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

Project Title

Curriculum Development for Sustainable Seafood and Nutrition Security

Project Acronym

SSNS

Deliverable 1.1b: Identification of similar curricula and best practice in Indonesia

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:

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EXECUTIVE SUMMARY

As a tropical country, Indonesia has approximately 51,000 km² of coral reefs (it does not include reefs in remote areas that have not been mapped or subsurface reefs) (Cambridge, UK: UNEP-WCMC, 1999), accounted for about 18 percent of the world's coral reefs. Most of these reefs are fringing reefs, adjacent to the coastline and easily accessible to coastal communities.

Reefbase reported that Indonesia's coral reefs are also among the most biologically rich in the world, containing an extraordinary array of plant and animal diversity. Today, more than 480 species of hard coral have been recorded in eastern Indonesia, approximately 60 percent of the world's described hard coral species, with more than 1,650 species in eastern Indonesia alone. While BIG (Board of Geospatial Information, 2013) has mapped the Indonesia's coral reefs area as large as 25,000 km^2. However, the coral condition is only 5.30% very good, 27.18% good, 37.25% fair, and 30.45% bad.

The Asia-Pacific region continues to be the world's largest producer of fish. The capture production of the Asia-Pacific region has exceeded 50 per cent of world production since 2006.The Asia-Pacific capture production declined slightly from 2004 to 2006, after which it started to increase, with a 3.5 per cent rise between 2009 and 2010. In most countries, capture fishery is either declining or remaining constant, but demand is increasing due to which farming of fish has grown rapidly becoming the fastest growing food production sector. However, recently aquaculture has suffered a lot, e.g. shrimp farming due to frequent occurring of various diseases and lack of proper management practices. It has threatened the whole industry thereby food security.

Seaweed is one of Indonesian major fisheries commodities. The annual production of seaweed was 11 million ton in 2016, and targeted to reach 13.4 million ton in 2017. This production is expected to come from the seaweed culture area as large as 1.1 million hectare or about 9% of the whole potential area for seaweed culture (12,123 million hectare).

The review of higher education program is reported to provide and develop human resources in the seafood industry in order to insure their sustainability. Review on thirteen curricula of M.Sc. Program in Fisheries Science has been done from: Bogor Agricultural University (IPB), Universitas Gadjah Mada (UGM), Riau University (UNRI), Padjajaran University (UNPAD), Maritim Raja Ali Haji University (UMRAH), Jakarta Fisheries University (JFU), Sam Ratulangi University (UNSRAT), Hasanuddin University (UNHAS), Halu Oleo University (UHO), Airlangga University (UNAIR), Brawijaya University (UB), Pattimura University (UNPATTI), Jenderal Soedirman University (UNSOED) has been performed.

There are variations in the curricula of fisheries science among Indonesian universities because fisheries professions do not have professional closure. The report has been recognized that there is a strong need to develop MSc program (whether academic or vocational) in response to sustainable seafood and nutrition security issues and challenges. This report, which attempts to aggregate existing graduate qualifications and current and

future skill needs through skill gap analysis, will also help provide context for the national curriculum development overall strategy in Indonesia. The report will also be useful to all relevant stakeholders in the field.

Based on the assessment of current courses and gap analysis, some courses with modifications and new in existing program should be included in SSNS program to make an attractive program with special focus on “Sustainable Seafood and Nutrition Security. In addition, the training will be conducted as the easiest way to fulfil the SSNS program.

Chapter 1. Introduction

1.1. Contextual background

Indonesia is an Archipelagic Tropical State which consists of over 16,000 islands (UNCSG, 2017). Indonesia has the second longest coastline in the world (± 81,000 km), and covers the waters area as large as 5,193,250 km^2 (consist of territorial waters 0.3 million km^2, inter inland waters 2.95 million km^2, and Indonesian Economic Exclusive Zone 2.55 million km^2, with the land area 1,919,440 km^2). Their mega-diversity of aquatic resources have a huge potential for economic and nation's welfare development.

On geo-politics overview, Indonesia is located in southern part between the landmass of Asian and Australian continents, and between Pacific and Indian Ocean. This position has a very strategic role on the global trade supply chain system connecting Asia with other continents especially with -Pacific Region to Australia.

As a tropical country, Indonesia has mostly tropical rainforest climate (highest precipitation) in western and central part of Indonesia, followed by tropical monsoon and tropical savanna (lowest precipitation) in the East of Nusa Tenggara. However, oceanic climates and subtropical highland climates are also found in a number of high-altitude regions in Indonesia, mostly between 1,500 and 3,500 metres above sea level. Regions that are above these levels (mostly in the Papuan highlands) fall into the tundra climate category and the sub-polar oceanic category (CLIMATE-DATA.ORG, cited 2018)

Indonesia has over a trillion-dollar economy, which is largest in ASEAN or Southeast Asia. Industrial sectors account for the largest share of GDP (46.5 percent of total GDP) with manufacturing as the main growth engines (24 percent of total output). Mining and quarrying account for 12 percent, construction for 10 percent and electricity, gas and water supply for 0.75 percent. Service sectors constitute 38 percent of total GDP with the most important area including trade, hotel and restaurants (around 14 percent of GDP); transport and communication (7 percent of GDP); finance, real estate and business services (7 percent of GDP) and government services (6 percent). While, agriculture accounts for the remaining 15 percent. The agricultural sectors include fisheries, animal husbandry, forestry, and surely the agricultural.

Increase in global population and rapid emergence of middle class, has resulted in a skyrocketing demand for food, particularly seafood. Maintaining the long-term production and supply of such food, from both wild-capture fisheries and aquaculture, is a significant and on-going challenge for society. Production has to be sufficient, safe and nutritious to meet immediate needs and preferences, but it also has to be environmentally, socially and economically sustainable to provide for the long term. Environmentally sustainable production is needed to maintain the productivity and diversity of the food resource and the ecosystems that support it and to ensure that the impacts of food production do not compromise other ecosystem services. Socially acceptable and economically sustainable

production is needed to ensure the communities, industries and supply chains that generate food continue to function without compromising the welfare of organisms and the people involved.

Food security is a complex issue of global significance and understanding the role and contribution of seafood especially nutrition security is an emerging research area. Seafood products are provided by both aquaculture and capture fisheries and are the most nutritious and highly traded food products globally. Inclusion of seafood in our daily diet provides an affordable source of macro and micronutrients required for optimal physical and mental health development.

The Asia-Pacific region continues to be the world's largest producer of fish. The capture production of the Asia-Pacific region has exceeded 50 per cent of world production since 2006.The Asia-Pacific capture production declined slightly from 2004 to 2006, after which it started to increase, with a 3.5 per cent rise between 2009 and 2010. In most countries, capture fishery is either declining or remaining constant, but demand is increasing due to which farming of fish has grown rapidly becoming the fastest growing food production sector. However, recently aquaculture has suffered a lot, e.g. shrimp farming due to frequent occurring of various diseases and lack of proper management practices. It has threatened the whole industry thereby food security.

Thailand was world's biggest exporter of shrimp for over two decades, but the industry collapsed in mid-1990s. It took about 5 years to revive but again collapsed after a decade, and still in coma. Diseases are occurring one after another. Vietnam produces nearly 1 million MT of Pangasius catfish and supplies white fillet all over the world. Farmers use excessively high density, and intensive farming method, it may also face disease and other problems. Sustainable farming principles and practices are crucial, and proper education and awareness are needed so as to avoid such failures. Indonesia is now in a race to compete with Thailand and Vietnam for aquaculture. Aquaculture is growing rapidly as it has been highly emphasized recently. Fast growing industry has highest environmental damages, and also high risk of collapse. Therefore, growth is needed to be optimized to make is sustainable. Despite the prominence of fisheries and marine related studies in the region's HEIs in the last few years, there seems to be a lack of appropriate Master's degree programmes especially focusing on Fisheries and Aquaculture for Food and Nutrition Security addressing the emerging problems of the real world, which the SSNS project aims to fill.

1.2. Purpose of report

The report is intended to give a review of higher education program in connection to human resources development in the seafood industry. High demand for seafood is compelling to grow the sector rapidly. Fast growing sector often challenges of long-term sustainably. In contrast, fisheries/aquaculture sector is not attracting adequate students at higher degrees. Even the students with degrees are having difficulty in finding jobs in the sector. Therefore, employability of graduates and alumni acceptability by the employers is a question. Even if they are taken jobs, whether they can play roles in achieving seafood

industry growth and its sustainability. The employers consist of universities/colleges, research institutions, governments, nong-governmental sector and private businesses.

This report has been recognized that there is a strong need to develop MSc program (whether academic or vocational) in response to sustainable seafood and nutrition security issues and challenges. This report, which attempts to aggregate existing graduate qualifications and current and future skill needs through skill gap analysis, will also help provide context for the national curriculum development overall strategy in Indonesia. We anticipate that the report will also be useful to all relevant stakeholders in the field.

1.3. Defining the sector

Initially, fisheries is included in agricultural sector (in form of Directorate General of Fisheries) till 1998. So, the government intention on it was lack caused of natural resources degradation and fish resources overfished. Starting the new era of government, the Ministry of Fisheries and Marine Affairs was established in 1998. Changing on governing style, made the fisheries development program were inconsistent.

Defining the sector The Government of Indonesia recently adopted a food security law, outlining the importance of food security for the Indonesian population and the need for agricultural diversification. More emphasis is being given to the promotion of fish and fish products as essential elements of the Indonesian diet, and providers of high quality protein. The blue growth sectors (primarily capture fisheries and aquaculture) are recognized as important sources of nutritious food that can contribute to environmentally sustainable economic growth, and social well-being.

1.4. Methodology

The report is arranged after having several methods of data gathering and problem identification. Data gathering involves focus groups discussion (FGD) with audiences from the fisheries industries businessmen, alumni and graduate students. Moreover, we also organize,d workshop, questioners, surveys, field visits, and desk studies. Problem identification involves some steps with one of the most important steps is collecting information regarding the problem. Thus, the gap can be determined as well as defining an appropriate recommendation that the SSNS curricula should be met. We applied the need assessment methods below:

i. Documents review; related curricula can be compared to determine the gap.
ii. Interviews and observation.
iii. Surveys; for relatively large groups to gain information about current skills and knowledge levels and about perceived education needs and problem areas as well in particular the seafood industry professionals.

The FGD has been done for minimum in double, with different participants. In terms of collecting data from respondents we applied questioners, for minimum 10 persons per category. The questionnaire sent to respondents by e-mail or by phone. The evidence of survey methodology presented in Annexes.

Chapter 2. Current Performance of sector

2.1 Status of Fisheries and Aquaculture

The fish potential production in 2013 was estimated about 7.3 million ton per year (Komnas Kajiskan, 2013); with the maximum sustainable yield (MSY) was 5.8 million ton per year or about 80% of sustainable potencies. However, according to the Minister of Marine Affairs and Fisheries, biomass in Indonesian waters was up 240%. The maximum sustainable yield was 9.9 million metric tons (MT) in 2017, and government analysis indicates it will increase to 11 million MT in 2018. The clustering of fish production is based on major species e.g. shrimp/prawn, tilapia, carps, catfish/pangasius, crab, lobsters, seaweed, and others. Indonesian waters have about 8,500 species of fish, 555 species of seaweed, and 950 species of corals. Some of those species have high economic value, either as food or pharmaceutical raw material or its substances. Total national production of fish in 2017 is 23.26 million ton; consist of fishing catch production 6.04 million ton and 17.22 million ton from fish culture.

As a tropical country, Indonesia has approximately 51,000 km^2 of coral reefs (it does not include reefs in remote areas that have not been mapped or subsurface reefs) (Cambridge, UK: UNEP-WCMC, 1999), accounted for about 18 percent of the world's coral reefs. Most of these reefs are fringing reefs, adjacent to the coastline and easily accessible to coastal communities.

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National consumption of fish is increasing gradually. Statistical data indicated that the fish consumption rose from 33.89 in 2012 to 43.94 kg/capita/year in 2016, and in 2017, the consumption was estimated reaching 46.49 kg. The seafood come from fishing catch and fish culture (mariculture, brackish water pond, and fresh water pond), and transported to consumer via fish handing and processing industries (big scale), or local fish handling and processing (medium and small scale).

2.2 Seafood processing,

Marine fish processing in Indonesia could be divided into 2 groups, modern and traditional. The modern fish processing industries use advanced electrical machineries; while

the traditional communities use simple technologies of seafood processing which mostly utilize natural energy, such as salting/drying, roasting, boiling, steaming, fermentation process, etc. The disposition of seafood processing is in fresh/chilled, dried/salted, boiled, fermentation products (fish paste/belachan, fish peda, fish sauce), smoked, frozen, canned, fish meal, and others. The percentage of every type of product from marine seafood are approximately dried/salted 31.2%, boiled 8.3%, fermentation products (fish pasted/belachan 0.8%, fish peda 0.3%, fish sauce 0.02%), smoked 6.3%, frozen 48.5%, canned 2.0%, fish meal 0.7%, and others 1.9%.

In addition to marine fish production, Indonesia also produces freshwater fish. The volume of several species of freshwater fish is increasing. Production data from 2014 and 2015 shows marble goby or marble sleeper (*Oxyeleotris marmorata*) increased 6.69%, while catch fish (*Clarias batrachus*) 7.29%, snakehead (*Channidae* sp.) 11.43%, mad barb or sultan fish (*Leptobarbus hoevenii*) 15.34%. However, several species was decreased, such as tinfoil barb (*Barbonymus* sp.) 17.94%, java/silver barb (*Barbonymus gonionotus*) 2.93%, and kissing gouramy (*Helostoma temminckii*) 2.42%. Other groups were also found to be increasing such as turtle (*Dogania* sp.) 207.93%, shrimp 42.20%, and mussel 32.03%. Total Production of fish is shown on Table 2.1.

Table 2.1 Fish production on 2013-2015 (million tonnes)

No	Sources of seafood	2013	2014	2015	2016	2017
1	Fishing catch	5,86	6,70	6,52	?	?
2	Aquaculture	13,70	14,52	17,47	?	?
	Total	19,56	21,22	23,99	?	?

Indonesian Government has set a target to increase fish production to 39.97 million tonnes in 2019, a 40% higher than 2015 production.

2.3 Market

Statistically, Indonesian marine fish market is still dominated by fresh/chilling fish which shared around 65.9% of total production. Frozen and dried/salted fish shared 13.8% and 12.2% of total production, respectively.

Since the most populated inhabitant is in Java Island, so the seafood come not only from coastal area in Java but also from other islands (Sumatera, Borneo, Celebes, Mollucas, and also imported products.

Fisheries development in Indonesia is facing several obstacles that could be classified into 4 major groups: legal aspect, human resources, natural resources, and geographical situation.

2.4 Legal aspect

- IUU Fishing {Illegal fishing by foreign fisher (caused by: very large area with minimum monitoring system, a lot of remote areas); Unreported fishing (fish is sold at the sea to agent of foreign fish traders) and unregulated;
- Several regulations/law do not give benefit to local fishers, such as: banning of fish bombing and fish poisoning, banning of trawls' liked fishing gear, size limitation of lobster, etc. (too short duration of socialization);
- Lack of law enforcement (lack of political will to solve the problem).

2.5 Human resources

- Lack of educated fishers especially on sustainability knowledge of fish resources;
- Violation of law/regulation Lost of fisher, processor, and fish trader livelihoods;
- Lost of fisher, processor, and fish trader livelihoods.

2.6 Natural and Environmental resources

- Depletion of fish resources due to environmental degradation (water pollution, sedimentation and abrasion);
- Fish habitat damages due to over-exploitation and destruction fishing (bombing and poisoning fishing);
- Catching fish fry and the high stage of gonad maturation of fish.

2.7 Geographical situation

- Since the distribution of population is imbalance between the west and the east part of Indonesia, the exploitation rate of fish resources is very high in the western part of Indonesian waters;
- Even though the fish resources is abundant in eastern part of Indonesian water, it is only several species which could be sold to dense population which less fish supply, due to high cost of transportation;
- Conflict of interest between fish aquaculture development program with the zonation act.

2.8 Marine Business trend

Based on the Statistical Data Bureau, the growth of seafood export increased 8.12% from USD 3.78 million in 2016 to USD 4.09 million in 2017. Trends of fisheries export and import is shown on Figure 1.

Figure 2.1. Trends of fisheries export and import during 2012-2016

According to Nurkholis et al. (2016) in Aquatic Procedia 7, Indonesia marine industries conserve abundant marine resources by which makes the maritime industry to be a strategic sector for national development. According to the Ministry of Marine and Fisheries (Ministry of Marine and Fishery, 2013), the total production of processed fish in this sector reached 4.10 × 106 t in the third quarter of 2013. The total production was the highest in 2012. At that year, the total production of processed fish was 4.83 × 106 t. Looking at trends in the domestic production of processed fish, there is a positive growth about 6.6 % per annum. Fish processing employment also supports the development of Fish Processing Unit (Unit Pemrosesan Ikan - UPI). Until 2012, the numbers of UPI development were 64 028 units and dispersed throughout Indonesia. Most of UPI developments (about 45 %) are located in Java. UPI also exists in Sumatra (25 %) and Borneo (13 %). There maining are scattered on Sulawesi (8 %), Bali Nusa Tenggara (8 %), Papua and Maluku (1 %).

Chapter 3. Existing Curricula taught at Universities

Review on thirteen curricula of M.Sc. Program in Fisheries Science has been done from: Bogor Agricultural University (IPB), Universitas Gadjah Mada (UGM), Riau University (UNRI), Padjajaran University (UNPAD), Maritim Raja Ali Haji University (UMRAH), Jakarta Fisheries University (JFU), Sam Ratulangi University (UNSRAT), Hasanuddin University (UNHAS), Halu Oleo University (UHO), Airlangga University (UNAIR), Brawijaya University (UB), Pattimura University (UNPATTI), Jenderal Soedirman University (UNSOED) has been performed (Table 3.1). Results of review show that the nature of skill of each university is unique and each university has different skill characteristic as reflected by its curriculum. In general, all universities have similar goals, i.e. (1) globally competitive graduates in the areas of sustainable aquaculture, fisheries resources management, and post-harvest technology, (2) fisheries professionals imbued with high level of integrity, nationalism, and ethical

standards, (3) professionals with knowledge, skills, and positive attitudes in fisheries sector, and (4) leaders in their profession and respective communities.

3.1 Institut Pertanian Bogor (Bogor Agricultural University)

Initially, Institut Pertanian Bogor (IPB) is an agricultural university with only 5 majors faculties, i.e. agricultural, veterinary science, fisheries, animal husbandry, forestry, and food product technology. Right now, IPB has 9 faculties, economic and management, human ecology, and math and sciences. Faculties of Fisheries and Marine Science consist of 5 departments: Aquaculture, Aquatic Resources Management, Aquatic Products Technology, Fisheries Utilization (Fishing Catch Technology), and Marine Science Technology, and also School of Business, and School of Vocational. All faculties serve all level of study, S1, S2, and S3.

3.2 Universitas Gadjah Mada (UGM)

UGM has a M.Sc. program in Fisheries Science and the program offers three distinct courses of interests, i.e. (1) aquaculture, (2) fisheries resources management, and (3) fish processing technology. Furthermore, this M.Sc. program is a double degree Masters courses with the Masters of Applied Science Program, Institute for Marine and Antarctic Studies, University of Tasmania, Australia.

3.3 Padjajaran University (UNPAD)

UNPAD has two study programs, which are fisheries and marine science. UNPAD also offers master program in fisheries.

3.4 Riau University

Riau University has undergraduate and Graduate Program. Undergraduate program offers five difference concentrations in aquaculture, aquatic bio-resources management, fisheries socio-economics, fisheries capture technology, and marine science master program.

3.5 Maritim Raja Ali Haji University (UMRAH)

The UMRAH offers three study programs, which are aquaculture, aquatic bio-resources management, and marine sciences.

3.6 Jakarta Fisheries University (JFU)

JFU has six study programs for undergraduate and graduate level, which are fisheries capture technology, fisheries machinery, fisheries product processing technology, aquaculture technology, bio-resource management and technology, and master program for utilization of fisheries bio-resources.

3.7 Sam Ratulangi University (UNSRAT)

UNSRAT has two M.Sc. programs in Aquatic Science, i.e. (1) National Program and (2) International Program. The national program focusses on aquaculture, fisheries resources management, marine geosciences, and fish processing technology. Whereas the international study program focuses on organismal biology and ecosystem in order to better understand functionality of coral reefs and adjacent ecosystems as the base for understanding threats, how to conserve coral reef and use them in a sustainable way. It is important to note here that only UNSRAT that has compulsory course of community service.

3.8 Hasanuddin University (UNHAS).

UNHAS has a M.Sc. program in Fisheries Science. The offered courses cover courses of interests of (1) aquaculture, (2) fisheries resources management, and (3) fish processing technology.

3.9 Halu Oleo University (UHO).

UHO has a M.Sc. program in Fisheries Science and the program offers three different courses of interests, i.e. (1) aquaculture, (2) aquatic resources management, and (3) capture fisheries.

3.10 Airlangga University (UNAIR).

UNAIR has a M.Sc. program in Fisheries and Marine Biotechnology. The program focusses on the development of fisheries and marine biotechnology by integrating biology, genetics, biochemistry, genetic engineering, and health of aquatic biota.

3.11. Brawijaya University (UB).

UB has a M.Sc. program in Aquaculture. It has four courses of interests, i.e. (1) fish seed and reproduction engineering, (2) fish diseases, (3) feed and nutrition, and (4) aquatic environment.

3.12. Universitas Pattimura (UNPATTI).

UNPATTI has a M.Sc. program in Marine Biology and Fisheries with concentration in fisheries resources management. It is important to note here that there is few information regarding this M.Sc. program.

3.13. Jenderal Soedirman University (UNSOED).

UNSOED has a M.Sc. program in Aquatic Resources. The program has three courses of interests, i.e. (1) biodiversity of aquatic resources, (2) exploration of aquatic resources, and (3) conservation of aquatic resources.

3.14 Value of Skill

Institutions of higher education (IHE) must continue to innovate to meet the diverse and often conflicting needs of many stakeholders. They must continue to pursue new strategies to advance and succeed in an increasingly competitive environment. Masters programs must equip students with the skills and tools for best responding to them at a departmental and institutional level.

IHE in Indonesia has become increasingly important on national agendas. The nation recognized that skills and human capital have become the backbone of economic prosperity and social well-being in the 21st century. This can be done by developing and sustaining a skilled workforce, maintaining a globally competitive research base, and improving the dissemination of knowledge for the benefit of society at large. In this context, university education system represents a critical factor in innovation and human capital development and plays a central role in the success and sustainability of the knowledge economy.

The knowledge, skills, and abilities required to become successful graduates/fisheries scientists have changed over time as fisheries professions have evolved. In Indonesia, the national demand for professionals trained in this field has also changed with increasing interest in environmental protection and changes in environmental policy and national economy. For instance, the Minister of Maritime Affairs and Fisheries, Susi Pudjiastuti,

through the Ministerial Regulation No. 2/2015 has banned the use of *cantrang* (a kind of Danish seine net), a fishing instrument identified as unsustainable and not environmentally friendly. In addition, the regulation bans the use of all types of trawls and seine nets, which the ministry argues are destructive to coral reef and the seabed ecosystem in general. Such novel important issue/trend both nationally and globally should be incorporated in the university curricula. The main reason is mainly due to the success of M.Sc. program in Fisheries Science depends upon the relevance of curriculum/module contents with cutting-edge knowledge and research as well as market demand. This incorporation has been implemented by most Indonesian universities including UGM.

3.15 Skill Implication

Skills offer better employment prospects, higher earnings, job satisfaction, and better health. In general, graduate students who seek out diverse experiences will be the ones most employable. Results of the Focus Group Discussions held at UGM (see Chapter 4) suggest that all stakeholders have acknowledged the university educational system that has fostered the appropriate skills and values for graduates to become productive and interactive members of society. In order to elevate the graduates' skill value and the opportunity to get job, they recommended university to enhance both tangible and intangible skills. Tangible skills consist of specific knowledge, whereas intangible life-long learning skills are abilities such as creativity, critical inquiry, problem solving, entrepreneurship, participation, and other relational and inter-personal values. Furthermore, all stakeholders agreed that a set of creative, problem solving, and critical thinking abilities, self-management, professionalism, and communication skills are becoming ever more important and students need to build up these skills. Also, the ability to compile, analyze, and disseminate large amounts of spatially disaggregated data information will also be an increasingly important requirement for employment.

3.16 Differences Between Universities

There are variations in the curricula of fisheries science among Indonesian universities because fisheries professions do not have professional closure (Table 1). Professional closure occurs when someone's competence is certified by a professional association or board, as is the case for lawyers, doctors, or certified public accountants. The similarity among them is that the curricula were developed starting with competencies and learner outcomes. In order to identify the difference between curriculum systematically, the identification was performed based on the three fields of interests, i.e. (1) aquaculture, (2) fisheries resources management, and (3) fish processing technology. Results show that only UNPATTI that does not have field of interest in aquaculture. Whereas for the interest in fisheries resources management only UNAIR and UB that do not have this field of interest. For fish processing technology, UHO, UNAIR, UB, and UNPATTI do not have this field of interest. The following is the curriculum of eight universities.

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Table 3.1 Curricula of the Indonesian Universities

CURRICULA IDENTIFICATION													
UNIVERSITY	**UGM**	**IPB**	**UNPAD**	**UNRI**	**JFU**	**UMRAH**	**UNSRAT**	**UNHAS**	**UHO**	**UNAIR**	**UB**	**UNPATTI**	**UNSOED**
Field of Interest: Fisheries Resources Management													
Conservation and Management of Aquatic Bioresources	v	v	v	v	v	V	v	v	v	-	-	v	v
Fisheries Oceanography	v	v	v	v	-	V	v	v	v	-	-	-	-
Fisheries and Marine Policy	v	v	-	v	v	V	v	v	-	-	-	-	-
Fisheries Stock Assessment	v	v	v	v	v	V	v	v	v	-	-	-	-
Fisheries Market Products	v	-	-	-	-	-	-	v	-	-	-	-	-
Sustainable Fisheries Governance	v	v	v	-	-	-	v	v	v	-	-	v	-
Coastal Community Organization and Institution	v	v	v	v	v	V	-	-	-	-	-	-	-
Fisheries Socio Economics	v	v	-	v	v	-	v	v	v	-	-	v	-
Fisheries Management Information System	-	-	-	-	-	-	v	v	v	-	-	-	-
Fisheries Entrepreneurship	-	v	-	v	v	V	-	v	v	-	-	-	-
Fishing Gear Technology	-	v	v	v	v	V	v	v	v	-	-	-	v
Community Service	-	v	v	v	-	-	v	-	-	-	-	-	-

Field of Interest: Fish Processing Technology													
Fisheries Product Development	v	v	v	v	v	V	v	-	-	-	-	-	v
Quality Management of Fisheries Products	v	v	v	v	v	V	-	v	-	-	-	-	-
Waste Control of Fisheries Industry	v	v	-	v	-	V	-	-	-	-	-	-	-
Design and Management of Fisheries Industry	v	v	-	v	-	V	-	v	-	-	-	-	-
Functional Properties of Fisheries Products	v	v	-	-	-	-	-	-	-	-	-	-	-
Technology of Fermented Fish Products	v	v	-	v	-	-	-	-	-	-	-	-	-
Molecular Technique in Fisheries Industry	v	v	-	-	-	-	-	v	-	-	-	-	-
Field of Interest: Aquaculture													
Fish Immunology	v	v	-	v	v	V	-	v	v	v	v	-	-
Fish and Environmental Health Management	v	v	-	v	v	V	-	v	v	v	v	-	-
Fisheries Biotechnology	v	v	-	v	v	V	v	v	v	v	v	-	v
Aquaculture Engineering	v	v	-	v	v	V	v	v	v	v	v	-	v
Design and Construction of Aquaculture	v	v	-	v	v	V	-	-	-	-	-	-	-

Feed, Bioenergetics and Fish Growth	v	v	-	v	v	V	v	v			v	-	-
Bacterial and Viral Fish Diseases	v	v	-	v	v	v	-	-	-	-	-	-	-
Fish Reproduction Physiology	v	v	v	v	v	v	-	-	v	-	-	-	-

Chapter 4. Future Skill Needs

4.1 Drivers of changes

4.1.1. The 2030 Agenda and the Sustainable Development Goals: The Challenge for Aquaculture Development and Management.

The Sustainable Development Goals (SDGs) are a universal set of goals and targets agreed by 194 UN member states to guide their development policies and initiatives over the next 15 years and apply equally to developed and developing countries. The focus of the 2030 Agenda is elimination of hunger and reduction of poverty and inequality in all forms. Almost all the SDGs and many associated targets are relevant to aquaculture development. Existing guidance and initiatives designed specifically to promote sustainable aquaculture development (including the Code of Conduct for Responsible Fisheries (CCRF). Food security, nutrition, and poverty alleviation lie at the heart of the SDGs. Aquaculture development, when undertaken sustainably and equitably, has and will contribute significantly to these fundamental development goals. Aquaculture products are highly nutritious and in demand locally and internationally. The production and sale of aquaculture products can contribute directly (food, sales) or indirectly (wage labour, purchases of nutritious food) to increased income, food security and nutrition. Therefore, it is important to create a framework that seeds and stimulates aquaculture enterprise, allows and facilitates sustainable development, identifies and removes bottlenecks, constrains unsustainable or unfair practice, and corrects market imperfections or inappropriate social constraints.

4.1.2. Paris Climate Agreement (UNFCCC, 2015).

Global climate change threats the sustainability of freshwater and marine fisheries as well as fish stocks. The twenty-first session of the Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCC) concluded with the adoption of the Paris Agreement in December 2015. Its aim is to strengthen the global response to climate change, including through sustainable development and efforts to eradicate poverty. COP21 emphasises the importance of oceans and aquatic ecosystems for temperature regulation and carbon sequestration, and highlights the need to counter pollution, over-exploitation and restore productivity and ecosystem services. Global climate change will affect marine systems at multiple levels of organization (Fig. 4.1). Freshwater and marine fisheries will be directly affected by climate-related stresses via changes and access to fisheries resources, and indirectly through habitat changes. Changes in ocean conditions directly affect the physiology of marine organisms, i.e. affecting growth, reproduction, mortality, and population dynamics. As a consequence, such changes lead to shifts in the biogeography, community structure, and trophic interactions of marine ecosystems. Marine ecosystem-dependent sectors like capture fisheries would be affected through the effects on catches, revenues, costs as well as the effectiveness of fisheries management. In the end, all of these changes connect to global issues such as population growth, seafood security, consumption patterns, and energy policies. Furthermore, future

changes in the distribution and abundance of stocks due to climate change and the expected increases in fuel prices are likely to influence fishers' ability to travel greater distances to catch moving stocks or change gear or practices to target different species.

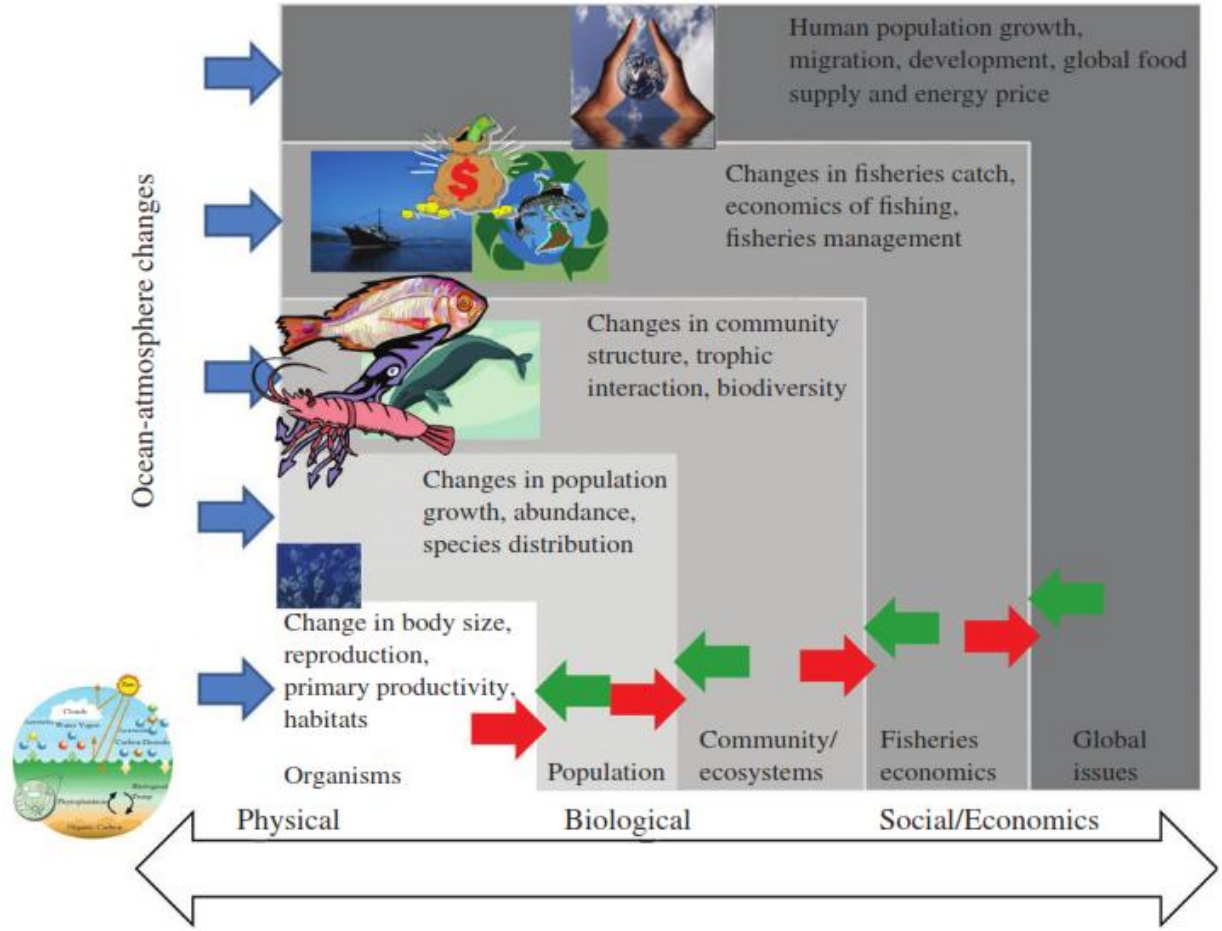

Fig 4.1. Diagram of multi-level responses of coupled marine and human systems to climate change. The arrows indicate drivers of changes in different levels of organization of marine-coupled human and natural systems (Cheung, 2018).

The magnitude of future changes depends on the rate of change and the response of the marine system to climate change. The adaptation pathways chosen will be critical to the future sustainability of fisheries. Indeed, the adaptation needs consideration of the followings:

a) which species, communities, or ecosystems are most vulnerable to climate change;
b) the likelihood of climate-related ecological changes affecting fisheries community and industry; and
c) what adaptations can be implemented to effectively respond to future change.

Ultimately, research will need to remain committed to addressing climate change impacts and adaptation knowledge gaps. It is expected that appropriate and effective adaptation strategies can be applied in the future.

4.1.3. Industrial Revolution 4.0.

In the fourth generation of industrial revolution, information and communication technology is fully utilized. Not only in the production process, but also across the industry value chain hence creating new business models on a digital basis to achieve higher efficiency and better product quality. The Indonesia's Ministry of Industry has designed 'Making Indonesia 4.0' as an integrated roadmap to implement a number of strategies to enter the Industry 4.0 era. The roadmap requires collaborative actions among multiple stakeholders that range from government institutions, associations and industry players, to academic elements.

In Indonesia, the implementation of Industry 4.0 has tremendous potential in overhauling the industrial aspects and changes many aspects of human life. Improvement of human resources competencies through the link and match program between education and industry should be the initial step, and this will be accomplished in mutual synergy between related ministries or institutions like Ministry of Research, Technology and Higher Education, Ministry of Education and Culture, Ministry of Industry, Ministry of National Development Planning, Ministry of State Owned Enterprises, and Ministry of Manpower.

4.2. Gap between existing curricula and needed skills

In order to identify current and future demand for knowledge and skills, some actions have been developed. IPB has been held two Focus Group Discussions (FGDs). Stakeholders were from industries and master students and alumni came to discuss SSNS in existing and future planning. In addition, to complete the requirement, the questioners have been distributed to prospective students, alumni, head of study program, lecturer, related seafood industries. The result is shown in Table 4.1.

Table 4.1. Gap analysis between existing curricula taught in the university with user's demand

Existing Curricula	User's Demand	Gap Analysis
1) Introduction of Seafood Industrial Raw Material and Analytical methods of Raw Materials and Aquatic Resources Products (microscopic and Bio-toxicology) 2) Physiology, Formation and Degradation Metabolites of Aquatic Product 3) Handling of Aquatic Product and transportation technology 4)	1) Industry needs Aquatic products quality insurances course 2) Soft skills training or courses is needed 3) Enhancement of teaching facility (laboratory equipment and it supporting e.g. no cold	1)Industry needs Aquatic products quality insurances course has been covered in existing curricula (Standardization and Integrated Quality Assurance) – (NO GAP) 2) Existing curricula lack soft skills topics – suggestion: a) developing a softskill training b) Add some softskill topics on existing course (entrepreneurship, self esteem, communication skill) 3) Presently our laboratories equipment are out of date (see

Introduction to Rapid Test and Devices Development Technology 5) Seafood Processing and Fisheries Industrial Technology 6) Standardization and Integrated Quality Assurance 7) Diversification and Seafood Product Development 8) Internship does not exist in the existing curricula 9) Fisheries entrepreneurship 10) Course of Applied Aquatic Biochemistry and Biotechnology of UGM is without practice	storage room available) 4) Entrepreneurship course is needed 5) Introduction to marketing management course is needed 6) Food safety course is needed 7) Improvement course of Fisheries Industrial Technology 8) Industry needs skilled employee for fresh graduate 9) Industry needs employee with integrated knowledge in fisheries trans discipline. Internship 10) Enhance collaboration capability	annex) 4) Existing curricula lack of entrepreneurship topics (see point 1b above). 5) The course of marketing management has been put on the elective course group 6) Existing curricula lack of seafood safety topics 7) The course of Fisheries Industrial Technology has been put on the elective course group 8) Fresh graduate from universities is a semi-skilled employee. 9) There is no fisheries inter-discipline master program – to initiate the SSNS, we will develop training courses, elective course in existing curricula. 10) Field and lab experience/skills 11) Weak collaboration and network 12) Lack of skills in lab work due to lack of equipment

UGM has held two Focus Group Discussions (FGDs) with key stakeholders from (27 April 2018 and 9 May 2018) Focus Group Discussions (FGDs) with key stakeholders from the government (Ministry of Marine Affairs and Fisheries of Republic of Indonesia, Department of Marine Affairs and Fisheries of Yogyakarta, Department of Marine Affairs and Fisheries of Central Java, and Fish Quarantine Agency Yogyakarta), public (consultant of SME), and private (Indokor, JAPFA) sectors as well as other universities (Semarang State University). The FGDs were also attended by Masters students and alumni. A degree in fisheries science can lead to very different career opportunities ranging from natural resources manager,

conservation officer, environmental educator, researcher, consultant, nature or recreational guide and many others. The necessary knowledge, skills, and abilities won't be the same among these career options. However, all stakeholders have agreed that the following are the most urgent knowledge and capacity needs:

1. Students should be introduced to the diverse disciplines and contexts relevant to fisheries science and management. They should incorporate some level of transdisciplinary into their research through, for instance, cross-training in both natural and social sciences. Students should also be able to communicate across disciplines and sectors (i.e., industry, government, academia, and NGOs), which are characterized by different backgrounds, knowledge, interests, values, and objectives.
2. The present university education system only focuses on theory and knowledge and lacks on skills and competencies. Field visits and practical works do not exist in the current curricula and student internship is not a common practice. The government officer and company staff suggested that graduate program with a fisheries orientation should supplement their academic programs with specific internships. It is important to employ skills and competency-based education system in order to connect Master education to business/society needs. Furthermore, they suggested that it is pivotal to get practical skill and field experience in order to overcome certain issues, e.g. in aquaculture production such as in-breeding problems or high mortality levels, in capture fisheries such as impact of overfishing and reducing bycatches, and improvement of fish quality.
3. With respect to practical works, it can be field and/or laboratory work. In the case of UGM, the curriculum does not provide practical works at all. Stakeholders from research institutes suggest that it is necessary to equip students with laboratory practical work particularly for biochemistry and biotechnology. This situation is a major issue for UGM as the university does not have equipment to support such lab work.
4. All stakeholders agreed and suggested that it is necessary to enhance the fisheries sector's image as an attractive career opportunity for students with a higher education degree. It was noted that the importance of the fisheries industry for the economy was not reflected at all in the educational system.
5. In order to enhance students' skills, courses can be designed to involve stakeholders and to include one or more of essential skills. The courses should be thoughtfully integrated throughout a curriculum so that students become progressively more competent.

According to the results of the review and FGDs, there are gaps between existing curricula and skills need. The following is an overview of the issues and needs to support of future capacity-building for a sustainable and economically viable aquaculture and fisheries sector.

1. All participants of the FGDs have agreed and suggested that it is pivotal for university to offer course of internship as such course does not exist in the existing curricula.

Students will get many benefits from internship, e.g. field experience and practical work. Thus, curriculum needs to be revised.

2. In doing so, it is crucial to enhance collaborations between government, university, and industry. To date, there is few collaborations among them.
3. It is important for university to provide cutting-edge instrument to support student's research skill. Many jobs required candidates to have experience in working with sophisticated instruments especially in the field of biotechnology. Until today, Department of Fisheries UGM does not have state-of-the-art instrument for biotechnology research. So that students not only learn theory but also practicing.

Based on the study, some actions are needed to develop future SSNS mater program:

1. Establish collaboration activities among university and stakeholders like visits to companies, short-term study visits in companies, collaboration in R&D projects, direct financing through scholarships, and various internship practices.
2. Increase the credit numbers of introduction to entrepreneurship course. Currently the soft skills topics has been taught in entrepreneurship course but it only has 1 credit point per semester.
3. Procurement and renewal of laboratory equipment.
4. Increase the credit numbers of introduction to entrepreneurship course.
5. Conducting short course on marketing management.
6. Enrich the courses of bio-toxicology, aquatic products microbiology and introduction to rapid test and devices development technology with food safety topics.
7. Enrich the course of seafood processing technology
8. Enrich the internship topics with on the job training in the seafood industry.
9. From two of resources data (IPB and UGM), we have to establish an integrated study program (trans discipline) which cover knowledge fisheries trans discipline master program.

Based on the assessment and gap analysis, there is no existing fisheries interdisciplinary/oligo-discipline master's degree program which directed with SSNS. In the future, there are possibility to develop an SSNS Master Program. However, considering our rigid administrative procedure on opening a new study program, we agree to develop step by step program toward establishing the SSNS Master Program, started with short training course, running SSNS's specialities/interest in an existing master program.

The following courses should be included in SSNS program to make an attractive program with special focus on "Sustainable Seafood and Nutrition Security":

A: The following existing courses should be included in SSNS program

1) Enzyme System on Fish and Seafood

Original syllabus: The course cover enzyme system on fish and seafood, include: enzyme and enzyme inhibitor characteristics, its role and connection on aquatic product quality, its extraction technique, its purification, and its application onto industrial activities.

2)

Syllabus:
This course covers the terminology, definition, classification, level, scope and type of standard and standardization, the importance of standardization in the whole aspects of life, impacts of standardization on trading, economic and public health protection, process and organization of standardization, conformity assessment, metrology, regulation (legal issues), and its application on aquatic product processing technology and biotecnology,

3) Sustainable Fishing Industry

Syllabus:
This course covers fishing indutries for highly economical fish commodities such as tuna and prawn; also discuss small scale fisheries industries in order to support sustaibility of capture fisheries management.

B: Existing course with modification

1) Aquatic Flora and Fauna (Fishes) Nutritional Changes after Harvesting

Original syllabus:
Every species of flora and Fauna (Fishes) has own physical & chemical characteristic. Harvesting might change them which lead to undesirable substances and harm to consumer.

Addition topics:
seafood security and safety,

2) Fish and Environmental Health Management (revision from PIP 5234-UGM)

Original syllabus:
Understanding the environmental of fish habitat and impact of the culture process on the fish health and nutrition content; method and duration of negative substabnces netralization process. Interaction between environment, host and pathogen, and its management; biosecurity concept; issues on fish health and environment (eco-) labelling.

3) System Handling and Transportation of Fish and Seafood

Original syllabus: On the course is discussed a technology of handling and transportation of aquatic product since its harvested till the consumer. Besides analyzing the physiological and chemical changing of aquatic product (death or alive) before, during, and after transportation, the course also cover its transportation technique (and also multi-moda of transportation) in order to keep the freshness, lasting, and additional value. Additional knowledge concerning Good Transportation Practices will also be discussed. Review of current issues on its journals. Discussing the cases studies. Additonal syllabus:

C: New courses

1) **Fish Quality and Traceability of Seafoods**

Syllabus: Seafood safety and security is a major concern on the modern supply system of food. Fraud of seafood raw materials; detection of pathogenic bacteria; chemical contaminats detection; and their impact on health and economic aspect.

2) Seafood allergents

Syllabus: Bioactive substances from fish and seafood which lead to allergic and poisoning/intoxication to human; sign of allergic and poisoning/intoxication (body responses to allergen and toxic substances); how to cope the allergic and poisoning/intoxication cases (preventive and curative action); type of toxins and allergen, its physical and chemical characteristics; method of toxins and allergen inactivation.

3) Advance Seafood Technology

Syllabus: The course covers seafood postharvest, advance seafood processing in order to create new inovative and seafoods development products, as part of global seafood supply need. Seafood safety and security aspect will also be studied as well as their risk of seafood consumption.

According to the assessment and gap analysis, there is no fisheries transdiscipline master's degree program, suggesting that it is necessary to develop a program of sustainable seafood and nutrition security (SSNS). The following courses should be included in SSNS program to make an attractive program with special focus on "Sustainable Seafood and Nutrition Security".

A. The following existing courses should be included in the SSNS program:

1) Course of Fisheries Socio Economics. The main reason is due to the major player of entrepreneurship in fisheries sector is not fisheries graduate.

B. Existing course with modification:

1) Course of Fisheries Market Products. Field assignment has to be added in this course.
2) Course of Quality Management of Fisheries Products. Field assignment has to be added in this course.
3) Course of Fisheries Product Development. Field assignment has to be added in this course.
4) Course of Fish and Environmental Health Management. Field assignment has to be added in this course.
5) Course of Conservation and Management of Aquatic Bio-resources. Field assignment has to be added in this course.

C. New course:

1) Practical laboratory work will be proposed by UGM as a compulsory course for the course of Applied Aquatic Biochemistry and Biotechnology.

4.3. Employment

All stakeholders agreed that there is a different expectation towards higher education. They suggest that there is a mismatch between graduate knowledge and business expectations. This situation occurred may be due to a lack of communication between industry and academicians. It is also possible due to competitive business issues that hinder collaboration and development. Hence, it is very important to establish forms of collaboration like visits to companies, short-term study visits in companies, collaboration in R&D projects, direct financing through scholarships, and various internship practices. Partnerships between universities and major employers is necessary to develop a joint responsibility for education and training. All these forms of collaborations will enhance the employability of students after graduation.

Chapter 5. Conclusion and Recommendation

Based on the assessment of current courses and gap analysis, the following courses should be included in SSNS program to make an attractive program with special focus on

"Sustainable Seafood and Nutrition Security" (in form of SSNS speciality on existing curriculum or just in form of training courses):

A: From existing courses:

Course 1. Enzyme System on Fish and Seafood

Course 2. Fish and Seafood Standardization

Course 3. Sustainable Fishing Industry

Course 4. Biomolecular Technics for Aquatic Product

B: Existing course with modification

1) Aquatic Flora and Fauna (Fishes) Nutritional Changes after Harvesting
2) Fish and Environmental Health Management (revision from PIP 5234-UGM)
3) System Handling and Transportation of Fish and Seafood
4) Aquatic Bioresources Charracteristics

C: New courses

1) Fish Quality and Traceability of Seafoods
2) Seafood Safety
3) Advance Seafood Technology

Those new courses will be offered on the existing master program.

For the first step, conducting training is the easiest way to add knowledge on SSNS aspect (see Annext 3).

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Annexes

Annexes 1. IPB's Documentation of Focus Group Discussiuon 1 (February 12th, 2018)

Annexes 2. IPB's Documentation of Focus Group Discussiuon 2 (June 4th, 2018)

Annex 3. List of Existing Training Course Conducted by the Departement of Aquatic Product Technology, Faculty of Fisheries, IPB

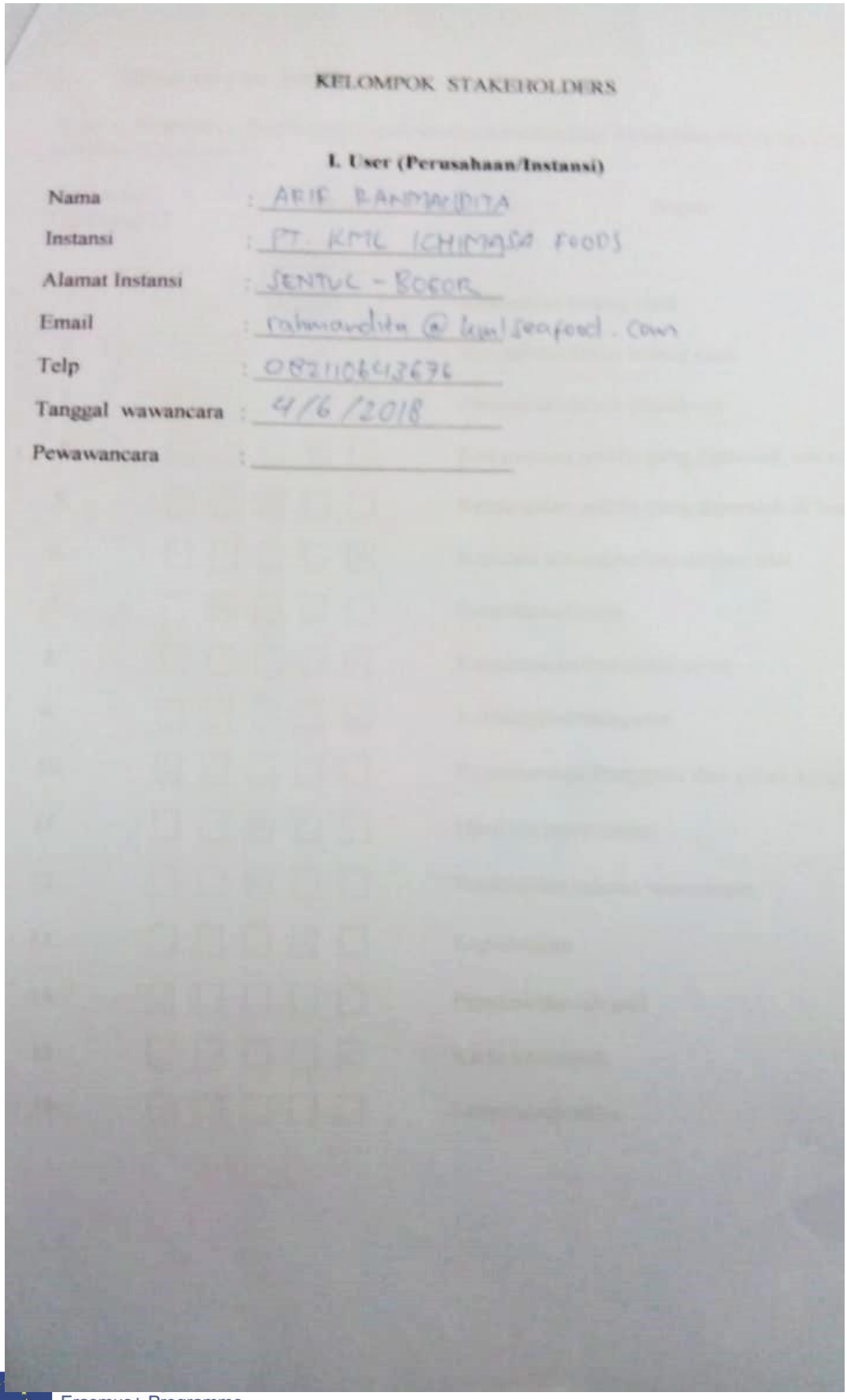
Nu.	Type of Trainings	Duration	Obstacles
1	HACCP and ISO 22000 Training	10 days	Availability of trainers
2	Sensory test in Fish and Fishery products	5 days	Availability of trainers
3	Thermal Process in Fish Canning	5 days	Availability of trainers
4	Scientific writing and publication	3 days	Availability of trainers and language barriers for students
5	Objective analysis fish and fishery products	5 days	Laboratory equipments
6	Handling and transportation of fish and fishery products	7 days	Availability of trainers
7	Fish and Seafood Authentication using DNA-based and protein-based approach	7 days	Laboratory equipments
8	Collagen and Gelatine production	7 days	Laboratory equipments
9	Achievement Motivation Training	3 days	It has not included on the curricula

Annexes 4. UGM's Documentation of FGD


Curriculum Development
for
Sustainable Seafood and Nutrition Security (SSNS)
Department of Fisheries, Faculty of Agriculture
Universitas Gadjah Mada, Indonesia


Curriculum Development
for
Sustainable Seafood and Nutrition Security (SSNS)

Annexes 5. IPB's Documentation of Questionnair



KELOMPOK STAKEHOLDERS

I. User (Perusahaan/Instansi)

Nama : ARIF RAHMAWIDITA

Instansi : PT. KMC ICHIMASA FOODS

Alamat Instansi : SENTUL - BOGOR

Email : rahmawidita@kmcseafood.com

Telp : 082110643676

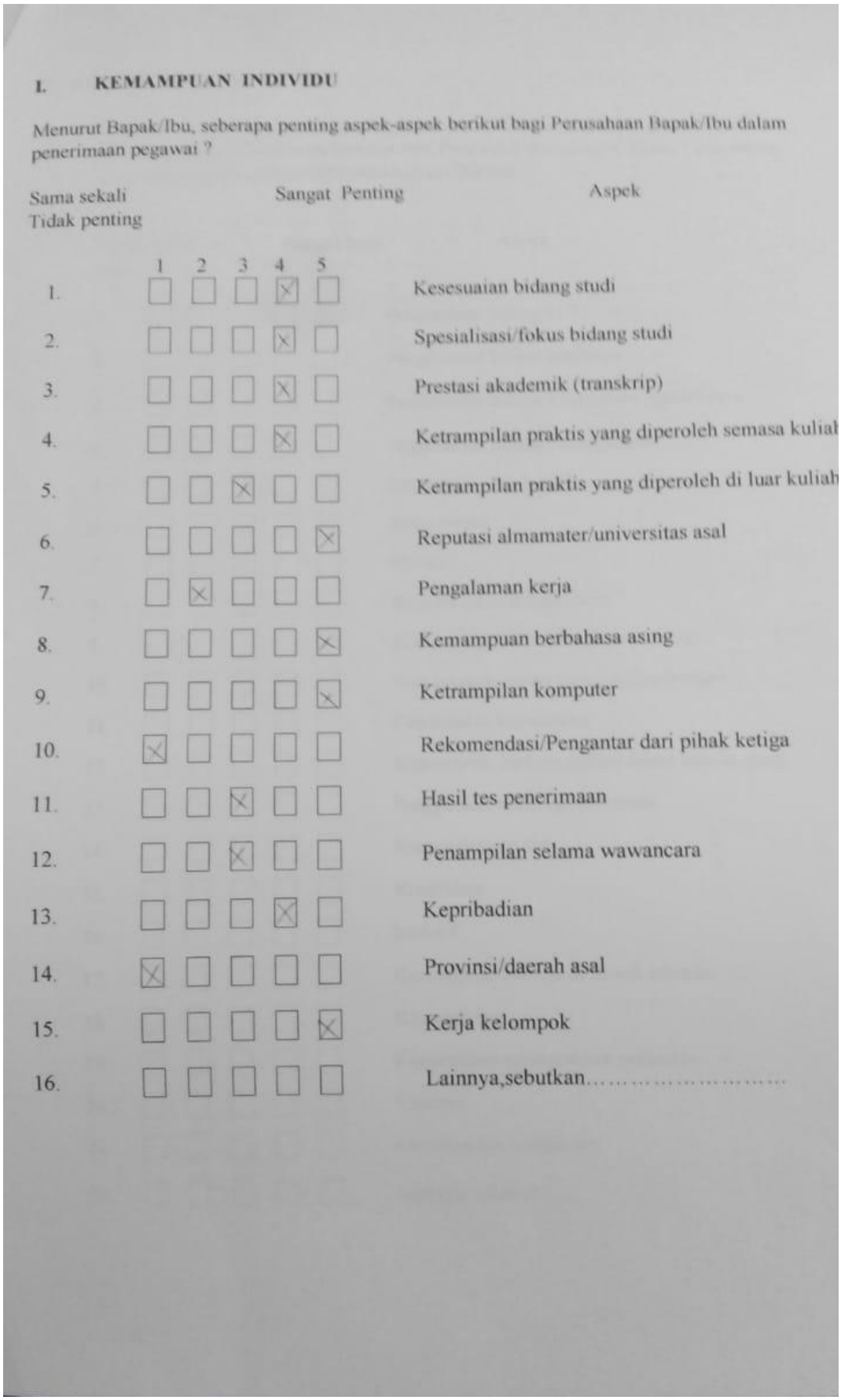
Tanggal wawancara : 4/6/2018

Pewawancara :

III. PROGRAM STUDI PERIKANAN DENGAN MINAT *SUSTAINABLE SEAFOODS AND NUTRION SECURITY* (SSNS)

Bagaimana pendapat Bapak/Ibu tentang rencana Pembukaan Program Studi SSNS *(Sustainable Seafood and Nutrition Security)* ?

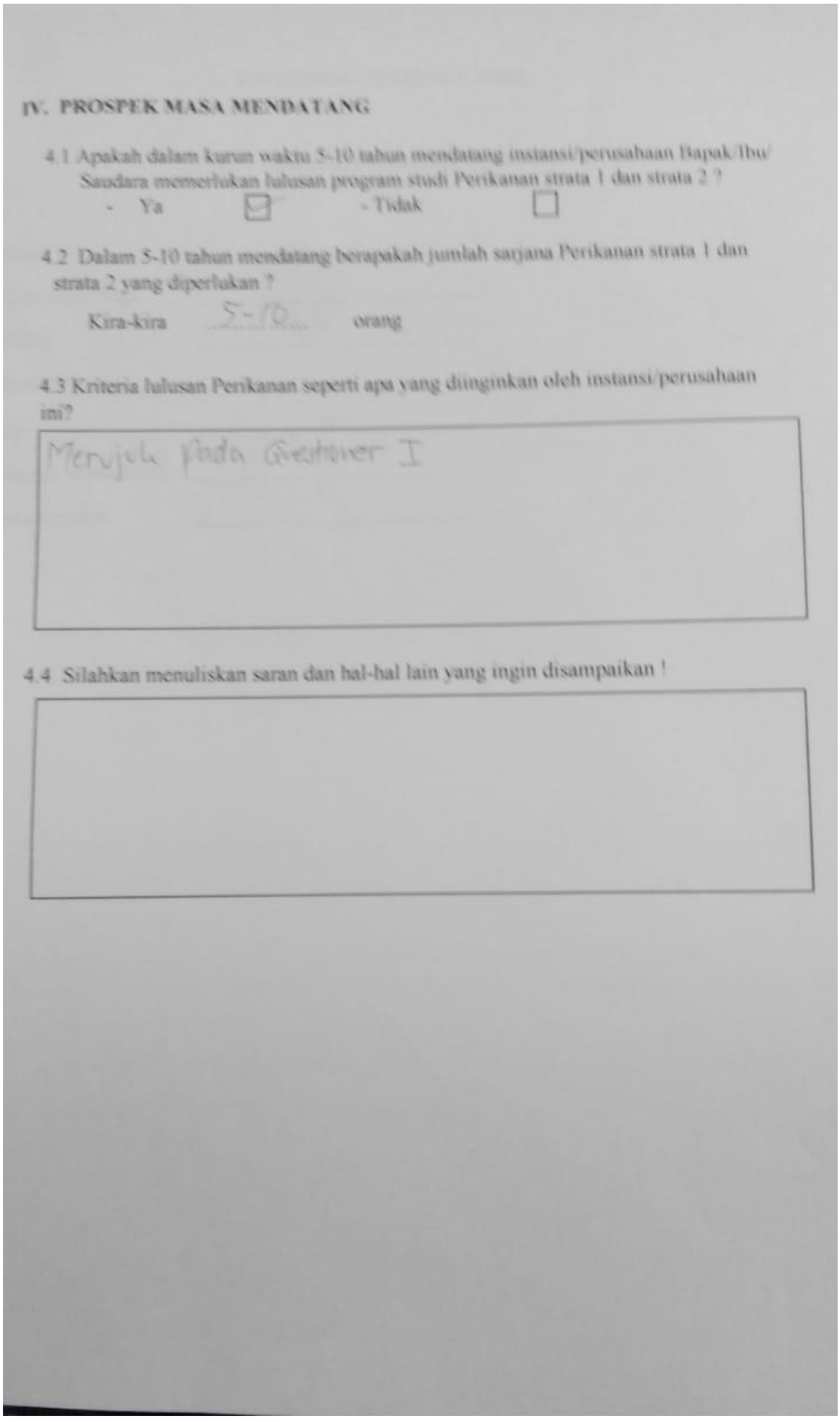
	Sangat Tidak setuju 1	2	3	Sangat Setuju 4	5	Aspek
1.				X		Lulusan perguruan tinggi kurang menyadari pentingnya *Sustainable Seafood and Nutrition Security*
2.					X	Untuk menjamin keberlanjutan stok bahan baku dan produk perikanan yang aman perlu diterapkan kurikulum bermuatan *i*
3.			X			Pendidikan *Sustainable Seafood and Nutrition Security* bertujuan untuk memberi bekal Ilmu /knowledge dan ketrampilan dibidang *suplay chain* atau rantai pasok hasil perairan bagi para mahasiswa sesuai dengan bidang ilmu, minat, dan hobi
			X			SSNS menjadi minat dengan mata kuliah Wajib berupa transportasi, logistik, penanganan, standardisasi hasil perairan, pengetahuan bahan baku hasil perairan, dll (sesuai mata ajaran yang terkait *Sustainable Seafood and Nutrition Security*)



I. KEMAMPUAN INDIVIDU

Menurut Bapak/Ibu, seberapa penting aspek-aspek berikut bagi Perusahaan Bapak/Ibu dalam penerimaan pegawai ?

	Sama sekali Tidak penting			Sangat Penting		Aspek
	1	2	3	4	5	
1.				X		Kesesuaian bidang studi
2.				X		Spesialisasi/fokus bidang studi
3.				X		Prestasi akademik (transkrip)
4.				X		Ketrampilan praktis yang diperoleh semasa kuliah
5.			X			Ketrampilan praktis yang diperoleh di luar kuliah
6.					X	Reputasi almamater/universitas asal
7.		X				Pengalaman kerja
8.					X	Kemampuan berbahasa asing
9.					X	Ketrampilan komputer
10.	X					Rekomendasi/Pengantar dari pihak ketiga
11.			X			Hasil tes penerimaan
12.			X			Penampilan selama wawancara
13.				X		Kepribadian
14.	X					Provinsi/daerah asal
15.					X	Kerja kelompok
16.						Lainnya,sebutkan……



IV. PROSPEK MASA MENDATANG

4.1 Apakah dalam kurun waktu 5-10 tahun mendatang instansi/perusahaan Bapak/Ibu/ Saudara memerlukan lulusan program studi Perikanan strata 1 dan strata 2 ?

- Ya ☑ - Tidak ☐

4.2 Dalam 5-10 tahun mendatang berapakah jumlah sarjana Perikanan strata 1 dan strata 2 yang diperlukan ?

Kira-kira 5-10 orang

4.3 Kriteria lulusan Perikanan seperti apa yang diinginkan oleh instansi/perusahaan ini?

Merujuk pada Gestuver I

4.4 Silahkan menuliskan saran dan hal-hal lain yang ingin disampaikan !

Annex 5. List of IPB's and UGM's proposed equipment, listed below by priority

List by priority	
No	Tools
1.	Mini Cold storage dimension (3x4x4 m3), capacity 10 tons
2.	Waterbath shaker Centrifuge
3.	Multiskan™ GO Microplate Spectrophotometer - Thermo Scientific-No. Catalog : No. 5111920
4.	Soxhlet apparatus
5.	Furnace tanur
6.	Oven
7.	Fraction collector
8.	Aquaread's ammonium /ammonia water test equipment/ and water quality test kit

Nature type and specifications of the item	**Amount Excluding VAT (EUR)**	**Total**
Small and Middle Seze Cold Storage for Chicken and Fish in China (specification at https://czadzl.en.made-in-china.com/product/ayqmLRnrjEVG/China-Small-and-Middle-Seze-Cold-Storage-for-Chicken-and-Fish-in-China.html)	2971	2971
SureCycler 8800 Thermal Cycler from Agilent Technologies temperature Range 4C to 99C. (For specification, please see Annex 1)	8000	8000
Eppendorf - 5404000014 - Eppendorf Microcentrifuges, 5424/5424R Microcentrifuge 5424R, with Keypad, Refrigerated -10 to 40 C. (For specification, please see Annex 1)	3204.9	3204.9
Thermo Scientific™ PRECISION 27L SHAKING BATH. (For specification, please see Annex 1)	4140.1	4140.1
Thermo Scientific™ portable analytical instruments. (For specification, please see Annex 1)	2000.0	2000.0
Benchtop centrifuges-Thermo Scientific Sorvall ST 8 Centrifuge Series	7765.0	7765.0
Fraction collector Bio-Rad. (For specification, please see Annex 1)	10000.0	9890.0
Aquared's ammonium/ammonia water test kit (https://www.aquaread.com)	2000	2000

Multiskan™ GO Microplate Spectrophotometer - Thermo Scientific- No. Catalog : No. 5111920	14800.0	14800.00

Instrument proposed by UGM:

1. Biorad, CFX96^{TM} Real Time Detection System-IVD. Price: $18,000.00.
2. HERAcell 150i Incubators, 150L capacity. Catalog Number: 3615-50. Price: $ 7,645.00.