,000 per basket of 8000 fish (or IDR 37.5 per bait), which is low because no fishers at that time used milkfish as bait. The cost of production was calculated as IDR 316 per bait. PT Ocean Mitramas gave a special discounted price to its fishers to encourage them to experiment using milkfish as bait. Only some fishers were receptive to this idea of using milkfish as bait and they used it with varied degrees of success in tuna catch (Table 1).

The third production cycle was started on 18 October 2013 where the bait was partially harvested on regular basis until 31 March 2014. All 8 ponds were stocked with a total of 550,000 fry from Gondol, which were chosen for their quality and size. The cost of fry at this time, including transportation to Maumere airport, was IDR 45/fry, less than previously. During transportation from Gondol to Larantuka, there was only 7% mortality, which was a significant improvement over the previous cycle (32% mortality). In total, 447,772 baitfish were harvested during the cycle, with an 81% survival rate from purchase to harvest. Due to lack of crop planning, the bait could not be completely harvested during December – February, as this is the lean fishing season where there is a lack of demand for bait. The fish were stunted during this period without additional feeding. During March

Bait length should be 6-9 cm

Bait weight should be about 6-9 g

Wild Baits (Sardine, ikan tembang, teri, layang)

Boat lift net for wild bait collection

Photo credit: ©Arun Padiyar.

- peak fishing season with good demand for bait - all the fish were harvested at 7 cm and sold at a price of IDR 500,000 per basket (IDR 62.5 per fish).

During the trial milkfish bait production, PT Ocean Mitramas made a capital expenditure of IDR 346.4 million for farm construction and purchase of farm equipment. For the first crop, farm records were not maintained so the cost of production is not available. For the second crop, the operational cost to produce 55,000 baitfish was IDR 17.4 million, or IDR 316 per bait. During the third crop, the operational cost of production significantly reduced to IDR 102 per bait.

There was also a significant reduction in mortality rate during transportation of milkfish fry from Gondol to Larantuka. The recorded decrease from 32% during second crop to 7%

during third crop was mainly due to improved seed selection process and importance given to seed quality by selecting older fry. In addition, the survival rate during farming gradually increased from 5% in first crop to 55% in second crop and 81% in third crop. This improved survival rate is due to improved experience of farm workers and hiring of an experienced farm manager.

Fishing efficiency using farmed milkfish bait

The efficiency of tuna fishing with milkfish as bait has been found to vary with the fishing season. During March 2014, between 15 and 441 kg of tuna were caught per basket of bait (Table 1). During the same period, the average tuna catch using wild bait by 50 pole-and-line boats operating under PT. Ocean Mitramas was 463 kg tuna per basket.

Initially, there was difficulty in handling the milkfish and understanding their use as bait by the fishermen, which resulted in very poor catch efficiency. However, handling milkfish quickly improved, and so did tuna catch efficiency. To understand any difference between tuna catch efficiency using wild bait and milkfish bait, there should be a detailed study undertaken during the next season.

Table 1. Tuna catch efficiency with milkfish fry as bait during trial operations in Larantuka

Date	Vessel Name	Number of Baskets	Catch (kg)	Catch per Basket	Number of Trips	Total Catch (kg)	Catch per trip
17-Sep-13	Nelayan Bhakti 30	3	174	58	6	2494	416
17-Sep-13	Nelayan Bhankti 72	3	199	66	6	2494	416
29-Sep-13	Nelayan Bhankti 72	3	223	74	13	3351	258
9-Nov-13	KM Asty Sayang	6	90	15	7	3550	507
11-Nov-13	Nelayan Bhankti 72	3	116	39	7	3142	449
12-Nov-13	Nelayan Bhakti 72	3	282	94	4	2704	676
3-Dec-13	KM Asty Sayang	4.5	510	113	4	10970	2,743
9-Dec-13	KM Asty Sayang	6	250	42	6	13334	2,222
6-Mar-13	Nelayan Bhakti 39	2	98	49	6	2574	429
8-Mar-14	Surya Mas	4	1178	295	5	5765	1,153
9-Mar-14	Surya Mas	6	2313	386	6	7004	1,167
27-Mar-14	Surya Mas	6	804	134	3	2101	700
17-Mar-14	Flotim 16	4	1088	272	3	2101	700
30-Mar-14	Flotim 16	5	2204	441	9	8394	933
31-Mar-14	Flotim 16	4	1164	291	10	10156	1,016

2. Assessment of present and future demand/potential for milkfish for bait purpose and local consumption

A. Bait fish demand for pole-and-line fishing

As per the national capture fisheries statistics (MMAF, 2011), during 2010, the pole-and-line fisheries in Maluku-Papua, Sulawesi and NTT province in Eastern Indonesia landed 79,557 mt, 55,341 mt and 14,961 mt of skipjack tuna respectively (Table 2). Thus, NTT province occupies the third position in pole-and-line tuna fishing in Eastern Indonesia.

In NTT province, the pole-and-line fishing activities are focused around Sikka, East Flores and Kupang Districts. The data collected from some of the fish landing centres in NTT province (Table 3) has shown that skipjack tuna is the main species caught in NTT waters and Savu Sea in particular (PPP Kupang, 2010). As per the information provided by PT. Ocean Mitramas and other tuna fishing companies, at present Larantuka is the main landing centre for pole-and-line fisheries activities in NTT Province. This is mainly due to availability of bait at cheaper prices in the Larantuka area compared to other parts of NTT provinces such as Kupang, Maumere etc., where human population is dense and baitfish are used for human consumption.

Table 2: Catch of Skipjack by pole-and-line which is landed in Eastern Part of Indonesia (NTT, Sulawesi, Maluku and Papua), 2006-2010 (metric ton)

	2006	2007	2008	2009	2010
Nusa Tenggara Timur	1 891	6 008	11 792	6 909	14 961
Sulawesi	68 199	69 545	82 104	51 584	55 341
Sulawesi Utara	40 686	43 932	38 930	39 804	40 514
Gorontalo	1 510	627	1 720	4 126	2 675
Sulawesi Tengah	482	630	26 979	135	4 282
Sulawesi Selatan	13 616	15 971	5 989	2 179	93
Sulawesi Barat	-	-	-	-	-
Sulawesi Tenggara	11 905	8 385	8 486	5 340	7 777
Maluku - Papua	62 437	72 502	76 593	75 950	79 557
Maluku	16 559	27 024	30 278	21 334	24 302
Maluku Utara	35 852	40 806	43 183	51 484	52 123
Papua	2 453	2 240	-	-	-
Papua Barat	7 573	2 432	3 132	3 132	3 132

Source: Statistics of Capture Fisheries, MMAF, 2011

Table 3. Tuna species composition caught from fish landing centres of NTT province (PPP Kupang, 2010)

Total		**1,714.8**
Lemadang	*Rainbow runner*	0.3
Tongkol abu-abu	*Longtail tuna*	50.6
Tongkol krai	*Frigate tuna*	0.5
Tongkol komo	*Kawa kawa/Eastern little tuna*	33.4
Cakalang	*Skipjack tuna*	1,301.1
Albakora	*Albacore*	7.1
Madidihang	*Yellowfin tuna*	321.3
Ikan lainnya	*Other fishes*	0.5

Table 4. Pole-and-line fishing fleet in East Flores District of NTT Province

No	**Name of Vessel**	**Number (unit)**
	LARANTUKA VESSELS	
1	Flores Timur	33
2	Nelayan Bhakti	30
3	Prukap	1
4	Bahtera Flotim	4
5	INKAMINA	7
6	KAYU	11
	MAUMERE VESSELS	
1	Nelayan Bhakti	4
2	Kayu	14
	TOTAL	**104**

Four large companies - PT. Ocean MitraMas, PT. Okishin, PT. Prima Indo Ikan and PT. Tri Buana Lintas - have a tuna trading base in Larantuka. Of these, PT. Ocean MitraMas and PT. Okishin are members of AP2HI. PT. Ocean MitraMas has a tuna export centre in Banyuwangi, East Java, and has over five carrier ships or "mother ships", each with 300 mt fish holding capacity; two of these mother ships operate all across Indonesia. In NTT province they are anchored in the fishing port at Larantuka, which is the nearest place to the fishing grounds. The pole-and-line boats come to the mother ship and unload/sell their tuna. The mother ships then transport the fish back to the export centre. PT. Okishin has a fish processing centre and cold storage in Larantuka.

The large companies buy the skipjack catch from 104 pole-and-line fishing vessels "owned" by small-scale fishers (Table 4), though there are various contractual obligations and arrangements with the larger tuna companies. These large companies financially support the pole-and-line fishing boats by supplying fuel (diesel), baitfish, food and other onboard living essentials for fishers through advance payments. Also, they offer credit to trustworthy fishers for buying the boats. In return, they expect the pole-and-line fishers to sell the catch to them at prevailing market price, as a buy-back arrangement. Pole-and-line fishers not in this kind of agreement sell their catch in the open market.

There are two types of pole-and-line vessels, based on their fish holding capacity; wooden boats (5-10 mt) and fiberglass boats (3-5 mt). On average they catch about 5 mt of tuna per boat per trip during the peak fishing season. The wooden boat needs 17-20 fishermen for fishing and each fisher can catch about 120 fish per hour. The size of caught skipjack tuna ranges 1-3 kg, a decline from peaks of 8 kg ten years ago. The duration of each fishing trip is 1-2 days, depending on the presence of tuna shoals and the survival rate of bait in the holding tanks; dead baitfish do not attract tuna thus reduce fishing efficiency. Each pole-and-line vessel undertakes 10-15 fishing trips per month. On an average, each boat requires about 5 baskets of bait per fishing trip - 3-5 baskets per trip for small boats (<30 GT) and 7 baskets per trip for big boats (>30 GT). Each basket contains about 8,000 live baitfish, weighing about 50-60 kg. Baitfish purchase represents approximately 50% of the total expenses for pole-and-line fishing.

At present, only 50 of the 104 boats are active due to severe scarcity of baitfish. The 50 active boats require about 2,500 baskets, or 20 million baitfish, per month. If all the 104 boats were active and undertook 10 fishing trips per month, they would require about 5,200 baskets of bait, or 41.6 million live bait, per month.

Currently, tuna fishing companies prefer to use farmed milkfish only as supplement to the wild bait, especially during bait scarcity period. Complete replacement of wild bait may not be economically feasible in the present circumstances.

The major wild baitfish species used in Larantuka are tembang (*Sardinella fimbriata*), juvenile rambeng (*Pterocaesio pisana*), layang (*Decapterus sp.*) and teri or anchovy (*Encrasicholina sp.*). Tembang is a very common baitfish that forms around 70 % of the total bait used by the fishers. Rambeng, also known as pisang pisang when larger, is commonly used as bait. Together, tembang and rambeng are the most common baitfish used in Larantuka. Teri or anchovy is categorised into three species; white, black and red. White

anchovy (*Encrasicholina heteroloba*) is reported to be weak and with a low survival rate, according to local fishers. The red anchovy (*E. devisi*) may be even weaker, and looks similar to the white anchovy but appears red under the light at night. The black anchovy (likely to be *E. punctifer*) is described as a very strong species by the Larantuka Fishers and is caught from the open ocean.

Wild bait are caught using bagan or lift nets in the coastal waters of Larantuka. Bagans are clustered around five areas in Larantuka and one in Lembata.

All the wild bait species are very seasonal in occurrence. There are also inter-annual changes in occurrence; for example the black anchovy, the most preferable bait, has been difficult to find for the past two years.

Tuna populations also experience seasonal variation, with the fish being available only during eight months of the year. Uncontrolled purse seine catches of tuna has led to reduced tuna availability and tuna sizes, thought to be a sign of overfishing. Catches are low or nonexistent during the periods January-February and July-August. Therefore, the annual bait requirement (for 8 months only) is about 332.8 million (41,600 baskets) for all 104 boats or 160 million (20,000 baskets) for 50 active boats.

According to the commercial tuna fishing companies in Larantuka, the present market price of live wild bait is IDR 300,000–425,000 per basket (IDR 37.50–53 per bait). The price of wild bait depends on the tuna fishing season, demand from tuna fishing boats and daily availability of baitfish. This current cost of wild bait in pole-and-line fishing is about 50% of the total fishing cost (Table 5). The estimated annual value of baitfish supply for 40,000 baskets in Larantuka at present price is about IDR 16 billion (US$ 1.45 million),

Photo credit: ©Arun Padiyar.

Mother ship and pole & line boat

Skipjack tuna

and it is steeply increasing annually. In 2011, the cost was only about IDR 100,000–150,000 per basket. This steep increase in bait prices is due to scarcity of wild bait and competition from demand for local human consumption. Scarcity of bait has led to reduced tuna catches and reduced exports of pole-and-line caught tuna by big companies in Larantuka. In order to activate the remaining 54 inactive pole-and-liners, there is a significant need for additional bait - an additional 2,700 baskets, or 21.6 million baitfish, per month, totaling 21,600 baskets, 172.8 million baitfish, per year.

Gillet (2014) reported that tuna to bait ratios, obtained by various pole-and-line fishing operations in Larantuka, were 15:1, meaning an annual catch of 15,000 mt of tuna requires 1,000 mt of baitfish, totaling a requirement for 150 million baitfish per annum. This estimate is close to our own figure of 160 million baitfish required per annum for the 50 active boats. However, one company suggests tuna:bait ratio is closer to 11:1 during peak fishing season.

Trial fishing using milkfish bait for small boats obtained tuna:baitfish ratios of 8:1 for the wooden vessels (25-29 GT) and 9:1 for fiberglass boats (16 GT) prior to the start of peak catch season at end of March. This evidence suggests milkfish could be more efficient bait than wild fish during the peak fishing season. However, a more systematic comparative study during the whole fishing season needs to be conducted for confirmative results. Pole-and-line caught tuna commands a premium price in the international market (1.4

Table 5. An example of economics of a tuna pole-and-line wooden boat at peak season (direct collection of data from a boat KMN Surya Mas on 22 April 2014)

Inputs	Quantity	Unit price(IDR)	Total price (IDR)
Diesel for boat	400 L	6,000	2,400,000
Wild Bait	7 baskets	425,000	3,000,000
Rice	25 kg	10,000	250,000
Cigarette and lighter	2 packs		276,000
Total expenses			**6,051,000**
Revenue from tuna catch	6,122 kg	8,494	**52,000,000**
Operating Profit			**45,949,000**

**Duration of fishing: 1 day*

** Total fishermen in the boat: 17*

US$/kg for pole-and-line tuna versus 1.1 US$/kg for purse seiner tuna). According to the tuna fishing companies and Director of International Market of MMAF, there are two reasons for this higher price:

1. Pole-and-line caught tuna is perceived as more sustainable than purse seine caught

2. Pole-and-line caught tuna are higher quality, with limited damage (such as loss of fins, opercles, damage to skin) which is more prominent in purse seine caught tuna

Problems faced by pole-and-line tuna fishing industry

Pole-and-line fisheries are highly dependent on the availability of live baitfish. A 2012 study conducted by the Research Center for Capture Fisheries in Sikka District and East Flores District noted that bait catch was drastically reduced in the coastal area of East Flores. The reduction was due to the operation of lampara fishing gear, which sells its catch to fishmeal industry, and was further exacerbated by rampant illegal dynamite explosive fishing from 2004 to 2011 (Setyawan, 2012). Scarcity of bait due to the conflict among lampara, pole-and-line fishers and bagan fishers and to some extent conflict of fishing ground have collectively caused decreased CPUE of pole-and-line fishing since 2000 (Gillet 2014). Gillet (2014) also observed high mortality of baitfish during transportation to fishing ground due to poor handling.

Other aspects that affect pole-and-line fisheries production include increasing fuel price and the distance to the fishing grounds. A decrease in the number of pole-and-line vessels in Kota Kendari was reported by Husen (2008), where pole-and-line vessels drastically decreased from 19 to 6 during 2005 to 2008.

Similarly in Larantuka, although the fleet includes around 104 vessels, only half of these are in operation due to scarcity of bait. Bait is rare and its price has also increased from 75,000 IDR in 2005 to 400,000 IDR per basket in 2014 (Mr. Bambang Prihadi, PT Ocean Mitramas, per. comms.). However, increasing operational costs have not been compensated by the increasing international price for tuna product

Some of the key problems faced by pole-and-line fishers can be summarised as follows:

1. Availability and prices of bait – availability is decreasing annually whereas price is increasing rapidly; since 2012, price has quadrupled from 100,000 IDR per basket to

400,000 IDR per basket. These barriers to access bait are creating conflict amongst pole-and-line fishers.

2. The fish used as bait are also used for human consumption in the local market. The species used for bait are also some of the cheapest seafood in the local market and hence demand is growing.

3. Purse seine vessels competing with pole-and-line fishers for the same resource.

4. Increasing fuel costs.

5. Stagnant or decreasing prices of tuna in recent years.

B. Estimated demand for milkfish for human consumption in NTT province

Milkfish is not farmed in NTT province on a commercial basis and therefore is not available in the local market. It is rarely imported from other provinces, but when available, it sells at a retail price of IDR 30,000-35,000 per kg. There is reported demand for purchasing milkfish for food. During 2013-2014, the DKP Larantuka financially supported construction of a brackish water fish farm in Lewolega village (1 h by road from Larantuka), owned and operated by Mrs. Maria Theresia Maran, a retired school teacher. Mrs. Maran received a farm-gate price of IDR 20,000 per kg (250 g size fish at harvest).

As per the information given by the local DKP in Larantuka, the present population of NTT province is 274,000 and the annual local fish consumption is 4,550 mt. Therefore the

Photo credit: ©Arun Padiyar.

Brackishwater fish farm at Lewolega

Freshwater fish farm (catfish - Ikan lele) in Konga

per capita fish consumption is 16.6 kg per year. This is far below the Indonesian national per capita fish consumption of 31 kg, potentially due to higher level of poverty and lower purchasing power in NTT province. If the farmed milkfish consumption is targeted at 10% of the total annual fish consumption in the province, then the demand could be about 450 mt per year.

3. Techno-economic feasibility of milkfish bait production and investment needed in Larantuka

A. Introduction

Aquaculture milkfish production has two broad aspects; hatchery production of eggs and fry, followed by farm production of bait sized fingerlings from fry.

Hatcheries include both egg and fry production units. The egg production unit consists of broodstock kept in holding or spawning tanks, which produce eggs on daily basis. The fry production unit includes larval rearing tanks (LRT) and natural food production tanks, for both phyto- and zoo-plankton. Natural food is produced in both indoor pure culture units and outdoor mass culture units. A hatchery requires a continuous supply of good quality seawater and limited quantities of freshwater; egg production units require raw seawater, whereas fry production requires filtered seawater (slow sand filters, UV and ozone filters).

The milkfish broodstock maintained in an egg production unit produces eggs on daily basis. The quantity of eggs depends on the male:female ratio, broodstock feed and nutrition, photoperiod and water quality. A single cycle of fry production takes 20 days, and is

Egg Production Unit	• Broodstock maintenance cum spawning tank • Egg holding tanks
Fry production unit	• Larval rearing tanks • Natural food production tanks (indoor and outdoor) • Water filtration units • Fry packing shed
Fingerling/bait farm	• Earthern ponds (nursery) • Farming of Fry to Fingerling size (bait) • Fertilisation of pond to produce natural food for fish • Supplementary feeding using local agriculture byproducts such as rice bran, oil cakes

the time taken to grow fry from egg stage or completion of larval development stages. 20 day old fry have fully developed bone structure and all appendages, thus making the fry sturdy enough to withstand the wider environmental fluctuations in natural water bodies and aquaculture farms.

B. Feasibility of establishing a milkfish hatchery in Larantuka

Larantuka is an ideal location for establishing milkfish hatchery both in terms of geographical proximity to pole-and-line fishing activities and economic considerations, such as seed transportation and related issues. It has very good quality seawater from a very calm coastal area and tropical weather almost similar to Gondol, the center of milkfish hatchery production in Indonesia. Therefore, year-round seed production is possible.

In order to meet the estimated monthly additional bait demand of 21.6 million milkfish from farming, there is need to produce 27 million fry from hatchery accounting for an 80% survival rate from fry to bait size. In this study, we have presented an economic analysis for establishing one unit of hatchery, which can produce 10 million fry per month or 7 million fry per hatchery cycle. Hatcheries are designed and constructed based on economically and technically optimised fry production capacity models (units). If the capacity of the design falls below this minimum production level, the cost of fry production increases. This minimum design unit can be replicated to match the required quantity of fry production. Therefore, to meet the demand of 27 million fry per month we need to construct 3 units and for all the follow-up financial estimates, we need to multiply by 3 in order to arrive at the scale-wise financial figures based on the demand of 27 million fry per month.

To produce 7 million fry per cycle of 20 days (10 million fry per month) we require about 6000 m^2 (0.6 ha) land. This means, to produce 27 million fry per month we require about 18,000 m^2 or 1.8 ha of land. The existing milkfish farming land near Larantuka airport is ideal for hatchery establishment. Also, the brackish water land belonging to Ibu Maria Teresa in Lewolega village can also be considered. She has already accessed the government subsidy and support to grow milkfish for food production during 2013-2014.

There are two parts in hatchery operations, namely:

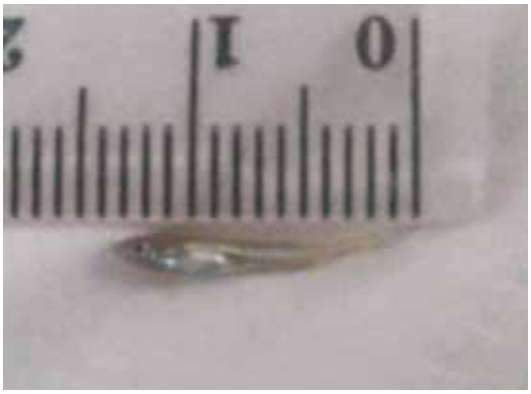
1) Egg production unit and

2) Larval/fry rearing unit

Broodstock holding tank in BBAP Situbondo

Larval rearing tanks in CV. Dewata Laut, Gondol

Milkfish Eggs



Milkfish frybondo

Photo credit: ©Arun Padiyar.

Based on the investment interest and manpower availability, we can have two different models of hatchery operation

1) Establish only a larval rearing unit in Larantuka which is operationalised using eggs imported from Gondol commercial milkfish hatcheries, or

2) Establish a complete set of egg production unit and larval rearing unit in Larantuka.

a. Economics of milkfish egg production

Egg production units require milkfish broodstock, which have to be maintained in a circular concrete water tank of minimum 235 m^3 capacity - 10 m diameter and 3 m deep. It requires daily 300-500% water exchange and there is a need for special feed for broodstock. Breeder fish can be purchased at a reasonable price (US$ 35 per breeder fish including transportation) from Gondol Aquaculture Research Center. As per our estimate, 60

Table 6. Economics of Egg production center in Larantuka (10 million eggs per month or 120 million eggs per year)

One unit of broodstock tank with 60 fish and egg production capacity of 300,000-800,000 egg per day

	Units	Rate (US$)	Total ($)	Rate (IDR)	Total (IDR)
Capital Expenses					
Land (m^2)	250	10	2,500	110,000	27,500,000
Earth work required and fencing	250	1	250	11,000	2,750,000
Fencing (cu. m)	180	2	360	22,000	3,960,000
Concrete Broodstock tank-m^3 (Circular)	250	50	12,500	550,000	137,500,000
Plumbing (Pipeline)	1	1,000	1,000	11,000,000	11,000,000
Tube-well at suction point	1	1,000	1,000	11,000,000	11,000,000
Electricity connection from Main Line (15 KW)	1	3,000	3,000	33,000,000	33,000,000
10 HP pump Electric	2	1,600	3,200	17,600,000	35,200,000
2 HP pump Electric	1	400	400	4,400,000	4,400,000
10 KW Diesel Genset	1	3,000	3,000	33,000,000	33,000,000
HighBlow aerator	1	450	450	4,950,000	4,950,000
Shed and accessories (packing and worker stay)	1	2,000	2,000	22,000,000	22,000,000
Pick-up van	1	15,000	15,000	165,000,000	165,000,000
Breeder fish including transport	60	35	2,100	385,000	23,100,000
Hormones, Oxygen Cyclinder Set and Accessories	1	2,500	2,500	27,500,000	27,500,000
Sub-total (Capex)			***49,260***		***541,860,000***
Operational Expenses					
Feed (kg) for fish (6 kg X 30 days X 12 months)	2,160	1	2,160	11,000	23,760,000
Feed additives (Vitamins, Fish Oil, Honey, Eggs)	432	1	432	11,000	4,752,000
Electricity (11 KWH X 24 h X 365 Days)	96,360	0.12	11,563	1,320	127,195,200
Fuel for Genset and van (10 Ltr X 365 days)	3,650	0.55	2,008	6,050	22,082,500
Technician cum electrician cum mechanic (1)	12	300	3,600	3,300,000	39,600,000
Full-time Manager (1)	12	450	5,400	4,950,000	59,400,000
Sub-total (Opex)			***25,163***		***276,789,700***
Other Expenses (interest and depreciation)					
Depreciation on Capex excluding Land @ 15% p.a.		7,014		77,154,000	
Interest rate on long-term capital - Capex @ 12% p.a.		5,611		61,723,200	
Interest rate on short-term capital - Opex @ 18% p.a.		4,529		49,822,146	
Total Expenses			***42,317***		***465,489,046***
Number of eggs sold per year			120,000,000		
Cost of egg production (per egg)			0.00035	3.88	
Annual Revenue from egg sales	**120,000,000**	**0.000545**	**65,455**	**6.00**	**720,000,000**
Annual Net profit from sales			**23,137**		**254,510,954**

Table 7. Cash flow statement in US$ (Egg production)

	Cash out (Expenses)	Cash in (revenue)	Net cash flow	Cumulative cash flow
Initial Capital investment	49,260		**(49,260)**	
Net income in year 1	32,500	27,273	**(5,228)**	(5,228)
Net income in year 2	38,267	65,455	**27,187**	21,960
Net income in year 3	38,267	65,455	**27,187**	49,147
Net income in year 4	38,267	65,455	**27,187**	76,334
Net income in year 5	38,267	65,455	**27,187**	103,522
Net income in year 6	38,267	65,455	**27,187**	130,709
Net income in year 7	38,267	65,455	**27,187**	157,896
Net income in year 8	38,267	65,455	**27,187**	185,084
Net income in year 9	38,267	65,455	**27,187**	212,271
Net income in year 10	38,267	65,455	**27,187**	239,459
IRR			**35%**	
Payback period			**36 months**	

breeder fish maintained in one tank with a male:female ratio of 1:3 can produce about 10 million eggs per month or 120 million eggs per year. Daily egg production ranges from 300,000–1,000,000, averaging around 400,000 eggs per day. Normally there is no egg production for about 4-5 days in a month.

The capital investment required for setting up an egg production unit (excluding land) is about IDR 550,000,000 (US$ 50,000) (Table 6) and operational expense including depreciation and interest is about IDR 460,000,000 (US$ 42,000). The cost of egg production is IDR 3.88 per egg. At a selling price of IDR 6 per egg, the annual revenue is IDR 720,000,000 (US$ 65,000) and net profit is IDR 250,000,000 (US$ 23,000). The Internal Rate of Return (IRR) is 35% and payback period is 36 months. The average price of milkfish egg from Gondol is IDR 6.41 (including transportation) but there could be lower hatching rate (10-20%?) due to transportation stress.

b. Economics of milkfish larval rearing (fry production from eggs)

The larval rearing unit for producing 7 million fry per cycle of 20 days, or 84 million fry per year, requires about 58 larval tanks of each 9 mt water holding capacity. 10 million eggs can yield about 7 million fry when accounted for a 70% survival rate. In addition, rotifer (zooplankton) and nanochloropsis (phytoplankton) tanks need to be constructed. The ideal ratio of tank water volume is 1:2:4 (Larva: Rotifer:Nanochloropsis). The capital investment required to set up the larval rearing unit is IDR 3,200,000,000 (US$ 290,000)

Table 8. Economics of Fry production (7 million fry per month or 84 million/year @ 70% Survival rate)

(Set of 58 Larval tanks each producing 100,000 fry per cycle and 1.2 cycles per month)

	Units	Rate (US$)	Total ($)	Rate (IDR)	Total (IDR)
Capital Expenses					
Land (m^2)	5000	15	75,000	165,000	825,000,000
Earth work	5000	1.5	7,500	16,500	82,500,000
Fencing	3000	2	6,000	22,000	66,000,000
Indoor algal culture facility (Equipments, Aircon etc)	1	1000	1,000	11,000,000	11,000,000
Larval rearing tanks with plumbing (m3) - 58 tanks	525	70	36,750	770,000	404,250,000
Rotifer tanks with plumbing (m^3) - 116 tanks	1,050	70	73,500	770,000	808,500,000
Chlorella tanks with plumbing (m^3) - 232 big tanks	2,100	70	147,000	770,000	1,617,000,000
Electricity connection from Main Line (10 KW)	1	1500	1,500	16,500,000	16,500,000
Electric pump (5 HP)	1	1000	1,000	11,000,000	11,000,000
Electric pump (0.5 HP) Freshwater	1	150	150	1,650,000	1,650,000
Electric pump (2 HP) - filtration tank to storage tank	1	400	400	4,400,000	4,400,000
Tube-well for freshwater	1	350	350	3,850,000	3,850,000
HighBlow Aerators	8	450	3,675	4,950,000	40,425,000
Aeration line (airstone and hose)	1,633	0.4	653	4,400	7,186,667
10 KW Diesel Genset	1	3000	3,000	33,000,000	33,000,000
SeaWater storage tank including roof	50	100	5,000	1,100,000	55,000,000
Slow Sand filter (6X2X1.5 m3)	18	100	1,800	1,100,000	19,800,000
Sub-total (Capex)			***289,278***		***3,182,061,667***
Operational Expenses					
Cost of egg	120,000,000	0.00055	65,455	3.88	465,489,046
Fertiliser and chemicals for algal tank	30,240	0.5	15,120	5,500	166,320,000
Electricity (7 KWH X 24 h X 365 Days)	61,320	0.1	6,132	1,100	67,452,000
Fuel for Genset (5 L X 365 days)	1,825	0.55	1,004	6,050	11,041,250
Worker salary (15% of revenue)	1	5,360	45,360	498,960,000	498,960,000
Sub-total (Opex)			133,070		1,463,773,250
Other Expenses (Interest and depreciation)					
Depreciation on Capex excluding Land @ 15% p.a.		32,142		353,559,250	
Interest rate on long-term capital - Capex @ 12% p.a.		25,713		282,847,400	
Interest rate on short-term capital - Opex @ 18% p.a.		19,961		219,565,988	
Total Expenses			210,886		2,319,745,888
Number of fry sold per year			84,000,000		
Cost of fry production (per fry)			0.00251	27.62	
Annual Revenue from fry sales	84,000,000	0.0036	302,400	39.60	3,326,400,000
Annual Net profit from sales			91,514		1,006,654,113

Table 9. Cash flow statement in US$ (Fry production)

	Cash out (Expenses)	Cash in (revenue)	Net cash flow	Cumulative cash flow
Initial Capital investment	289,278		(289,278)	
Net income in year 1	96,476	126,000	29,524	29,524
Net income in year 2	193,047	302,400	109,353	138,877
Net income in year 3	193,047	302,400	109,353	248,230
Net income in year 4	193,047	302,400	109,353	357,584
Net income in year 5	193,047	302,400	109,353	466,937
Net income in year 6	193,047	302,400	109,353	576,290
Net income in year 7	193,047	302,400	109,353	685,644
Net income in year 8	193,047	302,400	109,353	794,997
Net income in year 9	193,047	302,400	109,353	904,350
Net income in year 10	193,047	302,400	109,353	1,013,704
IRR			**29%**	
Payback period			**41 months**	

and operational expenses including depreciation and interest is about IDR 2,320,000,000 (US$ 210,000) (Table 8). At a selling price of IDR 40 per fry, the annual revenue is IDR 3,300,000,000 (US$ 300,000) and annual net profit is IDR 1,000,000,000 (US$ 90,000). The IRR is 29% and payback period is 41 months. The cost of fry production (including depreciation and interest and including egg price of IDR 3.88) is IDR 27.6. If the egg is directly imported from Gondol, instead of the own eggs in Larantuka, at a price of IDR 6.4 per egg, then the cost of fry will be higher by IDR 2.5 (IDR 30.1). If the fry is directly procured from Gondol at a price of IDR 39.8 including transportation, then the cost of fry will be higher by about IDR 12.2 per fry.

c. Economics of procuring eggs and fry from Gondol

Eggs and fry can be directly procured from commercial milkfish hatcheries located in Gondol on Bali. The average cost of egg and fry (including transportation up to Larantuka) would be IDR 6.41 and IDR 39.8, respectively. The price of eggs and fry from the hatchery in Gondol (without transportation cost) varies from IDR 3 to 8 and from IDR 22 to 27, respectively.

d. Summary and conclusion on milkfish fry production feasibility in Larantuka

A summary of the economics of three different models of fry production and procurement for farming bait size fingerlings in farms in Larantuka is presented in Table 13.

Table 10. Cost of packing and transportation per box

Items	Amount (IDR)
Styrofome box	60,000
Packing plastic	18,000
Road transport (Gondol to Airport) by public vehicle/wholesale	20,000
Air Cargo Freight charges for 18 kg box (24,500 IDR/kg)	441,000
Air Cargo handling costs	40,000
Quarantine fee	100,000
Road Transport (Maumere airport to Larantuka Farm)	25,000
Total cost of packing and transport per box	704,000

Table 11. Economics of egg procurement from Gondol

	Units	Unit cost (IDR)	Total cost (IDR)
Cost of eggs per box	500,000	5	2,500,000
Cost of packing and transportation	1	704,000	704,000
Total cost			3,204,000
Cost per egg at farm-site		6.41	

Table 12. Economics of fry procurement from Gondol

	Units	Unit cost (IDR)	Total cost (IDR)
Cost of fry (Grade B) per box	50,000	25	1,250,000
Cost of packing and transportation	1	704,000	704,000
Total cost			1,954,000
Cost per fry at farm-site		39.08	

Model 2, which consists of establishing a complete hatchery with both egg production and fry production unit in Larantuka, is economically most feasible followed by Model 1, which consists of egg purchase from commercial hatcheries in Gondol and rearing it to fry size in hatchery at Larantuka. The last economic model (Model 3) consists of direct fry procurement from commercial hatcheries in Gondol. However, successful implementation of Model 2 or Model 1 in Larantuka depends on availability of trained manpower, attitudes of local work-force, support from local government agencies, local community and the level of investment interest from private sector players.

Table 13. Summary comparison of cost of production or procurement of milkfish fry in Larantuka (IDR)

	Model 1: Egg purchase from Gondol and fry production in Larantuka	Model 2: Both egg and fry production Larantuka	Model 3: Direct procurement of fry from Gondol
Cost of egg at Larantuka including transportation if any	6.41	3.88	-
Cost of fry production at Larantuka including transportation if any	23.74	23.74	-
Total cost of fry at Larantuka	30.15	27.62	39.80

C. Feasibility of milkfish bait farming (growing the fry to bait size) in Larantuka

a. Economics of intensive production system

This system is already practiced at the farm of PT. Ocean Mitramas in Larantuka. The economics of such an operation at a commercial scale is presented in Table 14. The cost of production per fingerling, including fry cost, with an estimated 80% survival rate from fry to bait size is IDR 90. However, this does not include the capital investment to construct the ponds and buy the necessary farm accessories and equipment. Simple farming practices with locally available farm inputs such as pig manure, inorganic fertilisers, rice powder and rice bran is sufficient to farm the baitfish. Since the baitfish size is small at 6-9 cm or 6-9 g, there is no need for additional commercial pellet feed for farming the baitfish. The estimated yield is 400,000 baitfish per ha, per cycle of 40 days. This means, the monthly yield on an average is 366,000 bait/ha. Therefore, to produce 21.6 million baitfish per month, we require 59 ha of intensive farm.

b.Potential for brackish water farming

Almost all the brackish water area in NTT province, including Larantuka, is covered by thick mangrove forest and therefore it is not feasible to convert it to fish ponds. About 110 ha of saltpans are present in Kupang island - 18 h by boat or 45 min by flight from Larantuka - and pole-and-line fishers are willing to shift their base to that area if bait is reliably produced. Though this land is suitable, it is not advisable to convert it to fish farming purpose due to the priority for salt production.

Table 14. Estimated cost of production of bait milkfish in intensive farming system based on initial experiences from Larantuka

	Units	Unit cost (IDR)	Total cost (IDR)
Capital investment			
Pond construction (1 ha, 8 ponds)	1	314,000,000	314,000,000
Pump set (3.7 HP each)	2	3,700,000	7,400,000
Pump accessories and pipes	1	15,000,000	15,000,000
Fencing	1	9,000,000	9,000,000
Harvest nets	1	1,000,000	1,000,000
Sub-total (Capex)			346,400,000
Operational cost per cycle in 1 ha (8 ponds)			
Farm Manger	1.5	2,500,000	3,750,000
Workers (Full-time)	1.5	1,500,000	2,250,000
Fry (including transport from Gondol to Maumere)	500,000	35	17,500,000
Transportation cost (Maumere-LTK)	3	600,000	1,800,000
Rice powder + bran	250	10,000	2,500,000
Urea	233	3,000	700,000
TSP	100	5,000	500,000
Pesticide	1	1,200,000	1,200,000
Dry Pig Manure (bags)	150	10,200	1,530,000
Diesel	317	6,000	1,900,000
Electricity	1	300,000	300,000
Packing and transport of fingerling to fishing boat			2,100,000
Sub-total			36,030,000
Crop duration	40 days		
Bait size at harvest	7 cm		
Total survival rate from hatchery to bait	80%		
Harvest number	400,000		
Cost of production for bait (including fry cost)	90		

c. Potential for freshwater farming: Paddy-cum-milkfish farming

Since there is no environmentally feasible brackish water land available in Larantuka, freshwater areas are an alternative option. Most of the arable freshwater land in Larantuka is used for agriculture crop production, such as paddy and corn. Cornfields are not suitable to farm fish due to low water requirements, however to produce paddy crops, fields are flooded with water during the crop and also during the inter-crop period. There is possibility to use the land for monoculture of fish in an intensive system, and paddy-cum-milkfish polyculture farming could be a sustainable and ideal solution to address baitfish production needs.

Photo credit: ©Arun Padiyar.

Paddy field in Konga village

Paddy-cum-fish farm in BBBAT Sukabumi

However, this is only a hypothesis and needs to be confirmed and validated through field trials, the first of which is currently underway at BBBAT Sukabumi. If the trial yields positive results, then the expansion plan for commercial milkfish bait production can provide additional income to paddy farmers in Larantuka.

Milkfish is a euryhaline species and can grow in salinities ranging 0-50 ppt. The hatchery-produced fry can be easily acclimatised to freshwater within two to three days, and once at bait size they can be reacclimatised to seawater conditions, again within two to three days.

Irrigated freshwater in the paddy field can be used as farming media for milkfish, however minor land work such as heightening the embankment to 30 cm, digging ditch at the sides and constructing fencing is required to raise the fish safely. Larantuka has about 130 ha of paddy land spread in a cluster of three villages (Konga, Lewolega and Kanada) which are about one hour's drive from Larantuka airport and about 50-100 m from the beach. This cluster can be developed as a milkfish bait production hub. In addition to this, there is about 40 ha of paddy farms in Sago village of Adonara sub-district near Larantuka.

There is no prior experience in farming milkfish in paddy fields in Indonesia. However, there is experience in farming milkfish in freshwater ponds and reservoirs in Indonesia. Based on the experiences with other fish species used in paddy-cum-fish farming such as carps, catfish and tilapia, it is possible to produce up to 500 kg of fish per hectare only on fertilisation and without any additional feed. The average body weight of fish produced is 7 g. Therefore, we can anticipate a production of about 70,000 milkfish baits per ha per cycle of 30-40 days. To produce 8-20 million bait milkfish per month, we need about 115 – 286 ha of paddy farm.

Table 15. Estimated economics of Paddy cum fish culture (70,000 baitfish per hectare per cycle of 30-40 days)

	Units	Unit cost (IDR)	Total cost (IDR)
Capital cost			
Earth work required to raise the embankment and dig the ditch	400	2,750	1,100,000
Harvest net and	1	275,000	275,000
Fencing (cu. m)	200	5,500	1,100,000
Sub-total (Capex)			**2,475,000**
Operational Expenses			
Milkfish fry from Gondol to Larantuka (including transportation)	100,000	40	4,000,000
Organic fertiliser (additional)	500	1,100	550,000
Sub-total (Opex)			**4,550,000**
Estimated Survival rate			70%
Number of fingerlings produced per month			70,000
Total Cost of fingerling production (fry + fertiliser)			65
Cost of fry after considering the survival rate of 70%			57
Cost of fingerling production (fertiliser only)			8
Price offered to farmers for raising the fish			**40**
Gross buying cost of each bait for IPNLF			97
Revenue to famer from fingerling sale per cycle	70,000	40	2,800,000
Gross Profit for farmer per cycle			2,250,000
Gross Profit for famer per year or 6 cycles			13,500,000
Net profit for farmer per year after deducting the earthwork expenses			12,400,000
Cost of 70,000 bait for IPNLF per cycle			6,800,000
Cost of 70,000 bait for IPNLF per year or 6 cycles			
(after including capital expenses fencing + harvest materials)	42,175,000		
Net buying cost of each bait for IPNLF			**100**

Paddy crop production takes four months, from planting to harvest. Therefore, it could be possible to produce three cycles of milkfish bait production per paddy crop. Annually, two crops of paddy are farmed with freshwater irrigation from a nearby dam/reservoir. The paddy crop seasons are December – April (first crop) and June to October (second crop). It appears that the low tuna fishing seasons (Jan-Feb and Jul-Aug) falls during paddy seasons. Therefore, during the paddy break period (May-June and Nov-Dec) there is opportunity to intensify the fish farming activity by monoculture system without the paddy, allowing year-round bait fish production from paddy farms. However, these hypotheses have to be tested during trial period.

Table 16. Estimated economics of how the paddy cum bait fish farming would benefit the farmers

	Units	Unit price	Total price (IDR)
Paddy production in Larantuka (kg per crop)	4000		
Rice yield from Paddy (%)	65%		
Rice yield from Paddy (kg per crop)	2600	9,900	25,740,000
Cost of paddy farming per crop			
(ploughing, seed, planting, fertilisers, pesticides, harvesting etc)	10,000,000		
Net profit from paddy per crop			15,740,000
Net profit from paddy per year (2 crops)			**31,480,000**
Net profit from raising bait fish per year (6 cycles)			**12,400,000**

The Konga paddy cluster has a government agriculture extension unit (BPP) with 12 staff under Dinas Pertanian dan Peternakan (DPP). Head of agriculture division in DPP, Mr. Hendrik, is very much interested in a paddy-cum-bait fish farming demonstration programme at BPP and offered 1.7 ha of paddy farm for demonstration during the next cropping season - June 2014 onwards.

d. Freshwater farming: Other opportunities

There is a small freshwater fish farm, containing seven ponds – each around 25 m^2 and 0.5 m deep – farming Ikan lele or catfish, which is owned by Mr. Daniel in Konga village. One of the ponds could be used for milkfish nursing demonstration. However, there is an issue of poaching.

There are also freshwater swamps in Konga cluster. However, the swamps have very soft soil of more than 1 m deep and therefore not suitable for pond construction.

4. Human resources and capacity development needed for implementation

Since the milkfish live-bait has been introduced for use for pole-and-line fisheries in Larantuka, several attempts have been made through KPDT bait program to grow coopera-

tion between KPDT and PT. Ocean Mitramas. The two hectares of brackish water ponds owned by DKP East Flores have been rehabilitated physically followed by management improvement. Prior to the arrival of West Java labour skilled in farm management, some problems including higher mortality rate during handling of fish larvae and at growing period were common. Most of the Larantuka people do not have fish culture technology know-how and there is a specific need for training. Training may be carried out within and outside Larantuka namely in Technical implementing Units of DGA, as well as Gondol marine research center for aquaculture either in Situbondo, Gondol or in Sukabumi for Rice paddy-cum-fish culture. Currently there is a MoU between the Indonesia Pole-and-line Association and the Agency of Human Resources for Marine and Fishery Affairs. Budget and programme for such training can be requested to this Agency. BBPAT Sukabumi can also support capacity building in the area of rice fish culture in Larantuka

The current level of knowledge of local people in NTT of hatchery management and baitfish farming is very minimal or non-existent. For baitfish farming, there is a growing experience in farm staff of PT. Ocean Mitramas. Therefore, there should be full-scale effort to expose and train the local people in hatchery and farm operations. The suggested extension aspects are:

1. Hands on training to lead/key local people (farmers and government extension staff) on nursery management
   a. Paddy-cum-fish farming system in Freshwater Aquaculture Development Center (BBPAT), Sukabumi.
   b. Intensive farming system at PT. Ocean Mitramas farm, Larantuka

2. Demonstration of paddy-cum-baitfish farming at Agriculture Extension Unit (BPP), Konga (Larantuka).

3. Production and distribution of leaflets on nursery management to local farmers.

4. Hands on training of key staff of hatchery unit organised at BBAP, Situbondo.
   a. Egg production unit operation
   b. Backyard hatchery operation (larval rearing)

5. Field visit for Larantuka hatchery staff to Gondol commercial hatcheries.

5. Institutional involvement and responsibilities

We recommend the following activities for various stakeholders in this programme. The milkfish hatchery (egg production centre and larval rearing units) needs higher-level professional management and therefore it should be established and operated by AP2HI members. Milkfish bait farming is the relatively easier aspect and can be easily managed by local farmers and entrepreneurs.

However, there is need for initial trial and demonstration of paddy-cum-milkfish bait farming in freshwater and also improvement in intensive farming of baitfish under monoculture system. Also, hands-on training on hatchery management and farm management has to be provided to the Larantuka key stakeholders. Therefore, the services of DGA centres specialised in this subject (BBBAT Sukabumi and BBAP Situbondo) should be utilised. For local level demonstration and trials for milkfish bait farming, extension facilities at BPP Konga should be utilised. The following provides a summary of suggested institutional involvement.

IPNLF/WorldFish:

IPNLF/WorldFish cooperation should facilitate partnerships between local Indonesian stakeholders for various purposes to achieve the common objective of milkfish bait production in economically, socially and environmentally sustainable manner.

AP2HI members (Private fishing companies):

The investment cost for some of private fishing companies is likely a big constraint. However, it may be possible by using a scenario of cooperation between government and private companies, where all entities contribute funds, managing the project together with a local fish farmer who owns the hatchery; private fishing companies could supervise in terms of managing local fish farmers, and could engage in the project and buy fish from the farmers. A buy-back contract system would be most ideal for this purpose. Upon termination of the project, cooperation between a private fishing company and group of farmers can be continued with renegotiations with regard to the price of fry and other input cost procured by fishing companies.

Directorate General of Aquaculture

AP2HI should arrange for a MoU with DGA for arranging hands-on training and field visits to the stakeholders from Larantuka at its centres – BBAP Situbondo for milkfish

hatchery training, and BBBAT Sukabumi for freshwater paddy-cum-baitfish farming. Trials on milkfish bait farming in freshwater have to be conducted with pre-agreed protocol at BBBAT Sukabumi.

AP2HI should also submit a proposal to DGA on planning a financial assistance scheme for Larantuka farmers under "Farmer group development programme".

Center for Aquaculture Research and Development, Pasar Minggu, Jakarta

AP2HI members who plan to invest in the hatchery establishment in Larantuka can buy the readily available milkfish broodstock from BBPPBL, Gondol.

Ministry of Disadvantaged Region Development (KPDT)

AP2HI should facilitate development and submission of a proposal by DKP East Flores District, which is approved by DKP NTT Province either to KPDT or DGA-MMAF for financial support to establish a milkfish hatchery in Larantuka.

DKP NTT Province

DKP NTT Province in Kupang and DKP East Flores District in Larantuka should be involved in planning and implementation of the programme. The extension staff of DKP (both province and district) should be trained in milkfish hatchery and nursery management at DGA technical implementing units in Situbondo and Sukabumi. The DKP should provide its land on lease basis to AP2HI members to establish milkfish hatchery and nursery.

Agriculture and Livestock Office Larantuka (DPP) and Agriculture Extension Unit of Konga (BPP)

Agriculture Extension Unit of Konga belongs to East Flores Agricultural and Livestock Office in Larantuka. Facilities and extension staff of BPP have to be utilised for demonstration of paddy-cum-milkfish bait farming. An MoU with DPP is necessary for this purpose.

6. Action Plan

An action plan for implementation of activities is given in Table 17. All the activities should be implemented in phase-wise manner with different sets of objectives in order to achieve the common goal of seamless milkfish bait production in Larantuka.

Table 17. Proposed follow-up action plan

Date/Time	Actions
May - June 2014	Develop and sign MoU between AP2HI member (PT Ocean Mitramas) and DGA – BBBAT Sukabumi for (1) conducting the freshwater paddy-cum-milkfish bait farming trials in Sukabumi, (2) providing the technical assistance to set up a demo farm at BPP Konga, Larantuka, (3) to organise field tour/training at Sukabumi for key stakeholders from Larantuka .
	Conduct initial field trial of paddy-cum-milkfish bait farming in Sukabumi. Organise field tour/training to BPP Konga staff to Sukabumi.
	Develop and sign MoU between AP2HI and BPP Konga for demonstration of paddy- cum-milkfish farming during next paddy season, starting in June 2014
	Submit a proposal to KPDT and DGA on financial aid package for establishing a milkfish hatchery in Larantuka and also to support farmer group/kelompok development in Konga cluster
June - October 2014	Demonstration of paddy-cum-milkfish farming during next paddy season starting in June 2014 in BPP Konga with the fry procured from Gondol commercial hatcheries.
	Systematic study on the impact of baitfish in tuna fishing efficiency and economic efficiency, comparing wild and farmed milkfish baits. The study should be done by IPNLF members, with their regular fishing activities with pole-and-line fishing boats using the bait milkfish produced from PT Ocean Mitramas farm and BPP Konga.
October - December 2014	Train AP2HI member staff on milkfish hatchery operations at BBAP Situbondo.
January - December 2015	AP2HI Members, with the help from KPDT/DGA/DKP/DPP budget, support the paddy farmer Kelompks in Konga cluster for commercial production of milkfish bait.
January - December 2015	Establish and operate a milkfish hatchery in Larantuka (both egg production center and larval rearing unit) with the technical support from BBAP Situbondo

Milkfish is suitable bait for pole-and-line fishing in Larantuka. It is feasible to farm milkfish in sufficient quantities in Larantuka. However, there is strong need for partnership and collaboration among various stakeholders for effective implementation of the milkfish bait farming programme at a commercial scale. Phase-wise implementation of the programme is critical for success and sustainability. Capacity building in local stakeholders in milkfish hatchery and farm operations is the first step that is needed, and should be done by organising hands-on training and field visits at specialised centres under DGA. Local demonstrations should be organised in Larantuka for wider dissemination of technical know-how among local people. Since there is lack of capital among local people/ farmers, AP2HI members with the help from government should financially support the farmers by extending credits (crop loans) or a revolving fund. A buy-back arrangement has to be made between AP2HI members and farmers for successful and sustainable commercial operation.

There are some programmes of the KKP to empower fish farmers throughout Indonesia - the amount of IDR 65 million will be channeled through the National Bank to each group of farmers in a certain area. To access the benefits of such programs, the only pre-requisite is that the proposal / business plan should be supported by local government. Stakeholders with such proposals can approach the DGA-MMAF for seed capital for their business. Other sources of funds available at KPDT can also be explored.

Anonymous, 2012. Statistik perikanan tangkap, Direktorat Jenderal Perikanan Tangkap, Kementrian Kelautan dan Perikanan.

Gillet R. 2014. Improving the management of bait fisheries associated with Pole-and-line tuna fishing in Indonesia. IPNLF.

Husen S.A. 2012. Analisi aspek teknis unit penangkapan Pole-and-line di perairan teluk Kendari, Sulawesi Tenggara. Jurnal Penelitian. Universitas Muhammadiyah Kendari.

Setyawan A. 2012 (a). Pernanan umpan hidup dalam operasi pengnakapan ikan cakalang (*Katsuwonus pelamis*) dengan Pole-and-line (Huhate). Pusat penelitian dan pengembangan perikanan tangkap dan konservasi jenis, Badan penelitian dan pengembangan kelautan dan perikanan, Kementarian Kelautan dan Perikanan.

Setyawan A. 2012 (b). Potret perikanan tuna di Larantuka, Flores Timur, Nusa Tenggara, P4KSI, Badan penelitian dan perikanan, Kementarian Kelautan dan Perikanan.

Annex 1. Institutions visited and persons met

Date	Place	Institution	Person and position and contact
4-7 April	Jakarta	Directorate General of Aquaculture, Ministry of The Disadvantage Region Development (KDPT)	Mr. Ali, Head of Section of Small Scale Fish Hatchery
			Mr. Coco Kokarkin, Director for Fish Production Development
			Mr. Herry Ilyas, Deputy Director of Aquaculture Statistics
			Mrs. Endang, Assistant Deputy for Investment of KPDT,
			Mr. Harry, Assistant Director of Program and Budgeting
			Mr. Rusnadi Padjung, Expert to Minister of KPDT
			Mrs. Era Joenoes, KPDT,
7-8 April	Jakarta	Puslitbang Perikanan Budidaya	Dr. Tri Heru, Director of Puslitbang Perikanan Budidaya
14 April 2014	Jakarta	Directorate General of Aquaculture	Mr. Firman Parhusip, Deputy Director for Farmer Empowerment
14 April 2014	Jakarta	Puslitbang Perikanan Budidaya	Dr. Estu Nugroho and Ir. Iswari Ratna Astuti
15-16 April 2014	Bogor	Conference of Puslitbang Perikanan Budidaya	Dr. Slamet Subyakto, Director General of Aquaculture
			Dr. Achmad Purnomo, DG of Marine and Fisheries Research and Development
			Dr Tri Heru, Director of Puslitbang Perikanan Budidaya
			Dr. Rudi Gustiarno, Director of BBPPBL, Gondol
17 April 2014	Gondol	BBPPBL, Gondol	Mrs. Poppy
Mr. Edi Sudiana			
Prof Dr. Yanti			
Mr. Gigi - (081239633194)			
Mr. Gusti Wahyuadi			
All Scientists			
18 April 2014	Gondol	Private backyard milkfish hatchery	Mr. Edi Sudiana, Owner and operator

19 April 2014	Gondol	CV. Dewata Laut, Private large-scale milkfish hatchery	Mr. Sawit, Owner and operator
20 April 2014	Kupang	DKP NTT Province	Mr. Abraham, Director of DKP NTT
			Mrs. Lastri, Deputy Director for Aquaculture Development of DKP NTT
21 April 2014	Larantuka	PT. Ocean Mitramas, milkfish bait farm	Mr. Pito Simbolon, Manager (081314927535)
22 April 2014	Larantuka/ Lewolega	Brackish water fish farm	Mrs. Maria Theresia Maran, Farmer
		Freshwater fish farm	Mr. Daniel, Farmer
		KMN Surya Mas (Pole-and-line boat)	Fishermen in the boat
		PT Ocean Mitramas Mother Ship	Captain of the ship
23 April 2014	Larantuka	PT. Okishin	Mr. T Fujihara, Director
			Mr. Hilmardayton , Manager
		PT. Primo Indo Ikan	Mrs. Andayani
24 April 2014	Larantuka/ Konga	DKP, East Flores District	Mr. Ismail, Head of Section
			Mr. Hans Lubina, Deputy Director of Aquaculture Development
		Dinas Agriculture and Livestock Office, Larantuka	Mr. Hendrik, Deputy Director of Food Crop Development of DPP
		BPP Konga	Mr. Gregorious, Head of BPP Konga
		Social contact	Mr. Moses, Ex-Director of DKP East Flores
26-27 April 2014	Situbondo	BBAP Situbondo	Mr. Made Yodriska
			Mr. Bambang Hanggono
			Mrs. Gemmi
			Staff of BBAP
29-30 April 2014	Jakarta	Meeting with IPNLF and PT. Ocean Mitramas (OM)	Mr. Aminuddin Salka, Country Rep, IPNLF
			Mrs. Yanti Djuari, Director, PT. OM
			Mr. Bambang Prihadi, Commissioner
			Mrs. Ray Chandra Purnama, USAID Fisheries Management project
4-5 May 2014	Sukabumi	BBBAT, Sukabumi	Dr. Sarifin, Director
			Mr. Jaka Trenggana, Staff (08164630412)

			Mr. Kesit, Staff (085794017792)
6 May 2014	Jakarta	Detailed presentation on findings at IPNLF and PT. Ocean Mitramas	Mr. Aminuddin, Country Rep, IPNLF
			Mrs. Esther, CEO, PT. OM
			Mrs. Yani, Director, PT. OM
			Mr. Julius, Commissioner, PT. OM
			Mr. Bambang, Commissioner
7 May 2014	Jakarta	KPDT	Mr. Harry, Assistant Director of Program and Budgeting
			Mrs. Era Joenoes, KPDT
8-11 May 2014	Sukabumi	BBBAT Sukabumi	Dr. Sarifin, Director /
			Mr. Jaka Trenggana, Staff - (08164630412)
			Mr. Kesit, Staff - (085794017792)
			Mrs. Tuti

Annex 2. Itinerary of Mr. Agus A Budhiman

Date	Place	Mode of transport
2-8April	Jakarta/Bogor	Car
13-14 April	Jakarta	Car
15-16 April 2014	Bogor	Train
17-19 April 2014	Gondol	Flight
20 April 2014	Kupang	Flight
21-25 April 2014	Larantuka	Flight
26-27 April 2014	Situbondo	Flight
29 April - 2 May 2014	Jakarta	Flight
3 May	Bogor	Train
4-5 May 2014	Sukabumi	Train
6-7 May 2014	Jakarta / Bogor	Car
8-9 May 2014	Sukabumi	Train

Annex 3. Itinerary of Dr. Arun Padiyar

Date	Place	Mode of transport
12 April	Mangalore, India to Jakarta (via Bangalore, Bangkok)	Bus and Flight (TG)
13-14 April	Jakarta	Car
15-16 April 2014	Bogor	Train
17-19 April 2014	Gondol	Flight
20 April 2014	Kupang	Flight
21-25 April 2014	Larantuka	Flight
26-27 April 2014	Situbondo	Flight
29 April - 2 May 2014	Jakarta	Flight
3 May	Bogor	Train
4-5 May 2014	Sukabumi	Train
6-7 May 2014	Jakarta / Bogor	Car
8-11 May 2014	Sukabumi	Train
12 May 2014	Return back to Mangalore, India (via Jakarta, Bangkok, Bangalore)	Train, Flight, Bus

Annex 4: Economics of bait milkfish production in Larantuka managed by PT. Ocean Mitramas

	Units	Unit cost (IDR)	Total cost (IDR)
Capital investment			
Pond construction (1 ha, 8 ponds)	1	314,000,000	314,000,000
Pump set (3.7 HP each)	2	3,700,000	7,400,000
Pump accessories and pipes	1	15,000,000	15,000,000
Fencing	1	9,000,000	9,000,000
Harvest nets	1	1,000,000	1,000,000
Sub-total (Capex)			**346,400,000**
Cycle 1 (Nov 2012) – one pond			
Workers (Full-time)	2	1,500,000	3,000,000
Fry	50,000	50	2,500,000
Rice powder			-
Diesel			-

Harvest number	2,500		-
SR	5%		
Failed Crop			
Cycle 2 (20 July 2013) - 2 ponds			
Manger (Rasum)	1	5,000,000	5,000,000
Workers (Full-time)	2	1,500,000	3,000,000
Fry (including transport)	100,000	50	5,000,000
Rice powder			3,022,000
Urea	18	3,000	54,000
TSP	8	5,000	40,000
Pig Manure (dry)	80	1,000	80,000
Diesel	100	6,000	600,000
Workers (Short-term)			614,000
Sub-total			**17,410,000**
Total crop period	58 days		
Bait size at harvest	7 cm		
Harvest number	55,000		
Transport mortality	32%		
Total Survival Rate	55%		
Total baskets of fish sold	7 baskets		
Selling price per basket	300,000		
Total revenue from bait sale	2,100,000		
Cycle 23(18 October 2013) - 8 ponds			
Farm Manger	1	5,000,000	5,000,000
Workers (Full-time)	2	1,500,000	3,000,000
Fry (including transport)	550,000	45	24,750,000
Transportation cost (Maumere-LTK)			1,800,000
Rice powder + bran	250		2,500,000
Urea		3,000	700,000
TSP		5,000	500,000
Pesticide			1,200,000
Pig Manure (dry)			1,530,000
Diesel		6,000	1,900,000
Electricity	2	300,000	600,000
Transport local operational			112,000
Workers (Short-term)			-
Transport of fingerling			2,100,000
Sub-total			**45,692,000**

Harvest number	447,772		-
Transport mortality (Gondol to Larantuka)	7%		
SR from Larantuka to fingerling (inside pond)	93%		
SR from Gondol to fingerling (pond + transport)	81%		
Crop duration (Partial harvesting, main harvest in March)	21-155 days		
Bait size at harvest	7 cm		
Total baskets of bait sold	56		
Selling price per basket	500,000		
Revenue from selling the bait	28,000,000		

IPNLF
INTERNATIONAL POLE
& LINE FOUNDATION

UK Office
Registered Address: 1 London Street, Reading,
United Kindom RG1 4QW
Registered Charity: 1145586 (England and Wales)

Maldives office
IPNLF c/o 1st Floor, M. Mist, Fiyaathosi Magu, Malé-20223,
The Republic of Maldives

Web: www.ipnlf.org
Email: info@ipnlf.org
Twitter: www.twitter.com/IPNLF