# Managing Aquatic Agricultural Systems to Improve Nutrition and Livelihoods in Selected Asian and African Countries: Scaling Learning from IFAD-WorldFish Collaboration in Bangladesh

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## 2018 Technical Report

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# OVERALL PROJECT GOALS and OBJECTIVES

The goal of the project is to improve nutrition and livelihoods of poor, rural households in aquatic agricultural systems in Cambodia, Zambia and Indonesia through increased consumption and production of micronutrient-rich small fish and vegetables.

The objective of the project is to scale up the integrated Aquaculture/Agriculture-Nutrition Linkages approaches developed and introduced in Bangladesh, in targeted communities in Cambodia, Zambia and Indonesia. Specifically, by improving production and productivity of household ponds and dykes; increasing fish production, particularly small fish production and fish species diversity in wetlands; and supporting initiatives to increase consumption of micronutrient-rich small fish and vegetables.

# Cambodia Component

**Summary and context**

Over the past decade, Cambodia has enjoyed strong economic growth resulting in improved livelihood for its population of 14 million. Despite significant progress, 4.8 million Cambodians remain poor, with 90% living in rural areas. Subsistence farmers, members of poor fishing communities, landless people and rural youth comprise the majority of Cambodia's poor. Generally, this demographic does not have enough food to eat for the whole year, dietary diversity is low, and malnutrition remains high among children under five years of age.

Fish is an integral part of Cambodia's culture, economy, and food and nutrition security. It contributes around 7% to national GDP and supplies 66% of household animal-source foods. Yet, the diet of many rural Cambodians remains dependent on the staple food, rice, and dietary diversity is low. Therefore, increasing fish production, in particular small indigenous fish species, using the integrated Aquaculture/Agriculture-Nutrition Linkages approach can provide smallholder households with increased income and improve food and nutrition security.

Household aquaculture ponds stocked with both large, marketable fish and nutrient-rich small fish species can be managed with limited inputs to generate extra income for households and provide additional nutrient-rich food supply to households over an extended period of the year. In addition, ponds can be integrated into the smallholder's farming system, providing water for homestead vegetable production on pond embankments. This integrated approach has the potential to help address the constraints faced by many rural Cambodians and improve livelihoods and nutritional outcomes.

***Output 1: Increased availability, access and consumption of micronutrient-rich small fish and vegetables***

In 2018, the project supported the first production cycle of nutrition-sensitive aquaculture in 65 homestead ponds and 15 rice field ponds, for a total of 80 households. The final harvest of the first cycle was between May to June 2018 for homestead ponds and up to September 2018 for rice field ponds. All households were also supported for vegetable production.

The current second production cycle started in August 2018; 264 homestead ponds and 39 rice field ponds were selected. The 303 households are supported for vegetable production. Compared to the first production cycle, the stocking density of SIS has been increased and the species mix has been modified based on the requirements of the target households and market demand.

For the year 2018, the aquaculture technicians (local NGO partners) provided technical support to 303 farmers, with a total of 2,747 visits. Currently, the Fisheries Administration provide monthly visits to project sites (a total of 371 visits). The project continues to maintain the same protocol and support to target households as provided in 2017. The target households receive in-kind support after aquaculture training is conducted within the community. In 2018, 143 farmers received training in vegetable production in home gardens and compost production. The remaining 169 famers will receive in-kind support and training on vegetable production in early 2019.

Homestead ponds produced on average 78.5 kg fish, of which 4.4 kg were nutrient-rich small fish. Rice field ponds presented similar results (87 kg fish in average, of which 3.5 kg were nutrient-rich small fish). In homestead ponds, 70% of production of large fish (carp species and silver barb) was consumed within the households. For small fish, 90% was consumed within the household. Results show that both systems can be marginally profitable for households if no commercial feed is used to feed the fish.

On average, vegetable production increased per household to 73.5 kg during the year. Of 143 households that had gardens in production in 2018, a total of 13.1 tons vegetable was produced from September to December 2018. Six-months monitoring showed that vegetable production increased by 172% per household between May 2018 (323 kg produced between November 2017 to May 2018 per household) and November 2018 (528 kg produced between May 2018 to November 2018 per household).

In 2018, a total 73 nutrition and hygiene training workshops were conducted, each including three sessions, with a total of 665 participants. A 6 months monitoring baseline on nutrition behaviour showed that interventions increased the quantity of nutrient-rich fish consumed by households, especially in the dry season (March to July), when rice fields are dried out and nutrient-rich fish are not available in the wild. The project intervention had a significant effect in increasing availability of this resource during this specific season. Facilitating accessibility did not increase the frequency of fish consumption, however, it resulted in a larger number of households consuming larger quantities of SIS due to increased availability.

After the intervention, fish consumption and young child feeding practices showed positive changes. Project results showed increased consumption of nutrient-rich small fish in mothers and in children under 5 years of age.

**Output 2:** ***Improved gender equity and women's empowerment, especially regarding intra-household food intake, agricultural practices and work load***

Local partners supported 75 households to develop a family vision and plan for 2018. In addition, one local partner conducted additional training to households on gender and women empowerment, attended by 43 participants.

Intermediary results show that:

- For 65 homestead ponds, of the 227 cash transactions related to fish marketing, 212 were performed by women. This income cumulated to a total of KHR 9.7 million, corresponding to an average of KHR 150,000 KHR in the hands of women.
- Similar patterns were recorded for sale of fish from the 15 rice field ponds, with all of the market transactions operated by women, for an average of KHR 394,000 per household.

Income from vegetable marketing over 6-months was KHR 0.22 million in households without project interventions and KHR 0.38 million for project households between May to November 2018. The proportion of the income managed directly by women increased from 56% to 70%.

***Output 3: Increased knowledge, awareness and training of government and NGO partners in integrated aquaculture and agriculture-nutrition linkages approach for influencing policies and implementing interventions for scaling up***

Local partner NGOs participated in nutrition and vegetable training received by target households. Additionally, the NGO partners were also trained in gender equity and women's empowerment. One national reflection workshop was held in June 2018 and local partners also organized three provincial workshops as well as study tours with 178 participants.

WorldFish joined the SUN CSA network in Cambodia and participate in events organized by this network, presenting intervention approaches and preliminary results. Notably, through the SUN CSA network, WorldFish provided inputs to the opening remarks of the Prime Minister during the National Nutrition Day. In this opening remark, the Prime Minister mentioned the importance and role of fish to improve nutritional status of the population.

***Output 4: Strong regional and national partnerships and collaboration for adoption and dissemination of the aquaculture and fisheries/agriculture-nutrition linkages approach***

The project team collaborated closely with the Rice Field Fisheries II project (USAID-funded), NOURISH (USAID-funded project) and the World Vegetable Center to exchange and homogenize approaches to raising awareness on nutrition, hygiene, and vegetable production. Results of the research on biology of two small indigenous fish species done in collaboration with National Research and Aquaculture Development Institute (NARDI) provided indications for future domestication of those two species.

The project partners shared experiences with Helen Keller International (HKI) in Cambodia and WorldFish team, partners and target households in Bangladesh during two study tours. In addition, WorldFish organized field visits for four researchers of the Central Institute of Fisheries Technology (Indian Council of Agricultural Research, Ministry of Agriculture and Farmers Welfare, Government of India).

WorldFish provided support and recommendations to FAO for a future publication on "Nutrition-sensitive Fisheries Guidelines for Cambodia" and shared experience with a private sector enterprise piloting the development of ready-to-use fish products for malnourished children, to be used by the Government of Cambodia and UNICEF. This enterprise is a grantee of the Bill and Melinda Gates Foundation.

**Results**

The below results achieved in 2018 towards the project outputs are presented below.

### *2.1. Output 1: Increased availability, access and consumption of micronutrient-rich small fish and vegetables*

#### 2.1.1. Activities 1: Aquaculture and horticulture production

For 2018, we report two cycles of production. The first cycle of production, covering the period from September 2017 until July 2018 and the second cycle of production that started in August 2018 and will continue until mid-2019. For the latter, we will report only activities but no production results.

1st Production Cycle: 2017-2018

Eighty households in 3 provinces around the Tonle Sap Lake, Battambang, Siem Reap and Pursat were selected (Table 1). These households had children under 5 years old (48 households), children between 6 and 10 years old (25 households), at least one lactating women (15 households) and/or a pregnant woman (1 household).

*Table 1: Project households (HH): administrative location for the production season 2017 until August 2018*

| Province | District | Commune | Village | HH Homestead pond | HH Rice field pond | Vegetable Garden |
|---|---|---|---|---|---|---|
| BB Province | Bovel | Kdol Tahen | Tuol Krasaing | 7 | - | 7 |
| | | Khlaing Meas | Along Raing | 5 | - | 5 |
| | Thmor Kaul | Ou Taky | Trash | 13 | - | 13 |
| | | | Ou Taki | 1 | - | 1 |
| SRP province | Kralanh | Kralanh | Kralanh | 3 | - | 3 |
| | | | O'Kralanh | 9 | 3 | 12 |
| | | Sranal | Sranal | 7 | 3 | 10 |
| PUR province | Krakor | Sna Ansa | Veal Vong | 11 | - | 11 |
| | | | Ansa Kdam | 9 | - | 9 |
| | | | Prey Khla | - | 4 | 4 |
| **Total households** | | | | **65** | **10** | **75** |

Within the 3 provinces, 7 households dropped out after the first production season, due to engagement in other activities. Rice field ponds are ponds located within the rice fields and seasonally flooded. They are traditionally harvested for wild fish. In this project, we proposed an intervention whereby farmers harvest the rice field ponds for wild fish before re-stocking with carp polyculture and small indigenous fish that are nutrient-rich. This allows an additional production and a longer availability of fish during the early weeks of the rainy season, from May to August / September. The seasonally flooded rice field ponds ranged from 271 to 484 $m^2$ and were in culture from January until August / September.

2nd Production Cycle: 2018-2019

From August 2018, additional households were selected in new villages and communes within the 3 provinces for both homestead and rice field ponds interventions and horticulture production (Table 2).

*Table 2: Additional project households (HH): administrative location for the growing season starting in August 2018 (HH: households)*

| ***Province*** | ***District*** | ***Commune*** | ***Village*** | ***HH – Homestead pond*** | ***HH - Rice field pond*** | ***Vegetable Garden*** |
|---|---|---|---|---|---|---|
| Battambang | Bovel | Kdol Tahen | Tuol Krasaing | 4 | - | 4 |
| | | Khlaing Meas | Along Raing | 4 | - | 4 |
| | Thmor Kaul | Ou Taky | Trash | - | 2 | 2 |
| | | | Ou Taki | 3 | - | 3 |
| | | | Popeal Khae | 5 | 3 | 8 |
| | Moung Reusey | Kakoh | Chork Thom | 17 | - | 17 |
| | Sangke | Raing Kesey | Voat Kandal | 16 | 5 | 21 |
| Siem Reap | Kralanh | Kralanh | Kralanh | 4 | 2 | 6 |
| | | | O'Kralanh | 3 | - | 3 |
| | | Sranal | Sranal | 10 | 3 | 13 |
| | | | Lahong | 5 | - | 5 |
| | Pouk | Prey Chrouk | Doun Tok | 3 | - | 3 |
| | | | KetaYaus | 3 | | 3 |
| | | | Prey Chrouk | 4 | 1 | 5 |
| | | | Phlang | 2 | - | 2 |
| | | | Thmey | 12 | 3 | 15 |
| | Sotr Nikum | Khchas | Khchas | 3 | - | 3 |
| | | | Snatey | 5 | 4 | 9 |
| | | Rong Ko | Bos Thom | 7 | - | 7 |
| Pursat | Krakor | Sna Ansa | Veal Vong | 4 | - | 4 |
| | | | Ansa Kdam | 3 | - | 3 |
| | | Anlong Tnoat | Thkoul Thom | 8 | - | 8 |
| | | | Papet | 2 | - | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Prey Khlar | - | 7 | 7 |
| | | Ansa Chambak | Kchach Laet | 20 | - | 20 |
| | | Kbal Trach | Kralanh | 7 | - | 7 |
| | | | Daung | 4 | - | 4 |
| | Phnom Krvanh | Phteah Rung | Batromduol | 1 | - | 1 |
| | | | Kandal | 1 | - | 1 |
| | | | Phteah Rung | 10 | - | 10 |
| | | Pro ngil | Kampeng | 8 | - | 8 |
| | | | Ousrav | 5 | - | 5 |
| | | Santrie | Srae Porpeay | 9 | - | 9 |
| | Bakan | Rumlech | Pralay Romdeng | 9 | - | 9 |
| **Total HHs** | | | | **201** | **30** | **201** |

Before stocking in 2018, 36 ponds and 8 rice field ponds were renovated by deepening and raising the height of the dikes. Stocking took place from August to December, with stocking according to the water level in the floodplain and availability of fingerlings. Currently, a total of 264 homestead ponds and 39 rice field ponds are supported for the second production cycle. Twelve of the homestead ponds and fifteen of the rice field ponds will be stocked in early January 2019.

*Capacity building*

Seven local NGO partners, and three Fisheries Administration Cantonment (FiAc) officers received training on aquaculture techniques. The training was conducted by the Fisheries Administration, Department of Aquaculture Development (DAD) on 14$^{th}$ June 2018 in Battambang. The refresher training included key technical dimensions of fish culture with a focus on feed and feeding technique and specific aspects related to nutrition-sensitive aquaculture such as identifying and harvesting targeted small indigenous fish species in rice fields. WorldFish conducted a training on small fish species transportation with seven local partners and one staff of FiAc.

The aquaculture technicians (local NGO partners) provided technical support to 303 farmers, with a total of 2,747 visits. This support also included short thematic trainings conducted at the lead farmer location in the target intervention communes and one day workshop training on aquaculture technique in each province. Fisheries Administration, Department of Aquaculture Development (DAD) conducted monthly visits to target households in each province to monitor fish culture and provide technical support to local partners. FiA conducted a total of 371 visits to the target households.


*Photos: Left: Fisheries Administration officer training farmer to monitor water quality in pond; Right: Vegetable production training in August 2018 in Siem Reap province*

Vegetable production training was conducted in collaboration with the Rice Field Fisheries II project (USAID funded), occurring in the same communities. Vegetable production occurs next to the homestead ponds and rice field ponds, using water from the pond. In 2018, vegetable production took place all year round, with two main seasons (January to July and after the rainy season from November to December).

Compared to 2017, protocol and support to the target households were not modified. The target households received in-kind support after training conducted within the community. In 2018, 143 farmers received vegetable training in home gardens and compost production and received inputs to start vegetable production. In 2019, the remaining 169 farmers will receive support for vegetable production.

*Technical dimension of nutrition-sensitive aquaculture*

The protocol tested is based on WorldFish-IFAD experience from Bangladesh adapted to the Cambodian context. For the first cycle (2017-2018), fish polyculture for income generation stocked at 5 fish per square meter and additional stocking of nutrient-rich fish collected in rice fields for family consumption were promoted. The polyculture composition is as follow: 55% silver barb; 20% silver carp and 20% common carp or Indian carp. Nutrient-rich small fish are added at the density of 500 g per 100 square meters. The project aimed to develop a low-cost, affordable technology, therefore the feeding system of the pond is based on locally available food and on green water technology, enhancing natural productivity of the pond. However, some farmers chose to invest in commercial pelleted feed, at higher cost.

In homestead ponds, the culture started in August 2017 and the latest harvest was recorded in July 2018, with a majority of the ponds harvested in May and June 2018. Sequential harvest of small and large fish of the ponds started in December 2017 and continued until the final harvest.

Rice field ponds production cycle started from January up to February 2018 and grow-out continued until August-September 2018, with sequential harvest starting from April to May 2018. Similar stocking density and species assemblage was applied in rice field ponds.

For the second cycle, the species mix was modified. Common carp was excluded due to low market demand. Farmers preferred to stock tilapia and snakeskin gourami, with silver barb, silver carp and

Indian carp, in 230 households. Fifteen farmers in Siem Reap and Pursat provinces tested species mix with only silver barb (40%), snakeskin gourami (55%), and tilapia (5%). Thereafter, 19 households added 15% trey riel top (*Cirrhinus siamensis*), a micronutrient-rich small fish, while reducing to 40% of the proportion of silver barb and gourami.

In 2018, the density of small fish was doubled from 500 g per 100 square metre to 1 kg per 100 square metre. The modification of the species mix was the outcome of the annual reflection workshop held in Battambang in June 2018.

*Input support*

In 2018, 223 households received in-kind support to start nutrition-sensitive aquaculture, for with activities such as fencing the pond, constructing a happa for fingerling nursing, and inputs to prepare the pond (lime). The 80 farmers (65 homestead ponds and 15 rice field ponds) that received equipment in 2017 did not receive equipment again in 2018.

A total of 456,915 carp species, tilapia, trey riel, snakeskin gourami and silver barb large-sized fingerlings were distributed to target households to reach a stocking density of 5 fish per square meter. Farmers contributed to the intervention by providing labour to construct areas for compost, upgrade pond flood protection system and collect 500 kg of nutrient-rich small fish for stocking in the homestead ponds. Access and availability of SIS in 2018 was problematic in comparison with previous years. To overcome this challenge, local partners developed a local collection and distribution system for small fish.

In six villages, one pond was used during the stocking period as a storage and distribution centre of small fish for other ponds in the village. One pond where small fish sourced from rice field was accumulated, could provide enough stock for three to five ponds, on average. However, due to limited availability of small fish in rice fields and the increased stocking density decided, additional small fish were sourced from local fishermen and transported to ponds in Battambang and Siem Reap provinces to reach the decided stocking density.

In 2018, the project supported 143 micro and home gardens for vegetable production consisting of gardening inputs (fencing, plastic, watering can, hand sprayer) and seeds for a variety of vegetables: long bean, pumpkin, amaranth, bitter gourd and water spinach. The remaining 169 households will be supported with inputs in 2019 to operate gardens during the main growing season. Vegetables are not being grown on the dikes of the ponds as these are often too small and narrow. The gardens are located next to the ponds.

*Photo: Left: Stocking of fingerlings in ponds. left: farmers receiving fingerlings in Sna Ansa commune (Pursat province); Right: Mr. Ron Bunly stocking fingerlings in a pond in late August 2018 (Battambang province)*

*Progress toward indicators*

The monitoring system is based on a logbook updated daily by farmers and monitored and captured weekly by aquaculture technicians, electronically. The monitoring variables include: inputs and outputs of pond and plots as well as work load disaggregated by gender and destination of the production. In parallel, technicians visiting the households record their weekly observation about fish and vegetable farming. Vegetable production was not recorded with this monitoring tool but part of a 6-months monitoring in early 2018. In September 2018, this was added to the weekly monitoring. Nutrition outcomes will be assessed using the monitoring system for Nutrition and Hygiene (see section 2.1.2).

*Photo: Left: Farmer monitoring plankton growth and water turbidity using sechhi disk (Siem Reap province); Right: monitoring fish weight during the final harvest Pursat province)*

The production results of the first cycle are presented in Table 3.

*Table 3: Production of homestead and rice field ponds (standard deviation in parenthesis)*

| | **Total production (kg/HH)** | **Wild Fish production (kg/HH)** | **Large Fish production (kg/HH)** | **Small Fish production (kg/HH)** |
|---|---|---|---|---|
| Homestead Ponds (n=65) | 78.5 (52.7) | 3.4 (5.7) | 71. 1 (49.2) | 4.40 (3.74) |
| Rice Field Ponds (n=15) | 87.0 (73.2) | 6.8 (4.4) | 80.6 (70.0) | 3.5 (0.9) |

In homestead ponds, 70% of production of large fish (carp species and silver barb) was consumed within the households. For small fish, 90% of the production was consumed within the household. Production was found extremely variable with 13 ponds recording a low productivity, below 200 g per square meter. This low performance resulted from various factors: i) age of the pond containing high levels of organic matter and leading to low water quality; ii) mismanagement in feeding leading to low water quality; and iii) presence of predatory fish species. In addition, some ponds were affected by mass mortality events after rainfall in the early stage of the rainy season. When these ponds were excluded from the analysis, the total production of the ponds reached an average of 89.0 kg fish per pond.

Rice field ponds present slightly different patterns in the composition of the harvest, with relatively more wild fish, as ponds are drained and wild fish harvested before filling up the pond again and re-stocking with carp species and silver barb. In these systems, 89% of the SIS harvested were consumed by the households. For the stocked carp species and silver bard, 64% of the production was consumed.

*Photos: Left: Mrs Soth Sam Al's vegetable nursery after horticulture training (Siem Reap province); Right: Project farmer in Anlung Reang harvesting pumpkin*

Economic return and benefits from these two production systems vary depending on the use of commercial feed (high price) and cost of fingerlings stocked. Table 4 summarises the results of the first production cycle. “Operational cost” includes all costs related to pond preparation and pond management (e.g. feed, fertiliser, harvest). “Value of production” represents the economic value of the production, also adding the economic value of the harvested fish which was consumed by the household. “Cash revenue” represents the gross return resulting from sale of the harvested fish. The “net return” is the value of production minus the operational cost.

*Table 4: Economic results (KHR) of homestead and rice field ponds. (KHR 4,100 = USD 1)*

| | **Operational cost (KHR/HH)** | **Value of production (KHR/HH)** | **Cash Revenue (KHR/HH)** | **Net Return (KHR/HH)** |
|---|---|---|---|---|
| Homestead Ponds (n=65) | 537,029 | 554,160 | 204,509 | 17,130 |
| Rice Field Ponds (n=15) | 406,586 | 641,232 | 395,000 | 234,646 |

Positive economic results are achieved when the cost of feed is below KHR 700/square metre and commercial pellet cost is limited to less than 30% of the feed cost. At this stocking density, fingerlings cost must remain around KHR 600/$m^2$ in order to ensure economic sustainability of the system. Stocking larger but more expensive fingerlings is not economically profitable.

Use of commercial feed was less frequent in rice field ponds, which partially explains lower operational cost and better economic results of the system. In addition, fingerling cost per unit area was reduced and contributed to higher return compared to homestead ponds.

On average, our intervention increased the vegetable production to 73.5 kg per household per year. In the 143 households that had gardens in production in 2018, 13.1 tons of vegetable were produced from September to December 2018. Six-months monitoring showed that vegetable production increased by 172% per household between May 2018 (323 kg produced between November 2017 to May 2018 per household) and November 2018 (528 kg produced between May 2018 and November 2018 per household).

### 2.1.2. Activity 2: Nutrition and hygiene training

To improve nutrition and hygiene in target households, trainings on nutrition, dietary diversity and hygiene and sanitation were conducted in project locations. The complete training consists of a series of “in house” workshops to groups of six to eight households. In total, each household attends six sessions, covering the following topics: i) Good water and sanitation practices; ii) Appropriate diets for pregnant and lactating women, and for children, from 6 to 24 months of age; and iii) How to include nutrient-rich fish in the family diet.

In 2018, a total of 67 trainings, composing of six sessions on nutrition and hygiene were conducted, for 665 participants. The households selected in 2018 will receive training in 2019.

*Photos: Left: Nutrition training with cooking demonstration in Tuol Krasang village (Battambang province); Right: Nutrition training in Voat Kandal village (Battambang province)*

*Progress towards target*

In 2018, a baseline survey was undertaken to benchmark access to and consumption of fish and vegetables at the household level. This baseline included data collection on women's and children's nutrition. To monitor and asses changes, a 6-months follow up survey is scheduled to monitor the progress towards the target. The bi-annual survey is programmed to occur twice a year to capture seasonal changes; during the period of the year when fish is abundant (November-January) and the period when fish is not abundant (May). The surveys conducted in the different groups and survey dates are detailed in Table 5.

*Table 5: Surveys conducted in project households: Group A and B*

| **Survey date** | **Sample** | **Survey**<br><br>**Baseline and Follow up** |
|---|---|---|
| January 2018 | Group A: 76 HH | Survey 1 - Baseline |
| May 2018 | Group A: 76 HH<br><br>Group B: 114 HH | Survey 2 - Follow up 1<br><br>Survey 2 - Baseline |
| November 2018 | Group A: 71 HH<br><br>Group B: 114 HH<br><br>Group C: 118 HH | Survey 3 - Follow up 2<br><br>Survey 3 - Follow up 1<br><br>Survey 3 - Baseline |

To estimate the effect of the intervention, we compared indicators within the same population sampled between baseline and the follow ups. There is also a strong seasonal effect, with a "low season", corresponding to the dry season and early rainy season when rice fields are not flooded and fish less available and at the opposite a "high season" corresponding to the flood season and when waters start to recede (November to January). During the peak season, fish is abundant in the rice fields and easy to catch.

We compared only indicators for the same season: January 2018 and November 2018 for the two household groups: A (HH = 76) and B (HH = 114), during both time points. For group A, we compared the baseline (January 2018) and follow up 2 (November 2018), as both took place within the same season. For group B, the survey in May 2018 corresponded to the baseline and the survey in November 2018 reflected some exposure to project activities and training. However, it is worth noting that group B ponds and vegetable garden are not yet harvested.

We present indicators for Group A households for the period of January to November 2018 and for Group B households for the period of May to November 2018 (Table 6).

*Table 6: Consumption of fish in two project households groups; A (n=76) and B (n=114) in 2018 (sample size in parenthesis)*

| | **Baseline**<br>**Peak Fish Season**<br>**Group A** | **Low Fish Season**<br>**Group A: Follow up 1**<br>**Group B: Baseline** | **High Fish Season**<br>**Group A: Follow up 2**<br>**Group B: Follow up 1** |
|---|---|---|---|
| Average consumption frequency of SIS in the preceding 7 days | 3.61 (n=56) | A: 2.65 (n=48)<br>B: 2.73 (n=59) | A: 4.52 (n=54)<br>B: 4.06 (n=69) |
| Average weight (kg) of SIS consumed in preceding 7 days per HH (% sourced from pond) | 1.82 kg (3%) | A: 1.03 (61%)<br>B: 1.37 (8%) | A: 1.68 (4%)<br>B: 1.73 (1%) |
| Average consumption frequency of stocked fish in preceding 7 days | 13 (n=72) | A: 9.36 (n= 74)<br>B: 9.27 (n=112) | A: 9.44 (n= 68)<br>B: 8.83 (n=111) |
| Average weight (kg) of stocked fish consumed in the preceding 7 days per HH (% sourced from pond) | 4.90 kg (7%) | A: 5.30 (47%)<br>B: 4.65 (7%) | A: 4.61 (4%)<br>B: 4.23 (2%) |

Between baseline and follow up 2, the frequency of consumption of small fish increased by 25% for Group A (Table 6). Small fish was consumed more than 2.5 times per week for both Groups A and B

during the low season, although the proportion of households consuming fish in the preceding 7 days was higher in Group A (85% compared to 51% in Group B). The source of small fish differed between seasons. During the low season, a majority of the small fish was sourced from the pond for Group A. Group B (that did not yet receive support from the project) sourced the small fish from the wild. This illustrates an outcome of the project; providing easier access to nutrient-rich small fish for stocking. Facilitating accessibility does not increase the frequency of consumption, however, a higher number of households consumed larger quantities of small fish.

The consumption of large fish was more frequent than that of small fish. This observation was common to all households, with more than 89% households having eaten large fish in the preceding 7 days. Frequency of consumption as well as quantity were more or less constant across seasons. Group A households sourced more fish from the pond than Group B during the low season. This result indicated that the intervention provided easier access to fish during the low season.

The monitoring system included behaviour change in feeding habits and diets of children under 5 years old (Table 7) and mothers (Table 8).

*Table 7: Diets of children under 5 years in two household groups: A and B (sample size in parenthesis)*

| | **Survey 1 – High Season** | **Survey 2 – Low Season** | **Survey 3 – High Season** |
|---|---|---|---|
| Small fish preparation - % of households using whole fish | A :8% | A: 8%<br>B: 0% | A: 38%<br>B: 26% |
| Average consumption frequency of small fish in the preceding 7 days | A: 3.00 (n=19) | A: 2.21(n=27)<br>B: 2.51 (n=35) | A: 2.96 (n=27)<br>B: 7.15(n=34) |
| Average weight (g) of small fish consumed in the preceding 24 h | A: 48.32 (n=13) | A: 32.77 (n=26)<br>B: 44.39 (n=18) | A: 65.05 (n=18)<br>B: 43.89 (n=19) |
| Average consumption frequency of fruit in the preceding 7 days | A: 6.61 (n=44) | A: 7.46 (n=39)<br>B: 11.42 (n=59) | A: 5.71 (n=38)<br>B: 6.74 (n=46) |
| Average weight (g) of fruit consumed in the preceding 24 h | A: 85.71 (n=44) | A: 371.87 (n=31)<br>B: 243.00 (n=55) | N1: 180.51 (n=35)<br>N2: 161.28 (n=32) |
| Average consumption frequency of vegetables in the preceding 7 days | A: 7.61 (n=36) | A: 5.18 (n=40)<br>B: 9.19 (n=59) | N1: 5.67 (n=36)<br>N2: 5.96 (n=51) |

| | | | |
|---|---|---|---|
| Average weight (g) of vegetables consumed in the preceding 24 h | A: 78.27 (n=36) | A: 74.8 (n=35)<br>B: 58.54 (n=50) | N1: 84.24 (n=33)<br>N2: 62.50 (n=42) |

The average age to start feeding children with fruit, vegetables and fish remained stable between surveys. More than 90% of the respondent start feeding their child between 6 to 12 months old with fish, vegetables and fruits. With awareness raising on consumption and preparation of small fish, we observe that small fish are increasingly prepared and consumed whole (with head and no eviscerate) for higher nutritional benefits.

The consumption frequency of small fish for children under 5 years did not improve for Group A households; however, it more than doubled for Group B households. The amount of small fish consumed increased for Group A households within one year of intervention. After one year of exposure to project activities, consumption of fruit increased in Group A households, from 85 g to 180.5 g per day. Vegetable consumption frequency decreased slightly for Group A households, but the quantity consumed remained stable, around 80 g per day.

For mothers, though frequency of small fish consumption decreased in Group A household between the baseline and follow up survey 2, the average quantity consumed almost doubled (Table 8). To date, we cannot see any effect of intervention on fruit and vegetable consumption.

The monitoring indicated that the project interventions increased accessibility and consumption of both small and large fish, especially in the “low season” when these resources are not or are less available in the rice fields. For the target population (children under 5 years of age and mothers), the project intervention and activities improved the consumption of small fish (and the way it is prepared), and vegetables in terms of quantity consumed and less in terms of frequency of consumption. However, this analysis is still partial and more detailed conclusions will be draw after the next survey, in May 2019.

*Table 8: Diet of mothers in households in group A and B (sample size in parenthesis)*

| | **Survey 1 – High Season** | **Survey 2 – Low Season** | **Survey 3 – High Season** |
|---|---|---|---|
| Average frequency of consumption of small fish in the preceding days | A: 5.19 (n=27) | A: 1.91 (n=23)<br>B: 2.91 (n=23) | A: 3.42 (n=24)<br>B: 3.77 (n=26) |
| Average weight (g) of small fish consumed in the preceding 24 h | A: 79.95 (n=18) | A: 23.80 (n=12)<br>B: 125.71 (n=7) | A: 145.07 (n=14)<br>B: 135.00(n=14) |
| Average frequency of consumption of fruit in the preceding 7 days | A: 7.54 (n=28) | A: 10.75 (n=8)<br>B: 8.64 (n=22) | A:7.7 (n=30)<br>B: 7.14 (n=43) |

| | | | |
|---|---|---|---|
| Average weight (g) of fruit consumed in the preceding 24 h | A: 399.8 (n=24) | A:467 (n=8)<br>B: 445 (n=20) | A: 327.65 (n=23)<br>B: 247.94 (n=31) |
| Average frequency of consumption of vegetables in the preceding 7 days | A: 10.87 (n=31) | A: 15.44 (n=34)<br>B: 9.43 (n=44) | A: 7.87 (n=31)<br>B: 6.60 (n=42) |
| Average weight (g) of vegetables consumed in the preceding 24 h | A: 217.42 (n=31) | A: 278.93 (n=34)<br>B: 201.34 (n=41) | A: 229.81 (n=27)<br>B: 187.02 (n=33) |

### *2.2. Output 2: Improved gender equity and women's empowerment, especially regarding intra-household food intake, agricultural practices and work load*

#### 2.2.1. Activities 1: Capacity building nutrition and gender equity

This activity aims to assess in a participatory manner, the role and activity of household members and identify future actions to improve gender equity in terms of work load, agricultural activities and nutrition. In 2017, local partners received training on family visioning and planning. Based on this knowledge, local partners supported 71 households to develop a family vision and plan in 2018. In addition, one local partner conducted additional training for 43 participants about gender and women empowerment.

*Photo: Gender training of 24 farmers in Kralanh commune (Siem Reap) on August 5th 2018*

*Progress toward indicators*

One aim of the project is that 75% of the women in targeted households report greater decision making. The 6-months surveys and pond monitoring provide indicators about women's empowerment, which include their role in decision making at it relates to income expenditure and investment. Intermediary results showed that in households with homestead ponds, of the 227 cash transactions related to fish marketing, 212 were performed by women. These sales totalled an

income of KHR 9.7 million for 65 households and corresponded to an average of KHR 150,000 in the hands of women. Similar patterns were recorded in the 15 households with rice field ponds, with all transactions operated by women, for an average of KHR 394,000 per household. Over 6-months, the income from vegetable sales increased from KHR 0.22 million to KHR 0.38 million for Group A and B households, between May to November 2018. The proportion of the income managed directly by women increased from 56% to 70%.

Monitoring indicated that the interventions provided additional financial resources to the households and that this resource is managed by women. The second indicator (e.g. 80% of project staff trained on gender equity) was achieved in 2017, with 100% project staff trained.

### 2.3. *Output 3: Increased knowledge, awareness and training of government and NGO partners in integrated aquaculture and agriculture-nutrition linkages approach for influencing policies and implementing interventions for scaling up*

#### 2.3.1. Activity 1: Local workshops

In sections 2.1.and 2.2, the activities related to training of local partners and Fisheries Administration on nutrition-sensitive aquaculture are described. Local NGO partners participated in nutrition and hygiene training (conducted by NOURISH and WorldFish staff) and vegetable production training provided by Rice RF II and the World Vegetable Center. They were also trained in gender equity and women empowerment. Note that local partners provided training on nutrition to village health support groups. Both village health support groups and local partners provide training to beneficiaries.

On June 15$^{th}$ 2018, WorldFish and FiA organized a reflection workshop in Battambang. The workshop provided the opportunity to present and discuss results of project activities. The workshop had 39 participants (including 12 women) from the 3 provinces and included local partners, farmers and Fisheries Administration from both Cantonment and Central administration. The Director of Department of Aquaculture Development, and Deputy Director General of FiA also attended the workshop. The outputs of the workshop were reflected in new fish species assemblages tested in the 2$^{nd}$ cycle of production, planning of activities and approach to training for nutrition, hygiene and vegetable production.

Each local partner organized an annual reflection workshop at the province. In addition, local partners in Siem Reap province held a district level workshop with 24 farmers, 1 district governor, 3 commune chiefs, 5 village chiefs, 1 FiAC, 3 fingerlings suppliers to explain the nature of the project and to enhance collaboration with local authorities, local partners and project beneficiaries. Additionally, 3 study tours within provinces, involving 107 participants and 3 study tours between provinces (71 participants) were organized to share experiences.

WorldFish and local partners are part of the Scaling Up for Nutrition CSA network and participate in the event organized by this network, presenting interventions and preliminary results.

*Progress toward indicators*

The national workshop organized in 2018 and presentations at national level events increased and facilitated knowledge sharing about nutrition-sensitive approaches. For example, project partners

and WorldFish presented their activities during the National Nutrition Day Celebration event held at the Council of Minister (Phnom Penh on November 7th, 2018) and during the 2nd National Conference on WASH and Nutrition Integration on December 4-5th 2018.

Through the SUN CSA network, WorldFish provided inputs to the opening remarks of the Prime Minister during the National Nutrition Day. In this opening remark, the Prime Minister mentioned the importance and role of fish to improve the nutritional status of the population.

### *2.4. Output 4: Strong regional and national partnerships and collaboration for adoption and dissemination of the aquaculture and fisheries/agriculture-nutrition linkages approach*

#### 2.4.1. Activity 1: Partnership and resource mobilization

The project organized a provincial and national workshop with partners to strengthen partnership and engage with non-direct stakeholders and local administration (see section 2.3.1). Similar to 2017, the project team collaborated closely with a Rice Field Fisheries II project (USAID-funded), NOURISH (USAID-funded) and the World Vegetable Center to exchange and homogenize approaches to raising awareness of nutrition, hygiene, and vegetable production.

The project collaborated with NOURISH to train farmers to produce fish powder. The training was held in Battambang province on 21st and 22nd August 2018 and engaged six target households. In addition to farmers, local NGO partners benefited from the training and learned about new techniques to preserve nutrient-rich small fish. Fish powder production is considered a potential for livelihood activity. The training also helped farmers to link with fish powder traders.

*Photos: Left: NOURISH staff providing training and explanation to local NGO partners and famers on fish powder production; Right: Study tour of WorldFish, FiA and local NGO partners to HKI project sites in Kampot province*

In 2017, WorldFish partnered with the National Research and Aquaculture Development Institute (NARDI) for research on understanding the biology of local nutrient-rich small fish species for domestication. The research focused on *Esomus longimanus*, an abundant rice field small fish species, rich in zinc and iron, and *Rasbora tornieri*, a small fish species with high vitamin A content. The results of the research provided new knowledge on the feeding of these species which is based on plankton, insect and algae. The analysis showed differences in growth between the two species and differences in feeding of the species during development and until maturity. Additionally, the

research also looked at techniques to capture and transport small fish. This research provided key recommendations to project partners on these topics. This research was funded by the CGIAR Research Program (CRP) on Fish Agri-food Systems (FISH).

In 2018, two study tours in Cambodia and Bangladesh were organized. A first study tour to visit Helen Keller International (HKI) project sites took place on January 29th and 30th 2018. During this study tour, WorldFish staff (10), project partners (6) and FIA (1) visited and shared experience with HKI staff and project households regarding their approach to nutrition-sensitive aquaculture. It was also an opportunity to create stronger links between nutrition-sensitive aquaculture projects that operate in different provinces of Cambodia.

From July 8th to July 14th, WorldFish organized a study tour to WorldFish Bangladesh project sites to learn about nutrition-sensitive aquaculture approaches. The tour group included 2 staff from Fisheries Administration, 4 project partner staff, 4 WorldFish Cambodian staff (including 2 from Rice Field Fisheries Project) and 2 GiZ staff, working on the Multisectoral Food and Nutrition Security (MUSEFO) Project.

The study tour was an opportunity to learn from the Bangladeshi experience in cultivating carp species together with the small fish species, mola; and the use of rice fields for decentralized fish hatcheries. The Cambodia group was extremely receptive on techniques to transport fingerlings, handling fish fingerlings and nutrition training approaches. This approach, based on lead farmers mentoring 22 other farmers was of interest for the Cambodia group. This study tour is described in a blog on the WorldFish Facebook page.

*Photos: Left: Bangladeshi farmers demonstrating mola production in rice fields; Right: Cambodian delegation with Bangladeshi farmers producing carp and mola*

In 2018, WorldFish, provided input to FAO for the production of a “Nutrition-sensitive Fisheries Guidelines for Cambodia”, under the EU-FAO FIRST program. This is to be released in 2019.

Additionally, WorldFish organized a study tour for four researchers of the Central Institute of Fisheries Technology from India (Indian Council of Agricultural Research, Ministry of Agriculture and Farmers Welfare, Govt. of India) to Cambodia from 22nd to 26th October 2018. The purpose of this study tour was for the Indian delegation to learn about the different approaches to rice field fisheries enhancement and nutrition-sensitive approaches to aquaculture and fisheries, as introduced by WorldFish and practised in Cambodia.

Finally, the project team members from WorldFish shared experience and knowledge with a local social enterprise, VISSSOT (http://www.vissot.com/), involved in producing a micronutrient-rich food supplement for UNICEF and engaged in developing a ready-to-use fish powder product. VISSOT received a grant from Bill and Melinda Gates Foundation for research and the project team will assist VISSOT in identifying the sources of small fish species from rice fields.

*Progress toward indicators*

In 2018, the project created a momentum of interest towards nutrition-sensitive aquaculture within Cambodia and outside of Cambodia that are illustrated by interest of the Indian delegates in learning from our approaches. We also involved other agencies (such as GiZ) in a study tour outside of the country for future scaling of approaches and technologies in Cambodia. This experience has been published on-line and results of the first cycle of production will be presented in January 2019 at the Sun CSA annual workshop in Cambodia.

### *2.5. Activities planned for 2019*

In 2019, the project will enter the last full year of activities. The project households will continue to be supported for carrying out nutrition-sensitive aquaculture and vegetable food systems as well as activities on production technologies as well as on nutrition and hygiene. The following key activities are planned in 2019:

- Complete training on nutrition and vegetable production for targeted households;
- Conduct a final workshop in September 2019 and learn from two years of implementation;
- Draft a lessons learnt brief on nutrition-sensitive fisheries approach in Cambodia.
- Participate in a workshop on nutrition-sensitive fish agri-food systems in Africa.

**Visibility and Communication Plan**

In 2018, WorldFish reported on project activities via the online platforms: LinkedIn and Facebook, notably on the study tour to Bangladesh.

The current project brochure and presentations made in workshops clearly acknowledge the European Commission and the European Union as the funding agency of this project and events.

In 2019, two short videos for social media coverage, targeting an international audience will be made.

# Zambia Component

**Background**

In 2016, an assessment was undertaken of small indigenous fish species (SIS) in Zambian aquaculture/fisheries and as nutritious animal-source food in rural markets. In 2017, the research team with assistance from The Department of Fisheries in Luwingu selected SIS from Lake Bangweulu and surrounding wetlands for pond polyculture trials. The pond polyculture trials started in 2017 and continued into 2018.

To assess and evaluate the impact of the introduction of, and training on pond polyculture with nutrient-rich SIS, WorldFish and Palm Associates conducted a baseline assessment of agriculture and aquaculture production as well as consumption practices at the household level. In 2017, a quantitative household survey was completed with a total of 380 households and an additional 30 qualitative semi-structured interviews were conducted with the person in the household in charge of food preparation.

**Activities planned for 2018**

- Analysis of baseline and qualitative data collected in 2017
- Design training and behaviour change communication material – informed by the quantitative and qualitative data collected in collaboration with local partners such as the Department of Fisheries, Department of Agriculture, and Self Help Africa (SHA)
- Household nutrition education training in June/July 2018 – in collaboration with SHA
- Farm level trials with selected households, after the training has been implemented

**Activities undertaken in 2018**

**Nutrition Education Training**

In Luwingu district, nutrition education training material was developed and delivered to 240 households engaged in pond aquaculture by the national NGO, SHA

SHA developed training material, in collaboration with WorldFish staff, and provided training on nutrition-sensitive fish food systems – a new area of training in Zambia. Partnerships with staff from the Ministry of Fisheries and Livestock, Ministry of Agriculture and Ministry of Health ensured a strong multi-disciplinary approach to the training.

Findings from the nutrition education training in Luwingu district:

- Learners had limited knowledge on the use of variety of food and food grouping, which might lead to low food and crop diversification.
- Household members in charge of food preparation had limited knowledge on food processing, preservation and utilisation (for example\, most of the cassava powders bought were not dried well for making fritters).
- Most participants lacked knowledge on utilisation of orange sweet potato.
- Some households sold all produce without considering issues of home consumption, a situation which leads to food and nutrition insecurity.

- Intra-household food intake is a serious issue as preference for food quality and distribution is given to men as compared to children and women.
- Learners said men generally make decisions in terms of which crop to grow and this is usually the crop which is easily sold.
- Socio-cultural norms can have a negative impact on feeding and preferences of foods – for example, it is considered not proper that women and children should eat before a man.
- Poor hygiene - poorly constructed toilets, poorly constructed kitchens, washing of hands especially after toilet use are issue. All mortars which were brought for use during the cooking practices were hygienically poor.

Outcomes

- Participants, women and men, practised cooking with nutrient-rich fish and orange sweet potato (OSP) powders.
- Sensory tasting suggested that participants liked fish powder and OSP powder.
- After the training, most learners agreed to try and look for OSP vines for planting and plant soya bean.
- Participants understood that 'hidden hunger' / lack of essential vitamins and minerals can be prevented through basic nutrition knowledge and daily actions, including the consumption of micronutrient-rich powders.
- Recipes using fish powder and OSP powder were developed and widely disseminated, including through schools and at the District Agricultural Show in May 2018.

Lessons learnt

- Restrict topics covered or extend the duration of the training – one day was not enough to cover nutrition education and include participatory cooking sessions.
- Household heads also wanted to attend the learning event. In addition, both household heads and food preparers should participate as the issue of disparity in intra-household food intake affects all and solutions need actions by all.
- OSP was hard to source in Luwingu district, and it had to be sourced from Mbala district. Household access to OSP cultivars, in this area, should be improved.
- Participants are too scattered to mobilise them in one place, and some people had to travel very far (20 km) to attend – perhaps next time sessions should be run in multiple locations, and influential leaders i.e. 'nutrition champions' should be utilised to further communicate the messages at the community level.
- Visual aids helped to communicate important information.

**Expansion of farm-level trials**

Promotion of pond polyculture was expanded, with attention given to engaging women.

Pilot experiments with stocking and management of small fish in pond polyculture are on-going. After breeding and household consumption, distribution of brood stock to neighbours and sale are promoted. Common SIS have been collected and analyzed by a Ph.D. fellow from the University of Hohenheim, Germany.

**Summary of findings: pond polyculture trials with SIS in Northern Zambia**

- Both tilapia species (*T. rendalli* and *T. sparrmani*) reproduced with high numbers of offsprings, which continued to grow. Over the period of the trials, the overall weight gain from reproduction and initial growth of offspring surmounted the total weight gain achieved through cultivation / fish growth of initially stocked fish.
- Barbus were found reproducing in considerable numbers, but in a few (2) ponds only. As a mix of barbus species was stocked, *Enteromius kerstenii* (Redspot Barb), was found reproducing in largest numbers: of initially 50 fish stocked, we harvested > 500 fish at the end of the trial.
- Mintesa (*Marcusenius macrolepidotus*) grew slowly, showed higher mortalities, were very difficult to harvest as nocturnal and often found buried in the pond ground to seek refuge. Although this species is a highly preferred food fish, often consumed small in size, the research findings suggest that this species is not suitable for a nutrition-sensitive pond-polyculture.
- Both women and men face difficulties accessing fingerlings and fertilizer, though women faced more difficulties transporting fish to markets as they lack transportation.
- Scattered households and ponds present a challenge in promoting pond polyculture, and an attempt to map ponds by a Peace Corps volunteer failed, due to lack of transport.



*Photos: (Left) a mix of barbus (mainly Enteromius kerstenii (Redspot Barb)) harvest from one pond; (Centre) Small T. rendalli – offspring from initially stocked mixed-sex T. rendalli; (Right) Mixture of small and large species fish harvested from trial ponds*

*Table 1. Growth and reproductive performance of the pond polyculture trials with SIS in Northern Zambia by species*

| ***T. rendalli* (stocked)** | **Pond** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Harvest weight (g) | 700.00 | 3279.00 | 1635.00 | 1637.00 | 2239.00 | 2216.00 | 2584.00 | 2595.00 |
| Ave. fish weight | 30.43 | 44.28 | 52.74 | 48.15 | 37.32 | 43.45 | 39.15 | 34.60 |
| Min. weight (g) | 5.00 | 15.00 | 12.00 | 13.00 | 10.00 | 20.00 | 12.00 | 17.00 |
| Max. weight (g) | 64.00 | 194.00 | 122.00 | 84.00 | 144.00 | 118.00 | 136.00 | 138.00 |
| SD | 19.24 | 26.25 | 26.34 | 17.03 | 29.47 | 24.46 | 19.54 | 20.45 |
| Survival (%) | 30.67 | 98.67 | 41.33 | 45.33 | 80.00 | 68.00 | 88.00 | 100.00 |
| **Total weight gain (g)** | **12127** | | | | | | | |
| ***T. rendalli* (offspring)** | **Pond** | | | | | | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| No. of fish | 441 | 976 | 492 | 867 | 284 | 467 | 1533 | 1065 |
| Total Weight (g) | 2017.00 | 1672.00 | 1803.00 | 3337.00 | 737.00 | 669.00 | 3571.10 | 3006.00 |
| Ave. fish weight (g) | 4.58 | 1.71 | 3.66 | 3.85 | 2.60 | 1.43 | 2.33 | 2.82 |
| **Total no. of fish** | **6124** | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Total weight gain (g)** | **16812.1** | | | | | | | |

| ***T. parrmani* (stocked)** | Pond | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Harvest weight (g) | 797.00 | 503.00 | 362.00 | 285.00 | 385.00 | 360.00 | 651.00 | 285.00 |
| Ave. fish weight (g) | 20.97 | 13.97 | 15.08 | 14.25 | 11.32 | 16.36 | 17.13 | 12.95 |
| Min. weight (g) | 10.00 | 6.00 | 6.00 | 6.00 | 7.00 | 10.00 | 10.00 | 5.00 |
| Max. weight (g) | 46.00 | 31.00 | 55.00 | 21.00 | 19.00 | 25.00 | 42.00 | 22.00 |
| SD | 8.34 | 5.20 | 9.30 | 4.83 | 3.37 | 4.62 | 8.46 | 4.33 |
| Survival (%) | 95.00 | 90.00 | 60.00 | 50.00 | 85.00 | 55.00 | 95.00 | 55.00 |
| **Weight gain (g)** | **1590** | | | | | | | |
| ***T. sparrmani* (offspring)** | **Pond** | | | | | | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| No. of_fish | 318 | 525 | 576 | 226 | 1022 | 1562 | 598 | 51 |
| Total Weight (g) | 713.00 | 1067.51 | 1191.00 | 571.00 | 2522.00 | 2259.00 | 1428.20 | 115.00 |
| Ave. fish weight (g) | 2.24 | 2.03 | 2.07 | 2.53 | 2.47 | 1.45 | 2.39 | 2.25 |
| **Total no. of fish** | **4879** | | | | | | | |
| **Total weight gain (g)** | **9866.71** | | | | | | | |

| **Barbus Mix (harvested)** | **Pond** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Total weight (g) | 621.00 | 745.80 | 111.00 | 67.00 | 84.00 | 155.00 | 43.00 | 36.00 |
| Ave. fish weight (g) | 1.50 | 1.00 | 4.83 | 1.18 | 7.00 | 8.16 | 2.87 | 7.20 |
| **Total no. fish** | **415** | **747** | **23** | **57** | **12** | **19** | **15** | **5** |
| **Total weight gain (g)** | **1124.8** | | | | | | | |

| ***Mintesa* (harvested)** | **Pond** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Harvest weight (g) | 541.00 | 497.00 | 532.00 | 749.00 | 459.00 | 567.00 | 865.00 | 932.00 |
| Ave. fish weight (g) | 21.64 | 14.62 | 17.16 | 18.27 | 13.50 | 12.89 | 14.42 | 13.91 |
| Min. weight | 10.00 | 6.00 | 7.00 | 9.00 | 5.00 | 5.00 | 6.00 | 6.00 |
| Max | 48.00 | 31.00 | 34.00 | 47.00 | 38.00 | 38.00 | 41.00 | 34.00 |
| SD | 8.78 | 5.51 | 8.78 | 7.88 | 7.50 | 5.86 | 7.29 | 6.21 |
| Survival (%) | 33.33 | 45.33 | 41.33 | 54.67 | 45.33 | 58.67 | 80.00 | 89.33 |
| **Weight gain (g)** | - **3** | | | | | | | |

**Outputs**

**Fish-based recipes booklet**

This booklet was produced to serve as a guide for staff from government agencies and NGOs to integrate fish-based recipes into nutrition programmes that aim to improve dietary diversity and

child feeding practices in Zambia. It can also be used alongside other resources, such as the Improved Complementary Foods Recipe Booklet, made by the National Food and Nutrition Commission.

The recipes were developed to meet the specific nutritional needs of pregnant and lactating women and young children, but they are beneficial to all household members. They are based on local food availability and preferences and are relatively affordable for rural and urban consumers. The ingredients included can be grown or purchased in local markets. Although it was developed in Northern Province, Zambia, these recipes can be used throughout the country where small fish species are accessible to promote the consumption of fish-based foods during the first 1000 days of life.

The booklet contains five fish-based recipes for pregnant and lactating women, infants and young children and other members of the household. These recipes were developed and tested during 2015–2016 in the Mbala and Luwingu districts in Northern Province, Zambia. WorldFish led the development and testing of these recipes, together with several national and district stakeholders, including staff from the Ministry of Health; Ministry of Agriculture, Ministry of Fisheries and Livestock; World Vision; and SHA. Funding to carry out the research for this booklet was provided by this project as well as by Irish Aid.

*Photo: Porridge for children, aged 6 - 23 months and pregnant and lactating women*

# Indonesia Component

Building on the partnership with the Ministry of Marine Affairs and Fisheries, (MMAF), Indonesia, we are developing three policy briefs focusing on nutrition-sensitive fish food systems, with focus on the role of fish for improving nutrition in the first 1000 days of life. The drafted policy briefs (see Annex 1, 2 & 3) will be reviewed and finalized in 2019.

1. Nourishing with Small Fish in the First 1,000 Days of Life in Lampung Province, Indonesia

2. Small Fish Processing, Education, and Social Behaviour Change for Fish Consumption to Support the First 1000 Days of Life in Indonesia

3. Sustainable Production of Small Fish to Support Micronutrient Supply for the First 1,000 Days of Life in Indonesia.

These briefs will be used for influencing fish production systems, for example, use of reservoirs to produce nutritious fish and collaboration with the Ministry of Health for the use of fish and fish products for pregnant and lactating women and young children. These activities will be used for advocacy and policy in the ASEAN countries, in collaboration with FAO in 2019.

Annex 1

Nourishing with small fish in the first 1,000 days of life in Lampung Province, Indonesia

By Maskur Maskur

## 1 BACKGROUND

Indonesia suffers high rates of undernutrition as indicated by the result of national monitoring of nutritional status in 2016. At the national level, the status of children under 5 with the lack of nutrition was 17.8 %, stunting was 27.5%, and underweight was 11.1%. In addition, pregnant women with energy deficiency was 53,9%, and protein deficiency was 51.9%,

Lampung is one of the provinces in Indonesia having an under-nutrition status. The percent of children under 5 with lack of nutrition is 11.8 %, stunting is 24.8%, and wasting is 9%. Numbers of pregnant women with energy deficiency was higher than the national level (i.e. 74.4%, and protein deficiency was 69.4%).

District of Lampung Selatan was also categorized as malnourished. The indicators were children under 5 having a lack of nutrition had reached at 13.9%, stunting was 24.8%, and wasting was 8.8%.

Compared with the other 14 districts in Lampung Province, Lampung Selatan is one of the districts having a high stunting level (Kementerian Kesehatan RI, 2017). Therefore, Lampung Selatan is one of the 50 targeted districts as priority in eradicating stunting in Indonesia (Sekretariat Wakil Presiden RI, 2017).

## 2 WHY THE FIRST 1,000 DAYS

The first 1,000 days of life means a period of infant started from the womb until age 2. This is the golden period of infant growth due to the most rapid growth of brain and other cells to support an infant growing maturely. Lack of nutrition during the first of 1000 days of life is crucially dangerous, and the impact cannot be improved at the next phases. Should there be a lack of nutrition during this period, brain development will be blocked, physics, cognitive as well as motoric development will also be impeded. Therefore, the child will be stunted, less intelligent, weak, and the child will be an adult person with less productivity.

Appropriate interventions in these vulnerable groups during this critical period will have great impacts on preventing a lost generation in the future. With the two thirds of area that is ocean, Indonesia is rich in using fisheries as a source of animal protein. Fish can be used as a key component of the diet during the first 1,000 days. Small fish can provide very important nutrients both for pregnant women, lactating women, and children during the first 1000 days of life.

Indonesia is a prominent fish producer. Located on the equatorial lines, Indonesia has a high diversity of fishery species. Among small fish species, anchovy is one of the species economically important in the country. Anchovy production in Indonesia reached 203,200 tons in 2012; 191,094 tons in 2013; and 199,226 tons in 2014 respectively. Anchovies are a high-quality diet source, since all parts of the body can be consumed, thus the nutrient contents such as protein, fat, calcium, phosphorus, and iron is higher than other fish at the same weight (Aryati and Dharmayanti,2014). In addition, anchovies contain minerals, vitamins and other nutrients that are very good for human health and cleverness (Bank Indonesia, 2009, Yuwono, 2015). This aligns with the results from a research conducted in Bangladesh by Bogard et. al. (2015), which showed that wild small fish caught in open fresh water bodies are very promising for food intake in the first 1,000 days of life, especially pregnant and lactating women.

In addition, fish *chutney,* a food cooked with a traditional recipe made from local small fish, served with rice and vegetables, has been successfully contributing micronutrients to children, pregnant and lactating women in Bangladesh (Bogard JR, AL Hother, *et all.,* 2015). Another finding showed that complementary rice porridge supplemented with a local small fish called *darkina* fish (*Esomus danricus*) that contains high iron, calcium and zinc gives a significant contribution to nutrition intake for infants and children (Bogard JR, Thilsted SH, Marks GC*, et al*. 2015).

## 3 WHY FISH AND FISH-BASED PRODUCTS?

While fish and fish-based interventions are a good fit for vulnerable communities in Indonesia, numerous issues have to be taken into consideration. In terms of fish supply, wild fish should be sustainably harvested, and cultured fish should be cultivated in a sustainable way and comply with food safety standards. Fish is very rich in nutrient content, but it is extremely perishable, therefore a

proper handling starting from harvest until it gets to theplate should be in place to comply with food safety requirements.

Eating fish products directly from the whole round form is not always easy for all consumer ages, namely infants over 6 months, children, and adults. Fresh fish need cold chain facilities. In contrast, accessability of power supply and electricity for rural areas is limited, so that fish and certain fish-based products should be easily stored. Therefore, fish-based product processing and diversification is required to be widely beneficial, increase shelf life, and fit to consumer preferences including the critical groups. Various recipes on simple practical fish processing to keep the nutrition content should also be widely disseminated.

Fish have significant comparative advantages rather than beef, lamb, pork and poultry. Fish is accepted by all religions, easy to digest, contains high nutritious elements for health, has numerous species, naturally available in open water bodies and can be cultured at any scale of business which produces less carbon footprints.

Nevertheless, the benefit of fish consumption is not widely known. There are misunderstandings and false perception in consuming fish, especially for young children, pregnant and lactating women. They are afraid of being “cacingan” (intestinal worm disease), or the breast milk will taste fishy if they consume fish. Some local governments do not claim the fishery sector as the main source of animal protein for their community, although, geographically, the area is feasible.

## 4 ISSUES, POLICIES, AND RECOMMENDATION.

Several factors contribute to malnutrition; namely diseases, lack of nutritional knowledge, poverty, non-availability of nutritious food supply, and lack of proper food processing knowledge. In some areas, prices of fish compared to other protein sources is relatively higher due to its perishable characteristic and limited distribution. Hence, malnutrition cases should be managed in a synergized program and supported by multi-stakeholders. According to the FAO (2016), Indonesia was the second largest fishery producer, however, certain community groups are considered malnourished. Some people are not aware of the nutritional values of food, including fish-based products.

Numbers of regulation related to food and nutrition have been issued. Presidential Regulation number 42, year 2013, regarding the National Movement on Accelerating Nutritional Improvement focuses on the first 1000 days of life involving multi sectors. This was followed by Presidential Regulation number 83, year 2017, regarding Strategic Policy on Food and Nutrition consists of among others’ action plan, surveillance and evaluation. Action Plan of Food and Nutrition at the national and regional levels is formulated by Minister of National Plan and Development Decree number one year 2018.

Considering that fish is potentially feasible to be a national main animal protein source, but level of fish consumption per capita remains low, the former President Megawati has been launching GEMARIKAN (movement to increase fish consumption) on 4 April 2004. This movement is supported by FORIKAN (a forum to increase fish consumption consisting of various professionals and institutions) chaired by a medical doctor at the national level and chaired by the spouse of Governor/Mayor) at

the province/district levels. Up to now, there are 34 FORIKANs at the provincial level and more than 300 FORIKANs at the district / municipality levels. Anchor of GEMARIKAN activities is the Ministry of Marine Affairs and Fisheries.

In 2017, the Government of Indonesia, led by the Ministry of Health, issued Presidential Instruction number 1 concerning Community Movement, which focuses on improving public health and increasing consumption of various balanced foods. In the district level, the nourishing program under this movement for pregnant women and young children uses fortified biscuit, milk, and porridge of mung bean for about 3 months. Distribution of the fortified biscuit, food supplement such as Fe tablet, vitamin A and food complimentary was conducted by Community Health Center involving midwives in the village level.

Meanwhile, mainstreaming fish consumption has been conducted at all governmental levels. Activities to create demand of more fish consumption are namely fish cooking contests, providing fish-based products for school pupils, and fish bazaar – a temporary market with discounted price. However, less frequent activities and limited coverage to grassroot level resulted various impact at the community.

The recommendations are:

1. GEMARIKAN and GERMAS should be more synergized especially at the district level. Utilize local fishery resources as many as possible and set up food and nutrition improvement as a continuous program.
2. Introducing household food security program for animal protein by culturing fish in 'container" in the home backyard
3. Introducing how to cook fish properly to prevent nutrition losses and increase the shelf life.
4. Supporting coverage of fish and fish-based products distribution up to upland and rural areas.

### 4.1 ISSUE: LACK OF ENVIRONMENTAL SUSTAINABILITY

To supply small fish for the nourishing program, it should not depend merely on the ocean. Some wild species from freshwater can be alternatives, such as seluang fish (*Rasbora sp*.) (Rosadi, 2014) and bilih fish (*Mystacoleucus padangensis Bleeker*) (Butarbutar et al, 2015), as well as cultured small fish (wader fish).

For wild small fish, both in ocean and open fresh water bodies, it is necessary to introduce a harvesting strategy to prevent overfishing. For culturing small fish, the use of eco-friendly culture systems in ponds, lake or rice field (rice-fish farming systems) is highly recommended. A pressure on culturing fish is the need of fishmeal as the main ingredient of fish feed. Small fish harvested from ocean some times are used as fish meal. Introduction on the use of algae as a fish feed can reduce the pressure on wild caught small fish, which could be shifted as foods for human consumption. Ultimately, this may lead to provide more fresh fish with a cheaper price in the market for people.

Policy recommendations

- Develop sustainable production systems for marine and freshwater small fish of indigenous species such as anchovy (*Stolephorus sp*.), seluang (*Rasbora sp*.), bilih (*Mystacoleucus padangensis Bleeker*), and wader fish to support the implementation of national movement policy on the first 1,000 days of life.

- Develop breeding and relevant technology of seluang and bilih fishes as well as others indigenous freshwater small fish for restocking in order towards sustainable production.

### 4.2 ISSUE: LACK OF VALUE-ADDED PRODUCTS AND COMPLEMENTARY FOODS

Currently, in Indonesia, anchovies are traded in various forms such as fresh, dry-salted, and ready to eat products, or with limited processing for adult consumption. The use of anchovies as a special food for pregnant women and children under five is still very limited. Recently, there is a special product, anchovy powder for babies over 6 months. It is mixed with children's porridge to add more nutritious elements as recommended by medical doctors. This is relatively a new product and inspiring for the alternative complementary food for nourishing the first 1,000 days of life.

Other small freshwater fish are traded locally in fresh and fried products or in other traditional products both as a snack and main dishes. Penetration of manufatured snack products which are less nutritious up to rural areas brought about negative impacts for young children if mothers lack of knowledge on nutrition.

Meanwhile, nutrition improvement program for the community in the village level are using complementary foods consiting of fortified biscuits, milk, mung-bean porridge, and as well as supplement such as iron tablets, vitamin A capsules for pregnant women, lactating women and young children undernourished for about 3 months. This is still critical in term of nutritional status until the child reaches age 2 years. For the time being, small fish products are not included in their daily diet.

It is necessary to prioritize fish-based product development and diversification using local resources. This programme will be successfully implemented with the support of the head of local government. The fish-based product should be easily accessible, affordable, tasty, acceptable and safe to be consumed by the poor, including for the intake of pregnant/lactating women and young children.

It is required to create small fish processed products, which are suitable in terms of nutritious content and preferences for the targeted populations i.e. pregnant/lactating women and young children.

Policy recommendations

- Anchovies and others small fish are high quality foods as all parts can be consumed.
- Incorporating locally small fish-based products in the food intake for the first 1,000 days of life as a part of daily food diet will be more effective and sustainable compared to fortified biscuits.
- Synergizing GERMAS (Gerakan Masyarakat Hidup Sehat / Healthy Living Community Movement) and GEMARIKAN (Gerakan Memasyarakatkan Makan Ikan - Movement for Eating Fish) programme specially the use of fish as the main animal-source foods in the complementary foods for young children, pregnant ad lactating women.
- Improve value chain and marketing of small fish by prioritizing product diversification such as powder, biscuit, and others products that are easily accessible, affordable, and safe to be consumed by pregnant/lactating women and toddlers.

### 4.3 ISSUE: LACK OF AFFORDABILITY

It is required to create small fish processed products that affordable for the poor. The malnutrition cases in the Kemukus village, Ketapang sub-district (Fig.1), Lampung Selatan Districtis probably due to low educational level and poverty. They cannot afford to buy main dishes, which are more expensive than tofu, tempe and egg. Current prices of anchovy is vary it depend on the type of anchovy (such as rice anchovy, buntiauw, nylon, and jengki) (Figure 2) are around IDR 60,000 - 90,000 per kg is too high compared to the price of tofu, tempeh, and eggs which is less than IDR 18,000 per kg.

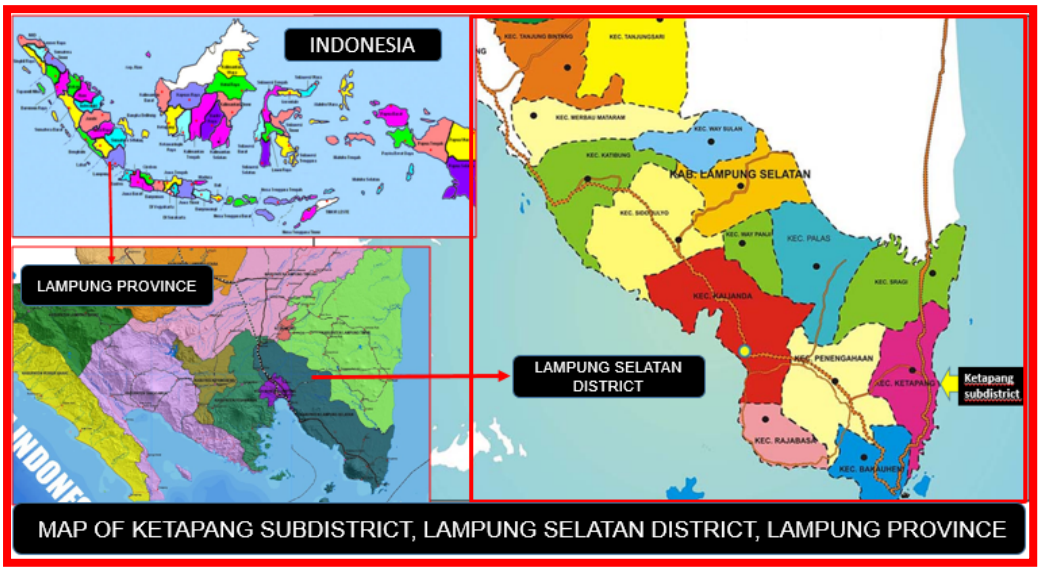


Figure 1. Map of Ketapang subdistrict, Lampung Selatan District


Figure 2. Types of anchovies (teri)

Policy recommendation

- It is required to create small fish processed products that are affordable for the poor. The Provincial and District Government may provide intervention to reduce the price of local fishery products and conduct special distribution for the poor.

### 4.4 ISSUE: LACK OF KNOWLEDGE AND AWARENESS OF THE NUTRITIONAL VALUE OF FISH

GEMARIKAN is an umbrella for increasing fish consumption program. Under this program there are so many activities namely outreaching the benefit of fish consumption involving medical doctor and nutritionist; education on food safety consisting of how to handle fish properly, how to select good fish, and how to cook fish to prevent nutrition losses; introducing fish based products for the community having low fish consumption

Policy recommendation

The central government encourages provincial and district / municipal governments to increase their knowledge and awareness of the use of fish as a good source of nutrition for children, pregnant and lactating women.

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## 6 REFERENCES

Aryati Endah E, AWS. Dharmayanti, 2014. The Benefits of Fresh Anchovy (*Stolephorus sp*.) on the Growth of Bone and Teeth (Indonesian). Odonto Dental Jurnal, Vol.1, no2, Des.2014.

Bank Indonesia, 2009. Small Business Financing Role: Anchovy Industry (Syariah Financing) (Indonesian). Direktorat Kredit, BPR dan UMKM, Bank of Indonesia.

Bogard J.R., Hother AL, Saha M, Bose S, Kabir H, Marks GC, Thilsted. The Inclusion of small indigenous fish improves nutritional quality during the 1000 days. Food and Nutrition Bulletin. 2015. Vol 36(3): 276-289.

Bogard JR, Thilsted SH, Mark GC, Wahab MA, Hossain MAR, Jakobsen J, Stangoulis J, 2015. Nutrient composition of important fish species in Bangladesh and potential contribution to recommended nutrient intakes. Jour. Food Compost Anal 42, 120-133.

Butarbutar S, Yulianda E, Hendrik, 2015. Production and marketing of bilih fish (*Mystacoleucus padangensis* Bleeker) in village Napitupulu, subdistrict of Balige, district of Toba Samosir, North Sumatera province.

FAO, 2016. The State of World Fisheries and Aquaculture 2016. Rome

Insruksi Presiden, 2017. Community Movement focuses on improving public health. *http://www.kesmas.kemkes.go.id/assets/upload/dir_519d41d8cd98f00/files/Inpres-Nomor-1-Tahun-2017-tentang-Gerakan-Masyarakat-Hidup-Sehat_674.pdf*

Kementrian Kesehatan RI, 2017. Buku Saku. Results of Monitoring of Nutritional Status Year 2016 (Indonesian).

MMAF, 2015. Statistics of Anchovy Production Based on Province and Fisheries Management Area Year 2006-2014.Ministry of Marine Affairs and Fisheries, Jakarta.

Peraturan Presiden RI, 2013. National Movement on Accelerating Nutritional Improvement (Indonesian).

Peraturan Presiden RI, 2017. Strategic Policy on Food and Nutrition Kebijakan Strategis Pangan dan Gizi (Indonesian).

Peraturan Menteri, 2018. Rencana Aksi Pangan dan Gizi (Indonesian). *http://birohukum.bappenas.go.id/data/data_permen/Peraturan-Menteri-PPN-1-Tahun-2018.pdf*

Rosadi E., 2014. Seluang batang (*Rasbora argyrotaenia* Blkr 1850) catch based on moon agein BaritoRiver,Kalimant an Selatan (Indonesian). Faculty of Fisheries, University of Lambung Mangkurat,

Secretariat Wakil Presiden RI, 2017. Action Plan of Handling for Stunting in Indonesia (Indonesian).

Yuwono Sudarminto Setyo, 2015. Anchovy (*Stolephorus indicus)* (Indonesian). University of Brawijaya, Malang. (http://darsatop.lecture.ub.ac.id/2015/07/ikan-teri-stolephorus-indicus/).

Annex 2

# Small Fish Processing, Education, and Social Behaviour Change for Fish Consumption to Support the First 1000 Days of Life in Indonesia

By Maskur Maskur

## Background

Good health and well being of people are one of the United Nation Sustainable Development Goals and Country Leaders are comitted to achieve these by 2030. According to Indonesian Law of Health number 36/2009 Chapter 1, healthiness is the state of health physically, mentally, spiritually and socially that enable every person to have a socially and economically productive life. A health degree is influenced by 40% of environment, 30% of behavior, 20% of health services, and 10% of genetics (Ministry of Public Health, 2018).

Improvement of Nutrition and Mother and Child Health is one activity under Health Indonesia Programme (2015-2019). To accelerate achievement of individual and public healthy life, the Ministry of Health (MoH) applies family and community approaches. *GERMAS*, community movement to have a healthy life has been introduced since 2015, and supported by the Presidential Instruction no 1/ 2017. In terms of public health, Indonesia suffers high rates of under nutrition as indicated by the result of nutritional status in 2016, that at the national level, the status of children under 5 with the lack of nutrition was 17.8%, stunting was 27.5%, and underweight was 11.1%. In addition, pregnant

women with energy deficiency was 53.9%, and protein deficiency was 51.9%. Stunting is the worse chronic status under the nutrition case and occurs in all economic class levels but tends to decrease in line with increased income.

According to the Global Nutrition Report (2017): Indonesia made some progress on under-5 stunting category against Global Nutrition Targets 2017. Meanwhile, OECD (2017) reported that in Indonesia, there is some significant improvement on food security since 1990s, but nearly 20 million people remain undernourished. Indicators of observed malnutrition also remain at alarming level, i.e. the number of stunting, wasting, overweight and obesity among children under five years. Those figures due to food inadequacy, micronutrient deficiency, in particular, iodine and vitamin A, and inadequate diets, notably with insufficient intakes of protein and vitamin and excessive intakes of carbohydrates. Poor sanitation and quality of environment also contribute to the malnutrition cases. Studies showed that stunting among children reduces IQ scores by 5-11 points; correlates with lower grades at school; and correlates with a 10% loss in lifetime earnings (GAIN, 2017). With alarming current nutritional status, the Indonesia's President, Mr. Joko Widodo urgently assigned his ministerial cabinet to avoid possible lost generation in the future by setting up an integrated action plan to reduce and prevent stunting. To do so, MoH has been conducting some interventions by involving multi sectors participation applying preventive and caring approaches. Preventive approach will be conducted by improving the quality of the first 1000 days of life covering the pregnant and lactating mothers and their children under two. Meanwhile, caring approach will be done by stimulation of sustainable care and education.

Three main components to tackle stunting are Parenting, Dietary Habit, and Clean Water and Sanitation. This paper will focus at the involvement of fishery sector in the dietary habit component. The fishery sector is potentially feasible to support the nutrition security since Indonesia is the largest archipelago and two third of its area is marine environment with the most diverse marine resources. Moreover, Indonesia also has numbers of fresh water bodies with numerous fish species. With that, in 2004 the Ministry of Marine Affairs and Fisheries (MMAF) has been introducing an umbrella program the so called *GEMARIKAN*, national movement to increase fish consumption.

Indonesia fisheries production is the second largest after China. In 2016, excluding seaweed, national fisheries production was 11.53 million tons consisting of capture fisheries (6.54 million tons) and aquaculture (4.99 million tons). In term of fish consumption, national average in 2015 was 41.11 kg/caput and in 2016, increased to be 43.94 kg/caput equals to whole fresh fish (MMAF, 2017). Fish also remains the biggest contributor of animal protein in the national diet.

Looking at the above data between malnourished state and fish consumption rate, it seems that there is a gap of the expected results. Consumption level among districts or households is varied, and a coastal district or a fisherman household not always has a high rate of fish consumption. In contrast, stunting cases also spread to various districts. Therefore, it needs deeper reviews of provincial and district data, as well as the linkage of *GEMARIKAN* and *GERMAS* programmes and their implementation.

The Plan of Action to cope with stunting would be conducted by three types of interventions namely: Specific Nutrition by MoH, Sensitive Non Health (MoH in cooperation with other sectors) and Other Health by MoH. In the nutrition-specific and nutrition-sensitive non-health interventions, there is room for developing synergic cooperation between health and increasing fish consumption programmes. *GERMAS* and *GEMARIKAN* should hand in hand to handle the same target groups especially for the first 1000 days of life. The challenges are how to provide fish based foods which are suitable for pregnant and lactating women and children under two. The attributes should be: ready to eat, high nutrition content, easy to store, affordable, and have long shelf-life especially for emergency cases. *GEMARIKAN* should also support the continuous supply of good quality fresh and

frozen fish or fishery products which are affordable and easily access especially for the poors in areas where the cases of under-nutrition happen.

Fish for Young Children to Prevent Stunting

People are the most valuable resource of a country. Healthy and well-educated people will contribute significantly to productivity, competitiveness and economic growth and experience a higher quality of a life. At the other side, stunting not only curbs the potential of individuals but also of the nation's human capital. Therefore, reducing and preventing stunting by improving quality of the first 1000 days of life will be particularly strategic investment of the future human capital.

In Indonesia, using fish-based food products for nourishing pregnant and lactating women and children under two years old seems challenging. Fish is a very healthy and nutritious option to get in some Omega 3s and other wonderfully healthy nutrients include vitamins A, B, and D as well as iodine, iron, zinc and calcium which are essential for brain development and baby's growth. Fish is an amazing source of pure Omega 3s which are powerful indeed for growing baby needs even to help for who have ailments. Fish is also a source of high quality protein, containing essential amino acids .

Fish especially when eaten whole will provide the optimum benefits. Therefore, small fish consumption is very advisable for the first 1000 days of life. Solid foods based on fish may be introduced to young children after 6 months of age. Many people are afraid of feeding young children fish due to some reasons. Concerns about fish for young children and lactating mother are possibly as an allergenic food, fishy smell, myths, health and safety aspects, and knowledge of how to cook fish properly to prevent nutrient losses. Some experts warn about shellfish and crustaceans that have greater risk as allergen should not be given to children under three years of age.

Fish Processing

Fish is a super food, containing DHA, EPA, vitamins and essential micronutrients and easily digestible protein, but fish is very perishable. To optimally maintain the valuable nutritious contents, fish should be properly handled throughout the supply chain and then processed in an appropriate way. Fish processing is an important step not only to add consumer choices of fish-based foods and increase its value but also to prolong shelf-life for logistic and storage purposes, especially in areas with limited refrigeration facilities. Fish would be a nutritious food if it is treated properly from ocean or farm up to table/fork. All parties involved may have sufficient knowledge of fish production management and safety from upstream to downstream. Fish processing is not only limited to produce feeds and foods, but also functional foods, healthy supplement or pharmacy products and cosmetics Fish processing plays a special role to extend the social and economic impacts of fishery sector.

In Indonesia, most processors of fish-based foods are classified as micro and small enterprises (MSE) (98%) and the rest is medium and large industrial enterprises. Types of fish-based food products by MSE are: boiled, salty dried, smoked, fermented, minced, and others with total national production in 2017 was 4.6 million tons. Most of these products are for adults and traded domestically. Meanwhile, types of products by medium and large enterprises are: smoked, frozen, canned, dried, surimi, fresh and others with total national production in 2017 was 1,6 million tons. Similar to that of MSE, products from these media to large scale enterprises mostly for adults, but their market orientation is for export purposes.

Among fish-based food products, the availability of commercial specialty products which are suitable for children under two years of age, pregnant and lactating women is very limited. At the moment, their fish consumption mostly depends on the household kitchen. For special emergency needs such as malnourished pregnant women and children under two years, special products which are ready-to-eat, high value nutritally, long shelf-life, easy to store, and convenience. Small fish, a rich micronutrient

food, may be processed into those special foods. This may be considered in the future policy and measures related to industrial development on the use of fish and fishery products for supporting the first ,1000 days of life.

Education

The success of increasing fish consumption to prevent stunting and nourish the vulnerable group depends on several factors. Indicators in the demand side namely: fish menu is regularly served in the targeted group and people are happy to buy fish for good, safe and healthy product, and worthy choice for family. In the supply side, the main indicator is the easy access for good quality of fish and fishery products at anytime and anywhere. It means that handling, distribution and processing should be good and efficient so that good quality fish and fishery products are affordable. According to Higuchi et al. (2017), learning from Brazil that different socio-economic categories select different factors as major contributing of influence on their food choices. Meanwhile, in Peru, even a coastal city Lima, easy access to high quality seafood does not support the increased fish consumption. Personal attitudes, norms and past experience positively influence the intention to eat fish and determine the frequency of fish consumption. Moreover, Lima fish consumers seem to be not concerned by positive health attributes related to fish consumption.

Based on the above figures, to support the effective use of fish in the first 1000 days of life needs a customized education and marketing strategy. All actors in the fish business and consumers should have sufficient knowledge about fish as a nutritious but perishable food through both formal and informal education. Consumers should get convincing items to consume fish and fishery products. There are directly or indirectly education components for the society under *GERMAS* and *GEMARIKAN* programmes. Considering that fish processing plays very important to the growth of fish industry, some vocational high schools and polytechnic academy develop fish processing relevant curricula. In addition, the Ministry of Marine Affairs and Fisheries has also established eight polytechnical schools with fish processing as a field of study. Further, formal degrees on fish processing (bachelor, master and doctoral) also spread out in several universities around Indonesia. In line with the tourism growth, cooking academies as well as food and beverage education also rose in many places. Moreover, in the social and mass media, there is some informal education on basic fish processing for daily life or households.

Social Behaviour Change

Different socio-economic status may differ in the decision-making processes to choose fish as part of the main menu. Understanding the various perceptions of fish consumption is an important part of public health as well as fisheries business management and marketing strategy. For the time being, myths, perceptions and oral traditions impeding fish consumption still exist in certain parts of the society, for instance, fish was poisoning and allergen or fish consumption resulted fishy breast milk, itchy skin and wormy digestion. This phenomenon is due to among others: lack of knowledge of fish consumption benefits, lack of knowledge on how to properly select and handle fish better, and bad past personal experience on the fish quality.

A customized approach should be undertaken in communicating the benefits of fish. Insufficient participation and consultation of relevant stakeholder groups may lead to less effectiveness in strengthening a fish consumption programme for nourishing the first 1000 days of life. Stakeholder concerns and societal expectations have the potential whether to speed up or to slow down the program of fish consumption including the fisheries processing industry. Social behaviour change will be successful and sustainable if it is supported by supporting policy, efficient systems, caring community and highly motivated individual and family or household.

Implementation of *GEMARIKAN* and *GERMAS*

Creating demand of fish and fishery products is very strategic action to increase fish consumption and could be the engine for improvement of public health as well as the growth of fishery industry. In 2019, target of national fish consumption per caput is 54.45 kg equals to fresh whole fish, and production of processed fishery products is 6,8 million tons. However, this production number is still a broad spectrum and there is no specialty products for supporting malnourished cases.

Under *GERMAS* programme, intervention of dietary habits to have a healthy life is conducted in the integrated community health post (*Posyandu*) in the sub-village level. There were 294,428 *Posyandu* in 2017 throughout 34 provinces and among 57.43% was considered active. However, the active level varies among provinces. There is a Circular Letter by the Director General of Public Health (2017), regarding Nutrition Supplementation for Pregnant Women, Children Under 5 Years and Schoolchildren. For chronic target groups, a special high enery, nutritious biscuit is given to the target groups for the maximum of one month. This can be followed by local foods having similar nutrition contents as biscuit. In most cases, foods selected to substitute biscuit mostly based on agriculture such as eggs, milk, and mung bean. Almost there is no fish or fishery products were selected even the availability of fish is not concerned. On the other side, *GEMARIKAN* is supported by FORIKAN, a formal forum with a special mandate to increase fish consumption, consisting of various governmental ministries and institutions, NGOs, professionals and informal community leaders. Forikan has been established from national up to sub-district levels. Up to now, there is an national Forikan at the Central Government, 34 at provinces, 226 at districts, and 115 at the sub-districts.

Presidential Instruction no. 1/2017 concerning *GERMAS* assigns the Minister of Marine Affairs and Fisheries (MMAF) to increase and enlarge the implementation of *GEMARIKAN* and to control quality and safety of fish and fishery products (President of the Republic of Indonesia, 2017). To effectively achieve nutrition improvement by using fish and fishery products, it seems that the implementation of *GERMAS* and *GEMARIKAN* should focus on strengthening in the local level and consider the frequent activities based on the local needs. Implementation of *GEMARIKAN* applies communication-information-education (CIE) principle i.e. a compact communicative, informative education or educative and informative communication or communicative educational information. Push or pull strategies are selected to effectively increase fish consumption. Push strategy for instance, providing fish- based foods, a specialty solid product for young children, 6 - 24 months of age and a special fish-based food for malnourished pregnant women and young women which are distributed via *Posyandu*. Meanwhile, pull strategy also could be conducted by creating a captive market such as canned fish products for an emergency food, fish products in addition to rice for the poor and providing fish based snacks in school canteen.

Activities under *GEMARIKAN* programme such as: annual fish cooking competition for cadres of Family Welfare Education from district up to national levels, and irregular schedule for public. Objectives of fish cooking competition are to improve family health status by increased fish consumption, create new fish-based menu and demonstrate to public that fish cooking is enjoyable and fun. Fish cooking competition focuses on the family menu, snack and special menu for children under 5 years. However, the fish menus for children under 5 are still too broad and not focused to children age 6-24 months, which are urgently required for tackling stunting issue. Other activities of creating demand are fish bazaar, fish-based foods feeding program to pupils, extension the benefits of eating fish based foods, fish drawing and game competition for children. Those activities are pioneering and conducted jointly by MMAF together with local governments. Frequent activity remains very low.

For some households, fish is perceived as an expensive food compared to other protein source such as egg, and traditional soya bean products (*tempe* and tofu). The government made some interventions, namely strengthening fish logistic system to reduce transportation cost and conduct regular fish bazaar. In addition, numbers of programmes are aimed at increasing poor people's

purchasing power. Local government such as Jakarta Province provides a coupon for buying subsidized fish for poor households.

Fish cooking needs less energy compared to meat, but fish cooking is considered as not convenient and takes time to prepare. Moreover, there are unpleasant physical properties of some varieties of fish such as bones, hard shell, and smell. Most people still prefer to buy fresh and eat whole fish, however this is slowly changing towards ready cleaned products especially in the urban areas. To respond this trend, currently, fish mongers may offer scaling, gutting and filleting. Frozen fish fillet ready to cook packed product now is also relatively easy to find in modern markets.

Fish losses in Indonesia are relatively high due to limited cold chain facilities started from the harvesting phase up to retailing, and lack of knowledge on good fish handling practices. The results are the deteriorating quality, fishy smell and may be an allergen especially when the histamine content grew up. These conditions may loss not only the economic but also the nutritious values Learning from a case of tongkol, the famous fish that mostly purchased fresh by Indonesian, 15-25% is lost annually. This amount equals 75,000-125,000 metric tons per year equals to Rp. 1.95-3.25 trillions equals to 16,500-27.500 metric tons of protein lost per year (GAIN, 2017). This is huge number and value. The government made some intervention namely, providing cold chain facilities such as construction cold storage in fishery production centers, procurement of refrigerated trucks for fish transportation, distributing flake ice machines, chest freezers and cool boxes for fishermen, and groups of small fish mongers and processors. The government also conducted education on good handling practices for parties along the supply chain actors and consumers. In addition to fish quality, reason to eat fish is also influenced by the cleanliness of the place where they buy fish. The MMAF has been initiating to construct clean fish markets, and renovate fishery zones of traditional wet markets in some regions.

Nowadays when the role of social and mass media plays very massive up to rural areas, irresponsible advertisements of foods produced by large industry also influence people lifestyle. For instance, the frequent ads of instant noodles may shift preferences from traditional foods. The convenience factor may also contribute to increase the preference to instant foods. To cope with this issue, the government regulates the food advertisement, and campaigns on going back to family dining table habit with diversified foods. This is in line with FAO recommendation that in order to improve their diet people should go back to local foods.

As a programme, *GEMARIKAN* has existed for more than a decade. Some activities were pioneering and expected that it would be repeated by other institutions or by FORIKAN at lower levels. So far, in term of mainstreaming programme, it has been successful bringing awareness among the stakeholders that fish is suitable as a major source of animal protein in the national level. But for preventing stunting and nourishing the vulnerable target groups, some activities and its location should be more focused and conducted jointly with *GERMAS*.

Policy Recommendations

- *GEMARIKAN* and *GERMAS* programmes need a more-open, broader dialogue that will increase transparency in the two sectors and improve public awareness. It is important to conduct joint activities to focus on preventing stunting and nourishing vulnerable groups. The priority locations should be selected by overlaying data of areas with high stunting prevalence, data of poverty, and data on fish consumption.

- Development of fish-based food products that are nutritious, having longer shelf life, easy to store, tasty, and affordable should be as the national priority. Fish processing industry should be encouraged to produce a specialty products which are suitable for pregnant and lactating women as well as for young children age 6-24 months. In line with recommendations to feed

breastmilk up to 24 months, starting from 6 months, the young child requires semi-solid complementary foods. This may be supplied by a small fish-based food product which is rich of micronutrients.

- In order to more effectively communicate the benefits of fish and fishery products consumption, the processing industry must collaborate more with other credible stakeholder groups. This should also be supported by continuous supply of good quality fish as raw material. Moreover, greater synergy and cooperation are needed among the various sectors of health and fisheries including the processor, so as to speak with one voice and achieve a greater political hearing, especially when to face the existing food industry.
- While some social and economic issues are still to be addressed, it is important to put fish consumption for health in a wider perspective by finding those most cost effective, risk less, wider target groups and greater benefits. In the future, fish-based food production systems must become even more efficient to produce many more with fewer resources to feed a growing world population.
- More social science research on the benefits of fish consumption is needed, particularly to better understand the influence on public perceptions. Future studies should combine qualitative and quantitative methods to obtain a more-in-depth view of different perspectives and how they are formed.
- In the near future, socio-economic data should be established and studies investigating public perceptions of *GEMARIKAN* and *GERMAS* should also be conducted on a regular basis.

References


Director General of Public Health, 2017. Provision of Nutritional Supplement, for Pregnant Women, Children under 5 years, and School Children. Circular Letter number Hk.02.02 / V /407/2017, Directorate General of Public Health, Ministry of Health of the Republic of Indonesia.

Ministry of Marine Affair and Fisheries, 2017. Map of Fish Needs Based on Household Consumer Preference in 2016. Directorate General of Marine and Fisheries Product Competitiveness, MMAF.

GAIN, 2017. Indonesia "Postharvest Loss Alliance for Nutrition (I-PLAN)", Design Workshop, Dalberg.

Global Nutrition Report, 2017. Nutrition Country Profile, Indonesia. Development Initiatives Poverty Research Ltd. http://globalnutritionreport.org/wp-content/uploads/2017/12/gnr17-Indonesia.pdf.

Higuchi A, DAVALOS J, Merino, M.H, 2017. Theory of Planned Behavior Applied to Fish Consumption in Modern Metropolitan Lima. Food Sci. Technol, Campinas, 37(2): 202-208, Apr-June 2017.

President of the Republic of Indonesia, 2017, Community Movement for Healthy Living (GERMAS). Presidential Instruction No. 1 Year 2017. Jakarta, February 27, 2017.

OECD 2017, Building Food Security and Managing Risk in Southeast Asia. Extract Chapter 7. Lessons from Indonesia on Fishing for Food Security. OECD, Paris.

Ministry of Health, 2018. Health Quality Improvement to Prevent Stunting. Presentation of the Director General of Public Health, Ministry of Health, 14 August 2018

Rokx C, Subandoro A, Gallagher P, 2018. Aiming High: Indonesia's Ambition to Reduce Stunting, World Bank Group, Washington DC.

www.wholesomebabyfood.momtastic.com, Feeding Your Baby Fish - Easy & Tasty Fish Baby Food Recipes.


Annex 3

SUSTAINABLE PRODUCTION OF SMALL FISH TO SUPPORT MICRONUTRIENT SUPPLY FOR THE FIRST 1,000 DAYS OF LIFE IN INDONESIA

by Maskur Maskur


Background

Indonesia has the second biggest fisheries and aquaculture producer in the world. In 2016, national fisheries production was 23, 123,258 tons consisting of capture fisheries (6,542,258 tons) and aquaculture (16,581,000 tons). Indonesian seaweed and culture fish production contributes 38,7% (11,631,000 tons) and 6.2% (4,950,000 tons) respectively to global aquaculture production (FAO, 2018). Meanwhile, fish consumption in 2015 was 41.11 kg/capita/year, equal to fresh whole fish (KKP, 2016; OECD, 2017).

Indonesia possesses a very high biodiversity, however, sustainable use of this biodiversity is not yet as the main concern of stakeholders in Indonesia (Sutarno & Setyawan, 2015). In Western Indonesia and Sulawesi, there are about 950 fish species in the regions that live permanently or temporarily in freshwater, and less than 25 species has direct economic value (Kottelat et al., 1993).

In the National Strategic Plan for Aquaculture (NSPA) year 2015-2019, national aquaculture production target in 2019 is 31,319,000 tons consisting of seaweed 19,544,000 tons, crustacea 1,248,800 tons, mollusk 715,000 tons, and finfish 9,811,100 tons (Directorate General of

Aquaculture, 2016). Unfortunately, the target species in the NSPA, mostly large- sized fish species, such as common carp, tilapia, catfish, gourami, barramundi, grouper and milkfish. This is similar to the prediction and trend of fish production in ASEAN region for the coming decade that are pangasius and other catfish, carp and tilapia (Chan et al., 2017).

Large-sized fish species specially farmed fish which not all parts are consumed, generally provide lower micronutrient contents compared to non-farmed species, particularly small indigenous species (SIS) (Bogard et al., 2016). Meanwhile, even though SIS is very rich in vitamins and essential micronutrients, essential fats and animal protein, SIS receive less attention in fisheries production policy by the government. Bogard et al. (2015a) revealed that from a nutritional perspective, species from inland capture fisheries, particularly SIS, hold the potential to provide greater contribution to micronutrient intakes for vulnerable groups in the population compared to common aquaculture species since all parts of SIS are consumed, with its head and bones. SIS offer a unique opportunity to contribute effectively for nutrition improvement programme during 1,000 days of life. SIS contain 12 g fatty acids, and micronutrients such as iron, zinc, calcium, vitamin A and vitamin B12 (Bogard et al., 2015b).

Bogard et al (2015a) reported that in Bangladesh when considering iron, zinc, calcium, vitamin A and vitamin B12 requirements, there were seven species that would contribute to more than 25% of RNIs (Recommended Nutrient Intakes) for Pregnant and Lactating Women (PLW) and six species that would contribute to more than 25% of RNIs for infants, when they consumed the fish a 50g or 25g portion respectively. So, fish is beneficial to nutrition and health and will play an essential role in sustaining healthy diets in the future (Thilsted et Al., 2015).

Learning from the use of small fish species as a micronutrient source for nutrition of vulnerable groups in Bangladesh, Cambodia (WorldFish, 2016), and Myanmar (WorldFish, 2017) , now is the right time for Indonesia to use native Indonesian SIS for nutritional intake for nutritionally vulnerable groups, both fish from natural catches or culture. Many SISs such as anchovies, *seluang* (*Rasbora argyrotaneia*), *bilih* (*Mystacoleucus padangensis*), *wader*s (*Rasbora sp*), and *uceng* (*Nemacheilus fasciatus*) have not utilized optimally for highly nutritious food resources. Those fishes are generally caught from nature. The objective of this paper is to provide policy brief of sustainable SIS production to support malnutrition programmes, especially for the first 1,000 days of life.

## Issues and policies

At present, the government focuses more on the production of large-sized fish, and attention to local small fish is still very little. Data on SIS production as well as research on the benefits of consuming SIS is also very limited. Government policy in capture fisheries and aquaculture production in the near future remains based on large size fishes to provide general source of animal protein without certain focus on providing special fishes for nutritionally vulnerable groups. Meanwhile, from biodiversity perspectives, Indonesia has many types of marine and freshwater small fishes in several islands in Indonesia (Kottelat et al., 1993). The SISs are generally captured from inland and sea water bodies, however the production tends to decrease due to the environment and over fishing.

For instance, anchovies (*teri*) are high economically important marine small fishes found along the Indonesian sea waters. Major species are *Stokphorus spp* (*teri* nasi), *Dussumiera accuta* (*teri* japuh), and *Stokphorus insularis* (*teri* jengki), and some areas in Indonesia are classified as anchovy production centers. Supply of caught anchovies in Indonesia, however, tend to decline from 204,893 tons in 2011 to 199,226 tons in 2014 (KKP, 2015).

The captured SIS from inland and sea waters so far has not yet been specially utilized to improve nutrition and used just as ordinary food. Commonly, those SISs are processed as traditional foods such as crackers (*seluang* fish), fried products (anchovy, *wader*, *seluang* and *bilih*). Freshwater SIS are traded locally in the fresh form , while anchovies are mostly marketed in the form of dry raw ma*teri*als, for consumption by adults in general.

Indonesia suffers high rates of under nutrition as indicated by the result of nutritional status in 2016, that at the national level, the status of children under 5 with the lack of nutrition was 17.8%, stunting was 27.5%, and underweight was 11.1%. Meanwhile, pregnant women with energy deficiency was 53.9%, and protein deficiency was 51.9% (Kementerian Kesehatan RI, 2017). OECD (2017) reported that level of stunting over 36% among children under the age of five, due to micronutrient deficiency in particular iodine and vitamin A, and inadequate diets, notably with insufficient intakes of protein and vitamin and excessive intakes of carbohydrates. On the other side, Indonesia is rich of SISs which are potentials as nutritious sources, so it is a great opportunity for Indonesia to utilize small fish species that are rich in micronutrients to improve nutrition for the vulnerable groups.

In addition to SIS, Indonesia also produces baby fish, which is a fingerling of cultured large fish species. This business carried out by a group of households by frying for baby fish and supplying to restaurants or supermarkets (Susilawati, 2015). The fish species for baby fish generally are common carp (*Cyprinus carpio*) and tilapia (*Oreochromis niloticus*) fingerling. There are so many species which are very valuable sources, therefore it is necessary to establish special policies to produce mass and sustainable SIS and baby fish to support the nutrition improvement program particularly in the first 1,000 days of life in Indonesia

Technology development for SIS production of *wader* fish

Various types of native Indonesian SIS can be produced from marine resources such as anchovies and freshwater resources such as *Seluang* fish (*Rasbora argyrotaneia*) (Rosadi, 2014; Diana, 2006), *bilih* (*Mystacoleucus padangensis*) (Butarbutar et al., 2015) , *wader* fish (*Rasbora sp*) (Sari et al., 2014), and *uceng* (*Nemacheilus fasciatus*). *Seluang* fish generally live and breed in flooded areas in Sumatera, Kalimantan, while *bilih* fish are indigenous in Lake Singkarak West Sumatera (Kottelat et al., 1993). *Bilih* has been introduced to Lake Toba in 2003 (Kartamihardja, 2009). Due to the environmental pressure and the water quality which is getting worse and worse, the stock availability and the fish caught are decreasing. Data of small fish caught from nature showed a decrease. In Rawapening, *wader* fish caught in 2003 to 2012 decreased from 181 tons to 119 tons respectively (Sari et al., 2014). Similar to that, Kartamihardja et al. (2015) reported that *bilih* fish caught in Lake Toba that has been introduced in 2003, indicating a decrease annual production from 45,000 tons in 2012 to 20,000 tons in 2013, and predicted to be less than 1,000 tons in 2014.

Therefore, it is necessary to undertake domestication and development of cultivation technology to produce sustainable production.

Small fish that have potential to be cultivated are *wader* fish consisting of *pari wader* (*Rasbora lateristriata*) (Sentosa & Djumanto, 2010), *cakul wader*s (*Puntius binotatus*) (Sari et al., 2014; BPBAT, 2016), *muraganting wader*s ( *Barbonymus altus*) (BPBAT, 2016), and *Uceng* (*Nemacheilus fasciatus*) (BPBAT, 2016; Risyanto et al., 2012; Prakoso et al., 2017). Currently Freshwater Aquaculture Center Umbulan, Pasuruhan district, East Java Province has successfully developed breeding and grow out technology for small indigenous fish of *wader* since 2011, beside domestication of *Uceng*, and other SIS.

Types of *wader* that have been culturally developed in Umbulan BPBAT are *cakul*, *pari* and *muraganting*. These three types of *wader*s have different growth, *muraganting* was the fastest followed by *cakul* and *pari*. Technologies for breeding and growing out in concrete tank , earthen pond and plastic pond for these three *wader*s have been successfully developed (BPBAT, 2016).

- Breeding: Female and male spawning can be done naturally in the controlled tank, which is equipped with happa, and shelter. The eggs will hatch for 24 hours, then the larvae are reared in a cement or plastic tank to produce 1-2 cm size seeds for 30 days. The 1-2 cm size seed will be cultivated in the grow out pond to reach consumption size.
- Grow out: Grow out culture can be carried out in a cement tank or earthen pond. Before stocking the seeds, the tank / pond should be well prepared including cleaning, giving organic fertilizer, and filling by clean water properly. After a few days, plankton will grow in the water medium, and *wader* seeds (1-2 cm) is ready to be sowed in the pond with stocking density of 400 to 1000 seeds / m2. Grow out period is 2 months to reach consumption size of 3-5 cm or 5-6 gram per fish.
- Distribution: Considering that *wader* fish is very popular especially for the people in Java island, the successful technology of *wader* cultivation by BPBAT Umbulan are warmly welcomed by many stakeholders. Broodstock *wader* from BPBAT Umbulan was distributed to new *wader* hatchery groups producing larvae and seeds of 1-2 cm in length. While the seeds from BPBAT Umbulan and private hatchery have been distributed to the regions of East Java, Central Java and Yogyakarta, for growing out and restocking activities in open waters such as rivers and reservoirs. Grown *wader* fish is distributed to *wader* culinary centers in Mojokerto district, East Java as additional supply of caught *wader* from inland waters.
- Benefit of cultured *wader* fish: a). Preserving local species to increase population and production of *wader* fish in open waters. BPBAT Umbulan has been carried out restocking activities of 3.5 million *wader* seeds to reservoirs and rivers in 14 districts during 2014-2016 (BPBAT, 2016). With the restocking, population and production of *wader* fish can increase continuously and prevent extinction; b) Growing the economy in rural areas: Discovery of the *wader* cultivation technology creates new economic activities in rural areas such as hatchery, grow out culture, and *wader* culinary groups. There are 3 groups of breeders, 3 groups of grow out culture since 2015 and 20 *wader* fish restaurants in the East Java province. ; c) Micronutrient sources: Considering that all parts of *wader* fish is consumed and similar to small fish in Bangladesh which contains a lot of micronutrients as the intake of vulnerable groups (Bogard et al., 2016), so that the *wader* has very high potential for intake in the first 1000 days of life in Indonesia.

Producing *wader* in Culture-based Fisheries (CBF)

Culture-based fisheries (CBF) is often conducted in small water bodies, perennial and or seasonal, that retain water for at least six to eight months of the year. CBF is a relatively low-cost activity, with the main external inputs being seed, that is why most government from developing countries consider that CBF is relevant to and should as an integrated part of rural development (De Silva et. al., 2015).

Indonesia has 2,077 water bodies, consisting of 736 lakes and 1,341 reservoirs. Major reservoirs (about 65%) are mostly situated in Java, while the small lakes and reservoirs or village reservoirs are mostly situated in Sumatera, Java, and Nusa Tenggara. In principle, all reservoirs and lakes are suitable for the development of CBF (Kartamihardja, 2015). He explained that CBF had implemented in Toba Lake and Reservoirs of Wonogiri, Malahayu, and Darma, and were stocked by *Mystacoleucus padangensis, Pangasianodon hypopthalamus, Macrobrachium rosenbergii* respectively. It is reported and the production increased significantly. Focussing CBF practices in Indonesia with small fish species, *wader* would be possibly cultured in the potential and suitable water bodies such as small lakes, reservoirs or rivers to produce *wader* with low production cost.

Producing fish in rice-fish farming system

Integrating aquaculture with agriculture results an efficient nutrient use through a recycling process since many of the agricultural by-products can serve as fertilizer and feed inputs to aquaculture. More than 24 countries in the world practiced rice-fish system (Halwart & Gupta, 2004). Rice-fish system practice in Indonesia began in the 1860s on the island of Java, then in the 1950s, it had spread to the other islands in Indonesia (Koesoemadinata, 1992). Furthermore, he explained that in Indonesia, there are three types of rice-fish farming practices, namely 1) *Minapadi* (rice and fish, 50 days); 2) *Penyelang* (intermediate cropping, 30 days), and 3) *Palawija* (rotational cropping, 75 days). Among the three types of rice-fish system, *penyelang* type 2 is commonly used to produce fingerling fish, while types 1 and 3 generally produce consumption-sized fish (Koesoemadinata, 1992).

Recently, rice-fish system has been developed by FAO in collaboration with the Indonesian government, using commonly type 1 to produce consumption-sized fish, with 3 technology innovations to improve productivities (Basuki, 2016; FAO, 2017). However, the type 2 *penyelang* practice (intermediate cropping) to produce common carp or tilapia fingerlings for seedling purposes remain exist in several areas such as Cianjur, Bandung and Sukabumi districts, West Java Province. Considering that *penyelang* is very simple and has relatively take short time, it is very potential to be developed to produce juveniles of common carp, tilapia (*Tilapia niloticus*), *nilem* (*Osteochilus hasselti*), *Tawes* (*Barbonymus gonionotus*), and other cultured fish species.

Policy Recommendations

Policies should be developed and implemented to increase production of small indigenous species and baby fish applying various sustainable cultivation technologies which are available in the country. Indonesian government under Ministry of Marine Affairs and Fisheries should pay more attention to developing small fish species and juvenile fish programme in the National Aquaculture Strategic Plan. Some recommendations as follows:

- Develop programme on *wader* or other small fish species to culture in concrete or earthen ponds by using seeds from hatchery production
- Producing *wader* or others small fish in culture-based fisheries system in the suitable rivers and reservoirs, as well as rice-fish farming system in Java Island
- Producing juvenile fish of common carp, tilapia and other species in rice-fish farming system in Indonesian region
- Central and local governments should provide financial support to implement sustainable aquaculture of Small fish species and baby fish in Indonesian region
- Government should provide financial support for research on the biology and nutrient composition of small fish species in order to select micronutrient-rich fish species for culture
- Strengthening collaboration and synergized program among relevant sectors to provide suitable areas to achieve sustainable aquaculture for small and juvenile fish production in Indonesia
- Government should implement Ecosystem Approach to Fisheries Management (EAFM) properly to maintain the sustainable production of anchovy

References


Balai Pengembangan Budidaya Air Tawar, 2017. Pisces reborn, ayo lestarikan ikan lokal kita. BPBAT Umbulan, Pasuruan, Jawa Timur. http://pbatumbulan.blogspot.com/2016/10/pisces-reborn-ayo-lestarikan-ikan-lokal.html.

Basuki, F., 2016. Innovative Rice-Fish Farming Technology and its demonstration. End-of-assignment report, FAO Indonesia, Jakarta.

Bogard JR, Thilsted SH, Mark GC, Wahab MA, Hossain MAR, Jakobsen J, Stangoulis J, 2015a. Nutrient composition of important fish species in Bangladesh and potential contribution to recommended nutrient intakes. Jour. Food Compost Anal 42, 120-133.

Bogard JR, Hother AL, Saha M, Bose S, Kabir H, Marks GC, Thilsted SH, 2015b. The Inclusion of small indigenous fish improves nutritional quality during the 1,000 days. Food and Nutrition Bulletin. 2015. Vol 36(3): 276-289.

Bogard JR, Marks GC, Mamun A, and Thilsted SH, 2016. Non-farmed fish contribute to greater micronutrient intakes than farmed fish: results from an intra-household survey in rural Bangladesh. Public Health Nutrition: 20 (4), 702-711.

Butarbutar S, Yulianda E, Hendrik, 2015. Production and marketing of *bilih* fish (*Mystacoleucus padangensis* Bleeker) in village Napitupulu, subdistrict of Balige, district of Toba Samosir, North Sumatera province. Faculty of Fisheries and Marine Science, University of Riau.

Chan, CY, Tran N, Dao CD, Sulter TB, Phillips MJ, Batka M, Webe K and Preston N., 2017. Fish to 2050 in the ASEAN region. Penang, Malaysia: WorldFish and Washington DC, USA: International Food Policy Research Institute (IFPRI). Working paper: 2017-01.

De Silva, S.S., Ingram, B.A. and Wilkinson, S. (eds.), 2015. Perspectives on culture-based fi sheries developments in Asia. NACA Monograph Series No. 3, 126p.

Diana E, 2007. Tingkat kematangan gonad ikan *wader* (Rasbora argyrotaenia) di sekitar mata air Ponggok Klaten, Jawa Tengah. Skripsi, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Sebelas Maret. https://eprints.uns.ac.id/4493/1/59301206200912531.pdf.

Directorate General of Aquaculture, 2016. National Strategic Plan for Aquaculture year 2015-2019. DGA, MMAF, Jakarta.

FAO, 2017. *Minapadi*: Successful Innovation of traditional farming practices. http://www.fao.org/indonesia/news/detail-events/en/c/463781/

FAO, 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome.

Halwart, M. and M.V. Gupta (eds.), 2004. Culture of fi sh in rice fi elds. FAO and The WorldFish Center, 83 p.

Kartamihardja, E., Hedianto DA, and Umar C., 2015. Enhancement strategy of *bilih* fish *(Mystacoleucus Padangensis)* resources and management control of glass fish *(Parambassis Siamensis)* at Lake Toba, North Sumatera. J. Kebijak.Perikan.Ind. Vol.7 No.2 November 2015:64, 63-69.

Kartamihadja, E.S., 2015. Potential of culture-based fisheries in Indonesian inland waters. In: Sena S. De Silva, B.A. Ingram and S. Wilkinson (eds.), Perspectives on culture-based fisheries developments in Asia, pp. 73-81. Network of Aquaculture Centers in Asia-Pacific, Bangkok, Thailand.

Kementerian Kesehatan RI, 2017. Buku Saku, Result of monitoring of nutritional status year 2016. Kementerian Kesehatan RI, Jakarta.

Kementerian Kelautan dan Perikanan RI, 2016. Angka konsumsi ikan (Setara ikan segar) Tahun 2015. Direktorat Akses Pasar dan Promosi, Ditjen PDS, KKP, Jakarta.

OECD, 2017. Building food security and managing risk in Southeast Asia: Chapter 7: Lessons from Indonesia on fishing food security, *Paris*.

Prakoso VA, Subagja J, and Kristanto AH., 2017. Aspek biologi reproduksi dan pola pertumbuhan ikan *uceng* (Nemacheilus fasciatus) dalam pemeliharaan di akuarium. Media Akuakultur 12 (2), 2017: 67-74.

Risyanto S, Ardli ER, and Sulistiyo I., 2012. Biologi Ikan *Uceng* (*Nemachilus fasciatus* C.V.) di Sungai Banjaran Kabupaten Banyumas. Biosfera 29 (1) Januari 2012. https://journal.bio.unsoed.ac.id/index.php/biosfera/article/view/235/188.

Rosadi E., 2014. *Seluang* batang (*Rasbora argyrotaenia* Blkr 1850) catch based on moon agein Barito River, Kalimantan Selatan (Indonesian). Faculty of Fisheries, University of Lambung Mangkurat.

Sari N, Pramonowibowo, and Nugraheni DA., 2014. Bioeconomic analysis of Gordon Schaefer model for Rasbora (*Rasbora* sp) resources in Rawa Pening, Semarang Regency. Jour. Fish. Res.Util. Tech. Vol. 3 No.3, 2014: 62-70. https://media.neliti.com/media/publications/136240-ID-none.pdf

Sentosa AR, and Djumanto, 2010. Spawning habitat of *Rasbora lateristriata* in Ngrancah River, Kulon Progo Regency. Jur. Ikhtio. Indo: 10 (1), 55-63, 2010. ): http://iktiologi-indonesia.org/wp-content/uploads/2017/03/06-Agus-Arifin-Sentosa.pdf.

Susilawati S, 2015. Usaha Baby Fish Bermodal 50 Kg, Kini beromzet ratusan juta. http://www.beritacianjur.com/read/3099/usaha-baby-fish-bermodal-50-kg-kini-beromzet-ratusan-juta.

Sutarno and Setyawan AD, 2015. Indonesia's biodiversity: the loss and management efforts to ensure the sovereignty, Pros. Sem. Masy. Biodiv. Indon. Vol. 1. No 1. 2015: 1-13.

Thilsted SH, Thorne-Lyman A, Webb P, Bogard JR, Subasinghe R, Phillips MJ, Alison EH, 2016. Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015. Food Policy 61 (2016): 126-131.

WorldFish, 2016. Press Release. U.S. government launches new project to boost food and nutrition security in rural Cambodia. https://www.worldfishcenter.org/content/us-government-launches-new-project-boost-food-and-nutrition-security-rural-cambodia

WorldFish, 2017. No more food worries: The big benefits of small fish farming in Myanmar. https://www.worldfishcenter.org/pages/the-big-benefits-of-small-fish-farming-in-myanmar/