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

Project Title

Curriculum Development for Sustainable Seafood and Nutrition Security

Project Acronym

SSNS

Deliverable 1.1c: Identification of similar curricula and best practice in Vietnam

Vietnam, July 2018

Funding details:
Education, Audiovisual and Culture Executive Agency
Erasmus+: Higher Education – International Capacity Building
KA2: Cooperation for innovation and the exchange of good practices – Capacity building in the field of Higher Education
Agreement Number: 2018 – 0028 / 001 - 001
Project Number: 585924-EPP-1-2017-1-TH-EPPKA2-CBHE-JP

Support:
Co-funded by the Erasmus+ programme of the European Union

Deliverable details:

Due date of Deliverable: 30-06-2018
Actual submission date: 10-08-2018

Start date of project: 15 - 10 - 2017 Duration: 3 years
Organisation name of lead contractor for this deliverable: NTNU

Dissemination level		
☒Department / Faculty	☐Local	☐National
☒Institution	☐Regional	☐International

Disclaimer:

Table of Contents

1. Background

1.1 Vietnam aquaculture and fisheries (seafood) production

Vietnam has been listed among the top countries of fisheries and aquaculture producer in the world. This country was ranked as top 10th in total fisheries production, top 3rd in aquaculture production and top 5th in export value in 2015 (VASEP, 2016). The sector is estimated to contribute approximately 3.5% of the total GDP of Vietnam.

According to the report of the Directorate of Fisheries (2018), the total production of aquaculture and fisheries (or seafood) reached over 7.28 million MT, including 3.42 million MT of capture fishery and 3.86 million MT of aquaculture (counted for 53.0% of the total) (Figure 1); and the aquaculture farming area hit 1.1 million ha.

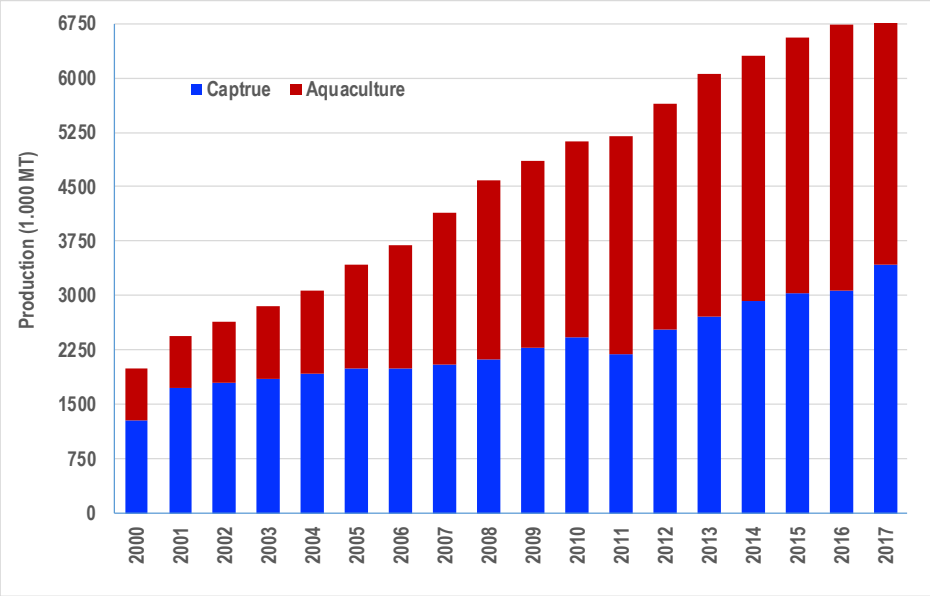

Figure 1. Vietnam seafood production (period: 2000 to 2017)

1.2 Seafood production sector in Vietnam: the case of aquaculture

The aquaculture sector in Viet Nam began with small scale extensive culture systems such as rice-cum-fish, livestock-cum-fish and earthen ponds in the early 1960s. The rapid growth the sector has achieved during the last two decades has been a direct result of the sector diversifying its farming practices and adapting to the production of exportable species at increased levels of intensification.

The culture systems are diversified according to national geographical and climatic conditions, the northern region is dominated by freshwater fish ponds, rice-cum-fish and marine cage culture; the central regions concentrate on the

intensive culture of black tiger shrimp (*Penaeus monodon*), white-leg shrimp (*Penaeus vannamei*), the marine cage culture of finfish (groupers and seabass) and lobster; and the southern part of the country has the most diversified farming activities that include pond and cage culture of catfish, tilapia, as well as several indigenous species, different intensification levels of black tiger shrimp culture, intensive high-tech culture of white-leg shrimp, integrated/alternative culture of rice and black tiger shrimp, giant freshwater prawn,...

In fact, the aquaculture sector began commercial production for export started in the early 1980s with the farming of the black tiger shrimp initially and with striped catfish in 2000s. A major motive towards expansion of aquaculture in Viet Nam was provided by the sharp increase experienced in the volume of aquaculture product being exported.

1.2.1 Shrimp production

Shrimp is a species with high production volume and export value. Vietnam has more than 721,000 ha of shrimp farming with two main species of black tiger shrimp and white-leg shrimp. The main culture area of shrimps is the Mekong River Delta. Top five provinces having largest shrimp farming area include Ca Mau, Bac Lieu, Soc Trang, Ben Tre and Kien Giang. Vietnam is the leading producer of black tiger shrimp in the world with a production of 250,000 MT in 2017 (Directorate of Fisheries, 2018). This is the traditional species in many past years. Besides, the while the white-leg shrimp has been cultivated in different part of the country since 2008, Its production reached 427,000 MT in 2017 (Directorate of Fisheries, 2018) (see Figure 2 for details).

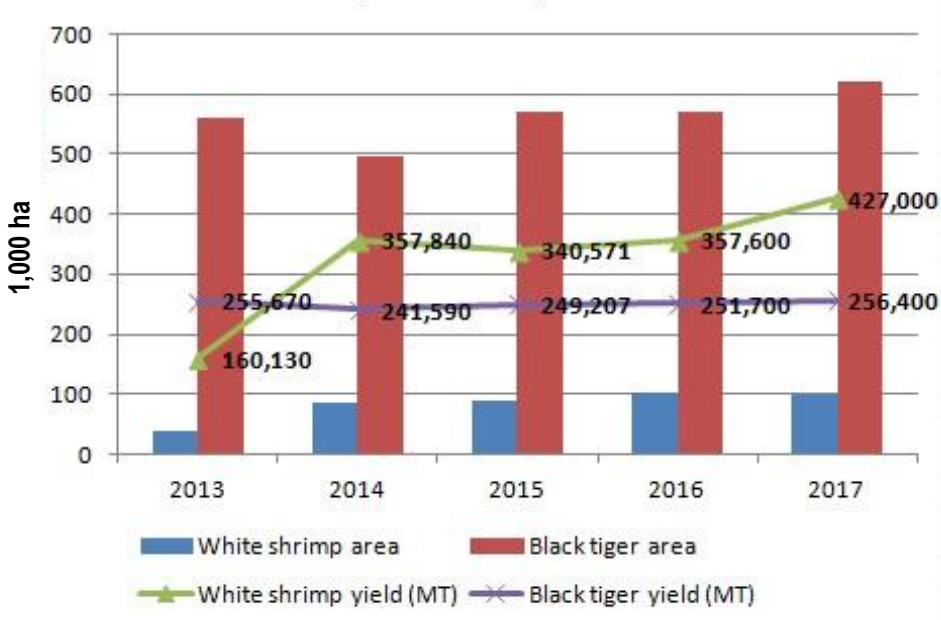

Figure 2. Vietnam shrimp area and production (period: 2013-2017)

The shrimp industry is taking its advantages and makes efforts to control the whole production chain from hatcheries - farms – to finished products under global certifications such as ASC, GlobalGAP, BAP,... Vietnam's shrimps are sold in 155 markets in the world; thanks to the high quality and social responsibility insurance. Shrimp export of the country reaches US$ 3.5 – 4 billion annually and shrimp is the top seafood exported by the country (Figure 3). Shrimp export in 2017 reported the breakthrough with the growth of 22.3% to reach over US$ 3.8 billion. In 2017, in the total of shrimp export products, white-leg shrimp shared a dominance with the proportion of 65.6%; black tiger shrimp accounted for 22.8%, and the remaining was others marine shrimp with 11.6% (VASEP, 2018).

In 2017, Vietnam imported shrimp from 39 countries with the value of US$ 495 million. India was the largest imported shrimp source of Vietnam with the value of US$ 334 million; accounting for 67.5% of total shrimp imports into Vietnam. Vietnam mainly imports white-leg shrimp, particularly live/fresh/frozen white shrimp (HS 03).

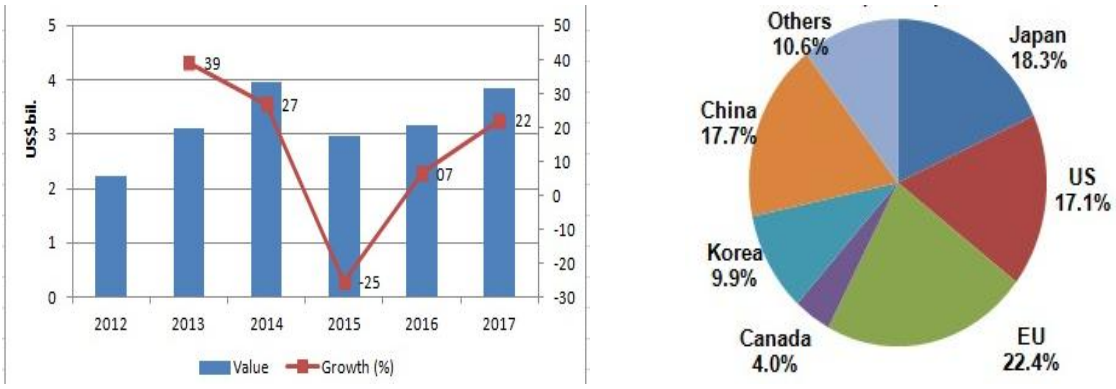

Figure 3. Vietnamese shrimp exports 2012-2017 (left) and export markets in value in 2017 (right)

1.2.2 Striped catfish

Striped catfish (tra catfish) sector has commercially produced from early 2000s. This species has been raising and developing mostly in 10 Mekong River Delta (MRD) provinces of Vietnam, including Can Tho city and An Giang, Dong Thap, Tien Giang, Vinh Long, Ben Tre, Hau Giang, Soc Trang, Tra Vinh, Kien Giang provinces. This fish has also started to grow in two other regions outside the MRD including Tay Ninh and Quang Nam provinces.

The total farming area of 5,227 ha and the production of 1.25 mil. MT (in 2017) (Directorate of Fisheries, 2017); and expected to rise up to 10,000 ha and production of 1.8-2.0 mil. MT in 2020 (Decree No. 1445/QD-TTg, 2013). Can Tho city and An Giang and Dong Thap provinces are main culture locations of striped catfish in the Mekong River Delta, account for over 75% of the total national striped catfish production. The striped catfish is farming in deep pond with very high level of intensification, and the productivity has extremely high that varies from 400 to 800 MT/ha/crop (Phuong *et al.,* 2016).

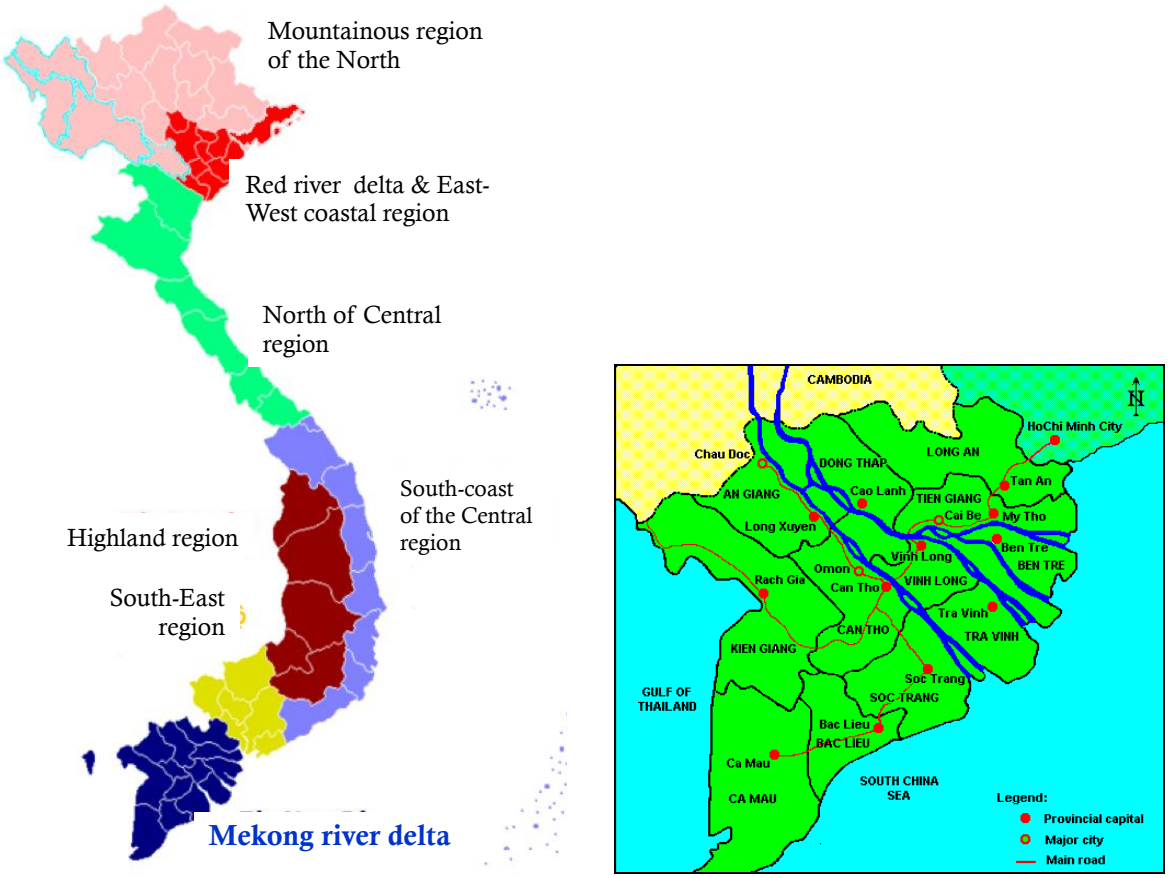

Figure 4: Map of Vietnam (left) and the Mekong River Delta (right) (Compiled by Phuong)

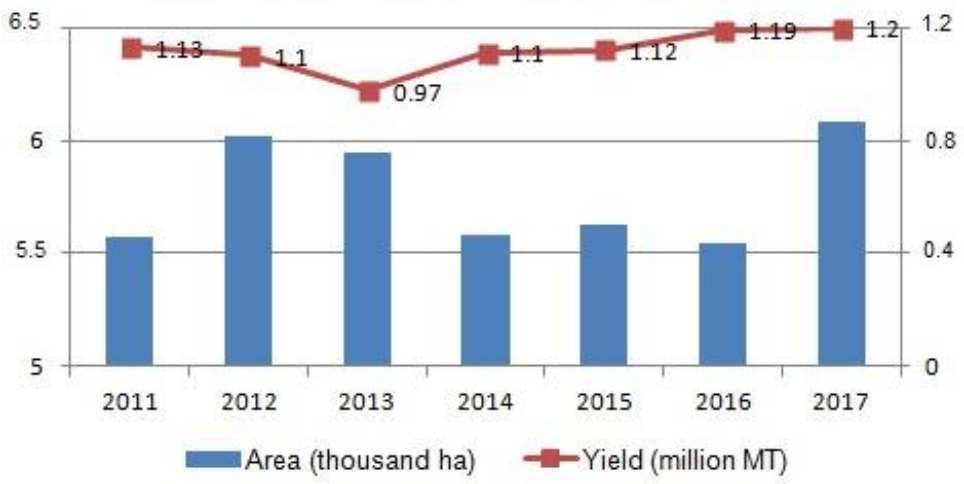

Figure 5. Striped catfish culture area and yield/production (period: 2011-2017) (VASEP, 2018)

Striped catfish industry is self-controlled in raw material sources toward sustainable production chain. Striped catfish products are produced in compliance with strict international food safety and international quality management standards such as GlobalGAP, ASC, BAP, *etc*. Pangasius is more and more popular in the world thanks its health and nutrition. The fish has been exported to 137 countries and territories in 2017, including demanding markets as the EU, Brazil, USA, Australia and Canada (Figure 5) (VASEP, 2018). There are nearly 100 pangasius factories in Vietnam. Mostly located in the Mekong River Delta. The majority of these factories are equipped with advanced equipment and technologies, which allow to be automating several stages of production line and producing added value products.

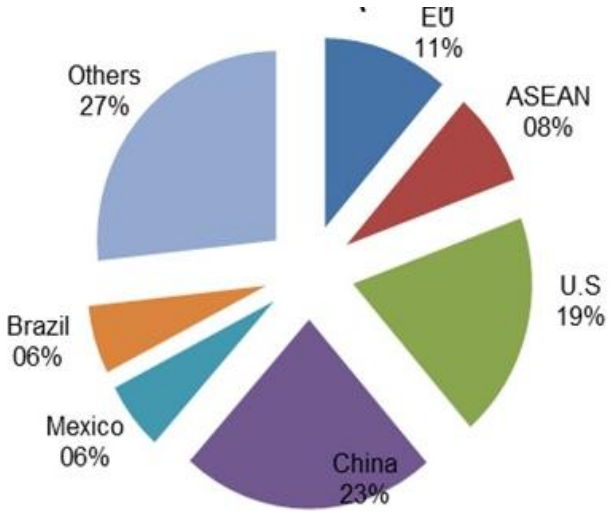

Figure 5. The export market of Vietnam's striped catfish in 2017 (VASEP, 2018)

1.2.3 Tilapia farming

Striped catfish and shrimps have known as two main production and export species of Vietnamese seafood sector. However, for the long-term development of the seafood industry, there has been to switch the focus to other species, especially tilapia (both red (*Orechromis spp*) and black tilapia (*Oreochromis niloticus*)). Tilapia is common species in Vietnam for many years, which has been farmed in ponds and cages. However, the development of this species is low or under its potential. Luckily, there has been a good progress of tilapia farming in Vietnam and export in recent years. The production of tilapia in Vietnam reached 25,748 ha, 1.2 million cubic meter of cages and 187,000 MT, of which 25,000 MT processed for export in 2015 (Directorate of Fisheries, 2015). Tilapia was planned to be one of top important culture species for export, which will reach 300,000 MT in 2020, of which 50-60% of the production for export (Decision No. 1639/QĐ-BNN-TCTS, dated on May 6, 2016). The total export value of tilapia was US$ 35.7 million in 2015 targeting major markets including the United States, Spain, Colombia, the Netherlands, Belgium, Germany, Mexico, the UK, the Czech Republic and Italy.

2. Challenges of the seafood industry

The seafood industry of Vietnam has been challenged with various arised problems, that include human resources, technical issues, trading competition and quality control, climate change impacts,.... However, strong or qualified human resources would be one of key factors contributing to over the problems.

2.1 Human resources

The total population in Vietnam was estimated at 93.7 million people which 23.1% working-age people involved in agriculture, forestry and fisheries in 2017 (Vietnam statistic, 2018). The fisheries sector is considered as one of Vietnam's key economic ones which creating around 9 million jobs for local workers; however around 80 percent of employees have not had enough high-tech skills (Seafood source, 2017).

In terms of quality, the human resources of Vietnam suffer from the following number of limitations and shortcomings such as *(i)* low level of technical and professional skills of the labor force - which is considered as a 'bottleneck'; *(ii)* low labor productivity; *(iii)* unskilled labors remains overwhelmingly popular; lack of experts, senior managers and technical workers in all industries and sectors, especially in key sectors and industries; and *(iv)* the human resource

structure is still inappropriate. The quality and efficiency of the education and training sector remains lower than required to achieve the goal of developing and improving the quality of human resources, especially with regard to higher education and vocational training. In recent years, educational institutions that having function of postgraduate training have been actively concentrating their energies on fundamental and comprehensive reform of education. This is the most important, significant strategic implication, related to human investment in the era of global integration, information and high technology.

2.2 Disease problems in aquaculture sector

Diseases in aquaculture production systems in Vietnam has been recognized as one of constraint factors in development. The intensification of culture systems such as shrimp, striped catfish, tilapia and others has shown a regular outbreak of diseases, which caused heavy losses, especially in shrimps striped catfish.

2.2.1 Diseases in shrimp

There have been common shrimp diseases in Vietnam as in shrimp farming of other countries. Major diseases have been found in shrimp farming in Vietnam are white spot syndrome virus (WSSV), yellow head disease (YHD), Monodon baculovirus (MBV), infectious Myonecrosis (IMN), Vibriosis (caused by various Vibrio bacteria). This disease reported outbreak in black tiger shrimp since 1999, but the first cause of mass mortality was in 2011 (Oanh and Phuong, 2012); and this WSSV has been a serious disease in recent years. Acute hepatopancreatic necrosis disease (AHPND) has been considered as a new emerging shrimp disease currently affecting brackish water shrimp aquaculture in Southeast Asia including Vietnam. It was first reported in 2010 among penaeid shrimps cultivated in the Mekong River Delta of Viet Nam albeit without any laboratory confirmation. The disease subsequently spread to a wide range of shrimp production areas in the same region. AHPND affected almost all shrimp production areas throughout the country with a total affected shrimp area of around 28,000 hectares in the year 2012. According to DAH (Department of Animal Health, 2014, 2015 and 2016) reported that although the shrimp culture areas affected by AHPND decreased significantly from 2012 to 2016, but the affected culture locations increased from 192 to 299 shrimp farming communes, respectively.

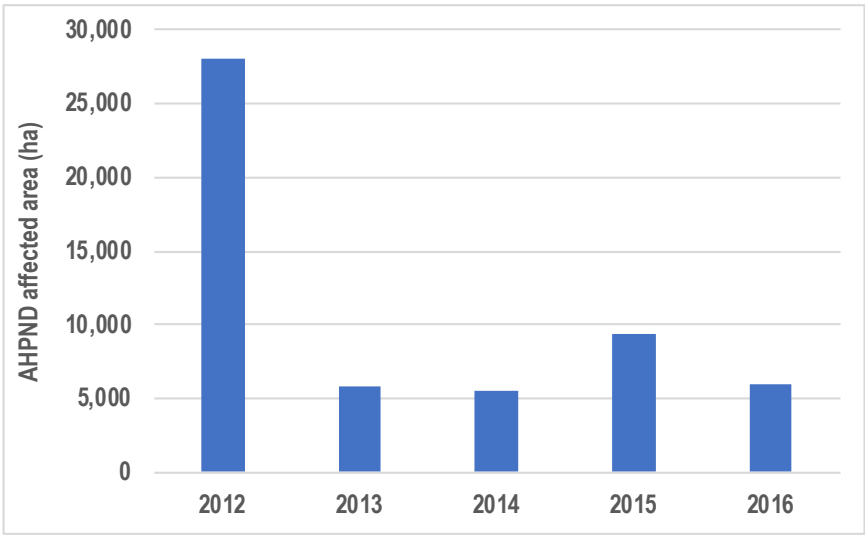

Figure 6. Spread of AHPND in Vietnam throughout years (Source: DAH reports 2014; 2015; 2016)

2.2.2 Diseases in striped catfish

Intensive production in open farming systems, *i.e.* sharing influent and effluent water sources and their use by several adjacent grow-out farms, is associated with frequent disease outbreaks and high mortality rates, mainly as a result of bacterial infection. Typical mortality rates are up to 30% from after stocking to the mid-production cycle and less than 10% in later months (Phan *et al.,* 2009). Bacillary necrosis of Pangasius (BNP) caused by *Edwardsiella ictaluri* is the most serious disease, causing acute mass mortalities of up to 60 % (Crumlish *et al.,* 2002; Phan *et al.,* 2009). Motile *Aeromonad septicaemia* (MAS) or haemorrhagic disease, caused by several opportunistic *Aeromonas* spp. (*A. hydrophila, A. sobria* and *A. caviae*), also causes significant losses (Ly *et al.,* 2009; Phan *et al.,* 2009). Furthermore, a number of endo- and ecto-parasite infections reduce growth and increase susceptibility to bacterial infections (Nguyen *et al.,* 2008; Phan *et al.,* 2009). Rapid progress is being made in developing vaccines for bacterial infections of striped catfish in Vietnam (Dung, 2011), *e.g.* a commercial BNP vaccine for injection has been approved by the Vietnamese authorities and was launched on the market in early 2013.

2.2.3 Disease in tilapia

Diseases in tilapia has not been reported as serious as diseases in striped catfish and shrimp. However, some common diseases have been outbreak in intensive culture of tilapia in cage and pond. According to Boerlage *et al*. (2017) the most common diseases/clinical signs/lesions that tilapia culture farmers reported in their survey were in descending order, hemorrhages, abnormal eyes,

Streptococcus-like clinical signs, abnormal liver or kidney, white spots (internally or externally), and gill and skin abnormalities. Disease caused by Streptococcus (or streptococcosis) has been reported by many researchers and farmers that is most serious disease causing large mortality of tilapia, especially in cage culture.

In recent years, Tilapia lake virus (TiLV) has been reported as a disease that could cause mortality from 10-90% of tilapia, especially in fingerling stage. The disease was invasive and circulating in Viet Nam. On the other hand, due to the new disease, the ability of farmers, traders to recognize TiLV is limited along with uncontrolled transport, leading to the outbreak of TiLV in the future, and have great impact on the production, rearing, consumption in-country and export of tilapia of Vietnam.

2.3 Certification and quality assurance

The rapid growth of the aquaculture industry has led to international concerns among retailers, authorities, various organizations and customers about its sustainability, *e.g.* negative environmental impacts, food safety, traceability. As a consequence, a number of certification standards have been introduced or have been being developed. Certification schemes have been applied in striped catfish, shrimp and tilapia farming in Vietnam to meet market demand and to guarantee the quality and safety of products, environmental impacts, social responsibility, and the traceability and transparency of production processes. These include GlobalGAP (Good Agriculture Practices), GAA-BAP (Global Aquaculture Alliance-Better Aquaculture Practices) and PAD-ASC (Pangasius Aquaculture Dialogue-Aquaculture Stewardship Council) standards (ASC, 2018; GAA-BAP, 2018; GlobalGAP, 2018).

Although certification makes a contribution towards the sustainability of the aquaculture industry, it also has significant limitations. The certified farms are mainly large-scale farms owned by processing and/or feed companies, whereas few small-scale farms have the necessary capability or resources to become certified. In 2013, the VietGAP standard was developed, promoted and considered as a first step towards compliance with international certification standards (MARD, 2014). The requirements in VietGAP and other certification schemes are quite similar, but VietGAP's approval procedures are simpler and less costly and small-scale farmers can also receive training from local governmental extension services, e.g. on how to meet the requirements of fish health management that must include consultations by a trained veterinarian. Both the VietGap aquaculture standards and Better Management Practices (BMP)

will help improve the management capability of small-scale farmers to ensure that chemicals are used prudently and therefore reducing any contamination risks in processed and exported products (Phan *et al*., 2009).

2.4 Drug and chemical use in aquaculture and food safety

The Vietnamese aquaculture production has intensified rapidly through the adoption of technological advances, and the use of a wide array of chemical and biological products to control sediment and water quality and to treat and prevent disease outbreaks. The use of chemicals in aquaculture farms has raised food safety and environmental concerns. The study of Rico *et al*. (2013) has shown that a wide range of drug and chemical has been used in intensive production systems such as marine shrimps (e.g. black tiger and white-leg shrimps), striped catfish, tilapia, and others.

Food safety has been a highlighted issue in seafood export of Vietnam. Food quality requirement (especially, drug and chemical residue limits) of imported markets such as EU, USA, Japan,... has challenged the industry.

Table 1: Antimicrobial, chemical and microbial residues notifications by imported markets (2013 to Aug. 2016) (unpublished data)

Market	2013	2014	2015	August, 2016
EU	1	26	7	5
Japan	28	22	31	13
Korea	1	1	2	3
Australia	0	0	4	1
Total	30	49	44	22

2.5 Climate change and global warming

Vietnam is projected to be heavily affected by climate change (IPCC, 2007; 2013), especially the Mekong River Delta located in the Southern part. Responding to these climate change impacts, the Vietnamese government issued the Decree No.158/1999/QD-TTg in 2008 on the approval of national target program on climate change adaptation for the period from 2009 to 2015. The increase of temperature, sea level raise and water acidity due to increase of CO_2 are the three main factors of concern with climate change. In the Southern part of Vietnam, the temperature is projected to be increased from present average of 27°C to 30°C and seawater level raise to 1 m causing salinity intrusion within the century. Very recently (beginning months of 2016), the MRD faced to serious

problem of drought and saline water intrusion deeply into inland areas caused great damage to 160.000 ha of rice production areas (http://www.tongcucthuyloi.gov.vn/, accessed on March 24th, 2016), which has been recognized as the impacts of El Nino and climate change.

Thus, maintaining the healthy development and adaptation of the aquaculture sector of the MRD to the increased salinity of freshwater areas and elevated temperature is of crucial importance to the region. The impacts of the increased temperature and salinity can be forecasted such as on (i) the biology, physiology, feed and feeding habit of the aquatic animals; (ii) pathogens transmitting and disease outbreaks; (iii) characteristics of aquatic ecosystem and pond environment; and (iv) production and profitability of the aquaculture systems. Moreover, the climate change can impact on the marine environment, capture fisheries and coastal social-economic as well.

3. Objectives

The main aim of this study is to survey and identify the existing postgraduate training programs (focusing on Master level) of higher educational institutions (HEI) in Vietnam on aquaculture and fisheries food security, as well as similar lifelong-learning/VET training programs. Additionally, there will be an assessment of the employment needs of aquaculture and fisheries industry for acquiring graduates from the project proposed MSc program. In this way, the project will be in a position to better assess the availability of existing courses and labor needs in the region and thereby create a truly new and innovative MSc program that will apply know-how, best practices and processes from European HEIs thus filling the gap and addressing the regions academic needs and needs in specialized personnel.

4. Methodology

The master programs on aquaculture, food technology and post-harvest technology from five universities in Vietnam including Can Tho University (CTU) and Nong Lam University (NLU) in the South; Nha Trang University (NTU) and Hue University of Agriculture and Forestry (HUAF) in the Central; and Vietnam National University of Agriculture (VNUA) in the North of Vietnam were collected through websites and/or communication by phone or emails. Syllabi/courses within each program were compared to identify the similarities. Special syllabus/courses serviced for the topic sustainable seafood and nutrition security were also looked for. Meeting of stakeholders from private sector, students and lecturers were organized to collect the needs for further established

syllabus. The meetings were organized in College of Aquaculture and Fisheries, Can Tho University on 27 June 2018 with 14 participants; in Faculty of Fisheries, Nong Lam University, Ho Chi Minh City with 17 participants; and in Research Institute for Aquaculture No.1, Bac Ninh, Vietnam with 19 participants. Details of meeting from the three institutions are provided in Annex 1 including information of participants, presentations and outcomes of the meetings

5. Results

5.1 Aquaculture master programs in Vietnam

Six aquaculture MSc programs were collected from five universities located in the South (CTU and NLU), in the Central (NTU and HUAF) and in the North of Vietnam (VNUA) (Table 1). These Universities presented as the dominated and top universities in Vietnam for aquaculture education.

In general, all of programs are designed as four sections such as general compulsory courses, fundamental and advanced compulsory courses, fundamental and advanced optional courses, and thesis. General courses commonly included Philosophy (3 ETC) and research methodology (2 ETC) or English (2 ETC) or other courses. Can Tho University has offered two MSc program in Aquaculture, one taught in Vietnamese and one taught in English which international students can enroll, running since 2016. Can Tho University and University of Agriculture and Forestry-HUE have divided compulsory and optional courses into fundamental and advanced courses. All of programs request student to do a small research considered as “Thesis” with ETCs ranged from 9 to 15. It is noted that one ETC is accounted for 15 “working-hours”, one “hour” refers as 45-50 minutes.

Common compulsory courses for Aquaculture MSc program included Scientific research methodology (5/6); Feed and nutrition in aquaculture (6/6); Physiology of aquatic organisms (5/6); Water quality management in aquaculture systems (6/6); Fish health management / Diseases of Aquatic Organism (6/6) and one program offer Disease outbreak management course; Aquaculture genetics (6/6); aquaculture production or aquaculture system or advanced aquaculture in both fresh and saline water (6/6), Field trip on practical aquaculture (5/6) (Annex 2). Other compulsory courses are diverse depending on the institutions where the aquaculture activities is dominated or institution capacity.

Table 1. Master's degree of Aquaculture Programs in Vietnam

No	University	General courses (ETC)	Compulsory courses (ETC)	Optional courses (ETC)	Thesis
1	Can Tho University[a]	15[d]	32	18/28	15
2	Can Tho University	5[e]	9+18[b]	8/16+ 10/20[c]	10
3	Hue University of Agriculture and Forestry	3 ETC of Philosophy	15+14	10/14+ 20/30	15
4	Nong Lam University	5[e]	19	12/23	9
5	Vietnam National University of Agriculture	5 ETC Philosophy+ English	27	16/39	12
6	Nha Trang University	7 ETC Philosophy+ Others (4)	18	12/24	10

[a]: courses in the program are taught in English, remaining programs are taught in Vietnamese
[b]: presented as fundamental courses + advanced courses with the compulsory courses
[c]: presented as fundamental courses + advanced courses with the optional courses
[d]: compulsory English course
[e]: Philosophy (3 ETC) + Research Methodology (2 ETC)

Optional courses within the aquaculture MSc program are presented in Annex 3. Aquatic resources management (5/6)[1], Aquaculture wetland ecosystem (5/6), Applied immunology in aquaculture/Immunology and vaccine (4/6), Application of GIS in aquaculture (4/6), Planning for aquaculture development (4/6) are the most common courses for student to select. Other courses, for example, Applied biotechnology in aquaculture (3/6), Environmental impact assessment on Aquaculture (3/6), Fisheries project management (3/6), Seaweed aquaculture (3/6), Technology of fisheries products processing (3/6), Food safety and hygiene of aquaculture products (3/6), Applied microbiology in aquaculture (3/6), live feed (3/6) are also key courses for the MSc optional courses.

5.2 Food technology master program

Table 2 presents the summary of master program of Food technology in Vietnam, of which five programs on food technology (No. 1 to 5) and one program on aquatic products processing technology (No. 6). Similar to aquaculture master

[1] 5/6: indicating 5 univesities offer course out of 6 universities surveyed

programs, the obtained programs here represent for the whole of food technology education in Vietnam. It is clear to see the big difference in the structure of master programs of food technology that is high variation in total credits of each of program. Sixty credits for master program is minimum credit indicated in the regulation of the Ministry of Education and Training (Circular No. 15/2014/TT-BGDĐT, dated on 15/5/2015)

Table 2. Master's degree of Food Technology Programs in Vietnam

No	University	Compulsory Courses (ETC)	Optional courses (ETC)	Thesis	Total
1	Vietnam National University of Agriculture	30	18/41	12	60
2	Can Tho University	17 + 15[b]	4/8+ 14/17[c]	10	60
3	Nong Lam University	24	12/33	10	46
4	Hue university of Agriculture and Forestry	15+22	10/14+ 12/14	15	74
5	Nha Trang University	11+18	4/8+ 12/22	15	60
6	Nha Trang University[a]	11+18	4/8+ 12/20	15	60

[a]: presented for MSc program of Aquatic product processing technology

[b]: presented as fundamental courses + advanced courses within the compulsory courses

[c]: presented as fundamental courses + advanced courses within the optional courses

From the compulsory courses and optional courses of the MSc Food technology programs, few courses focus in seafood production due to the wide range of courses in different food commodities (Annex 4). Philosophy is the mandatory course for all of program in aquaculture. English is requested in 4/6 programs. Biochemistry and advanced food biotechnology (4/6), Advanced food microorganism (4/6) and Analysis of food contaminants/Modern techniques applied in food quality assessment (5/6) are courses offered by most of program for quality assurance of food products. Student practice in food processing plant/field visit is mandatory course NTU Trang university related to seafood, On-board fish handling and preservation technology, and Management and by-product utilization in seafood industry.

For optional courses, Agriculture products quality analysis or Food safety management are proposed in all of programs. Nutrition security or Human

nutrition course is given in the three programs of CTU, NLU and HUAF. Aside with courses offered by NTU in aquatic product processing program, VNUA offers an course on Technology of harvest, preservation and processing of seafood products and NLU provide a course entitled Advanced technology of edible fats and oils

5.3 Post-harvest Technology MSc program

Table 3 presents the summary of master program of Post-harvest technology in Vietnam. Similar to above mentioned programs, the obtained programs represent for the three regions of Vietnam, the North of Vietnam (VNUA), the South (CTU), and the Central (NTU). It shows a significant difference in the structure of master programs of Post-harvest technology in term of courses (Annex 5).

Table 3. Master's degree of Post-harvest technology Programs in Vietnam

No	University	Compulsory Courses (ETC)	Optional courses (ETC)	Thesis	Total
1	Vietnam National University of Agriculture	30	18/40	12	60
2	Can Tho University	17+18[a]	8/12+ 10/12[b]	10	61
3	Nha Trang University	11+18	4/8+ 12/22	15	60

[a]: presented as fundamental courses + advanced courses within the compulsory courses
[b]: presented as fundamental courses + advanced courses within the optional courses

Within the compulsory courses, philosophy and English are requested. Scientific research, Cereal and bean post-harvest technology, Advanced fruit and vegetable post-harvest technology, Supply chain management for food and agricultural products, and Internship are courses provided by 2 out 3 programs. For optional courses, Advanced agricultural products package, Agriculture products quality analysis/management, Disease management in agriculture products post-harvest, Agriculture products Marketing, Pre-harvest Handing Techniques of Agricultural Products are also provided by 2 out 3 programs. The remaining courses are solely provided by each of programs, which can be explained by the needs where agriculture production is different among the three regions. There are few or no courses offered with topic related to aquaculture products.

Interestingly, 6/9 compulsory courses and 7/11 optional courses offered by NTU within the Food Technology and Post-harvest technology programs are the same.

5.4 Meetings with stake holders

Meetings with stakeholders including lecturer, private sectors and students presented significant outputs with details described in Annex 1, highlighted as follows:

- The food safety issue is got concerned and risk assessment is proposed including chemical and microbials contamination risks.
- Education for farmers, technicians and chemical sellers are needed to presented proper use of chemical and antimicrobials in aquaculture.
- VLE training is highly necessary because the workers, technicians, managers, *etc.* need new knowledge and updates. In addition, online courses could help them to approach the course easily and anywhere.
- Many participants agreed that the graduated students are strong in aquaculture knowledge, but other skills like on-farm working, independent working, communication, presentation, argument, leader, *etc.* need to be improved.
- One of the weakness of graduates is their English proficiency that need to be improved in the training program.
- The master students are also requested to have an in-depth study to solve a problem solely and to organize a team to do it practically.
- The companies are willing to offer internship opportunities for aquaculture students (bachelor and master levels). The internship periods should be extended for master program.
- The lecturers also noted block grade the current courses and proposed new courses with attention of training capacity. The linked between related courses into one module is also proposed (module or block).
- The support from EU side on building master courses and training teaching staff members of Asian institution partners are also requested, *e.g.* policy on aquaculture production management, food safety laws and regulations in EU, food safety monitoring and management,...
- It is agreeable that establishing a “Sustainable Seafood Center” is essential for the Vietnamese institutions to support their training activities and then research and innovation. Its functions would include providing short

courses based on market request; promoting collaboration with potential partners in conducting research and training; providing services in testing products such as chemical, feed, and so on.

6. General Discussions

Screening courses offered by different universities in Vietnam related to seafood production and processing revealed that the Master programs in Aquaculture have more courses related to seafood production if compared to Master program in Food technology and Master program in Postharvest Technology. Courses provided within the Master programs in Aquaculture basically focused on Scientific research methodology, Fish nutrition, Fish physiology, Aquaculture production technology, Fish health management/Aquatic animal diseases, and Internship/Field trip. The other courses provided optionally such as Aquatic resources management, Aquaculture wetland Ecosystem, Applied immunology in aquaculture/Immunology and vaccine, Application of GIS in aquaculture, Planning for Aquaculture development are key courses.

With the aim of the project to create a truly new and innovative courses that can incorporated into current master programs of Asian partners institutions or even new Master program that will apply know-how, best practices and processes from European HEIs thus filling the gap and addressing the regions academic needs and needs in specialized personnel, the proposed courses are presented in Table 4.

Table 4. Proposed courses for the SSNS

Can Tho University		
For Aquaculture Bachelor Courses	For Aquaculture Master Courses	Food Seafood Processing Master program
1) Aquaculture and fisheries industry context 2) Personal skills development 3) ...	1) Seafood safety and quality control 2) Seafood and human nutrition 3) Ethical issues in aquaculture production 4) Aquaculture and the environment 5) Risk management in	1) Quantifying food risks/analytical methods for food risk elements 2) Int'l food safety laws and regulations 3) Seafood and human nutrition 4) Risk management in food supply chain

	food supply chain 6) Aquaculture certification 7) ...	5) ...
Nong Lam University, HCMC		
1) Introduction to value chain of aquatic products 2) Personal skills development: communication skills, teamwork, time management skills, self-motivation, leadership skills, negotiation, problem solving skills … 3) ...	1) Safety of aquatic products raw materials (certificates for aquaculture+policies) 2) Value chain of aquatic products 3) Organic aquaculture 4) Ecologically sustainable food systems (module) 5) ...	1) Risk assessment of aquatic products 2) Value chain of aquatic products 3) Food and nutrition Security and Policy (module) 4) Biosecurity for aquaculture and food products (module) 5) ...
Research Institute for Aquaculture No.1: Under regulations of the Ministry of Education and Training (MOET), RIA1 is currently not allowed to offer any MSc programs.		

For vocational education training (VET) courses, available courses and proposed courses are presented in Table 5.

Table 5. Vocational education training courses in institutions in Vietnam

Can Tho University	
Available Courses	1) Fish, shrimp, prawn and crab seed production (module for each topic) 2) Diagnosis of fish and shrimp diseases 3) Fish nutrition 4) Water quality analysis 5) ...
Proposed Coursed	1) Seafood safety, hygiene and quality control 2) Seafood safety rule and regulation in international markets (EU)

	3) Analytical methods for food risk elements 4) Seafood and human nutrition 5) Seafood products reservation 6) Aquaculture citification 7) ...
Nong Lam University, HCMC	
Available Courses	1) Aquatic animal disease diagnosis 2) Aquatic animal seed production 3) Water quality analysis for aquaculture 4) Fish Nutrition 5) .....
Proposed Coursed (based on the demands of entrepreneur)	1) Aquaculture: basic knowledge (trainee: different specialty+worker) + updated techniques 2) Aquatic products processing: updated techniques 3) Aquatic products and Food safety and hygiene 4) Disease diagnostic laboratory techniques: updates (for entrepreneur technicians) 5) Disease analysis for fish and shrimp: for entrepreneur personnel 6) Marketing ....
Research Institute for Aquaculture No.1	
Available Courses	1) Cage aquaculture; 2) Aquatic animal disease; 3) Live feed production for marine hatcheries; 4) Fish disease diagnosis and control; 5) Integrated aquaculture and polyculture; 6) Seed production and grow-out for tilapia; 7) Algal aquaculture; 8) Aquaculture production; 9) Cobia (*Rachycentron canadum*) aquaculture; 10) Orange-spoted grouper (*Epinephelus coioides*) aquaculture; 11) Biological safety of modern, large-volume marine

	fish farming; 12) Bio-security and fish health management in modern fish farm; 13) Establishing a modern marine fish farm; 14) Marine fish nursing and culture techniques; 15) Cage and net installation and management in a modern fish farm; 16) Fish cage aquaculture study tour in Vietnam (for foreigners); 17) Marine and coastal aquaculture study tour in Vietnam (for foreigners);
Proposed Coursed	1) Seafood safety and quality control; 2) Biosecurity in aquaculture; 3) Aquatic animal disease prevention and control/management; 4) Breeding technology in aquaculture.

Coming up with equipment, it is required equipment for on-site trainings, *e.g*. quick check water quality equipment (pH, oxygen, conductivity, salinometer,...). Also, small lab equipment is also required for SSNS center where we do the primary sample treatment and analysis. Computer, printer and other teaching utensils are also needed.

7. Conclusions

Generally, Universities in Vietnam provided diversified courses for training program in aquaculture production. A list of existing courses is required for SSNS program can be listed as

a) Compulsory courses

1) Scientific research methodology
2) Feed and nutrition in aquaculture
3) Physiology of aquatic organisms
4) Water quality management in aquaculture systems
5) Fish health management / Diseases of Aquatic Organism/ Disease outbreak management
6) Aquaculture genetics

7) Aquaculture production or aquaculture system or advanced aquaculture in both fresh and saline water.
8) Field trip on practical aquaculture

b) Optional courses

9) Aquatic resources management
10) Aquaculture wetland ecosystem
11) Applied immunology in aquaculture and vaccine
12) Application of GIS in aquaculture
13) Planning for aquaculture development
14) Applied biotechnology in aquaculture
15) Environmental impact assessment on aquaculture
16) Fisheries project management
17) Seaweed aquaculture
18) Technology of fisheries products processing
19) Applied microbiology in aquaculture
20) Live feed production (3/6)
21) ..

It is noted that the field trip or internship would be prioritized with at least two months in-depth working with company, farm or other stakeholders. The new courses proposed for SSNS could be listed as

1) Seafood safety and quality control
2) Seafood and human nutrition
3) Ethical issues in aquaculture production
4) Aquaculture and the environment
5) Quantifying food risks/analytical methods for food risk elements
6) Int'l food safety laws and regulations in international markets (EU)
7) Aquaculture certification
8) Value chain of aquatic products
9) Organic aquaculture
10) Ecologically sustainable food systems (module)
11) Food and Nutrition Security and Policy (module)
12) Biosecurity for Aquaculture and Food Products (module)
13) ...

For Vocational Training Courses, universities and institutions in Vietnam provided diversified courses with the requested from the stakeholders, see Table 5. However, proposed VET courses could be included

1) Aquatic products and Food safety and hygiene
2) Quantifying food risks/analytical methods for food risk elements
3) Seafood and human nutrition
4) Aquaculture: basic knowledge (trainee: different specialty + worker) + updated techniques
5) Aquatic products processing: updated techniques
6) Disease diagnostic laboratory techniques: updates (for entrepreneur technicians)
7) Disease analysis for fish and shrimp: for entrepreneur personnel
8) Marketing
9) Biosecurity in aquaculture;
10) Aquatic animal disease prevention and control/management;
11) Breeding technology in aquaculture.
12) Aquaculture certification

8. References

ASC, Aquaculture Stewardship Council. 2018. Certifying environmentally and socially responsible seafood. Accessed date: June 4th, 2018. Available at https://www.asc-aqua.org/?iids=258&lng=1

BAP, Best Aquaculture Practices Certification. 2014. Integrity In Certification Standards Development. Accessed date: June 4th, 2018. Available at https://www.bapcertification.org/Standards

Boerlage, A.S., Dung, T.T., Hoa, T.T.T., Davidson, J., Stryhn, H., Hammell, K.L., 2017. Production of red tilapia (Oreochromis spp.) in floating cages in the Mekong Delta, Vietnam: mortality and health management. Dis Aquat Org 124:131-144. https://doi.org/10.3354/dao03115

Circular No. 15/2014/TT-BGDĐT, dated on 15/5/2015. Issuing the regulation for master training program

Crumlish, M., Dung, T.T., Turnbull, J.F., Ngoc, N.T.N., Ferguson, H.W., 2002. Identification of *Edwardsiella ictaluri* from diseased freshwater catfish, *Pangasius hypophthalmus* (Sauvage), cultured in the Mekong Delta, Vietnam. J. Fish. Dis. 25, 733-736.

Decision No. 1445/QD-TTg, dated on 16/8/2013. Approval of the aquaculture development of upto 2020 and vision for 2030

Decision No. 1639/QĐ-BNN-TCTS, dated on May 6, 2016. Approval of the development plan of tilapia culture upto 2020 and vision for 2030.

Department of Animal Health, 2016. Report summary of the workshop on the prevention of fish disease in 2016 and plan 2017.

Directorate of Fisheries, 2016. Results of aquaculture and fisheries implemented plan of the 2015 and tasks and solutions for 2016. 36 pages (in Vietnamese)

Dung, T.T., 2011. Trial on vaccine against 'Bacillus Necrosis Pangasius' (BNP) in grow-out Pangasius culture. Vietfish. International. 8 (4), 76-80.

GlobalGAP, Global Good Agriculture Practices. 2018. The GLOBALG.A.P. Aquaculture Standard. Accessed date: June 4th, 2018. Available at http://www.globalgap.org/uk_en/for-producers/aquaculture/

IPCC (Intergovernmental Panel on Climate Change), 2013. Working Group I Contribution to the IPCC Fifth Assessment Report. Climate Change 2013: The Physical Sciences Basis Summary for Policymakers. Cambridge, UK: Cambridge University Press.

Ly, T.T.L., Nguyen, D.N., Vo, H.P., Doan, C.V., 2009. Hemorrhage disease of cultured tra catfish (*Pangasianodon hypophthalmus*) in Mekong Delta (Viet Nam). Isr. J. Aquacult./Bamidgeh. 61 (3), 215-224.

MARD, Ministry of Agriculture and Rural Development of Vietnam. 2014. Decision No. 3824/QĐ-BNN-TCTS, dated September 6th, 2014 on release of Good Aquaculture Practice Vietnam, VietGAP (In Vietnamese). Accessed date: November 30th, 2014. Available at http://www.fistenet.gov.vn/vietgap-thuy-san/quyet-dinh-3824.pdf

MARD, Ministry of Agriculture and Rural Development, 2017. Prevention of new disease caused by tilapia lake virus in Vietnam. Report at the workshop.

Nguyen, T.T.H., Dang, T.M.T., Dang, T.H.O., Nguyen, T.P., 2008. Investigation on parasitic infection in tra catfish (*Pangasianodon hypophthalmus*) farming in An Giang province. Sci. J. Can Tho Uni. 1, 205- 213.

Oanh, D.T.H., Phuong, N.T.P., 2012. Serious diseases in marine shrimp and freshwater prawn farming in the Mekong. Can Tho University Journal of Science. No. 22c: 106-118

Phan, L.T., Bui, T.M., Nguyen, T.T.T., Gooley, G.J., Ingram, B.A., Nguyen, H.V., Nguyen, T.P., De Silva, S.S., 2009. Current status of farming practices of striped catfish,

Pangasianodon hypophthalmus in the Mekong Delta, Vietnam. Aquaculture. 296, 227-236.

Rico, A., Phu, T.M., Satapornvanit, K., Min, J., Shahabuddin, A.M., Henriksson, P.J., Murray, F.J., Little, D.C., Dalsgaard, A. and Van den Brink, P.J., 2013. Use of veterinary medicines, feed additives and probiotics in four major internationally traded aquaculture species farmed in Asia. Aquaculture. 412: 231-243.

Seafood Source, 2017. Vietnam boosts aquaculture training with Norwegian support. Available at https://www.seafoodsource.com/news/aquaculture/vietnam-boosts-aquaculture-training-with-norwegian-support

VASEP, 2016. Report of seafood export 2015. 75 pages

VASEP, 2018. Key seafood sectors. Available at http://seafood.vasep.com.vn/617/seafood.htm

Vietnam statistic, 2018. Vietnam social-economic in 2017. Available at http://www.gso.gov.vn/default.aspx?tabid=382&idmid=&ItemID=18667

Annex 1. Meeting with stakeholders

Annex 1a: Report on stakeholder meeting orginized by the College of Aquaculture and Fisheries, Can Tho University

Meeting: Re-structure and/or improve the current MSc programs related to aquatic animal production in Vietnam to meet the needs of the employment market	
Date	Wednesday, 27/06/2018
Time	13:30 – 17:00
Place	Meeting Room of College of Aquaculture and Fisheries, Can Tho University
Chairperson	Prof Nguyen Thanh Phuong, project manager of the SSNS project in Can Tho University, Can Tho City, Vietnam

Executive Summary

The SSNS Project Vietnamese partner, College of Aquaculture and Fisheries, Can Tho University hosted a meeting on re-structuring and/or improving the current MSc education programs in aquatic animal production to meet the needs of the employment market. The purpose of this meeting was to hold a discussion about issues relating the current MSc curriculum, and proposing appropriate strategies to structure a new MSc program, focusing on sustainable seafood and nutrition security.

This report summarizes meeting discussions on Wednesday, June 26, 2018.

Meeting Overview

Raised issues and purposes

Issues raised by the host: by raising the following issues, the host expected to receive answers, comments and suggestions from participants in order to propose appropriate strategies to structure a new MSc program, propose course for SSNS project

1) What are the needs for "sustainable seafood and nutrition security" in term of education?
2) What are comments for the current education program for the "sustainable seafood and nutrition security"
3) How the company evaluates the graduates in terms of their knowledge, skills and attitude?
4) What knowledge, skills and attitude of the graduates that the company needs an improvement via the new MSc program?

5) Do VLE is important for education in the future?

6) What are the requests from the EU side?

7) Open discussion

Purpose: The purpose of the meeting was to discuss the current MSc education programs related to aquatic animal production being offered by the College of Aquaculture and Fisheries, Can Tho University and other universities and to propose strategies on how to re-structure and/or improve it to meet the needs of the employment market.

Meeting materials
• **Meeting agenda:** The meeting agenda is included in Appendix A. • **Participant list:** A list of all meeting participants is included in Appendix B.

Meeting Speech, Presentations and Discussions		
Speech	Speaker	Facilitator
1. Welcome speech and participant introduction 2. Introduction of SSNS project 3. Review of MSc curriculum related to aquatic animal production in Vietnam	Prof. NT Phuong Prof. NT Phuong Dr. TM Phu	
Discussion and outputs	Speaker	Facilitator
To discuss the current MSc programs related to aquatic animal production being offered by Can Tho University and other universities in Vietnam and to propose strategies on how to re-structure and/or improve it to meet the needs of the employment market	Meeting participants	Prof. NT Phuong

1- Key outputs are as following:

2- Participants contributed to the food safety aspect as it is hot issue now in Vietnam. The risk assessment is proposed including chemical and microbials contamination risks. Education for farmers, technicians and chemical sellers are needed to presented proper use of chemical and antimicrobials in aquaculture.

3- VLE training is necessary according to participants because the workers, technicians are need new knowledge and updates. They do not have much time thus online learning is suitable for them.

4- The available e-learning in CTU have not been widely used efficiency, it should be

promoted for MSc education.

5- Many participants agreed that the graduated students are strong in aquaculture knowledge, but other skills like on-farm working, working independently, communication, presentation, argument, leader, etc. need to be improved. Additionally, students need to be trained for their survival under high pressure working conditions. The employers highly evaluate graduates who are willing to learn, hard-working, and especially who follow working instructions. One of the weakness of graduates is their English proficiency that need to be improved in the training program. In general, students have to be practically trained more during studying period.

6- During the training program, MSc students need to be individually supervised by a lecturer for their own study strategies to meet their work expectations in the future. The MSc students are also requested to have an in-depth study during the studying period with expectation to solve a problem solely and to organize a team to do it practically.

7- The companies are willing to offer internship opportunities for aquaculture students. The key managers are also happy to contribute to the training program by giving talks in seminars in collaboration with the CTU.

8- The internship periods should be extended for MSc student.

9- Some courses and/or modules (especially in food security and sustainability, Food safety management, Business in aquaculture, Fish Nutrition and Human nutrition, Climate change and aquaculture adaptation, water environment in aquaculture, ethics in aquaculture and etc) are recommended to be added to the MSc program. Specific course's name will be decided later. The lecturer also noted to upgrade the current courses and proposed new courses with attention of training capacity. The linked between related courses into one module is also proposed.

10- The support from EU side on building MSc courses and training are also requested. Also, policy on aquaculture production management from

11- To attract more students to aquaculture programs, participants proposed to enhance the advertisement using high-tech technology, presenting the new technology in aquaculture activities.

In conclusion, the host of the meeting found these above outputs become highly valuable for the project to re-structure and improve the MSc programs and propose courses focusing sustainable seafood and nutrition security. The MSc program will be designed to meet the employers' requirement.

Appendices

Appendix A – Seminar agenda

13:30 – 13:45 **Welcome speech and participant introduction**

13:45 – 14:15 **Introduction of the SSNS project** (Prof. Nguyen Thanh Phuong)

14:15 – 14:45 **Review of MSc curriculum related to aquatic animal production in Vietnam** (Dr. Tran Minh Phu)

14:15 – 15:00 **Coffee break**

15:00 – 16:00 **Discussion**

Content: Re-structure and/or improve the current MSc curriculum of aquatic animal production to meet the needs of the employment market

(Chairperson: Prof. Nguyen Thanh Phuong; secretary: Dr. Tran Minh Phu)

17:00 **Dinner**

Appendix B – List of participants	Representative
1. Prof. Nguyen Thanh Phuong	– Lecturer – Can Tho University
2. Dr. Tran Minh Phu	– Lecturer – Can Tho University
3. Prof. Tran Ngoc Hai	– Lecturer – Can Tho University
4. Assoc Prof. Do Thi Thanh Huong	– Lecturer – Can Tho University
5. Assoc Prof. Pham Thanh Liem	– Lecturer – Can Tho University
6. Ms. Nguyen Le Anh Dao	– Lecturer – Can Tho University
7. Mr. Phan Cong Minh	– Manager, APC chemical company
8. Mr Phan Thanh Nha	– Regional Sale manager, UV Vietnam
9. Mr Nguyen Ba Quoc	– Viet Thang Feed company
10. Mr Vo Tuan Kiet	– Manager, Can Tho shrimp seed production company
11. Mr Ngo Anh Toan	– Manager, The Anh Tuan company
12. Ms Huynh Thi Kim Duyen	– MSc in Food Technology student (Course 2018)
13. Mr Nguyen Van Thom	– MSc in Food Technology student (Course 2018)
14. Mr Nguyen Vinh Tri	– MSc in Aquaculture student (Course 2017)

Submitted by Dr. Tran Minh Phu **Approved by** Prof. NT Phuong

Annex 1b: Reporting of seminar held at the Faculty of Fisheries, Nong Lam University, Ho Chi Minh city

SEMINAR: Re-structure and/or improve the current MSc in Aquaculture program to meet the needs of the employment market	
Date	Wednesday, 20/06/2018
Time	8:30 – 12:00
Place	Meeting Room of Faculty of Fisheries
Chairperson	Dr Nguyen Hoang Nam Kha, project manager of the SSNS project in Nong Lam University, Hochiminh City, Vietnam

Executive Summary

The SSNS Project Vietnamese partner (Faculty of Fisheries (FoF), Nong Lam Univesity, Ho Chi Minh City) hosted a seminar on re-structuring and/or improving the current MSc in Aquaculture to meet the needs of the employment market. The purpose of this seminar was to hold a discussion about issues relating the current MSc curriculum, and proposing appropriate strategies to structure a new MSc program, focusing on sustainable seafood and nutrition security.
This report summarizes seminar discussions on Wednesday, June 20, 2018.

Workshop Overview

Raised issues and purposes

Issues raised by the host: by raising the following issues, the host expected to receive answers, comments and suggestions from participants in order to propose appropriate strategies to structure a new MSc program

1) How many aquaculture-graduated staff would be employed by the company in the next 5/10/20 years?
2) How the company evaluates the graduates in terms of their knowledge, skills and attitude?
3) What knowledge, skills and attitude of the graduates that the company needs an improvement via the new MSc program?
4) How the employers could support and collaborate with FoF in their MSc program?
5) Which courses the current students expect to be improved/changed/modified? And how?
6) What courses should be added to the MSc program?
7) How a "Center of Excellences" should be established and operated? And what are its functions?
8) Open discussion

Purpose: The purpose of the seminar was to discuss the current MSc in Aquaculture program being offered by the Faculty of Fisheries, Nong Lam University- Ho Chi Minh City (FoF) and to propose strategies on how to re-structure and/or improve it to meet the needs of the employment market.

Seminar materials
• **Seminar agenda:** The seminar agenda is included in Appendix A. • **Participant list:** A list of all seminar participants is included in Appendix B.

Seminar Speech, Presentations and Discussions		
Speech	Speaker	Facilitator
Welcome speech and participant introduction	Dr. Nguyen Nhu Tri (Dean of Fisheries Faculty)	
Discussion and outputs	Speaker	Facilitator
To discuss the current MSc in Aquaculture program being offered by the Faculty of Fisheries, Nong Lam University- Ho Chi Minh City (FoF) and to propose strategies on how to re-structure and/or improve it to meet the needs of the employment market	Seminar participants	Dr Nguyen Hoang Nam Kha

Key outputs are as following:

12- Related companies found that there is a current shortage of trained labors in aquaculture field at university levels in the Vietnamese market, so they wonder where had the graduates gone? And in the next ten years, as their business expansion, they will employ a large number of aquaculture graduates, mostly bachelor degree and also master or higher levels.

13- Many participants agreed that the graduates are strong enough in aquaculture knowledge, but other skills like working independently, communication, presentation, argument, leader, etc. need to be improved. Additionally, students need to be trained for their survival under high pressure working conditions. The employers highly evaluate graduates who are willing to learn, hard-working, and especially who follow working instructions. One of the weakness of graduates is their English proficiency that need to be improved in the training program.

14- During the training program, MSc students need to be individually supervised by a lecturer for their own study strategies to meet their work expectations in the future.

15- The companies are willing to offer internship opportunities for aquaculture students. The key managers are also happy to contribute to the training program by giving talks in seminars in collaboration with the FoF.

16- Current courses are well fixed with the program objectives, however, it is agreed that lecturing and studying should use more English in order for students to improve their English proficiency.

17- Some courses and/or modules (especially in food security and sustainability, Biosecurity for Aquaculture and Food Products, Ecologically sustainable food systems, eco-risk assessment, environmental protection in aquaculture,) are recommended to be added to the MSc program. Specific course's name will be decided later.

18- It is agreed that establishing a "Sustainable Seafood Center" is essential for the FoF to support their training activities and then research and innovation. Its functions would include providing short courses based on market request; promoting collaboration with potential partners in conducting research and training; providing services in testing products such as chemical, feed, and so on. This Center will work in the self-support principle financially.

19- Current students suggested that the Center should offer short courses for graduates to update knowledge and information regarding new and advanced technology in aquaculture, and they are happy to pay for such courses.

In conclusion, the host of the seminar (FoF) found these above outputs will be highly valuable for them to re-structure and improve their MSc program in aquaculture focusing sustainable seafood and nutrition security. Soon after this seminar, the FoF will conduct a survey with more interviewees from all related sectors who employ aquaculture graduates, for a comprehensive information set. Then the MSc program will be designed to meet the employers' requirement.

Appendices

Appendix A – Seminar agenda

8:20 – 8:30 **Welcome speech and participant introduction**

8:30 – 8:50 **Introduction of the SSNS project** (Dr Nguyen Hoang Nam Kha)

8:50 – 9:10 **Raising the discussion issues** (Dr Nguyen Hoang Nam Kha)

9:10 – 9:30 **Coffee break**

9:30 – 12:00 **Discussion** (Chairperson: Dr Nguyen Hoang Nam Kha, Dr Nguyen Nhu Tri)

Content: Re-structure and/or improve the current MSc curriculum of Aquaculture to meet the needs of the employment market

12:00 **Lunch**

Appendix B – List of participants	Representative
1. Dr. Nguyen Nhu Tri	– Faculty of Fisheries – Nong Lam University
2. Dr. Nguyen Hoang Nam Kha	– Faculty of Fisheries – Nong Lam University
3. Dr. Nguyen Phuc Cam Tu	– Faculty of Fisheries – Nong Lam University
4. Dr. Nguyen Huu Thinh	– Faculty of Fisheries – Nong Lam University
5. Dr. Dinh The Nhan	– Faculty of Fisheries – Nong Lam University
6. Dr. Nguyen Van Trai	– Faculty of Fisheries – Nong Lam University

7. Dr. Vu Cam Luong	– Faculty of Fisheries – Nong Lam University
8. Mr Chang Gim Thye	– Vice General Director, Vinhthinh Biostadt
9. Mr Le Trung Viet	– Chief Customer Officer, Binh Minh JSC, Vinhthinh Biostadt
10. Mr Phuc	– Human Resources Manager, Vinhthinh Biostadt
11. Mr Nguyen Anh Ngoc	– CEO, The NAN Group
12. Mrs Nguyen Thi Hong Duyen	– MSc student (Course 2015)
13. Ms Huynh Thi Ngoc Huyen	– MSc student (Course 2015)
14. Mr Le Trong Nghia	– MSc student (Course 2016)
15. Mr Nguyen Phuong Thoai	– MSc student (Course 2017)
16. Mr Pham Minh Chau	– MSc student (Course 2017)
17. Ms Pham Tuyet Van	– MSc student (Course 2017)

Submitted by Dr Nguyen Van Trai **Approved by** Dr Nguyen Hoang Nam Kha

Annex 1c: Reporting of Consultation Workshop held at the Research Institute for Aquaculture No. 1 (RIA 1)

SEMINAR: Re-structure and/or improve the current MSc in Aquaculture program to meet the needs of the employment market	
Date	Friday, 29/06/2018
Time	9:00 – 16.:00
Place	Meeting Room of RIA 1
Chairperson	Dr Dang Thi Lua, project manager of the SSNS project in RIA 1, Bac Ninh, Vietnam

Executive Summary

The SSNS Project Vietnamese partner (RIA 1, Vietnam) hosted a seminar on re-structuring and/or improving the current MSc in Aquaculture and Food Technology to meet the needs of the employment market. The purpose of this seminar was to discuss about issues relating the current MSc curriculum, the gap, the reasons and solutions for the new MSc program relating to the sustainable seafood and nutrition security. The seminar is also the place for the company to share their expectations to the graduated students and the contents/requirement of training cources.

This report summarizes seminar discussions on Friday, June 29, 2018.

Workshop Overview

Raised issues and purposes

Issues raised by the host: by raising the following issues, the host expected to receive answers, comments and suggestions from participants in order to propose appropriate strategies to structure a new MSc program and training cources:

1. What is the current status of aquaculture/food technology education programs?
2. What is the recruiter/company/trainer's assessment of graduated students in term of knowledge, skills, attitudes?
3. What knowledge/skills should be reinforced/equipped for graduated students?
4. What subjects that students/employers expected to change/modify? (Aquaculture, Food technology)
5. What are the issues/courses should be focused on/added for the "Sustainable Nutrition and Sustainable Fisheries" education program?
6. What are the needs for “sustainable seafood and nutrition security” in term of education?
7. What are the subjects should be focused for the short course training?

8. Open discussion

Seminar materials
• **Seminar agenda:** The seminar agenda is included in Appendix A. • **Participant list:** A list of all seminar participants is included in Appendix B.

Seminar Speech, Presentations and Discussions		
Speech	Speaker	Facilitator
Welcome speech and participant introduction	Dr. Dang Thi Lua (Deputy Director of RIA 1- SSNS Project Manager in RIA 1)	
Discussion and outputs	Speaker	Facilitator
To discuss about issues relating the current MSc curriculum, the gap, the reasons and solution for the new MSc program and training courses relating to the sustainable seafood and nutrition security. to share their expectations of the company to the graduated students.	Seminar participants	Dr Dang Thi Lua

Key outputs are as following:

1- All participants agreed that the numbers of students enrolled to the aquaculture field is more and more decreased. This is because of hard working but low salary. Students nowadays prefer to study in modern technology fields (such as IT), marketing, financial accountants … in order to get jobs in cities rather than to study in aquaculture to get jobs in farms in countryside or isolated areas. This leads to the situation that the input requirements are low.

2- Almost the MSc. students were from the management units, not from the companies.

3- The companies found that there is a current shortage of trained labors in aquaculture field at university levels in the Vietnamese market. The quality of the graduated students could not meet with the work requirement. MSc students need to be individually supervised by a lecturer for their own study strategies to meet their work expectations in the future. The MSc students are also requested to have an in-depth study during the studying period with expectation to solve a problem solely and to organize a team to do it practically.

4- The companies suggested that the students should also be trained other skills like

working independently, communication, presentation, argument, leader, etc. Students need to be trained for their survival under high pressure working conditions. The employers highly evaluate graduates who are willing to learn, hard-working, and especially who follow working instructions.

5- Some courses and/or modules (especially in food security and sustainability, Biosecurity for Aquaculture and Food Products, eco-risk assessment, environmental protection in aquaculture,) are recommended to be added to the MSc program.
6- Participants agreed that there is a need of the company's involvement in building the training curricula.
7- It is agreed that establishing a "Sustainable Seafood Center/program" is essential for the RIA 1 to support their training activities and then research and innovation. Its functions would include providing short courses based on market request; promoting collaboration with potential partners in conducting research and training; providing services in testing products such as chemical, feed, and so on..
8- The companies are willing to offer internship opportunities for aquaculture students. The companies has annual budget for the staff's soft skill improvement. They suggested that RIA 1 should contact the companies and offer the continuing short training courses. Some of the courses should focus on disease diagnosis or hatchery management.
9- Participants contributed to the food safety aspect as it is hot issue now in Vietnam. The risk assessment is proposed including chemical and microbial contamination risks. Education for farmers, technicians and chemical sellers are needed to presented proper use of chemical and antimicrobials in aquaculture.
10- To attract more students to aquaculture programs, participants proposed to enhance the advertisement using high-tech technology, presenting the new technology in aquaculture activities.
11- To meet the requirement of "sustainable seafood and nutrition security", the new MSc program should be based on quality chain strategy from "the farms to the dishes/markets".

In conclusion, the host of the seminar (RIA 1) found these above outputs will be highly valuable for the Vietnamese partners to re-structure and improve the MSc program in aquaculture focusing sustainable seafood and nutrition security.

Appendices

Appendix A – Consultation workshop agenda

09:00 – 09:15 Registration
09:15 – 09:30 Welcome speech and participant introduction
09:30 – 10:20 Introduction of the SSNS project and the result of the survey of Msc. Program on sustainable seafood and nutrition security (Dr Dang Thi Lua)
09:30 – 10:30 Raising the discussion issues (Dr Dang Thi Lua)
10:30 – 10:45 Coffee break
10:45 – 11:30 Discussion (Chairperson: Dr Dang Thi Lua)
Content: Current situation, reasons and solution
Gap between the available curriculum and the demands
Internship program – requirements from the company to graduated students
11:30 – 13.30 Lunch
14.00 – 15.30 Discussion (Chairperson: Dr Dang Thi Lua)
Content: Current situation, reasons and solution
Gap between the available curriculum and the demands
Internship program – requirements from the company to graduated students
15.30 – 16.00 Closing and photo

Appendix B – List of participants	Representative
1. A/Prof. Kim Van Van	– Lecturer, Fisheries Faculty (VNUA)
2. Hoang Hai Ha	– Lecturer, Food Science Faculty, VNUA
3. Nguyen Thanh Hai	– Lecturer, Biotechnology Faculty VNUA
4. Nguyen Thuy Hang	– Master students, VNUA
5. Le Phi Hung	– Master students, VNUA
6. Ngo Thi Lanh	– Master students, VNUA
7. Hoang Thi Niem	– Master students, VNUA
8. Pham Thanh Do	– ASM- De Heus Company
9. Nguyen Huy Thong	– Director- Nguyen Huu Dev. & Investment Company
10. Pham Hong Nhat	– Researcher, Aqua. Biotechnology Center, RIA 1
11. Le Van Khoi	– Researcher, Aqua. Biotechnology Center, RIA 1
12. Nguyen Thi Thu Thuy	- Researcher, Aqua. Biotechnology Center, RIA1
13. Nguyen Dieu Phuong	- Researcher, Science Department, RIA 1
14. Truong Thi My Hanh	- Researcher, Environment and Disease Monitoring in Aquaculture Center, RIA 1
15. Kim Thi Thoa	- Researcher, Aquatic Biodiversity Center, RIA 1
16. Dang Thi Lua	- SSNS Project Manager, RIA 1
17. Vu Thi Ngoc Lien	- SSNS Project Trainer/Coordinator, RIA 1
18. Tran Thi Anh Nguyet	– SSNS Project Administration staff, RIA 1
19. Hoang Thu Thuy	– SSNS Project Administration staff, RIA 1

Submitted by	Vu Thi Ngoc Lien	**Approved by**	Dr Dang Thi Lua

Annex 2. Compulsory courses (ETC) within MSc Aquaculture programs

	CTU		NLU	HUAF	VNUA	NTU
Language	English	VN	VN	VN	VN	VN
Total Compulsory	**32**	**27**	**19**	**29**	**27**	**18**
Scientific research methodology	2	2	2	2	2	optional
Feed and nutrition in aquaculture	3	3	2	3	2	Physiology – Biochemistry Nutrition of Aquatic Animal, 2
Physiology of aquatic organisms	2	2	optional		2	
Water quality management in aquaculture systems	2	2	2	2	2	2
Fish health management / Diseases of Aquatic Organism	3	2	2	2+2, Disease outbreak management, 2 ETC	2	2
Aquaculture genetics	3	2	2	3	2	2
Fresh- and brackishwater aquaculture production		2+2	Aquaculture System, 2 ETC	Marine aquaculture production, 2 ETC and freshwater, 2 ETC	Aquaculture production, 2 ETC	Advanced Aquaculture, 2 ETC
Practical training on Aquaculture	3	3	Field trip, 2 ETC	-	Field trip, 2 ETC	Field trip, 2 ETC
General aspects of Aquaculture	2	2				
Applied statistics in aquaculture	2		2			

	CTU		NLU	HUAF	VNUA	NTU
Tropical Aquatic ecosystems	2				2	
Aquaculture system and management				2		
Recirculation Aquaculture Systems		2				
Advanced Tropical fish culture	2					
Advanced Tropical shellfish culture	2				2	
Crustacea aquaculture				2	2	
Applied biotechnology in Aquaculture	2					
Reproductive Endocrinology and Application in Aquaculture					2	2
Marine fish aquaculture and seed production			Aquatic seed production, 2 ETC		2	
Production and Value chains in aquaculture	2					
Semina/essay on fundamental aquaculture knowledge		2				
Semina/essay on advanced aquaculture		2				

	CTU		NLU	HUAF	VNUA	NTU
knowledge						
Proposal defense			1			
Internal thesis defense			1			
Applied immunology in aquaculture and vaccine				3		
Fisheries Resource						2

CTU: Can Tho University; NLU: Nong Lam University – Ho Chi Minh City; NTU: Nha Trang University; HUAF: University of Agriculture and Forestry-HUE; VNUA: Vietnam National University of Agriculture

Annex 3. Optional courses (ETC) within MSc Aquaculture programs

	CTU		NLU	HUAF	VNUA	NTU
Language	English	VN	VN	VN	VN	VN
Optional courses	**18/28**	**18/36**	**12/23**	**30/34**	**16/39**	**12/24**
Aquatic resources management	2	2	2	2	2	
Aquaculture wetland Ecosystem	2	2	Aquatic Animal Ecophysiology, 2		2	Fisheries Ecology, 2
Applied immunology in aquaculture/ Immunology and vaccine	2	2			2	2
Application of GIS in aquaculture	2	2	3	2		
Fish biology		2		Fish biodiversity, 2		Developmental Biology in Aquatic Animals, 2
Planning for Aquaculture development	2	2	2		2	
Applied biotechnology in Aquaculture			2		2	2
Environmental Impact Assessment on Aquaculture			2	2	2	
Fisheries project management		2		2	2	
Technology of fisheries products processing	2				2	Fresh Fish Quality Assurance, 2

	CTU		NLU	HUAF	VNUA	NTU
Planning and aquaculture system				2	2	
Seaweed aquaculture				2	2	2
Food safety and hygiene of aquaculture products	2	2		Toxic and chemical use in aquaculture, 2		
Applied Microbiology in aquaculture	2	2			2	
Reproductive Endocrinology and Application in Aquaculture			2	2		
Economic and marketing of Fisheries			2		2	
Genetic classification and population		2				
Water environment science		2	Aquaculture Wastewater Treatment, 2	Aquaculture Wastewater Treatment, 2		
Live feed				2	2	2
Broodstock quality				2	2	
Marine coastal management		2			2	
English in aquaculture		2				
Tropical aquaculture specialty	2					
Feed Additives in Aquaculture			2			
Internship			2			

	CTU		NLU	HUAF	VNUA	NTU
Artemia culture	2					
Bio-monitoring in the aquatic environments	2	2				
Aquatic toxicology	2	2				
Recirculation Aquaculture Systems	2					
Quality assurance in aquaculture production chain	2	2				
Shellfish aquaculture				2		
Aquaculture extension					2	
Advanced aquaculture					2	
Pharmacokinetic in aquaculture				2		
Advance epidemiology				2	2	
Parasite pathology in aquaculture					2	2
Infectious disease in aquaculture					2	
Climate change and environment					2	
Virus Pathology						2
Bacterial Pathology						2
Manufactured Feeds						2

	CTU		NLU	HUAF	VNUA	NTU
Aquaculture Experimental Design and Data Analysis						2

Annex 4. Food Technology MSc programs offered in Vietnam

No.	Courses	VNUA	CTU	NLU	HUAF	NTU	NTU *
		Food Technology					
	Compulsory courses	30	17+15	24	15+22	18+11	18+11
1.	Philosophy	3	3	3	3	3	3
2.	English	2	B1			8	8
3.	Biochemistry and advanced food biotechnology	2	3	2+3	3		
4.	Advanced food Microorganism	2	3	2	2		
5.	Analysis of food contaminants/ Modern Techniques Applied in Food Quality Assessment	2		Advance biochemical analysis, 3	Modern methods, 2	2	2
6.	Methods and skills of scientific research	2	2	2	Data analysis, 2		
7.	Advanced food processing technology	2	2	2	2		
8.	Bioactive compounds/ Extraction and Application of Bioactive Compounds				2	2	2
9.	Experimental design and advanced statistics	2	2	2			
10.	Student practice in food processing plant/Field visit		2	1	2	2	2
11.	Advanced Chemical and biology food safety	3					
12.	Nutrition quality of food	2					
13.	Changes of Food during Processing and Preservation					2	2
14.	Enzyme Technology and Its Application in Food Industry					2	2
15.	Advanced Food Packaging					2	2
16.	Food Industry	3					
17.	Supply chain management for food and agricultural products	3				2	2
18.	Quality management system of agricultural products	2					
19.	Heat transfer process technology		2		2		
20.	Principal of food processing		2				

No.	Courses	VNUA	CTU	NLU	HUAF	NTU	NTU
	technology						
21.	High temperature food processing		3				
22.	Low temperature food processing		3				
23.	Fermentation		3		2		
24.	Functional food		2		2		
25.	Physical Properties of Food Materials			2			
26.	Special seminar 1&2			2	3		
27.	Protein and protein product production				2		
28.	Food structure property				2		
29.	Toxicology in Food				2		
30.	Post-harvest technology in agriculture				2		
31.	On-board Fish Handling and Preservation Technology						2
32.	Management and By-product Utilization in Seafood Industry					2	2
33.	Starch raw material and product production				2		
34.	Sensory Science/Food Choice and Acceptability					2	
	Optional courses	18/41	4/8+14/17	12/33	10/14+10/14	4/8+12/22	4/8+12/20
1.	Advanced agricultural products package	2		2			
2.	Agriculture products quality analysis	3	Quality Management, 2	Food Quality Management, 3	Food quality standards, 2	Food safety Management 2	Food safety Management 2
3.	Grain and Bean Processing Technology	2					
4.	Advanced vegetable and fruit processing technology	2					
5.	Minimal vegetable processing technology	2					
6.	Advanced Food Technologies					2	2
7.	Livestock products preservation and processing Technology/advance meat processing	2		3			

No.	Courses	VNUA	CTU	NLU	HUAF	NTU	NTU
8.	Treatment of waste by-products in post-harvest technology	2			2		
9.	Cold storage technology/ Advanced Food Chilling and Freezing Engineering	2		3			
10.	Additives in food preservation	2		2			
11.	Advanced program and project management	2					
12.	Beverage technology	2					
13.	Heat Process Technology	2					
14.	Animal welfare/right	2					
15.	Plants products post harvest technology	2					
16.	Food sensory properties/ Sensory Science/Food Choice and Acceptability	2		3			2
17.	Technology of harvest, preservation and processing of seafood products	2					
18.	Agriculture products Marketing	2	2				
19.	Plants Quarantine	2					
20.	Food products design and development	2		2	2		
21.	Environmental toxicology and control	2					
22.	Advanced chemical analysis		2				
23.	Food Physical property		2				
24.	Food Rheological Properties					2	2
25.	Environmental Impact Assessment in Food Industry					2	2
26.	Optimization		2				
27.	Postharvest Technology 1 (Fruits and Vegetables)			2			
28.	Postharvest Technology 2 (Cereals)			2			
29.	Postharvest Technology 3 (Tea, Coffee & Cacao)			2			
30.	Post-harvest technology in agriculture		3				
31.	Ventilation in storage cabinet		2		2		

No.	Courses	VNUA	CTU	NLU	HUAF	NTU	NTU
32.	Green production		2		2		
33.	Enzyme in food processing		2				
34.	Nutrition security/Human nutrition		2	2	2		
35.	Toxicology in Food		2				
36.	Colloidal food		2				
37.	Advanced Food Drying Technology			3			
38.	Functional food			2		2	2
39.	Advanced Technology of Edible Fats and Oils			2			
40.	GMO food				2		
41.	Aromatic compounds in food technology				2		
42.	Food law				2		
43.	Basic principal in Food Technology				2		
44.	Design and Management of Storage and Distribution Structures					2	
45.	Food Flavors and Colorants Technology					2	
46.	Scientific research methods/ Data analysis				2	2	2
47.	Biopolymers and their Application in Food Industry					2	2
48.	Application of Irradiation in Food Technology					2	2
49.	Microbio products: Production and Applications in Food industry					2	2
50.	Scientific Management					2	2
51.	Leadership					2	2
52.	Production Management					2	2
53.	Management of Technology and Innovation					2	2
	Thesis	**12**	**10**	**10**	**15**	**15**	**15**
	Total	**60**	**60**	**46**	**74**	**60**	**60**

*: presented for MSc program of Aquatic product processing technology

Annex 5. Post-harvest Technology MSc programs offered in Vietnam

No.	Courses	VNUA	CTU	NTU
	Compulsory courses	30	15+18	11+18
1.	Philosophy	3	3	3
2.	English	2	B1	8
3.	Physiology agriculture products post-harvest	3		
4.	Biochemistry agriculture products post-harvest	3		
5.	Methods and skills of scientific research	2	2	
6.	Cereal and bean post-harvest technology	2	3	
7.	Advanced fruit and vegetable post-harvest technology	2	3	
8.	Semina in post-harvest technology 1&2	1+1		
9.	Advanced food safety	2		
10.	Supply chain management for food and agricultural products	3		2
11.	Quality management system of agricultural products	2		
12.	Experimental design and advanced statistic	2		
13.	Advanced instrument/equipment in post-harvest technology	2		
14.	Advanced statistic		2	
15.	Principal of agriculture products post-harvest		2	
16.	Process and equipment application for post-harvest technology		2	
17.	Biology and biotechnology in for post-harvest technology		2	
18.	Physical property of agriculture products		2	
19.	Post-harvest and processing of aquatic products		3	
20.	Post-harvest and processing of animal products		3	
21.	Fruit and vegetable processing technology		2	
22.	Internship		2	2
23.	Modern technology for food processing		2	
24.	Modern Techniques Applied in Food Quality Assessment			2
25.	Changes of Food during Processing and Preservation			2

No.	Courses	VNUA	CTU	NTU
26.	Enzyme Technology and Its Application in Food Industry			2
27.	Advanced Food Packaging			2
28.	Ripening Control of Post- Harvested Agricultural Products			2
29.	Application of Irradiation in Post- harvest Technology			2
30.	Post-harvest Losses			2
	Optional courses	18/40	8/12+10/12	4/8+12/22
1.	Post-harvest Biotechnology	3		
2.	Advanced agricultural products package	2	2	
3.	Agriculture products quality analysis/management	3	2+2	
4.	Flower and decorative post-harvest technology	2		
5.	Cereal and Bean Processing Technology	2		
6.	Advanced vegetable and fruit processing technology	2		
7.	Minimal vegetable processing technology	2		
8.	Livestock products preservation and processing Technology	2		
9.	Treatment of waste by-products in post-harvest technology	2		
10.	Cold storage technology	2		
11.	Drying technology for agriculture products	2		
12.	Insect management in agriculture products pots-harvest	2		
13.	Disease management in agriculture products post-harvest	2	2	
14.	Advanced project management	2		
15.	Technology of harvest, preservation and processing of seafood products	2		
16.	Agriculture products Marketing	2	2	
17.	Advanced Food products design and development	2		
18.	Environmental toxicology and control	2		
19.	Agriculture products storage cabinet	2		
20.	Management of distribution chain and logistic		2	
21.	Machinery and equipment for agriculture products post-harvest		2	
22.	Additives in agriculture products post-harvest		2	

No.	Courses	VNUA	CTU	NTU
23.	Food toxicology		2	
24.	GLOBAL-GAP		2	
25.	Pre- harvest Handing Techniques of Agricultural Products		2	**2**
26.	Green production		2	
27.	Food Safety Management			2
28.	Biopolymers and their Application in Food Industry			2
29.	Microbio Products: Production and Applications in Food Industry			2
30.	Postharvest Technology of Seeds			2
31.	Post-harvest technology of cereal and bean			2
32.	System Design of Postharvest Equipment and Storage Structures			2
33.	Advanced Food Technology			2
34.	Food Rheological Properties			2
35.	Environmental Impact Assessment in Food Industry			2
36.	Data analysis			2
37.	Scientific Management			2
38.	Leadership			2
39.	Production Management			2
40.	Management of Technology and Innovation			2
	Thesis	**12**	**10**	**15**
	Total	**60**	**61**	**60**