MIID/Cornell University LIFT Project

Securing Positive Nutritional Outcomes through Agriculture Extension and Institution Building in Rural Chin State (NOAC)

Report on

Assessment of Access to Fish and Current Capacities of Aquaculture in selected NOAC target villages

by
Peter Degen

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Abbreviations

DoF	Department of Fisheries
EPI	Local (village based) Environment Protection Initiatives
FFFS	Fish Farmer Field School
FFS	Farmer Field School
GAqPs	Good Aquaculture Practices
IPPM	Integrated Production and Pest Management
MFF	Myanmar Fisheries Federation
MIID	Myanmar Institute for Integrated Development
MOALI	Myanmar Ministry of Agriculture, Livestock and Irrigation
NOAC	Securing Positive Nutritional Outcomes through Agriculture Extension and Institution Building in Rural Chin State - Project
NSA	Nutrition-sensitive Agriculture
SAI	State Agricultural Institute, Lungpi, Falam, Chin State
WF	World Fish (Center) – international fisheries specialized NGO operating under the Consultative Group for International Agricultural Research (CIGAR) consortium
YAU	Yezin Agricultural University

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Abstract

The main aquaculture practice in Hakha Township is an integrated fish-rice model that uses the exotic Common Carp. Specific precautionary measures to prevent escape from rice fields, e.g. during extreme rainfall or landslides are absent from the model. Consumers in the area prefer fish harvested from rice paddies, as it is considered more delicious than fish from ponds or from the market (which is mainly from aquaculture in the lowlands).

Fishpond farming in Hakha Township is constrained by unsuitable flat land availability, unreliable water supply, competitive disadvantages in seed and feed supplies as compared to lowland aquaculture, as well as a low level of technical knowledge.

The approach to support access to fish as a highly nutritious source of protein and valuable micronutrients presented here, focuses on improving access to fish by improving existing fish production practice. Concurrently, a better understanding of current fishing practices in rivers is necessary to improve fisheries management; rivers and creeks still remain the main sources of fish in Hakha Township.

1. Introduction

Fish, next to rice, is one of the two main sources of Myanmar's food security. (Belton et al. 2015) Availability and access to fish is considered very important, especially for poorer segments of the population.

The NOAC project document acknowledges "Livestock and fish can play an essential role in the subsistence economy of rural households in Chin State." (MIID & Cornell University 2016: 7) Furthermore, it proposes fishponds are linked into integrated small-scale farming approaches that aim to combine fish and crop farming with livestock raising in a mutually beneficial manner. While the initial project proposal focused exclusively on aquaculture and its potential linkages to integrate farming practices, the Inception Mission found that most fish consumed comes from natural water bodies that are increasingly under threat as they are largely unmanaged. The Chin State Department of Fisheries highlighted "environmental protection" of fisheries habitats as its highest priority for future actions. Thus, it is also recommended to take stock of the natural wild fisheries, its ecological context, fishing practices focusing mainly on its selected partner villages. (NOAC 2016: 38) Also, in terms of sustainability, any aquaculture promotion or intensification needs to be part of land use and fisheries management planning. (Cowx 2011)

This report presents the findings from a field assessment of aquaculture practices and, briefly, how community members access wild fish in NOAC target villages. The main aquaculture practices are based on an integrated rice-fish model while fishpond aquaculture is practiced mostly extensively. Recommendations are formulated for NOAC to implement during the project period in the next 30 months.

2. Purpose and Structure of this report

The stated purposes of this assessment are to:

- Assess and document current capacities of fishponds aquaculture in selected villages for fingerlings, feed, water management and profitability;
- Develop a plan to optimize fishponds and their integration into other farming practices, including how fishponds will be used to educate farmers about aquaculture potential and cost/benefit to farmers;
- Present findings about backyard aquaculture to MIID NOAC team and finalize plan on how to optimize fishponds within project timeframe & budget.

As indicated above, this report also presents observations on the overall fisheries context in Hakha Township since Good Aquaculture Practices[1] require paying close attention to site specific and

[1] Myanmar, through its Department of Fisheries, Aquaculture Division, is committed to implement GAqPs in accordance with the guidelines agreed under the ASEAN umbrella. (ASEAN 2015)

environmental sustainability considerations. (Schwartz et al. 2010) Moreover, it was found that wild fish from nearby rivers are the major source of fish for local communities. Therefore, recommendations for project support initiatives/interventions, include initiatives for both aquaculture as well as fisheries management.

3. Methodology

The assessment methodology made use of a series of information gathering strategies including literature review, interviews with high ranking representatives of fisheries authority at different levels (DoF), specialized organizations (WF), as well as, and most of all, primary data collection through field visits to fish ponds, interviews with fish farmers and community meetings in NOAC target villages.

It is noted that there is, at best, very sparse information on upland fisheries and aquaculture available in academic literature or official statistics. Thus this report relies mainly on primary data generation in target villages.

The field data collection was conducted as part of the project introduction to target villages and parallel to training, coaching, and reflection sessions with Community Facilitators in classroom and field exposure sessions. Considerable time had to be spent introducing the overall approach and objectives of the NOAC project to village authorities and farmers and women groups. Simultaneously, the project field team undertook wealth ranking, collected responses for "Concept Mapping"[2] and conducted initial Farming Systems Analysis in the form of crop and land use mapping.

Overall, the project field team visited fourteen project target villages, namely Chuncung, Thipul, Hniarlawn, Aive, Nabual, Cinkhua, Nipi, Bualtak, Loklung, Zathal, Zokhua, Surkhua, Leium B and Bunzung. Information was gathered from Village Tract Administration members, village elders, and farmer groups including women, as well as through direct observations of fishponds and interviews with fish farmers, women and fishers individually.

4. Current Aquaculture Practices in NOAC target villages

4.1 The nature of "backyard aquaculture" in Chin Mountains

The NOAC project proposal document refers to *backyard aquaculture* in the context of an integrated farming system that is characterized by the "…. ability to use animal waste from the livestock for fish food and dual use of land (with animal pens above fish ponds)." (MIID and Cornell University 2016:30) In the literature on integrated fish-livestock farming systems in Myanmar examples generally describe backyard aquaculture in lowland areas where indeed animal pens are constructed above fishponds in the immediate proximity of farm dwellings.

In the geographical conditions of Hakha Township with steep slopes, limited availability of flat land, and settlements along roads, the nature of backyard aquaculture is different. The scarcity of suitable land means fishponds are mostly further away from homesteads while domestic animals like chicken, pigs and cows are held nearby the farmhouse, since more frequent feeding is required (as compared to fish feeding). While it would be desirable to combine aquaculture with livestock rearing in an integrated manner, the opportunities to do so in the steep mountains in Hakha Township are limited. Flat land plots are also attractive for terracing or use as garden land. Likewise, the use of water competes with agricultural use.

In villages at lower elevations, such as Bunzug, Keizuan, Chawncum, Leium A, and Surkhua where landscape is less hilly with larger flat land areas, fishpond aquaculture is hardly practiced as rivers and creeks are easily accessible to catch fish in an effective and efficient manner. Flat land areas are preferably used for rice farming.

[2] "Concept Mapping", in the project context, is an opinion survey with key informants (poor women, poor farmers, Village Tract Administrators, health workers, educators, NGO representatives, INGO representatives, Civil Society representatives and Government Officers) on the reasons for people in the region not having enough food.

4.2 Pond Aquaculture

The Department of Fisheries introduced fishpond aquaculture to the project target area during the first half of 1970s. Following experimentation with Common Carp, Grass Carp and Tilapia the most common fish found in pond aquaculture is Common Carp. Tilapia did not adapt to the cold environment of the Chin Mountains and Grass Carp was not able to breed without induced spawning. DoF reported that it is still experimenting with Grass Carp to adapt it to Chin upland conditions.

Common Carp, *Cyprinus carpio*, called in Chin language "Shwe War Nga Kyin"[3], is currently the most frequently used species by far, as it is well adapted to the colder environment and breeds naturally, as reported by specialized local fish farmers. Grass carp, *Ctenopharyngodon idellus,* called "Mietsa Nga Kyin" is cultured to much lesser degree, mainly due to the fact that it can not be bred locally and fingerlings need to be imported from Kalay or from Mandalay.

Some fish farmers in Hniarlawn and Chuncung know how to manage brood stock of Common Carp and are able to produce fingerlings in a controlled manner. Reportedly, though Grass Carp is easy to raise and to feed but it is not very popular among villagers for consumption.

Table 1: Fishpond profile in project partner villages

Village name	*Number of HH**	*HH with fishpond*	*Total No of fishponds*	*No HH with fingerling production**	*Fish species cultured*	*Remark*
Chuncung	347	≈ 60	≈ 100	≈ 10	Common Carp; Grass Carp	Mr. Hkthla Ceu is a model fish farmer practicing exemplary fishponds; he is willing to serve as a fish farmer field school; 5 HH producing Common Carp fingerlings separate male and female brood stock some time before breeding [information on number of fishponds and fish farming households has been contradictory]
Tiphul	156	8	18	0	Common Carp	Ponds are small <40x40 feet; buy fingerlings from Hniarlawn; stocking of rice paddies – soil keeps water
Hniarlawn	183	49	≈ 105	≈ 7	Common Carp; Grass Carp	Mr. Phir Mawng is one of the most prominent fish farmers in Hniarlawn and Hakha; provides fingerlings to many villages for rice field stocking
Nabual	53	6	12	0	Common Carp	Pond size between 0.06 and 0.4 acres; by fingerlings in Hniarlawn; only for HH consumption;
Zokhua	162	7	10	3	Common Carp	5 fishponds have been lost due to landslides; fingerlings are sold for stocking rice fields (500 fingerlings for 1 acre)
Bualtak	39	0	0	0	--	No stocking in rice paddies because lack of water
Nipi	34	3	5	0	Common Carp; Grass Carp	3 fishponds damaged by landslide; 2 operating very extensively without maintenance or feeding only for household consumption; fish farmers also go fishing to the river
Aive	35	6	10	0	Common Carp	4 fishponds damaged by landslides; 3 ponds cannot operate in dry season due to water scarcity.
Cinkhua	89	16	23	NA	Common Carp	Small-scale fingerling production by individual fish farmers for local stocking in rice paddy fields
Loklung	160	12	20	0	Common Carp	Extensive use of fishponds; fishpond owners also go fishing in river during rice harvest.
Zathal	87	5	5	0	Common Carp	Nearly all households go fishing seasonally

[3] Please refer to Annex 3 for fish names

Village name	*Number of HH**	*HH with fishpond*	*Total No of fishponds*	*No HH with fingerling production**	*Fish species cultured*	*Remark*
Surkhua	248	0	0	0	--	Exclusive source of fish is rivers and creeks
Leium B	63	2	4	0	Grass Carp	Only 2 ponds operating; can only operate during rainy season; ponds <40x40 feet; 2 ponds not operating because of water issues
Bunzung	200	0	0	0	--	Fishing in rivers and creeks is the exclusive source of fish

* Hatchery practicing brood stock management

* HH = Household

Pond construction and management

Fishponds are located where suitable flatland and access to water are available. Reports from fish farmers indicate that the number of fishponds in operation was higher in previous years but has declined due to landsides and lack of maintenance in recent times.

The biggest fishpond observed is 0.7 acres. Most of the fishponds sized less than 0.5 acres, mostly between 0.15 and 0.3 acres. One very small fishpond, sized about 4 feet x 15 feet, was seen attached to a home garden in rather steep slopes –this seemed to be an exception. Commonly, ponds are 2 to 3 feet deep; deeper ponds, as experimented by some fish farmers, are not only more costly in construction and maintenance but also considered less productive.

Generally, fishponds are poorly managed. Only two fish farmers interviewed reported that they regularly drain and condition their fishponds on a yearly basis. Most other farmers interviewed did not undertake any fishpond cleaning and conditioning as most of them had only one pond and at least two ponds would be necessary for transferring fish between ponds and successively cleaning them. The drainage and cleaning process takes about 3-4 weeks and is generally undertaken during July/August. After draining the pond lime (Ca_2Co_3) is applied at a rate of 70 Kg/acre and dried for two weeks following which urea (70 Kg/acre) or natural manure/cow dung (≈500 Kg/acre) is spread onto the pond's bottom surface. Then the pond is filled up to 1.5-2 feet water depth and after another week or two the pond is stocked with fish.

Reports on labour investments for fishpond construction varied significantly as landscape conditions also differ from each location; however, it is concluded that the smaller the pond the higher labour input is required, e.g. a 0.7 acre pond may require 100 labour/days, but 7 ponds with a total surface area of about 1 acre may require 500 labour days. One dedicated fish farmer additionally refortified the walls of his ponds with stonewalls so as to prevent drainage of water and keep sufficient water in case of extreme dry summer months. However this comes with an additional cost.

The high cost of initial investment into pond construction puts fishpond aquaculture out of the reach of the poorer households – they continue to depend on access to and availability of river fish – or on the accessibility of reasonably priced fish fingerlings for stocking in rice paddy fields.

Breeding – access to fish seed/fingerlings

Fish seed production was introduced by the Government to private fish farmers in a basic manner. Further mouth-to-mouth communication and learning provided some initial knowledge on how to reproduce Common Carp in upland.

The Fisheries Department has two fish hatcheries in Chin State, one in Khaikam, Tidim Township, and one in Ram Thlo, Hakha Township, but only Khaikam is operating and producing fish seed, namely of Common Carp, Tapia (Nga Khung Ma Kyi) and Rohu. The fish seed supply market is dominated by private hatcheries.

Fish farmers' access to quality fish seed seems to be a major issue. There is no indication that any fish farmer is aware of the origin and quality of, or maintains and breeds pure strains of Common Carp (or other species) by certified breeders in licensed fish hatcheries.

Many fish farmers keep their fish over years in their ponds having a vague idea of how many fish there are in and scooping off some fingerlings at the time of stocking in the rice fields after transplanting – in June/July.

There are only few, yet well known fish farmers who focus mainly on Common Carp fingerling production and who know how to separate male and female breeders. In proper fingerling production female and male breeders are separated in about mid-January into separate ponds. In mid-March selected female and male breeders are joined into one pond at a ratio of 2 kg of female to 4-5 male. Within 1-2 days they start mating usually from 4 – 6 o'clock in the morning, depending on the active behaviour of the female breeder. Eggs are released and stick on floating water hyacinth which is moved to a nursery pond within two hours to avoid being preyed on by the parents. The more eggs the female carries the more often the mating occurs, and the longer the mating process takes. If the male is not strong enough the female will not be able to release all her eggs. Thus, expert knowledge and skills in fish brood-stock selection, management and breeding technology is key.

However, in general, fish farmers in NOAC partner villages do not have comprehensive knowledge about brood-stock selection; the few more knowledgeable farmers select their brood-stock by testing the availability of good eggs and sperm; by means of physical stripping of fish. If the eggs stripped from the female fish easily separate in the water the female is considered suitable for reproduction. If the sperm is very white coloured then the male breeder is considered good. None of the farmers interviewed did have any knowledge about other brood-stock selection criteria such as favourable body shape, body colour, responsiveness to feed, growth and mortality rates, resistance to diseases, or adaptability. This is not surprising as none of them did maintain any seed or fish production or management records.

The experience is that a female Common Carp that weights 1 viss (=1.65 Kg) produces about 250,000 eggs, whereas one that weights 1 Kg produces about 100,000 eggs.

The majority fish farmers who produce fingerlings in their ponds do this in a rather unmanaged manner. Mostly they keep female and male fish in one pond letting brood stock reproduce without any technical intervention; this results in very low reproduction rates as their parents prey on the eggs and hatchlings before they make it to juvenile and post juvenile stages.

Fish seed production of Common Carp could be significantly enhanced as the demand for fingerlings for stocking in rice paddy fields can absorb more than double of what is currently produced. This would also require improved knowledge and skills in brood-stock production and management with the aim of ensuring high quality seed production.

Training in brood-stock and seed production techniques and management as well as record keeping of those farmers who have suitable pond infrastructure and willingness of up-grading their seed production should be targeted.

Fish farmers do access fish seed from Kalay or Mandalay, but to a limited extent. In the past, few farmers reported to have bought fingerlings from private hatcheries in these towns, mainly Grass Carp. The option to enhance networking with fish hatcheries can also enhance fish seed availability for integrated rice-fish production.

Fish feeding

The most widely applied fish feeding technique is locally feed-based extensive Common Carp farming in small ponds, which can be considered as an environmentally friendly way of animal protein production (http://www.fao.org/fishery/culturedspecies/Cyprinus_carpio/en#tcNA0112).

Fish larvae are not fed during the first 4 days as they consume their yolk sacs. From the 5th day onwards, special feed is mixed from chicken egg yolk and Perplex vitamin in a ratio of 3-4 ground Perplex tablets to 10 yolks. During this time, larvae gather in a distance of 6 inches along the pond bank. After two weeks ground rice bran is fed and later complementary local feed sources are added with rice bran being reduced. These complementary feeds comprise banana and corn leafs as well as leftover cooked rice from household consumption. In one case where the fishpond owner also runs the only rice mill in the village (Zokhua – where as part of the rice milling

agreement the rice miller remains with the broken rice as part of the payment) cooked broken rice is regularly fed to Common Carp.

According to the general feeding cycle reported for Common Carp by better-managed fish farms, from December to February fish in ponds are not fed at all. From end February to June fish are fed every day, with the main ingredient being rice bran to support breeding behaviour. From July to November feeding is reduced to once every two weeks.

In general, the use of rice bran for fish frequently competes with its use for pig feed, and the latter being preferred as a pig also serves as a financial livelihoods asset in case of sudden need for money. Consequently, fish feeding is not oriented towards maximum growth and for market sale. Rather, fish remain a low input source of animal protein for casual sale or consumption. It is noted that many extensive fish farmer household also go fishing to rivers during the fishing season from November to May.

Fish health care

Fish farmers did not report any disease issues found in fishponds, yet sometimes they noted different sizes, colours, irregular scale patterns and body shapes of fishes from the same breed. They also admit that they have no training in identification of fish diseases, let alone in treating them. The DoF has no regular extension services for fish farmers that would be able to close this knowledge gap.

Fish health care issues should be addressed within a training package on Good Aquaculture Practices and/or in the context of brood-stock management and fish seed production.

Harvesting

There are two types of harvesting fishponds: one is closely related to the cleaning and maintenance procedures undertaken by more advanced fish farmers; the second, and more widely used practice, is that fish is harvested from extensively used fishponds at any time throughout the year mostly for home consumption. . Generally, cast net is used for catching fish in the pond; the bigger fish is taken out and the smaller fish is put back into the pond. Usually, the size of fish preferred for household consumption is between 200-350 g.

A fish farmer who are more focused on selling fish from their ponds reported a production of 130 viss (= 214 kg) during 2015, however, due to the drought in 2016 he could only harvest 30 viss (= 49.5 kg) in a total pond surface area of 1.2 acres.

The better-managed ponds harvest fish ahead of cleaning in July/August at the beginning of the rainy season when river fish is becoming scarce and fish prices tend to increase. Fish are usually traded within the own village. Also in these cases fish farmers do occasionally crop bigger fish from the pond throughout the growth cycle for household consumption as well as if somebody wants to buy some fish.

Cost-benefit considerations

The cash flow analysis attempted in Tables 2 and 3 for fish and fingerling production in a one-acre fishpond, respectively, is based on averaging and extrapolating production related information from different sources. As such, the data do not represent one specific fish farm factual operation as data on each farm were found sketchy (at best) and the capacity to recall actual investment and production figures was limited and precise records unavailable.

Table 2 shows that the initial investment is rather high and out of reach for poor families. Likewise, the investment and the production costs do not, under currently practiced production approaches, return yields that justify the investment as a profitable enterprise. However, if the fish farmer does orient his investment towards fingerling production (Table 3) for stocking rice paddy fields the investment is amortized within a five years period. This emphasises the focus on the rice-fish model that is practiced in the visited partner villages.

Table 1: Cash flow Fish production

	Production period / year	1	2	3	4	5	6	7	8	9	10
Start-up/fixed costs											
1	**Land**										
	Land acquis/ registration 1 acre	(30,000)									
	Registration fee	(2,500)									
2	**Pond Construction**										
	Labour excavation (160 m/d)	(1,100,000)									
	Compaction of pond dikes	(3,200,000)									
	Material costs (pipes, in/outlets)	(570,000)									
	Equipment Costs										
	Buckets	(12,000)				(12,000)				(12,000)	
	Shovels	(16,000)				(16,000)				(16,000)	
	Weighing scale	(15,000)				(15,000)				(15,000)	
	Hapa (material and labour)	(15,000)			(15,000)			(15,000)			(15,000)
	Hand seine net	(25,000)			(25,000)			(25,000)			(25,000)
	Cast net	(40,000)			(40,000)			(40,000)			(40,000)
Variable costs											
	Production costs										
	Fish seed	(75,000)	(75,000)	(75,000)	(75,000)	(75,000)	(75,000)	(75,000)	(75,000)	(75,000)	(75,000)
	Feed	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)
	Lime	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)
	Natural fertilizer (cow dung)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)
	Urea	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)
	Labour feeding/harvest (55 m/d)		(384,000)	(384,000)	(384,000)	(384,000)	(384,000)	(384,000)	(384,000)	(384,000)	(384,000)
	Maintenance & repair inputs			(50,000)			(50,000)			(50,000)	
	Labour for maintenance			(240,000)			(240,000)			(240,000)	
Yearly production costs		(5,183,300)	(541,800)	(831,800)	(621,800)	(584,800)	(831,800)	(621,800)	(541,800)	(874,800)	(621,800)
Revenue FISH = Quantity of fish (no fingerling) * fish price * amount sold			470,000	470,000	470,000	470,000	470,000	470,000	470,000	470,000	470,000
Net revenue FISH (Revenue - yearly production cost)			(71,800)	(361,800)	(151,800)	(114,800)	(361,800)	(151,800)	(71,800)	(404,800)	(151,800)

Table 3: Cash flow Fingerling production

Production period / year		1	2	3	4	5	6	7	8	9	10
Start-up/fixed costs											
1	**Land**										
	Land acquisi/registration 1 acre	(30,000)									
	Registration fee	(2,500)									
2	**Pond Construction**										
	Labour excavation (55 m/d)	(1,100,000)									
	Compaction of pond dikes	(3,200,000)									
	Material costs (pipes, in/outlets)	(570,000)									
	Equipment Costs										
	Buckets	(12,000)				(12,000)				(12,000)	
	Shovels	(16,000)				(16,000)				(16,000)	
	Weighing scale	(15,000)				(15,000)				(15,000)	
	Hapa (materials and labour)	(20,000)			(20,000)			(20,000)			(20,000)
	Hand seine net	(25,000)			(25,000)			(25,000)			(25,000)
	Cast net	(40,000)			(40,000)			(40,000)			(40,000)
Variable costs											
	Production costs										
	Fish seed	(75,000)									
	Feed	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)	(26,800)
	Lime	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)
	Natural fertilizer (cow dung)	(10,000)	(30,000)	(30,000)	(30,000)	(30,000)	(30,000)	(30,000)	(30,000)	(30,000)	(30,000)
	Urea	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)	(23,000)
	Labour for brood stock management and fingerling handling (80m/d)		(560,000)	(560,000)	(560,000)	(560,000)	(560,000)	(560,000)	(560,000)	(560,000)	(560,000)
	Maintenance & repair inputs			(50,000)			(50,000)			(50,000)	
	Labour for maintenance			(240,000)			(240,000)			(240,000)	
Yearly production costs		(5,188,300)	(662,800)	(952,800)	(747,800)	(662,800)	(952,800)	(747,800)	(662,800)	(952,800)	(747,800)
Revenue FINGERLING Quantity of Fingerling * fingerling price * amount sold				3,700,000	3,700,000	3,700,000	3,700,000	3,700,000	3,700,000	3,700,000	3,700,000
Net revenue FINGERLING (Revenue - yearly fingerling production cost)			662,800	4,652,800	4,447,800	4,362,800	4,652,800	4,447,800	4,362,800	4,652,800	4,447,800
Return to investment			(4,525,500)	127,300	4,575,100	8,937,900	13,590,700	18,038,500	22,401,300	27,054,100	31,501,900

Environmental management considerations

Current fishpond aquaculture practice is guided mainly by the availability of suitable flat land and source of perennial water nearby. Fish farmers frequently reported destruction of fishponds through landslides and loss of fish production either by escape of fish due to over spilling of ponds during extreme heavy rainfalls, or by death due to prolonged and very hot dry seasons like this year (2016). This seems to indicate that the construction of fishponds did not consider any environmental safeguards nor put in place any precautionary measures to mitigate intrinsic risks known from agricultural practices.

Missing opening sentence. The Myanmar Ministry of Agriculture, Livestock and Irrigation highlights among its updated strategic goals (MALI, October 2016) that "…..highly performing pure animal breeds and fish species developed, native breeds/species conserved and records kept…..". However, Common Carp, *Cyprinus carpio,* is listed among the 100 most invasive species by IUCN (2014). Furthermore, the Code of Conduct for Responsible Fisheries (FAO 2011) stipulates there is a strong need for putting upland aquaculture into the context of sound environmental management. This includes paying due attention to the use of pure fish breeds, the use of native fish species for aquaculture (and the gradual phasing out of Common Carp as a precautionary measure as it remains unknown under what environmental triggers the Common Carp could become invasive). At the same time, local fish species and fishing practices should be inventoried as a basis for the formulation of adequate fisheries management measures

4.3 Integration of rice paddy and fish farming

Stocking of fish, specifically and exclusively Common Carp, is practiced in two ways: (1) stocking fingerlings after transplanting rice seedlings and harvesting them shortly before rice harvest, and (2) stocking fingerlings after rice harvest and fishing them off the paddy land before tilling the land in preparation for transplanting rice seedlings; this form of fish-rice cultivation is considered as Integrated Production and Pest Management (IPPM)

Fish stocking of rice paddy land

As mentioned, stocking of Common Carp in rice paddy fields is the most prominent fish farming practice in project partner villages. Fingerlings, or post juveniles, from 1.5 to 3 inches of size, are stocked shortly after transplanting rice seedlings in June or July and harvested close to rice harvesting time in November or early December. During this period fish grow up to 6 or 7 inches, occasionally also up to 8 or 9 inches. Villagers highly appreciate fish harvested from rice paddy fields (or from rivers and creeks) as they claim to have a distinct better taste than fish harvested from fishponds. The success rate of paddy field stocking varies greatly as risks are difficult to mitigate, such as loss by predators (snakes, wild cats and dogs, water birds, etc.) or by unpredicted weather conditions like drought or heavy rains that cause paddy fields to overspill and fish escapes. The case of escape urges for considerations of stocking suitable native fish species rather than exotics like Common Carp as it is not known under which environmental conditions the exotic species would become invasive (with severe environmental consequences).

Integrated production and pest management (IPPM)

Another distinct form of stocking of Common Carp is the release or fingerlings into harvested rice paddy fields. The fish then grows until shortly before preparing the rice fields again for the next transplanting and rice-growing season in June/July. This production type yields distinct benefits in terms of swift fish growth, reduction of weed, and softening of bottom surface, all of which combines to integrated production and pest management (IPPM). The bottom feeding omnivorous Common Carp literally "ploughs" the bottom surface of the paddy field feeding on weed seeds, insects and all sorts of organic matter. This in turn translates into swift growth of the fish as well as into fewer requirements for weeding (i.e. 30-40% less labour costs) during the rice growing period.

However, this type of IPPM can only be practiced where year-round water availability is guaranteed and soil has sufficient amount of clay content that ensures water does not drain prematurely. Issues of natural predators and drought are the same as described above.

5. Capture Fisheries

The most important source of fish in NOAC project partner villages visited in the context of this assessment is by far wild fish from the nearby rivers. While pond aquaculture and rice paddy stocking is used in partner villages in higher elevations (about 3,500-6,000 feet asl) in villages at lower elevations located in the South of Hakha Township aquaculture and stocking of rice fields is not practiced as villagers have more direct access to larger rivers, such as the Ri Va, Phawk Va and Bawinu rivers and tributaries.

Table 3: Notes on wild capture fisheries in partner villages

Village name	*Number of Households*	*Involvement in capture fisheries in rivers & creeks*
1. Chuncung	347	About 300 households do go fishing every year; also those households that have fishponds; fishing mainly for household consumption
2. Tiphul	156	Fishing in Phau river; nearly all households go fishing in winter and summer; gender specific fishing methods; fishing for households consumption
3. Hniarlawn	183	Most households, including some of those that have fishponds, go fishing to nearby rivers during the rice harvesting season as well as towards the end of the dry season
4. Nabual	53	Main source of fish is from rivers;
5. Zokhua	162	All households go fishing at some time during the year
6. Bualtak	39	Due to landslides in 2015 fishing activities in rivers is limited now; before landslide everybody used to fish in rivers and fish was sold in Hakha fresh (6,000 K/. per viss). Main fishing grounds: Tirwan Va, Khua Va, Pangrawn Tiva, Cawsih Tiva, Tihna Va, Donpi Va
7. Nipi	34	Landslides have damaged fishing grounds in recent years; yet fishing in rivers is main source of fish
8. Aive	35	Fishing in rivers is main source of fish
9. Cinkhua	89	River fishing is main source of fish
10. Loklung	160	Fishing in rivers during the rice harvest period (Nov/Dec) as well as during the dry season in March/April
11. Zathal	87	Main source of fish is from rivers – nearly all households engage in fishing seasonally
12. Surkhua	248	Main source of fish is from rivers and creeks – nearly all households engage in fishing seasonally
13. Leium B	63	All households fish in Ri Va and Ciai Va rivers as main source of fish; fishing throughout the year; surplus fish is dried & smoked and sold to Hakha traders for K./20,000/viss
14. Bunzung	200	Main source of fish is from rivers and creeks

Fish ecology and spawning migrations

Little is documented and known in fisheries literature about upland fisheries of Chin State. Villagers report that most fish species come seasonally for spawning in the area. Preferred spawning places are often the outlets of small creeks in the bigger rivers where the clear water of the creeks provide a good environment (e.g. high oxygen and minimum suspended matter in the water) for vulnerable fish eggs to hatch. There reproduction areas of many fish species are also highly important for the sustainability of fish populations that spend part of the lifecycle in lowland environments or even marine habitats.

One example is an eel species that migrates up to the Chin Mountains for spawning purpose. The eel seen in the photo below was caught on 5 December in the Bawinu River in the West of Hakha Township. Eels spend most of their lives in marine environments but depend on freshwater habitats in upland areas for spawning.

Photo: Joxef A. Jay

Eel caught in Bawinu River on 5 December during its migration from marine habitat to upland freshwater spawning grounds.

Fish species

The main fishing season is during the dry period from November/December to May, with a peak in fishing activity towards the end of the dry season when water levels are very low. Fishing activities are often undertaken concomitantly with lowland paddy rice harvesting activities in November and December, as rice paddy fields are located in relative proximity to rivers and streams. A list of fish names is provided in Annex 3.

Villagers are able to identify for most of the fishes encountered in the area their spawning locations and seasons. Mostly, spawning areas are inside the outlets of creeks into rivers. It is highly likely that a significant number of the fish species that spawn in these upland creeks are long distance migrants that frequent other lifecycle habitats, such as refuge habitats, feeding and nursing grounds in lowland areas. Upland rivers and creeks, thus, most likely play a vital role for the sustainability of fisheries at national level and shall be managed appropriately.

Fishing practices

Young women, often accompanied by children, are also strongly involved in fishing activities, they frequently gather in small groups of two to five women who fish with baskets from January to April. One woman levers a bigger stone with a wooden pole while the remaining group members chase the escaping fishes with their baskets. Gill nets, hook and line and cast net are the main fishing gears used by men.

Issues of capture fisheries

Loss of forest cover, depletion of valuable forest products, increased water scarcity including drying out of small creeks in summer time, and increased threats from landslides, among others, have sensitized higher environmental awareness among rural communities in Hakha Township during the past several years. VTAs and local youth organizations, often in close collaboration,

have developed rules and regulations for access and use of natural resources including rivers and fish.

In recent years, in several communities landslides altered fish refuge and spawning habitats and, thus, impacted access to and temporary availability of fish in rivers. Likewise, uncontrolled use of unsafe fishing methods such as electro fishing, use of explosives and agro chemicals are reported as major reasons for decline in fish stocks. Control of fishing grounds is difficult as they are located far away from upland villages and frequent intrusion of fishers from outside is reported.

Here an example of the rules and regulations set up by the youth group in Loklung:

Not catch or kill beaver

Not catch fish during the spawning season

Not go to the river during spawning season for fishing

Not use fish catching methods such as:

- "Chang Kham" [weir across river with opening(s) for attached basket(s) to catch up-migrating fish; weir can also be used in combination with electrofishing gear and poisons]
- "Fuan bawn" [same as Chang Kham to catch down-migrating fish]
- Electrofishing
- Poisoning with agro chemicals
- Poisoning with natural plant substances from roots, barks, branches and leaves
- Mosquito net

Some regulations set up by some of the groups include a total fishing ban along a river stretch of four miles in front of a village. This makes fishing for villagers rather difficult and compliance with rules can be challenging. Another rule establishes "To put fingerlings in any suitable streams and rivers within Zokhua village boundary" and once every year the youth group stocks 300-400 Common Carp fingerlings in Lai Va river in the month of May.

These types of rules and regulations, though well meant, may turn out to be counter productive or environmentally damaging. Fisheries management rules and regulations will need to take into account the ecological intricacies of local fish stocks and seasonal lifecycle habitats. Management rules should allow villagers to go fishing in an informed manner that supports the understanding of sustainability of fishing activities and motivates compliance with rules and regulations. The stocking of non-native fish species is potentially damaging on the natural environment as they may outcompete native fish species and contribute to the reduction of biodiversity.

The development of well-meant fisheries rules and regulations give evidence that villagers have recognized the urgency of taking action aimed at maintaining fishing capacity in local waters. The energy of these local initiatives is considered a uniquely favourable starting point of taking stock of the local fisheries, i.e. fish species, fishing practices, fishing habitats, fish production, gender roles, etc. Also, given the fact that the literature and knowledge on upland fisheries and their importance in the national context is extremely sketchy, at best, the engagement with local youth groups and village development committees in terms of describing local fisheries and networking among villages under an action research framework is proposed as a start up initiative that ultimately contributes to one of the up-dated MALI (2016) strategic goals referring to "…… native [fish] species [to be] conserved and records kept".

6. Conclusion

Fish plays an important role in the diet of upland villages in Hakha Township. Wild fish from the rivers and creeks still remain the main source of fish, even in villages where aquaculture is practiced. Since the introduction of aquaculture in the first half of 1970s, extensive fishpond aquaculture has been established, mostly in villages at higher elevations. There is no commercial fishpond aquaculture, i.e. semi-intensive or intensive fish farming that would constitute the main income of a farmer household. Common Carp is by far the main cultured fish with Grass Carp only

cultured occasionally. Fish seed production is limited while demand for fish fingerlings appears to be high, especially for stocking in paddy rice fields.

Concerns are identified in many areas of Good Aquaculture Practice, including: the lack of clarity on the strain of fish, inadequate brood stock management, and the use of potentially pest threatening exotic fish species in aquaculture; limited attention to integrated production and pest management; and the need for strengthening community-based fisheries management initiatives and linking them into up-scaled fisheries co-management structures.

Comparable to agriculture, the options for promoting nutrition-sensitive food production in the fisheries sub-sectors aquaculture and fisheries depends strongly on the elevation of the target villages, which in turn conditions the landscape feature of gradient, temperature, and consistency of water availability. Consequently, the rational choices for food production of farmers, women and fishers/fish farmers is framed by the physiographic conditions that are linked to the level of elevation.

7. Recommendations

The following five NOAC project initiatives are proposed to address the current identified issues concerning limited capacity, lack of technical knowledge and low institutional and organizational capacity in the area of aquaculture and wild fisheries management. These recommendations are further outlined in LogFrame format in Section 8 where preliminary Outputs and corresponding Activities are set out for each initiative as further guidance. Once agreed on specific proposed initiatives this initial framework will need to be detailed for actual implementation.

The implementation of the NOAC project initiatives will take place in Farmer Field School[4] format that will be adjusted to the particular needs of each initiative. Due to the idiosyncrasy of the "backyard" fishponds in the target villages of Hakha Township rendered the potential for designing an integrated model with livestock-fish-crops for piloting in five villages impractical. The recommendations put forward here aim at

> (1) Improving the current aquaculture practices including fish seed production, availability and accessibility;
>
> (2) Testing the efficiency of Integrated Production and Pest Management combining rice pest management with fish production; and
>
> (3) Supporting the development of river fisheries co-management based on existing community-based initiatives for environmental protection and good governance.

7.1 Good Aquaculture Practice

In a situation where none of the local small-scale fish farmers are licenced, applying a process of promoting active participation of fish farmers and their communities can support responsible aquaculture on the production level, in which the main principles of environment and ecological protection are considered (FAO 2011 Code of Conduct, Article 9.4).

More specifically, good aquaculture practices provide a set of principles that can be broken down into learning platforms and practical tools for improving any form of aquaculture related activity.

> "Good aquaculture practices (GAqPs)[5] are a series of considerations, procedures, and protocols designed to foster efficient and responsible aquaculture production and

[4] The term Farmer Field School is used here to maintain consistency with the project proposal document and the terminology of mainstream discussion on this topic. However, in Chin language and during actual field implementation the term "school" is avoided so as to avoid the association with top-down teaching and learning by heart as the facilitation approach used aims at proactive engagement in and development of ownership of experimental farming activities in the so-called Farmer Field School.

[5] The concept GAqPs was developed for commercial aquaculture that aims at the export of fish originating from aquaculture so as to ensure environmental and biosafety in the country of origin and food safety in the destination

expansion and to help ensure final product quality, safety, and environmental sustainability." (Schwarz et al. 2010:1)

This initiative is designed to ensure that fish farmers in the project partner villages strengthen their knowledge and experience in Good Aquaculture Practices to enhance fish yields in their ponds by using technically sound and environmentally safe practices. The initiative would include all interested fish farmers from villages where there are fishponds in operation. Focus of this initiative will be on Common Carp aquaculture as it is the most farmed species and, since non-native, with high need for promoting farming procedures intended to protect local fish stocks and ensure biodiversity in the long term.

It would take the form of a cycle of awareness and hands-on practical training at selected, well-operated fishponds (of model "fish farmers") where interested fish farmers would convene at certain moments during the yearly aquaculture production cycle, e.g. at the time of pond preparation, fish stocking, and feeding & harvesting. To this end, the hired aquaculture specialist would prepare a syllabus; prepare visuals and training materials in Chin language (with the assistance of the NOAC project staff, if and as necessary).

Also, there is a need to gage the willingness of "model fish farmers" to participate as resource persons and make available their fishponds throughout the training and awareness building cycle. Pu Phirmawng and Pu Thla Ceu, from Hniralawn and Chuncung, respectively, have signalled their predisposition to participate in this initiative as "model farmers". Both have 6-7 fishponds and are known in Hakha Township and beyond as "model fish farmers". In Hniarlawn and in Chuncung there are also relatively high numbers of fishponds, many of them operating in low-yield mode. Chuncung is located close to the border of Falam Township and would be easily accessible by students from State Agricultural Institute, Lungpi.

Extension officers from the Fisheries Department at State and District levels would also participate and, depending on their particular expertise, would prepare for and train certain topics. Likewise, students from the State Agricultural Institute, Lungpi, and Yezin Agricultural University could as it may fit into their academic curriculum.

The main training/awareness topics would include: site location; production system design; source of fry and fingerlings; water quality for growing fish; facility biosecurity; feeding management, procurement, and storage; production techniques for disease prevention and control to maximize fish health; veterinary drugs; harvesting procedures; and cleaning and sanitation basics to ensure final product quality and food safety.

This initiative will be implemented during the timespan of one year (2017) in two "model fish farms" starting with the fishpond preparation and related training topics. During the fish production year three 2-3 awareness and hands-on training sessions would be provided. A similar training cycle will be implemented in the following year (2018) with training fish farms and syllabus adjustments as deemed necessary.

Complementary, the fish farmer resource persons, i.e. the "model fish farmers" will be engaged for short (3-4 days) periods by the project to conduct FishFarmer-to-FishFarmer extension activities in the 2nd cycle 2018 project target villages of project implementation. It is expected that as a result of this GAqPs training and awareness initiative dormant fishponds will be increasingly rehabilitated and better practices applied.

Finally, the implementation of this initiative will be monitored and lessons learnt documented. They will be the main ingredients for a final workshop with DoF extension workers and professors from SAI and Yezin University (and other knowledgeable stakeholders) to explore the elements that will need consideration in the formulation of a NSA curriculum in the area of fisheries extension.

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country. The main GAqPs items though are also applicable for small-scale aquaculture. (Schwarz et al. 2010; APEC-FSCF 2013)

7.2 Support to brood stock management and fish seed production

This initiative is designed to improve the knowledge and skills of quality fish seed production to enhance availability and accessibility of fish fingerlings in project partner villages and rural communities in Hakha Township.

The initiative will target current fish fingerling producers. It will review in a participatory manner, the details of current fish seed/fingerling production in project target villages and facilitate a learning process that encourages local fish farmers to improve breeding technology. Technical training topics include brood stock identification, brood stock management including renewal of brood stock, fish ecology and spawning behaviour, fish breeding, and management of fish spawn, larvae, juveniles and fingerlings, as well as good fish seed nursing and feeding practices.

The "model fish farmers" mentioned as resource persons for the GAqPs awareness training also practice high standards of fish seed production and their fish farms are considered as main sources of fingerlings for local fish farmers. Complementary to formal training and practice sessions at model farms, the resource persons could also engage as Fish Farmer-to-Fish Farmer extension work whereby a model fish farmer could visit fish farms in one village and discuss and share his knowledge on both general fish farming practice and more specifically on seed production so as to encourage village-based seed production.

In close collaboration with DoF, Aquaculture Division and the MFF this initiative will also promote the networking, communication and association of local Common Carp (or other species) breeders to maintain and breed pure strains of Common Carp (and other stocked fish) by certified breeders in licensed fish hatcheries.

The benefits will be measured in terms of increased dedication of fishpond owners to cleaning their ponds and installing separate small ponds for better brood stock management.

The implementation of this initiative will be monitored and lessons learnt documented. They will be the main ingredients for a final workshop with DoF extension officers, professors from SAI and Yezin University (and other knowledgeable stakeholders) and resource fish farmers to explore the elements that will need consideration in the formulation of a NSA curriculum in the area of fisheries extension.

7.3 Paddy field Integrated Production and Pest Management (IPPM)

This initiative is designed as an experimental platform that integrates paddy field rice production and pest management with stocking of Common Carp in paddy fields, and thus, leads to reduced weed occurrence and increased fish production. The initiative is based on the feeding behaviour of adult Common Carp stirring up the bottom surface of a water body, i.e. in this case a paddy field in its search for feed. In this way the omnivorous fish softens the soil while feeding on herbs, weed, weed seed, as well as on worms, insects, and all kind of organic matter. This in turn reduces the need for weeding requirements during the rice growing period by more than 33% (….) on the one hand and on the other, the fish grows much faster than in a pond due to highly nutritious feed available and readily accessible in the paddy land ahead of the rice farming season.

It will only be conducted where similar initial initiatives exist and soil conditions promise some level of success, i.e. the soil in a paddy plot should keep the water. Different trial plots will be installed to observe and measure differences in weed regrowth and fish growth. Three to four plots will be prepared with different stocking rates and with and without ploughing before transplanting rice seedlings.

This initiative could be conducted in form of a Farmer Field School in Tiphul village where one farmer, Pu Thong Kam, has been practicing a similar IPPM technique. The willingness of Pu Thong Kam still needs to be gaged for participation in this initiative as currently his paddy field is not in operation due to land slides; support to rehabilitation of demonstration plots should be considered. Exposure field visits will be organized from other villages where farmers express high interest in learning about these trials and where this technology could be potentially applied.

Importantly, the Farmer Field School will record all activities, inputs (time, fish size and numbers, type of work, land preparation expenditures, labour expenses, etc.) and outputs (fish, amount of weed, rice yield, etc.) for each trial plot so as to compare and explore the most efficient and/or high yielding practice. The most successful IPPM technology will then be propagated through Farmer-to-Farmer extension work in villages with suitable soil conditions.

The implementation of each of the steps of this initiative will be monitored and issues encountered and lessons learnt documented. They will be important ingredients for a final workshop with DoF extension officers and professors from SAI and Yezin University (and other knowledgeable stakeholders) where the elements that will need consideration in the formulation of a NSA curriculum in the area of IPPM extension will be explored.

7.4 Exploration of indigenous fish species for upland aquaculture (with DoF)

This initiative is designed to start exploring possibilities to farm indigenous fish species in upland communities so as to phase out and replace in the medium term the non-native Common Carp in aquaculture.

While wild stocks of Common Carp (*Cyprinus carpio*) are listed by IUCN-CITES as vulnerable, the domesticated Common Carp is often considered a destructive invasive species (Fishbase.org) and is included in the List of the world's 100 worst invasive species. (IUCN 2014)[6] Given its use in stocking practices of leasable fisheries in Myanmar it can be safely assumed that this species is established in the wild. Yet it is not known under what kind of environmental triggers (e.g. water quality, water condition, and combination of water and/or ambient factors, etc.) the Common Carp would become invasive. Fishbase.org, consequently, is listing Common Carp as a "potential pest", thus, demanding a precautionary approach to its management. (http://www.fishbase.org/)

NOAC will explore, in close collaboration with the Aquaculture Section of DoF, the use of indigenous fish species in upland areas with colder environmental conditions than the lowland. Potential native species to try out could be Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*), Catla (*Catla catla*). Also, this initiative will be implemented in close collaboration with SAI and Yezin University so as to incorporate the lessons learnt from different farming trials into their NSA-fisheries curricula.

7.5 Engaging with existing local "environment initiatives" for fisheries co-management

This initiative is designed to strengthen existing environmental conservation initiatives with particular attention to local rivers and their fisheries. The ultimate goal is to ensure sustainable management and use of fisheries resources and river habitats as an important source of quality food and nutrition.

Since wild fish are an integral source of animal protein in diets, communities have started to realize the urgency of conserving the fisheries. Under different organizational forms some of the communities, mostly villages of lower elevations such as Bunzung, Leium A, Chawncum and Keizuan, have started to develop initial rules and regulations. These rules focus on fishing repression and policing with little considerations of fisheries ecological aspects that ideally would inform fisheries management measures. Nevertheless, these local initiatives indicate a high level of urgency and commitment to address the issue of fisheries habitat conservation and management.

This NOAC project initiative takes stock of all rules and regulations that communities have developed through their Village Tract Administration or by Youth Fellowship, Minnow group, Ecology Committee, etc. so as to fully understand the current set of regulations and identify gaps and/or contradictions among them. Likewise, the project will explore with the local groups their

[6] This list is maintained by IUCN. It acknowledges "It is very difficult to identify 100 invasive species from around the world that really are 'worse' than any others."

institutional set-up of the development and enforcement of their current rules. The relationship between these groups and NOAC project will need to be formalized, to some extent, by developing a common work plan. The main outputs of this work plan will focus on documenting Local Ecological Knowledge (LEK) about fish and fisheries through action research approach, developing and use of a basic fisheries identification and monitoring tool to describe the local fisheries in terms of species; migrations; seasonal availability; spawning, nursing and feeding behaviour; history & trends; use of fishing gears, gender participation, fish processing and marketing. Grounded on the insights gained from this action research by local groups the existing local regulatory stipulations will be assessed, reviewed and, if required, adjusted for fisheries management that would allow regulated access to fish resources based on sustainability considerations.

Furthermore, the NOAC project initiative will promote networking among neighbouring communities within a water catchment for harmonization of regulations and enforcement. Dissemination materials for improved fisheries management will be developed and awareness events for the conservation and management of natural fish stocks in the rivers will be conducted.

Throughout the implementation of this initiative local administrative authorities and fisheries authorities will be informed and engaged. Authorities at the various levels will be part of the broader support network and integral part of a fisheries co-management governance framework. The Fisheries Department will be well positioned to replicate the fisheries co-management facilitation approach in other river basins or catchment areas.

The immediate benefits of this NOAC project initiative will be measured in terms of positive impacts on youth groups' and villagers' participation in action research activities. Also, broad consultation and support by villagers to fisheries management regulations will be an important measurement of success.

This NOAC project is a low input initiative as it depends on proactive engagement of local groups; it mainly requires some basic facilitation materials (flip charts, markers, etc.), notebooks, and fish identification sheets and measurement instruments as well as recording forms.

8. Draft plan for project initiatives in support of enhancing fish availability and accessibility for improved nutrition

Preliminary plan for discussion considering budget availability and allocations

Proposed Initiative	Time Line / LogFrame	2017												2018												2019					
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
1. Promotion of Good Aquaculture Practice	**Objective** **Strengthen fish farmers' knowledge and experience in Good Aquaculture Practices (GAqPs)**																														
	***Output 1*: GAqPs training/awareness initiative well managed**																														
	Activity 1.1: Support logistics, communication, transport, field stays,																														
	Activity *1.2*: Monitor implementation plan, expenditures within budget, and quality reporting																														
	Activity 1.3: Support production of facilitation materials, staff management																														
	***Output 2*: Training/awareness session plans and materials are prepared and documented**																														
	Activity 2.1: Prepare training session plan																														
	Activity 2.2: Prepare training materials																														
	Activity 2.3: Document training procedures																														
	***Output 3*: Willingness of participants is gaged & training schedule agreed**																														
	Activity 3.1: Agree roles & responsibilities and conditions with resource persons at demonstration fish farm																														
	Activity 3.2: Gage willingness of fish farmers to participate in GAqPs training																														
	Activity 3.2: Agree training schedule and implementation plan with participants																														
	***Output 4*: GAqPs training/awareness initiative implemented**																														

Proposed Initiative	Time Line / LogFrame	2017 J	F	M	A	M	J	J	A	S	O	N	D	2018 J	F	M	A	M	J	J	A	S	O	N	D	2019 J	F	M	A	M	J
	Activity 4.1: Field Session 1: Site location; pond preparation; production design; (species specific) fish ecology & environmental considerations; source & handling of fish seed/fingerling; seed/fingerling nursing																														
	Activity 4.2: Field Session 2: Fish feeding management, procurement, and storage; water quality for good growth; production techniques for disease identification, prevention and control to maximize fish health; veterinary drugs																														
	Activity 4.3: Field Session 3: Fish harvesting procedures; post-harvest considerations; Graduation of participants (linked to fish food preparation and nutritious food awareness event)																														
	***Output 5*: Lessons Learnt from GAqPs training/awareness initiative monitored and documented for feedback into NSA curriculum development at SAI and Yezin**																														
	Activity 5.1: Record regularly performance of GAqPs training/awareness and issues encountered																														
	Activity 5.2: Conduct Lessons Learnt workshop on GAqPs training/awareness with resource FishFarmers, DoF extension officers, SAI and Yezin professors for fish farming.																														
	Activity 5.3: Formulate approach and activities for SAI and Yezin NSA curriculum for fisheries																														
2. Support to brood stock management and fish seed production	**Objective** **Improve knowledge and skills of quality fish seed production and availability of and accessibility to fish seed in target villages**																														
	***Output 1*: Fish breeding and seed production training initiative is well managed and implemented**																														

Proposed Initiative	Time Line	2017												2018												2019					
	LogFrame	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
	Activity 1.1: Support logistics, communication, transport, field stays,																														
	Activity 1.2: Monitor implementation plan, expenditures within budget, and quality reporting																														
	Activity 1.3: Support production of facilitation materials, staff management																														
	***Output 2*: Current fish seed producers, their seed production practices and access to seed are identified**																														
	Activity 2.1: Conduct participatory SWOT analysis of fish breeding and seed production with fish farmers in selected villages																														
	Activity 2.2: Explore sources and quality of fish fingerings that are stocked in the village																														
	Activity 2.3: Explore solutions to produce and access better and more abundant fish seed with fish farmers in selected villages and establish training needs																														
	***Output 3*: Training session plans, materials and field demonstration pond facilities are prepared**																														
	Activity 3.1: Prepare training session plan and corresponding training materials (visuals)																														
	Activity 3.2: Ensure adequate timing, conditions and facilities for training in field demonstration ponds																														
	***Output 4*: Fish breeding and seed production training implemented**																														
	Activity 4.1: Conduct training in fish breeding and seed production at fingerling production farm																														
	Activity 4.2: Conduct participatory evaluation of the training and define follow-up FishFarmer-to-FishFarmer extension needs and modalities																														
	***Output 5*: FishFarmer-to-FishFarmer extension plan**																														

Proposed Initiative	Time Line / LogFrame	2017 J	F	M	A	M	J	J	A	S	O	N	D	2018 J	F	M	A	M	J	J	A	S	O	N	D	2019 J	F	M	A	M	J
	developed and implemented																														
	Activity 5.1: Prepare FishFarmer-to-FishFarmer extension work plan in close collaboration with resource FishFarmers																														
	Activity 5.2: Implement extension work plan																														
	***Output 6*: Lessons Learnt from FishFarmer-to-FishFarmer extension work is monitored and documented for feedback into NSA curriculum development at SAI and Yezin**																														
	Activity 6.1: Record regularly extension work performance and issues encountered																														
	Activity 6.2: Conduct Lessons Learnt workshop on extension work for improvement of production, availability and accessibility of fish seed with resource FishFarmers, DoF extension officers, SAI and Yezin professors for fish farming.																														
	Activity 6.3: Formulate approach and activities for SAI and Yezin NSA curriculum for fisheries																														
3. Paddy field Integrated Production and Pest Management (IPPM)	**Objective** **Explore efficient paddy field rice production & pest management (IPPM) by stocking Common Carp in an environmentally safe manner**																														
	***Output 1*: IPPM initiative is well managed and implemented**																														
	Activity 1.1: Support logistics, communication, transport, field stays, etc.																														
	Activity 1.2: Monitor implementation plan, expenditures within budget, and quality reporting																														
	Activity 1.3: Support production of facilitation materials, staff management																														
	***Output 2*: On-farm trial demonstration plan prepared and**																														

Proposed Initiative	Time Line	2017												2018												2019					
	LogFrame	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
	documented																														
	Activity 2.1: Prepare plan, in consultation with resource farmer, for on-farm trials of different plots (different stocking densities, with or without ploughing, etc.)																														
	Activity 2.2: Document on-farm demonstration procedures and record and measure all inputs, important events and outputs																														
	***Output 3*: Willingness of participants and resource farmers is gaged & training schedule agreed**																														
	Activity 3.1: Agree roles & responsibilities and conditions with resource farmer(s) at field demonstration plot																														
	Activity 3.2: Gage willingness of fish farmers to participate in IPPM on-farm experimental trials																														
	***Output 4*: IPPM initiative is implemented**																														
	Activity 4.1: Select on-farm demonstration plots																														
	Activity 4.2: Stock Common Carp at different densities in different plots according to plan																														
	Activity 4.3: Plough and till demonstration plot according to plan																														
	Activity 4.3: Plough and till demonstration plot according to plan																														
	***Output 5*: Lessons Learnt field exchange visit(s) and workshop implemented**																														
	Activity 5.1: Analyse on-farm trial data and prepare presentation materials about results of analysis for field exchange visits																														
	Activity 5.2: Prepare demonstration materials for field exchange visits to the demonstration plots by interested farmers																														
	Activity 5.3: Conduct field exchange visit(s) to the on-farm																														

Proposed Initiative	Time Line / LogFrame	2017 J	F	M	A	M	J	J	A	S	O	N	D	2018 J	F	M	A	M	J	J	A	S	O	N	D	2019 J	F	M	A	M	J
	IPPM demonstration plots by interested farmers and DoF, SAI and Yezin University																														
	Activity 5.4: Conduct IPPM lessons learnt workshop with SAI and Yezin University to explore usefulness for and integration into NSA curriculum																														
4. Promote indigenous fish species for upland aquaculture	**Objective** **Test potentially suitable indigenous fish species for upland aquaculture technology**																														
	***Output 1*: Potentially suitable indigenous fish species selected in close collaboration with DoF**																														
	Activity 1.1: Explore options with DoF and fisheries stations for promising fish species for upland aquaculture																														
	Activity 1.2: Gage interest with fish farmers in project target villages and SAI and Yezin to engage in farming trials with indigenous fish species																														
	Activity 1.3: Convene decision-making platform to decide on which species to test																														
	***Output 2*: On-farm trials for testing suitability of indigenous fish species for upland aquaculture designed**																														
	Activity 2.1:																														
	***Output 3*: On-farm trials for testing suitability of indigenous fish species for upland aquaculture implemented and documented**																														
	***Output 4*: On-farm trial data and prepare presentation materials for indigenous fish upland aquaculture analysed**																														

Proposed Initiative	Time Line / LogFrame	2017 J	F	M	A	M	J	J	A	S	O	N	D	2018 J	F	M	A	M	J	J	A	S	O	N	D	2019 J	F	M	A	M	J
	***Output 5*: Lessons Learnt workshop for designing further approach to promoting uplands indigenous fish aquaculture convened**																														
5. Engaging with local environment conservation initiatives for Fisheries Co-Management	**Objective** **Strengthen existing environment conservation initiatives with particular attention to the management of local rivers and their fisheries**																														
	***Output 1*: NOAC Fisheries Co-Management initiative is well managed and implemented**																														
	Activity 1.1: Support logistics; communication; transport; field stays; networking meetings.																														
	Activity 1.2: Monitor implementation plan, expenditures within budget, and quality reporting																														
	Activity 1.3: Support production of facilitation materials, staff management																														
	***Output 2*: Baseline survey on local environmental protection initiatives (EPI) with special focus in fisheries conducted**																														
	Activity 2.1: Design and test survey approach																														
	Activity 2.2: Conduct survey																														
	Activity 2.3: Compile and analyse survey results																														
	Activity 2.4: Design preliminary approach to and action plan for engaging with EPI and authorities at the various levels for fisheries co-mangement																														
	***Output 3*: Action plan with EPI and authorities for strengthening and developing fisheries co-management consulted and prepared**																														
	Activity 3.1: Consult with EPI and authorities on preliminary																														

Proposed Initiative	Time Line	2017												2018												2019					
	LogFrame	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
	action plan and adjust plan																														
	Activity 3.2: Define NOAC support and facilitation activities for EPIs' action research, networking, and institutional strengthening																														
	Activity 3.3: Prepare budget for approval																														
	***Output 4*: Facilitation support to EPIs' plan of action provided**																														
	Activity 4.1: Prepare facilitation materials as required																														
	Activity 4.2: Facilitate EPIs' action research on LEK, fish identification & ecology, and fishing practices																														
	Activity 4.3: Facilitate EPIs' institution building for fisheries co-management																														
	Activity 4.4: Facilitate EPIs' networking initiatives with neighbouring villages and within the catchment and authorities at the various levels																														
	***Output 5*: Lessons Learnt documented and fisheries co-management meeting with DoF convened**																														
	Activity 5.1: Document Lessons Learnt from this NOAC initiative																														
	Activity 5.2: Prepare communication and dissemination materials on Lessons Learnt on upland fisheries co-management																														
	Activity 5.3: Convene a meeting with DoF to present and discuss approach to and results of NOAC fisheries co-management initiative																														

ANNEXES

Annex 1: List of References

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Annex 2: Persons met

1. Dr. Khin Maung Soe, Department of Fisheries / WorldFish, Yangon
2. U Zaw Man Naung, Department of Fisheries, Hatchery Station, Mandalay
3. Shingo, JICA Project for Small-scale Aquaculture Extension for Promotion of Livelihood of Rural Communities in the Central Dry Zone (SAEP in CDZ), Mandalay;
4. U Paw Lwin, Director of State Department of Fisheries, Chin State, Hakha;
5. U Maung Soe, Fisheries Officer at Khai Kham Fisheries Station, Tedim Township, Falam District (near Kalay);
6. U Khin Htun, Falam district DOF chief, Falam.
7. U Za Bik, VTA chief, Hniarlawn
8. U Mang That, fish farmer, Hniarlawn
9. U Phir Mawng, fish farmer, Hniarlawn village
10. U Hkthla Ceu, fish farmer, Chuncung village
11. U Lian Chin, VTA chief, Chuncung village
12. U Lai Ling, former VTA chief, small fishpond owner, Loklung village
13. U Za Thang, village development committee member
14. U Thla Hmung, VTA chief, Loklung village
15. U an Biak Thong, farmer fisher, Nabual village
16. U Sa Awi, fish farmer, rabbit holder, Loklung village
17. U Bawi Zel Thank, fish farmer, Loklung
18. U Bawi Ling, fish farmer, Nipi village
19. U Rual Kung, former fish farmer, Nipi village
20. U ……, VTA chief, Zokhua village
21. U Tee Hong, village elder, Zokhua village
22. U Zo Hmung, village elder, Zokhua village
23. Rev. Ceu Uk, former fishpond owner, pastor, Zokhua village
24. U ….. , VTA chief, Cinkhua
25. U ….., VTA chif, Bunzung
26. U Sui Len Mang, Chief of Youth Minnows, Bunzung
27. Uk Chin Hmung, member of Youth Minnows, Bunzung
28. Biak Thong Lian, member of Youth Minnows, Bunzung
29. U Thong Kam, Tiphul village
30. Dr. Ron Zweig, e-mail correspondence on upland aquaculture model developed originally in upland China.
31. Rick Gregory, Pyoe Pyin and WFC consultant, Yangon

Annex 3: Lists of cultured and wild fish names

List of Fish Species cultured in target villages or found in Hakha market

Scientific name	*English name*	*Chin name*
Cirrhira migrala	Mrigal	Nga Kjin
Ctenopharyngodon idellus	Grass carp	Mietsa Nga Kjin
Cyprinus carpio carpio	Common Carp	Shwe War Nga Kyin
Labio rohita	Rohu	Nga Myit Kyin
Catla	Catla catla	Nga Thaing

Prochylodus lineatus	Hilly Hilsa or Streaked Prochilod	Taung paw nga thar lauk or Whee phae

Names of wild fish species:

1. Nga Berbak
2. Nga Cantial
3. Nga Conghler or Nga Zumzuk
4. Nga Fungtiel
5. Nga Hler
6. Nga Kha
7. Nga Kheng
8. Nga Laole
9. Nga Le
10. Nga Leang
11. Nga Loulae
12. Nga Lungkep
13. Nga Lungkhui
14. Nga Meipar
15. Nga Mi
16. Nga Nawlnok
17. Nga Pum
18. Nga Petma
19. Nga Samthih
20. Nga Sang
21. Nga Saotlang
22. Nga Thasan
23. Nga Ticambalak
24. Nga Tieltaren
25. Nga Tiltreang
26. Nga Vang
27. Nga Vangpu
28. Nga Zanglao
29. Nga Rul (eel)
30. Cang Ai (crab)
31. King Kuar (shrimp)
32. …….(frog, not consumed)

…….(frog, considered edible and consumed)

Note:

It could not be established if all the fish names recorded in the various villages do represent distinct fish species; potentially, the same name may refer to the different fish species in different villages, or different names may refer to the same species, or different names may refer to the same species at different lifecycle stages.

Systematic recording of fish names, photographing and identification of all fish species would require further research.