Co-funded by the Erasmus+ Programme of the European Union

Curriculum Development for Sustainable Seafood and Nutrition Security (SSNS)

A4.3 Report on Course Delivery and SSNS Curricula (Thailand)

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Report on

SSNS Curricula and Courses Delivery

(Thailand)

1. Background

Seafood as source of good protein, its demand is increasing year. FAO and other organizations predict that seafood production needs to be doubled by 2050 to feed the world. Catch from the wild is declining in most of the countries. Farming of aquatic animals and plants i.e. aquaculture has been emphasized as a solution. Compcared to beef, pig, poultry and other agricultural sectors, it is a quite young since, started since 1950s. It has expanded worldwide becoming the fastest food production sector. Fast growing sector also has negative environmental impacts. In order to cope with the challenges, this sector needs more professionals to engage in and more efforts, however, higher education in Aquaculture and Fisheries itself facing challenges (Problems) such as:

1) Academic degrees (BSc, MSc and PhD) are less attractive compared to fields of studies.
2) Student enrollment in the department / faculty of fisheries/aquaculture is declining in most universities
3) Graduates are often face problem of unemployment.
4) Traditional education or degrees were designed to produce graduates to fulfill the government employment e.g. universities, extension or research institutions. However, these positions are less and less available.
5) Private sector is booming due to high demand for seafood. Private sector employers have lots of demand for skillful people. They look for highly effective staff to recruit but difficult to find such graduates. Even if they hire, they are not satisfied with the performance of the graduates.

Therefore, there is some mismatch of graduates produced by universities and the demand in the industry. Realizing that as a problem, Curriculum Development for Sustainable Seafood and Nutrition Security (SSNS)" project funded by EU under Erasmus+ programme was designed to reshape/restructure the higher education in partner universities in Indonesia, Thailand and Vietnam with the help of European partners.

The SSNS project started from October 15, 2017 and will end on October 14, 2021 (extended 12 months due to Covid-19). During this period, over 50 courses were developed either newly designed or improved from existing ones. Internship programs were developed to incorporate into their curricula. In additional, vocational education training course were also developed to offer need-based training to develop skills of professionals who are already serving for the industry.

2. Objectives of the project

1) Capacity building of higher education institutions and professionals
2) Establish centers to offer VET courses and organize internships

3) Develop MSc & vocational training courses and incorporate them into the curricula
4) Develop/incorporate internship / link with industries
5) Strengthen collaborations and linkages among institutions and individuals

3. The main purposes of the interim evaluation

- To assess the status of course development, accreditation and delivery
- To make recommendations for improvement in the program and delivery methods

4. Courses recommended for Thailand by WP1

There were 19 courses for sustainable fisheries (catch) and other 19 courses for sustainable aquaculture (culture management) as show in the Table 1. Similarly, 11 courses were recommended for vocational education training and six best practices of courses delivery methods as listed below:

Table 1. Recommended courses for MSc level in Thailand.

SN	Sustainable Catch Management	SN	Sustainable Culture Management
1	Seafood and food security	1	Seafood and SDGs
2	Fisheries governance & policies	2	Entrepreneurship in Seafood business
3	Sustainable fishing technologies	3	Green/Organic aquaculture
4	Fisheries ecology & tourism	4	Precision aquaculture
5	Stock assessment & monitoring	5	Aqua feed business
6	Culture based fisheries	6	Aqua seed business
7	Sea grasses and seaweed conservation	7	Integrated multi-trophic Aquaculture
8	Coral reef conservation and restoration	8	Mari-culture (sea bass, grouper, eels.)
9	Plastics & wastes and water pollution	9	Deep sea/offshore aquaculture
10	Livelihood diversification for fishers	10	Aquaculture and the Environment
11	Gender and fisheries	11	Biosecurity & Fish Diseases
12	Rare Animals Breeding & stocking	12	Climate smart aquaculture (CSA)
13	Integrated coastal zone management	13	Aquaculture and global warming
14	Post-catch handling and management	14	Value-added seafood products
15	Climate change and Fisheries	15	Seafood safety and certification
16	Seminar	16	Seminar
17	Special case studies	17	Special case studies
18	Internship	18	Internship
19	Thesis research & publication	19	Thesis research & publication

List of vocational Education Training / short term courses:

Following courses are recommended:

1. Fish/shellfish diseases diagnosis and treatment
2. Seafood business start-ups
3. Hatchery and grow-out of tilapia

4. Hatchery and grow-out of shrimp/prawn
5. Biofloc / Aqua-mimicry
6. Hatchery and grow-out of sea bass
7. Water Recirculation Aquaculture System (RAS)
8. Aquaponics
9. Seafood processing and product marketing
10. Good Aquaculture Management practices
11. Seafood safety and certification

Best practices in teaching methods or course delivery are:

1. Planned Field Visits (e.g. AIT)
2. Feed factory visit (e.g. AIT)
3. Internship (e.g. AIT)
4. Special case studies (at least one very relevant to respective course)
5. Research with industry partnership
6. Seminar courses (e.g. Kasetsart University)

5. Status of courses developed and offered in Thailand

The list of courses developed are provided in Annex 1a-c, a list of MSc program and the courses incorporated are shown in Annex 2a-c and a report of student internship is enclosed as an example.

5.1 Partner 1 (AIT)

AIT started offering the SSNS courses since August semester 2020. As of October 2021, 75% of the total (8 out of 12) courses offered in the curricula of MSc in Aquaculture are either revised or improved from the existing courses as a part of SSNS project (Annex 2a). The remaining other courses have also been revised following the new format used for SSNS courses. Over 50% of the courses offered are directly addressing the sustainability issue. Altogether 26 students (5 PhD and others are MSc) have benefitted from the revised courses. An internship program with 12 credits have been also included for the degree (Annex 2a). The internship was developed as institute-wide program for all the academic programs as a compulsory part of the academic degree but due to some arguments from some lecturers, it has been made optional for the time being (2021). There is a plan to make it compulsory from 2022 or later. AIT (P1) has four farms/companies newly signed to serve as internship host, and a group of 10 students from India and five others (3 and 2) were working at SuthiFarm (one of the internship hosts). A sample of report of internship is enclosed (Annex 3).

Figure 1. A group of 10 students (left) collecting tilapia eggs at SutthiInter Farm, Sena Ayuthaya during June-July 2020 and another student (right) working as an intern.

Regarding the vocational education training (VET) courses, AIT organized 13 training programs during the 2019-2921 involving about 230 participants (Annex 1c). Out of 13 trainings, three were organized online due to COVID19 situation during 2020 and 2021.There courses were organized under the banner of Aqua-Centre (https://aqua-centre.org) which was strengthened by the support of SSNS project. The list training programs and the participants are available at the Aqua-Centre's webpages, such as https://aqua-centre.org/training and https://aqua-centre.org/training/participants

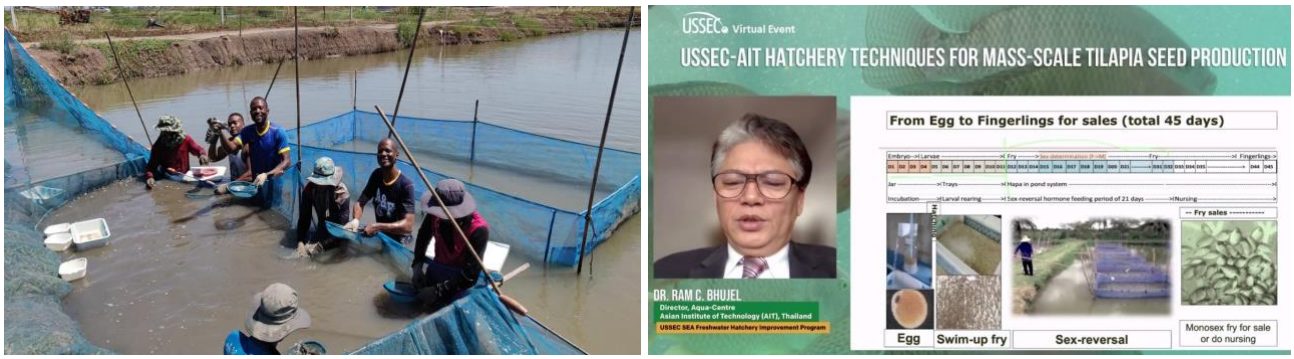


Fig. 2 Hands-on training for Nigerian group at SutthiInter Farm during Sept-Oct 2020 (left) and Virtual training organized for the groups of United States Soybean Export Council (USSEC)

AIT has also completed equipment purchases as planned having public tender as per required. All of these equipment have EU Erasmus+ logos. These equipment have been very useful for teaching learning activities. Thanks to the project.

Fig. 3 Equipment purchased for AIT using SSNS project funds

5.2 Partner 2 (Maejo University):

Maejo university started offering the SSNS courses since July-October semester of 2019 (Annex 1b). Altogether eight courses were developed; out of which two (2) were newly developed and six (6) were improved from the existing one as a part of SSNS project. A total (????) number of students benefitted by taking these courses.

Maejo University (P2) has developed four internship programs. However, due to COVID-19 situation, placing students was not possible.

5.3 Partner 3 (Khon Kaen University)

KKU has altogether five courses developed; out of which two were new and three were improved from the existing ones. The university started offering the courses since July 2019 semester (Annex 1c)

KKU has developed three internship programs signing the MoA (Memorandum of Agreement). However, due to COVID19 situation, sending students to work in the farm has not been possible.

KKU has developed 18 training programs and started offering since Feb 2019. Three training programs have been completed so far involving about 35 professionals as beneficiaries. These training courses have been offered under the Centre (…).

Conclusions and recommendations

Altogether 20 courses were developed in Thailand as a part of the SSNS project. About 17 courses have already been incorporated into their curricula and offered during 2019-2021. A total of 26+ MJU ? + KKU? students have taken these courses and took the benefits. Similarly, 11 internship hosts have been developed (MoA signed), out of which only two were possible to use due to COVID-19. As soon as situation becomes normal, all of them are ready to receive students. More than 30 vocational education training programs were developed and offered (face-to-face and online/virtual) during the SSNS project period benefiting over 200 professionals.

Out of the 20 courses developed in Thailand, eight are newly developed and 12 have been improved from the existing ones. These courses focused on three major aspects; 1) Sustainable aquaculture (AIT), 2) Sustainable fisheries technology and management (Maejo Univ); 3) Feed and processing technologies (Khon Kaen Univ). Majority of the courses recommended under WP1 have been included either developing new or improving from the existing courses.

While comparing the number of courses recommended and developed and offered, there are still many areas which have not been covered by the courses especially related to fisheries governance and policies, seagrasses, plastics and marine pollution, gender and fisheries, and climate change and fisheries. As all of these partners are located away from the seas, courses related to seas, marine environment were not covered. On the other hand, gender and fisheries and climate change and fisheries/aquaculture could not be covered mainly due to lack experts to teach those subjects. Other partners from other countries especially from Indonesia and Vietnam might have covered on these topics. Nevertheless, the Thai partners will continue revising their curricula considering these as recommendations for the future to include these whenever they have chance. AIT had about 15 (three groups) joining the hands-on work experience as internship combining with online and field visit for practice minimizing the field work during the COVID situation. However, other partners have not been able to offer internship to their student due to COVID-19 and requirement of social distancing, internship programs which involved working in the field with other staff were not possible to incorporate much as these were restricted.

In conclusion, SSNS project has good impacts in Thailand which has made substantial improvement in the MSc courses/curricula of aquaculture / fisheries, VET and also developed professional internship programs. Thai partners are advised to continue improving the curricula and add more internship programs. More importantly, they should try to exploit as much as possible.

Annex 1a. List of courses offered in Thailand

P#	P Name	SN	MSc coures	No. of credits	New/ improved	Instructor	Taught semester	No. of students	Use VLE	Sustainability	Employability
P1	AIT	1	ED71.9022 Cleaner aquaculture technology	3 (3-0)	New	Salin Krishna	Aug-Dec, 2020	6	-	Yes	Yes
		2	ED71.9023 Sustainable Seafood & Human Nutrition	3 (3-0)	New	Ram Bhujel	Aug-Dec, 2019	6	6	Yes	Yes
		3	ED71.9024 Sustainable Seafood Business	2 (0+2)	Improved	Ram Bhujel	Jan-April 2020, 2021	18	18	Yes	Yes
		4	ED71.9025 Sustainable Seafood and SDGs	3 (3-0)	New	Ram Bhujel	Aug-Dec 2020	6	6	Yes	Yes
		5	ED71.xxxx Aquaculture Economics and marketing	2 (2+2)	New	John Kuwornu	Not yet	0	-		
P2	Maejo Univ	8	FT501 Advanced research methodology	3(2-3-5)	Improved		Jul-Oct, 2019			Yes	
		8	FT511 Fishery Technology & Development	3(2-3-5)	Improved		Jul-Oct, 2019			Yes	Yes
		9	FT512 Technologies in Aquatic Resources	3(2-3-5)	Improved						
		10	FT513 Fisheries Innovations	3(2-3-5)	New						
		11	FT526 Aquatic Animal Immunology	3(2-3-5)	New						
		12	AT532 Aquatic Animal Feed Technology	3(2-3-5)	Improved		Jul-Oct, 2019			Yes	
		13	FT542 Fisheries Business management	3(2-3-5)	Improved		Jul-Oct, 2019				
		14	FT5xx Aqua Farm Business Management	3(3-0-5)	Improved		Aug-19			Yes	
P3	KHON KAEN	15	AG 187xxx Aquafeed formulation and feeding system	3(2-3-5)	Improved	Bundit	Jan-20			Yes	

		16	AG 187 xxx Broodstock management and fish production	3(2-3-5)	Improved	Siripavee	Jan-20				
		17	AG 187 xxx Water quality and fish disease	3(2-3-5)	Improved	Pattama	Aug-19				
		18	AG 187 763 Aquatic Animal Processing Technology for Entrepreneur	3(3-0-6)	New	Somsamorn	Aug-19			Yes	
		19	AG 187 xxx Marketing Management in aquaculture business	3(3-0-6)	New	Parichad	Jan-20				
			Total					30			

Annex 1b. Internship programs

P#	Partners	Country		Internship hosts	Organized time period	No. of participants
P1	AIT	Thailand	1	Testhong Catfish hatchery	March 2 - June 2020	10
			2	SutthiInter Farm, Ayuthaya	June-July 2021	15
			3	Jirasak Fish Farm		
			4	MAXSPeed Fish Farm		
P2	MAEJO	Thailand	1	Seabass breeding		
			2	Department of Fisheries stations		
			3	CPF-Thailand		
			4	CPF-India		
P3	KHON KAEN	Thailand	1	Thapra Fish Farm	April-May, 2020-2021	0
			2	Khon Kaen Farm	April-Oct, 2019-2021	0
			3	Phaka Farm	year round 2020-2021	0
				Total		25

Annex 1c. List of VET courses

P#	Partners	Country	SN	VET Courses	New/improved	Date organized	No. of participants	Public	Private
P1	AIT	Thailand	1	Tilapia farming1	Improved	Feb 18-Mar 1, 2019	9	4	5
			2	Seabass farming	Improved	May 18-30, 2019	2	2	0
			3	Shellfish breeding & culture	New	May 12-24, 2019	6	6	0
			4	Tilapia farming2	Improved	Aug 5-16, 2019	5	0	5
			5	Aquaculture value chain	Improved	Dec 1-10, 2019	8	8	0
			6	Seaweed farming	New	Dec 1-14, 2019	8	6	0
			7	Tilapia farming3	Improved	Dec 9-20, 2019	6	0	6
			8	Aqua-Internship	New	Mar 2- June, 2020	10	10	0
			9	Aua-Agri Training & Study tour	New	Sept 24-Oct 9, 2020	4	0	4
			10	Aquaculture & Biotechnology	New	Oct 28-Nov 8, 2020	2	0	4
			11	Tilapia training - (Online)	New	Dec 14-18, 2020	10	9	1
			12	Tilapia Hatchery & grow-out (online)	New	June 13, 2021	90	ND	ND
			13	Tilapia hatchery improvement (online)	New	Oct 4-8, 2021	70	ND	ND
							230		
P2	MAEJO	Thailand	1	GAP & Organic fish farming	New	Offered	-		
			2	Tilapia health management	New	Offered	-		
			3	Organic Fish feed	Improved	Offered	-		
P3	KHON KAEN	Thailand	1	Seafood products	New	Oct 15, 2019	13		13
			2	Disease management	New	Feb 20, 2019	10		10
			3	Water quality monitoring	Improved	Feb 7, 2020	12	2	10
			4	Dried Smoked Fish	New	open for application			
			5	Esan Style Sour Fish Sausage	New	open for application			
			6	Fermented Fish Paste	New	open for application			
			7	Fermented Fish Powder	New	open for application			
			8	Fermented fish sauce	New	open for application			

			9	Fermented Fish	New	open for application			
			10	Fermented Fish Dip	New	open for application			
			11	Fermented Fish and Chicken Sausage	New	open for application			
			12	Fish and Shrimp Cracker	New	open for application			
			13	Hot Smoked Fish	New	open for application			
			14	Instant Fermented Fish Dip Powder	New	open for application			
			15	Sour Fish and Pork	New	open for application			
			16	Thai Style Fish and Chicken Sausage	New	open for application			
			17	Thai Style Seasoned Dried Fish Strip	New	open for application			
			18	Fish and Chicken Ball	New	open for application			
				Total			35		

Annex 2. MSc Curricula of Partner Universities

Annex 2a: Curricula of AIT (P1)

ASIAN INSTITITE OF TECHNOLOGY
School of Environment, Resourecs and Development (SERD)
Aquaculture and Aquatic Resources Management (AARM)
MSc in Aquaculture

Considering the high demand of seafood and its role in global food and nutrition security, an MSc programme on "**Aquaculture and Aquatic Resources Management (AARM**) has been revised incorporating the courses developed or revised as a part of "Curriculum Development for Sustainable Seafood and Nutrition Security (SSNS)" project funded by EU Erasmus+ programme and AIT's internal revision process to contribute to sustainable development of aquaculture and fisheries sector. The list of courses and their credits, category and status (O-offered) include the followings:

List of courses

Year 1				
SN	**Semester I (August – December)**	**Credits**	**Category**	**Status**
1	ED71.04 Aquatic Seed Production	3(2-3)	Required	Existing (O)
2	ED71.36 Aquaculture Nutrition & Feed Technology	3(2-3)	Required	Revised (O)
3	ED71.9022 Cleaner Aquaculture Systems	3(3-0)	General	New (O)
4	ED71.xxx Aquaculture Health Management	3(2-3)	General	New (O)
5	ED71.9023 Sustainable Seafood & Human Nutrition	3(2-3)	Elective	New (O)
6	ED71.9025 Sustainable Seafood and SDGs	2(2-0)	Elective	New (O)
	Semester II (January – May)			
7	ED71.xxx Statistics for Aquaculture and Fisheries	3(3-0)	General	Revised (O)
8	ED71.9021 Applied Genetics in Aquaculture	3(2-3)	General	Revised (O)
9	ED71.xxx Applied Microbiology & Biotechnology	3(2-3)	General	New (O)
10	ED71.xxx Research Workshop & Seminar	3(3-0)	General	Revised (O)
11	ED71.xxx Aquaculture Economics and marketing	2(2-0)	Elective	New (P)
12	ED71.9024 Sustainable Seafood Business	2(2-0)	Elective	New (O)
13	Internship programme	12	Elective	Revised (O)
Year 2				
	Thesis	24		
	Total credits required	48		

Note: Those students who want to choose internship do not need to do Thesis. Those who want to do thesis internship will be for work experience without credits.

Registration:	20,000 THB/Semester	InterSemester:	June – July
Tuition:	16.000 THB/Credit	For more info:	info@aqua-

Annex 2b: Curricula of Maejo University (P2)

MAEJO UNIVERSITY
MSc Program in Fisheries Technology and Aquatic Resources
Sustainable Seafood and Nutrition Security (SSNS)

As the increase demand in fish products especially seafood, Maejo University, MJU, as part of the "Sustainable Seafood and Nutrition Security" programme has continuously revised the MSc program in Fisheries Technology and Aquatic Resources under the guidance of AIT leader and all partners in the Erasmus+ programme funded by EU to provide post-graduate education and to contribute sustainable development of aquaculture and fisheries sector. The courses include the followings:

MSc (Fisheries Technology and Aquatic Resources) – MJU, Thailand
Revised in 2018 / in preparation for revision for 2023

List of courses
Year 1

Code	Courses	Credit
	Semester I	
20903101	Advanced Research Methodology in Fisheries and Aquatic Resources (Revised during SSNS project)	S/U (no-credit)
20903102	Fisheries Technology and Development (Revised during SSNS project)	3(2-3)
20903104	Seminar 1	S/U (no-credit)
20903121	Fisheries Innovation (major elective course) (New during SSNS project)	3(2-3)
20903122	Aquatic Animal Immunology (major elective course) (Revised during SSNS project)	3(2-3)
	Semester II	
20903103	Technology in Aquatic Resources (Revised during SSNS project)	3(2-3)
20903105	Seminar 2	S/U (no-credit)
20903123	Aquatic Animal Feed Technology (major elective course) (Revised during SSNS project)	3(2-3)
20903124	Aquaculture Technology (major elective course)	3(2-3)
20903191	Internship (optional / during summer)	12
20903192	Abroad Experiences for Graduate Study (optional / during summer)	12

Year 2

Code	Courses	Credit

	Semester I	
20903106	Seminar 3	S/U (no-credit)
20903125	Algal and Aquatic Plant Technology (major elective course)	3(2-3)
20903126	Fisheries Business Management (major elective course) (Revised during SSNS project)	3(2-3)
20903108	Thesis 1	6(0-18)
	Semester II	
20903107	Seminar 4	S/U (no-credit)
20903109	Thesis 2	6(0-18)
	Total credits	36

Note: Everyone needs to do Thesis. Abroad Experiences for Graduate Study and internship are optional courses offered during summer.

First Semester:	July – November
Second Semester:	December – March

Registration:	20,000 THB
Tuition:	18,000 THB/semester
For more info:	fishtech.mju@gmail.com

Annex 2c: Curricula of Khon Kaen University (P3)

KHON KAEN UNIVERSITY

MSc Program in Fisheries

Sustainable Seafood and Nutrition Security (SSNS)

Demand of fish as food has increased in very parts of the words. To cope with the demand, fish product, fish utilization and marketing management in fish industries must work harmoniously and effectively. The MSc programme "Fisheries" has been improved based on the gap analysis and information contributed by Asian and European partners working under the project "Sustainable Seafood and Nutrition Security (SSNS)" funded by the Erasmus+ programme of EU. The courses include the followings:

List of courses

Code	Courses	Credit
	Semester I	
AG187 891	Seminar in Fisheries	1(1-0-2)
AG187 731	Statistics and Research Methods in Fisheries	3(2-3-5)
AG187 711	Physiology of Aquatic Animals	3(2-3-5)
AG187 723	Broodstock management and Aquatic animals production (major elective course) (New during SSNS project)	3(3-0-6)
	Semester II	
AG187 732	Fishery Resources Management and Utilization	3(3-0-6)
AG187 733	Marketing Management in Aquaculture Business (major elective course) (New during SSNS project)	3(3-0-6)
AG187 745	Fish Disease and Water Quality Control (major elective course) (New during SSNS project)	3(2-3-5)
AG187 894	Special Problems in Fisheries (optional/internship work in Thailand or in abroad during summer)	3(0-9-4)
	Semester III	
AG187 892	Seminar in Fisheries 2	1(1-0-2)
AG187 753	Aquafeed Formulation and Feeding System (major elective course) (New during SSNS project)	3(2-3-5)
AG187 763	Quality Assessment and Quality Control of Aquatic Animal Product (major elective course) (New during SSNS project)	3(2-3-5)
AG187 997	Thesis	6
	Semester IV	
AG187 764	Aquatic Animal Processing Technology for Entrepreneur (major elective course) (New during SSNS project)	3(3-0-6)
AG187 997	Thesis	6
	Total credits	38

Note: Internship work at the farm in Thailand or in abroad is registered under the course Special Problems in Fisheries (AG187 894) and offered during summer.

First Semester: July – November Second Semester: December – March	Registration: 20,000 THB Tuition: 18,000 THB/semester

Annex 3: Example of interns report

A worth sharing experience – egg collection from mouth brooder

Internship Experience By- Swatishree Nayak

Background

We were in Sena Farm which is 110 Km away from AIT. Work begins at 7 am and ends at 5 pm. Our main goal was to learn how to collect eggs from tilapia mouth. We all were curious to know and even excited to do practically. Thanks to the farm owner Mr. Pit to allow us to work in their farm along with their workers despite having some concerns during the COVID-19 situation.

About the work

The owner takes us to the place where egg collection was going on. He hands us gloves for our safety. Before we reach the farm workers already inside the ponds harvesting the fish. We wait for sometimes and then we bring fish near to one end and we went inside the pond. There is a temporary portable egg collection system (fig-1), as their hatchery is little far it makes them convenient to transfer the egg to the hatchery at one time. As we go inside the pond, at first, we are having some problem to walk and stand due to a lot of mud in the pond, then workers start teaching us how to hold the fish in one hand and how to search eggs. We segregate male and female by looking their mouth. The fish is bent down ward and we shake the fish and eggs start to fall from her mouth, we put finger inside the operculum to remove all the eggs. They taught us how to take out the eggs from mother tilapia mouth. Then they handed us the net to do by ourselves (fig – 2). We start doing it by ourselves and its little difficult in the beginning later on we learn and start performing well.

Fig 1- portable hatchery system

Fig 2- collecting eggs from tilapia

After the eggs are collected from the mouth in the net, we pour it in a tub and the tub is taken by another worker standing along with a scoop net having a long handle. She collects it from us and put inside the temporary hatchery(fig-3). The portable hatchery has a net above the opening to remove the dirt particle and only clean eggs to pass and the hatchery has 3 containers - eggs are divided on the basis of their stage

1. 1st container has stage 1 and stage 2 eggs.
2. 2nd container has stage 3 and stage 4 eggs.

3. 3rd container has stage 5 and swim up fry.

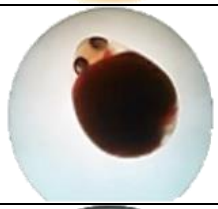
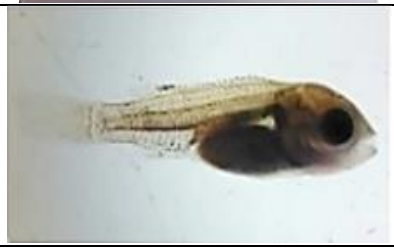
Fig 3- pouring eggs inside the

Then after the collection the eggs are being transferred to the plastic jars at hatchery unit of the farm. Here we observed the egg movement inside the jars with continuous good quality water supply. Here the piping systems as well as jars were cleaned before eggs put into it by normal water that was coming from settlement tank/reservoir.

Fig- 4- eggs incubation in glass jar

The jar system was completely run up to 5 days and the swim up fry collected in trays. Here the plastic jars used for hatching of eggs were of large sized jar along with flat bottom structure. We observed the jars with egg weighing 334g and 139g respectively (Fig 4) according to size of the egg as well as conversion of egg to swim up fry stage. After observing this, we left the hatchery and returned back from farm with little bit conversation with the farm owner.

Stages of tilapia eggs

Stages	Characters	Appearance
Stage-I	Just fertilised, yellow in colour without any eye spots	
Stage-II	With eye spots	
Stage-III	Darker in colour and with small tail and protruding eyes.	
Stage-IV	With longer tail and head	
Stage-V	Swim up fry	

Conclusion

It’s an awesome experience and unforgettable. We get injury but still we have fun. We waste many eggs as our first time but the farm people are so kind they didn’t mind. Overall, I learn about the stages of tilapia eggs and its good.

Recommendation

The pond is a community pond having variety of species like carps. It should change for better growth of the fish. The glass jar hatchery base should be round so that eggs move easily.