



Capacity building for sustainable aquaculture and fisheries development in Myanmar

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Executive summary

This report presents the results of a Dutch public-private capacity building (Knowledge to Knowledge or K2K) mission for fostering sustainable aquaculture and fisheries development in Myanmar. Commissioned by Solidaridad, the mission was conducted in February 2015, and facilitated by Myanmar's Department of Fisheries (DoF) and the Myanmar Fisheries Federation (MFF). Funding was provided by the Netherlands Enterprise Agency.

The objectives of the K2K mission were to:

1. analyse Myanmar's aquaculture and fisheries knowledge infrastructure including a gap analysis;
2. identify future stakeholder needs and recommend improvements in terms of capacity building;
3. provide basic practical knowledge in support of a sustainable aquaculture and fisheries sector to Myanmar stakeholders; and
4. develop a Terms of Reference for a possible future programme aiming at building capacity for a sustainable fisheries and aquaculture sector in Myanmar through Dutch knowledge infrastructure (public and private).

To achieve these objectives, the team conducted a brief literature review, held meetings and interviews with key stakeholders in Myanmar and conducted site visits to universities, laboratories, training centres, freshwater fish farms, hatcheries, feed mills, marine fisheries companies, jetties, and fish processing companies.

Results

Stakeholders generally felt that the development of a common vision on the development of an ecologically sustainable and economically viable aquaculture and fisheries sector in Myanmar is desirable. They identified the following components as being priorities in such a vision:

- an ecosystem-based approach to aquaculture and fisheries management;
- an effective fisheries (co-) management system;
- an improved international market access by producing good quality, high value species;
- an increased cooperation between government departments;
- an increased cooperation between public and private sector.

Status of the knowledge infrastructure (objective 1)

Universities and vocational training centres can play an important role in support of developing a sustainable aquaculture and fisheries sector. The knowledge infrastructure in Myanmar is at present mainly supply oriented and less demand oriented. In practice, this means that students are not trained to develop the skills and competencies required to foster (sustainable) economic growth in Myanmar. In the current university education system, there is a strong focus on theory and knowledge with no focus on skills and competencies. Field trips and practicals are included in the curricula, but there is no culture of cooperation with stakeholders such as the Department of Fisheries or private companies. Student internships are not a common practice. Most university curricula regarding fisheries are similar and embedded in the departments of zoology, having a disciplinary but no professional specialisation. Collaboration between departments within universities in order to provide interdisciplinary skills training hardly occurs.

Stakeholder needs (objective 2)

In the current setting, the capacity to develop a sustainable and economically viable aquaculture and fisheries sector is insufficient at all levels. Government field staff and company staff indicated that they are in need of more practical knowledge on overcoming certain issues in aquaculture production, such as in-breeding problems or high mortality levels. The same goes for resolving issues in capture fisheries,

such as risk of overfishing and reducing undesired by-catches. Authorities lack capacity to implement and enforce regulations. Fish quality improvement is required throughout the supply chain. Strategies to build a sustainable primary sector are hence urgently needed.

The most urgent knowledge and capacity needs identified by public and private stakeholders include:

- connecting vocational, Bachelor and Master education to business/societal needs;
- developing fisheries, aquaculture, seafood processing masters specialisations that connect to business needs;
- gaining experience in the field together with businesses, governments and stakeholders;
- improving knowledge and understanding of research methods;
- improving oral proficiency in English;
- introducing skills and competency based education;
- strengthening pedagogic training for lecturers and professors;
- aligning with the international education system, its levels and standards.

The recent introduction of the new education law offers opportunities to address these needs. The management of the universities, however, does not yet seem to have a clear intention to make substantial changes in the curricula.

Stakeholders feel that a more ecosystem-based approach to aquaculture and fisheries and a well-functioning fisheries governance system (including control and enforcement) are crucial, this because natural resources are the basis of a sustainable economy and secure part of the staple diet of Myanmar people. This is also relevant in view of their ambition to develop a strong export market to the EU and USA, which is a key objective of Myanmar's government and its private sector.

Practical knowledge for a sustainable sector (objective 3)

Considering the on-going international developments with respect to environmentally and socially responsible seafood products, the Myanmar government and private sector should be aware that their future buyers will have demands beyond those that are legally required from a hygiene and quality perspective. Myanmar companies should expect questions about the environmental status of production and social issues. In addition, for some of the species Myanmar would like to increase its production, bulk product markets are already saturated. It is important that the necessary capacity is built for Myanmar to meet the legal requirements and private standards in the international seafood market so that Myanmar can capitalise on sustainably managed natural assets. With a 'virgin green and sustainable image', Myanmar may take a strong competitive position for export to the US and EU.

During the 2015 Dutch trade mission prior to Myanmar that preceded the k2K mission, public and private stakeholders from Myanmar and from private stakeholders identified a number of needs. in support of a sustainable and economically viable fish sector. These needs fit very well with the development of such a green image. The enthusiasm the Myanmar stakeholders show to tackle this challenge in combination with (a) the opportunities provided to the universities by the national education reform policy; (b) the interest in Myanmar by programmes from amongst other the EU, USA and Australia; (c) the ongoing work of World Fish MYFISH project; (d) the fast development of internet access in the country; and (e) the interest of the Dutch private sector to work with partners in Myanmar, are strong drivers to develop the necessary capacity and knowledge infrastructure for the development of a sustainable fish sector.

A first opportunity to address some of these needs and build capacity was given in three basic workshops during the K2K mission. One workshop focussed on governance for sustainable fisheries, the second on experiences with innovations in and knowledge sharing on more sustainable fishing gears in The Netherlands, and the third on tilapia hatchery management, quality control and the prevention of fish

disease. The workshops were all well and actively attended, illustrating once again the enthusiasm and willingness of public and private stakeholders in Myanmar to work towards a sustainable and competitive seafood sector.

Future capacity building programme (objective 4)

For possible Netherlands support for capacity building grant opportunities offered by NUFFIC could be considered. The Netherlands Fellowship Programme (NFP) for Tailor-Made-Training (TMT) Programme managed by NUFFIC provides an opportunity to develop the necessary capacity and knowledge infrastructure at the universities. The TMT focusses on: (i) market based professional competency profile descriptions and learning goal formulation, including a market needs assessment and assistance of the experts for the final common report with profile descriptions; (ii) development of students' competency oriented curricula and course descriptions, including a feed-back workshop at each of maximum seven universities.

In addition, setting up concrete cooperative projects involving universities, companies and the authorities will provide a platform for hands on capacity building. During an earlier EU scoping mission and the 2015 Dutch trade mission, a number of opportunities for potential public-private partnership pilot were identified. These include: (1) the development of two sustainable and inclusive business models for freshwater and marine aquaculture supply chains (tilapia and *P. monodon* shrimp), linking smallholder farmers to the business cases of larger companies, which will act as the drivers for change; and (2) the development of one integrated pilot for marine shrimp fisheries focussing on enhancing sustainability and quality to enter the export market.

Recommendations

To support capacity building and the improvement of the knowledge infrastructure towards an ecologically sustainable and economically viable aquaculture and fisheries sector, we make five recommendations:

1. *Develop a common vision for aquaculture and fisheries in Myanmar:* Effective capacity building will need to be founded on a common vision on aquaculture and fisheries. The position Myanmar would like to have in 10 or 15 years from now and agreeing on actions and measures to achieve this position, will help to develop the knowledge infrastructure necessary to reach the milestones that are part of the roadmap to achieve the objective. We recommend the organisation of Policy Dialogue Meetings to further develop the current five year plan for fisheries and aquaculture including the identification of actions and 'owners of the actions'.
2. *Start university specialisations in fishery, aquaculture and seafood sciences:* To be able to serve society in the short term, the team recommends starting a dedicated MSc programme of 4 semesters with a supplementary internship. Given the presently limited local expertise we advise to develop each specialisation at a different university to increase efficiency and effectiveness and to become outstanding. We recommend specialisations in the following domains: (a) sustainable fisheries management; (b) fresh water and marine aquaculture; (c) fish diseases; (d) river management and biodiversity conservation; (e) water quality management; and (f) seafood processing and quality. To support this development, we recommend submitting a proposal to the NUFFIC NFP TMT Programme. K2K team member Wageningen UR is willing to assist the departments aiming to start an MSc in fisheries, aquaculture and seafood sciences to submit such an application.
3. *Improve English proficiency:* To prepare for international exposure through MSc programmes, research internships, training or workshops, the universities should offer their (junior) lecturers classes in English communication (listening, speaking). All staff having a local MSc or PhD should

demonstrate sufficient level of English through a test, before being admitted for international exposure.

4. *Development of vocational training:* Next to the MSc's, in cooperation with the DoF and the professional field, Myanmar should develop vocational training that might become a professional BSc. NUFFIC has shown interest in exploring a niche agricultural vocational training. GIZ supports Myanmar with the development of a qualification structure for vocational training.
5. *Working with the private sector in developing vocational and higher education curricula:* To make Myanmar's educational system on aquaculture and fisheries meet the needs of the private sector and society at large, the private sector should be involved in the development of the curricula and research programmes. Experiences from all over the world show that public-private partnership models to address problems and work towards sustainable solutions can be highly effective. By teaming the needs of companies, research and vocational institutions and the government, 'on the job' experiences can be gained to inform the further development of the knowledge infrastructure for the development of a sustainable and economically viable aquaculture and fisheries sector in Myanmar.

1. Introduction

1.1 Background

The global seafood industry plays an important role in securing livelihoods, international trade and providing food security for billions of people. Sustainable development of the aquaculture and fisheries sector is therefore a key challenge. Global production of capture fisheries has, however, stabilised over the last decades and world-wide many fisheries are suffering from overfishing and other management challenges. Aquaculture is witnessing a rapid growth, going hand in hand with environmental and social challenges (FAO, 2013).

Myanmar's total fishery production for 2010 was reported to be close to 4 million tonnes, of which 22% is estimated to originate from aquaculture. Fish is the country's most important source of animal protein. The average consumption levels are high and estimated to be between 21 - 40 kg per person per year (Johnstone *et al.*, 2012). Myanmar has impressive fisheries and considerable future aquaculture potential due to its geography and abundance of natural resources. Its aquaculture and fisheries have considerable commercial potential, contributing to future food security, GDP and employment. In order to accommodate the investments needed to achieve this potential in a sustainable way, sector-wide improvements and a geographical scope beyond domestic markets are needed. To further the achievement of this objective in a sustainable way, one important condition is the presence of a strong knowledge infrastructure.

This report presents the results of a public-private capacity building mission for fostering sustainable aquaculture and fisheries development in Myanmar. The mission was commissioned by Solidaridad and facilitated by Myanmar's Department of Fisheries (DoF) and the Myanmar Fisheries Federation (MFF). Funding was provided by the Netherlands Enterprise Agency.

1.2 Mission objectives

The capacity building mission for sustainable aquaculture and fisheries (hereafter referred to as Knowledge to Knowledge, K2K) was carried out by a public-private team. The team was tasked to:

1. analyse Myanmar's aquaculture and fisheries knowledge infrastructure including a gap analysis;
2. identify future needs and recommend improvements in terms of capacity building;
3. provide basic practical knowledge in support of making an impact for a sustainable aquaculture and fisheries sector to Myanmar stakeholders.
4. develop a Terms of Reference for a possible future programme aiming at building capacity for a sustainable fisheries and aquaculture sector in Myanmar through Dutch knowledge infrastructure (public and private);

2. Approach

2.1 Introduction

The K2K mission built on an earlier scoping mission on aquaculture and fisheries development in Myanmar financed for the European Union (EU) and carried out by Solidaridad, Wageningen UR and World Fish. This mission analysed the aquaculture and fisheries sector from a food security and sustainability perspective and recommended the development of a multi-annual support EU programme. This EU programme should revolve around five innovative concepts or strategies: (1) strategic product-market combinations (PMC); (2) research and development; (3) an integrated supply-chain approach; (4) public-private multi-stakeholder platforms; and (5) Knowledge to Knowledge.

Following the preliminary findings of the EU mission, a Dutch multidisciplinary team comprising of representatives from Wageningen University & Research, Solidaridad and the aquaculture and fishing companies Til-Aqua, Cornelis Vrolijk BV, Primstar BV and PEFA, was tasked to further explore the Knowledge to Knowledge (K2K) strategy as part of a multi-annual programme towards sustainable aquaculture and fisheries. This approach offered a unique opportunity to analyse the Myanmar knowledge infrastructure both from multiple perspectives, providing strong insights in what practical and academic knowledge and capacity is required for enhancing economic development while at the same time promoting sustainable use of aquaculture fishery resources. Appendix 1 provides the names and affiliations of the team.

2.2 Activities

To analyse the current knowledge infrastructure in the aquaculture and fisheries sector, the team undertook the following activities:

- a brief literature review of the educational system and the aquaculture and fisheries sector in Myanmar (see References);
- meetings and interviews with key stakeholders in Myanmar;
- site visits to universities, laboratories, training centres, freshwater fish farms, hatcheries, feed mills, marine fisheries companies, jetties, and fish processing companies.

The interviews focussed on the current situation and needs and on ideas and plans for the future including what is necessary to achieve these. In the meetings with educational stakeholders, the reform of the Education Law was also discussed. Appendix 2 provides a list of meetings and site visits.

The K2K mission benefitted greatly from the Dutch trade mission on aquaculture and fisheries organised by the Netherlands Council for Trade Promotion (NCH), which took place from 2-4 February 2015. The trade mission provided additional opportunities to visit fish companies and hence identify the objectives and needs of the Myanmar private sector. It also gave valuable insights from the Dutch and European attending companies with respect to opportunities and challenges in setting up partnerships with Myanmar fish companies.

Members of the team also gave 3 workshops as part of basic capacity building. These workshops provided another opportunity to engage with stakeholders on knowledge needs. Appendix 3 gives a short report of the workshops.

The preliminary findings were presented and verified at a closing briefing meeting at the DoF, which was attended by representatives from universities, the Ministry of Education (MoE) and the Ministry of Livestock, Fisheries and Rural Development (MLFRD) and World Fish. During the meeting, the

participants not only commented on the preliminary findings but also made a prioritisation of their needs for the development of a sustainable and economically viable aquaculture and fisheries sector. Their input has been included in this final report.

3. Results

3.1 Introduction

The scoping mission on Myanmar's aquaculture and fisheries development potential carried out for the EU in October 2014 identified a number of concerns. These related to (a) the 'fit' between the needs of the private and the government sector and the content of curricula and courses offered by universities and vocational training centres and (b) the quality of some of the curricula (W. van der Pijl, personal communication).

The outcomes of the K2K mission presented below support these preliminary findings and further elaborate on them. The findings of the K2K mission not only include the needs identified by academic and vocational training staff, but position the knowledge needs also from the perspective of the Myanmar private and international fish sector. Specific attention is paid to the context of the upcoming reform of the education system.

This chapter first discusses the status of Myanmar's knowledge infrastructure. It then presents the needs in support of a sustainable and economically viable aquaculture and marine fisheries sector identified by the public sector stakeholders of Myanmar, the private sector in Myanmar and the Dutch fish companies who are interested in doing business with Myanmar. This is followed by a discussion of practical knowledge needs and future capacity-building for a sustainable sector.

3.2 Status of Myanmar's knowledge infrastructure

3.2.1 Higher education institutes

The present objective of Myanmar's higher education department is "to nurture new generation as intellectuals and intelligentsia in human resource development" (MHE, 2015). To achieve this it intends to improve quality of teachers in the higher education sub-sector, and to utilize teaching aids more effectively.

Myanmar has in total 169 institutes of higher education providing at least a BSc, but hardly any well-functioning vocational or technical training institutes. Basic knowledge in aquaculture and on fish anatomy and taxonomy is part of the curriculum in Zoology which is a department at most of the 69 Universities of Science & Technology. The programmes of the Universities of Environmental Conservation & Forestry, Agriculture & Irrigation, Livestock Breeding & Fisheries, Veterinary science, Border Affairs, and Transport, could in some way or the other relate to fisheries or aquaculture. Three universities - Mawlamyint, Myeik and Patein - have a department of Marine Science. The curriculum of these departments focuses entirely on flora, fauna and other ecological aspects of the aquatic environment (estuarine and marine mainly). Table 1 provides an overview of the number of universities that may have involvement in fisheries and aquaculture related subjects.

Table 1. Universities that may be related to fisheries and aquaculture, and their numbers

Science & Technology	61
Environmental Conservation and Forestry	1
Agriculture & Irrigation (Yezin)	1
Livestock Breeding & Fisheries (Yezin)	1
Veterinary science	1
Border Affairs	3
Transport	2

Although fisheries are mentioned in the title of one of Yezin's University programmes (Livestock Breeding & Fisheries), this and other Myanmar' universities have no specialisation in aquaculture or in fisheries. It is unknown how much attention is given to fish at the university that offers veterinary science in its curriculum.

The department of Zoology of the university of Dagon expressed an interest in developing an MSc in Fisheries.

Present university curricula and course content related to fisheries and aquaculture

At least eight universities have a curriculum in Zoology: Dagon, Hinthada, Maubin, Mawlamyin, Myeik, Patein, Yangon, and Yangon West. These eight are all located in southern Myanmar and are, according to the interviewees, the ones interested in establishing a department/faculty of fisheries. The curricula of the departments of Marine Science at Mawlamyin, Myeik and Patein universities do not have basic facilities for aquaculture practicals. Little collaboration occurs between the departments within the universities.

The curricula and the content of the courses of all Myanmar Universities were determined by the Board of Studies (BoS). There is no input from the private sector in curriculum development. For most curricula, the BoS is chaired by a professor of Yangon University (YU). The BoS of Zoology is composed of all heads of the departments of Zoology and mostly meets once a year to discuss and adjust the curriculum and courses. The BoS of Zoology has advisors who are retired professors, but does not consult professionals outside the Ministry of Higher Education. However, the BoS of Geography consulted professionals in the mine and oil industry. The modules and courses of the curricula of the BSc, the MSc and the PhD for Zoology are determined by the BoS. All eight mentioned have an MSc and an MSc-Research programme.

Each academic year has 2 semesters and 12 modules. The first semester of an academic year is from June to September for post-graduate (MSc) and December for undergraduate (BSc) and the second from December to March for MSc and June to September for BSc. Hence, the four year length of the BSc programmes effectively covers 32 months. The disciplinary BSc's in Myanmar include the study of languages.

For each of all courses/modules in Zoology, YU's department of Zoology prepares a textbook for the other Universities available at an affordable price to all students. The exams are also prepared centrally, though universities may choose to prepare the exam separately. This centralisation is set up to ensure uniformity of quality. The knowledge transferred is, however, also determined by individual professors' knowledge (see Teaching methods below).

The BSc curricula of Science and Technology Universities aim to prepare students for their life after university in a broad way. The term paper of the BSc and BSc-Honours may be shared; that's to say that up to 10 students may work on the same topic. But the MSc candidates have to work individually on their research.

Except for the University of Yangon and Mandalay, all universities also offer Distance Learning courses. For the universities visited, the number of students registered for blended Distance Learning (HRD) is at least close to equal to the number of the regular full-time on-campus students (see Table 2). Except for the University of Yangon and Mandalay, the faculties of other universities listed above deliver practicals to the students involved in Distance Learning programmes, in November and December.

In general, most universities offer their students opportunities for building a service attitude through voluntary assisting in social and alphabetisation programmes. In the current situation, where academic education is mainly aimed at cognitive skills, it is not the university but the future employers who seem to bear the responsibility that their new employees (the former students) acquire the skills and competencies required for their job.

From BSc to MSc and PhD

After having completed their BSc, very few students are allowed to follow an MSc; between 5 to 10% at the visited universities (see Table 2 and 3 for examples). The MSc students are recruited to become the future university lecturers of the specialised departments. This process may be different for the Universities specialised in Agriculture, Forestry, Livestock, Cooperation, Irrigation and Transport.

The universities propose their best MSc students to carry out an MSc research project. This means that they must write a thesis. A review of some theses by the K2K team shows that these theses mainly comprise a literature review quoting some 10-15 articles, mostly with limited critical reflection on what the articles mean, how they connect, and generally lacking a critical reflection on the obtained results.

Table 2: Numbers of students enrolled at the University of Yangon in 2014-15

Curriculum	Total
PhD (Preliminary + Research)	859
Master of Research	100
MA (Master of Business Administration), MSc	416
BA (Q), BSc (Q)	3
BA (Bachelor of Business Administration, BSc	1,257
Diploma (Eng, Psy, Anthro, Arch, Phy, Geol, IC, LS, CS)	512
HRD* Diploma (CS, Geol, IR, Law, OS, Geog)	2,234
HRD* Master	565
Total	5,946

* HRD = Blended Higher Education including Distance Learning and 2 month/yr on campus.

Table 3: MSc student numbers at the Department of Zoology * at the University of Yangon in 2014

Level	BSc**	MSc			PhD***	
		1 st yr	2 nd yr	Research	Preliminary	Thesis
Stage	For separate years					
Number	19 to 25	1	0	0	13	40

*This department has 88 academic staff of which 40 are specialized in Ichthyology and 'Aquaculture'.

** the 1st year is a general preparatory year; *** coming from all Myanmar.

The MSc honours can continue to PhD level, but (at least for Zoology) at YU only. Having successfully defended an MSc thesis is an admission criterion for the PhD, which starts with a full year of courses at YU. After passing this year the candidates may be proposed to do their PhD research. After three years

of research they have to defend their thesis which may contain material for just one scientific paper. During these three years they take up the teaching duties at their university. PhDs students in Myanmar are currently not trained to become independent researchers. Most of the professors we met had done their PhD abroad (India, Japan, Thailand). However, during the last 10 years there have been no opportunities for getting such a scholarship.

Most theses do not contain a central hypothesis or detailed research questions. The literature research is an important section of both MSc and PhD thesis. Both the MSc and the PhD thesis are presented and defended before a restricted committee (Board of Examiners). The methodology of the PhD thesis is presented and defended also in front of a group of professors in the related field.

Teaching methods and materials

The BoS also indicates the inclusion of practicals and fieldtrips. The way these practicals are given depends on the equipment available at the departments of Zoology at each university. Some have a collection of conserved organisms, others just pictures. Some have rooms, equipment and means for dissection and microscope observation, others do not. In the latter case, students copy the images during the practicals. In the class room we visited, the students had to repeat orally the names of species, organs etcetera, as a group.

Other infrastructure

The departments of Zoology of the YU and Mawlamyine and Maubin University have rudimentary infrastructure and equipment for practicals in aquaculture; Patein University has the facilities but does not use them. It is unknown whether or not Myeik University has facilities for aquaculture practicals.

All departments of Zoology provide two fieldtrips per semester and one fieldtrip of several days in year 2, 3 and 4. None of the BSc curricula include an internship, but the Ministry of higher Education (MHE) is considering including this.

Libraries of universities or departments may have a catalogue on author and subject in both Myanmar and English; mostly this is only on traditional system cards. Some libraries have internet access, others not. Most of the contacted universities are preparing the access to e-libraries. One of the visited universities had a computer room (for language training). But the individual tables of the room were provided with headsets only. However some other universities have sufficient facilities for ICT learning.

Staff training

Teachers and professors get training on content mainly. Pedagogical training may be included in the annual refresher courses at the Institute of Education in Yangon, but these do not seem to include methods allowing the lecturers to assist students to acquire other than cognitive competencies. Some professors, in particular for the MSc's, ask students to read a chapter before coming to the class and then discuss specific questions relating to this chapter with the students.

English language skills

All textbooks are in English and the theses of both MSc and PhD have to be written in English. However, the English conversation skills of most of those having acquired a local MSc and many of those having a local PhD were below the level required for admission to an MSc at Universities such as the Asian Institute for Technology (AIT-Bangkok), the University of the Philippines in Los Banos (UPLB) and Wageningen UR. The disciplinary level of the thesis we viewed, were mostly at least one grade lower than the Wageningen UR standard would be, e.g., a Masters level thesis at a Myanmar university would qualify for Bachelor level only at Wageningen UR.

One of the actions requested/suggested by our Myanmar counterparts is international exposure for the lecturers having a local MSc and PhD. English reading and writing skills are acceptable. However, to prepare themselves for international exposure, the interested staff should train their skills in English listening and conversation. Any NUFFIC scholarship should request a proof of sufficient proficiency in these two.

Collaboration

As mentioned above little collaboration occurs between the departments of one university. The collaboration between universities focusses on curriculum preparation. The exchange of students would be easy as the curricula are uniform, but is rare.

International collaboration occurs, e.g. with Japan and South Korea. In the past students from Myanmar have studied in the US and EU countries like Germany and the Netherlands. At present the exchange focuses on lectures by foreign professors and research by foreign students (e.g. a University of Yezin with Wageningen UR and a University of Transport with TU Delft). Some universities prioritise the signing of a Memorandum of Understanding (MoU) before any exchange may occur.

3.2.2 Reform of the Education Law

In 2011, the Myanmar government announced actions towards “the development of an education system which is equitable with traditional, cultural and social values and also in keeping with the economic and political aspirations of the nation” (Lwin 2013, p.6). This included the launch of a Comprehensive Education Sector Review (CESR) comprising of three phases:

1. rapid assessment: a sector wide assessment for identification of urgent priorities and reform issues and information on knowledge gaps for Phase 2.
2. in depth analysis: a detailed sector analysis which is large scale, participatory and will incorporate more focussed investigations and capacity building;
3. development of one overall National Education Sector Plan, with cost analyses for government.

Phase 1 was completed in 2013. Phase 2 has now been completed and consultations are now well underway (www.cesrmm.org).

The comprehensive review of the higher education sector found that:

- universities’ administrative structures are different as they are under different ministries due to their specialized streams. The current teachers’ transfer system affects research activities due to lack of time. There are insufficient classrooms, teaching aids and dormitories due to an uneven numbers of student-teacher ratios;
- appointments, promotion, budgeting and teaching-learning are all administered by respective ministries’ departments instead of by the universities;
- according to 91% of the rectors the university entrance should not only include matriculation marks but also personal interviews;
- most of the universities and colleges under the Ministry of Education have distance education branches to provide courses for students from Yangon and Mandalay Universities of Distance Education. These branches are responsible for management, teaching and assessments (Thein, 2014).

The findings of the CESR are very similar to the key findings of the K2K mission.

Following the CESR, it was recommended that:

- universities should be consolidated based either on their field of specializations or locations in order to form comprehensive universities;

- universities should be given full autonomy for their teaching programs and to fund-raise freely for research activities;
- all universities should establish their own admission system that allows them to select students based on applicant's interest, matriculation exam's marks and personal skills that can be fostered to meet the needs of the region and nation;
- in order to have effective Distance Education courses, dedicated staff should concentrate solely on teaching and management. Universities that are able to provide online base Education courses should operate independently to assure quality of the awards conferred (Thein, 2014).

As part of the process, a National Education Law was presented to the *Hluttaw* (Assembly of the Union). This New Education Law includes a Higher Education Law. The new education law will bring about two significant changes:

1. the majority of universities will be brought under the responsibility of the Ministry of Education;
2. universities will get autonomy over their curricula and research funding.

In theory, the new autonomy would imply freedom to develop a curriculum that fits their domain. It would also offer the opportunity to distinguish more in specialisations, themes and domains. However, we found that universities are not planning to drastically change their BSc curricula. If change is going to happen it will be very slow, step by step. Most staff has been working with the current curriculum for many years. The financial and administrative decentralisation will also take time, and not be easy for some universities. The Myanmar's Department of Higher Education has set a long list of actions needed (See Appendix 4). At present, the department aims to implement the following six activities: (1) faculty and curriculum development; (2) capacity building; (3) research; (4) entrepreneurship and business development; (5) development of lifelong learning society (6) enhancement of international collaborations (MoE, 2015).

3.2.3 Vocational training related to fisheries and aquaculture

The meetings and interviews held during the K2K mission mainly involved universities. Vocational training is, however, also an important aspect of a well-functioning knowledge support infrastructure for sustainable aquaculture and fisheries. We visited the Fisheries Training Institute and the DoF hatchery.

The aim of the Fisheries Training Institute in Yangon (IFTY) is to provide training to government agents, farmers and fishermen. IFTY falls under the authority of the DoF. It employs 29 people of whom 6 are field trainers. The field trainers cover the whole of Myanmar. IFTY has equipment for training fishermen on net maintenance, but has no facilities for practical training in aquaculture. The existing ponds are not used. The materials for training in fish processing and quality control were not functional anymore. In the coming year the IFTY will receive assistance from the Italian cooperation to improve its curriculum and facilities. The on-going course of the DOF district agents used very classical teaching methods.

Some hatchery staff was trained at the World Fish station in Abassa, Egypt. All still required and requested technical training in fish nutrition, breeding, hatching, nursing and grow-out.

3.3 Stakeholder needs

The aim of the K2K mission was to analyse the knowledge infrastructure for the fish sector; it was not to provide an overview of the aquaculture and fisheries sector. For the latter we refer to publications by Johnstone et al. (2012), Soe (2008), LEI (2012). This means that this section on the needs of stakeholders in Myanmar focusses on the identification of needs only. These stakeholders include the Myanmar government, universities and training centres, Myanmar aquaculture and fishing companies, and Dutch companies that are interested in doing business in Myanmar.

3.3.1 Needs of the public sector in Myanmar

Myanmar's five year policy plan for fisheries and aquaculture has the following objectives:

1. environmentally friendly shrimp and marine fisheries production;
2. increase the production of value added fish products;
3. increase the GDP contribution of the fish sector by three times in the period 2015-2020.

During the kick off meeting of the K2K mission at DoF, a group discussion was held focussing on the following question: "*What are Myanmar's future needs for a sustainable and socio-economically viable aquaculture and fisheries sector?*" In other words: what is needed to achieve the objectives of the current five year policy plan?

For the purpose of an effective discussion, the discussion was organised around: (a) needs for the inland and marine fisheries sector, (b) needs for the aquaculture sector and (c) needs of the policy-makers. Collectively, issues were mapped under each of these 3 categories. The improvement of fish quality, access to markets, reducing environmental impact and stock management emerged as the main themes in this discussion at the kick off meeting at DoF.

The next step in specifying the needs for the fish sectors and those of the policy-makers was to identify the knowledge and educational needs in support of the development of the aquaculture and fisheries sector. To this end, interviews with university and vocational training staff were held and site visits to education facilities were carried out.

During the interviews and site visits, university professors and staff identified a number of actions they deem necessary for capacity building for aquaculture and fisheries education in Myanmar:

- training for curriculum and course design to revise the curriculum and syllabus;
- training in research methodology and collaborative research;
- enhance capacity building of staff from universities and DoF;
- start a programme for an MSc degree in Aquaculture;
- start a programme for an MSC degree in Fisheries Science;
- establish a Faculty of Fishery Science in selected universities;
- establish a Vocational Training School and a Marine Fishery Institute.

Staff from the Fisheries Training Centre identified the following needs:

- improve training of field staff and fisheries officers in terms of theory and practice;
- improve fisheries statistics (accessibility and analytical capacity);
- increase the number and intensity of activities of fishery officers;
- increase in number of field extension staff;
- strengthen cooperation with fishing companies and jetties;
- develop a close cooperation with universities;
- build capacity through joint project with companies and universities;
- establish a Marine Research Centre in analogy with the soon to be opened Freshwater Research Centre;
- development of a skills framework meeting the criteria of Myanmar's National Skill Standard Authorities (NSSA);
- harmonisation of competency levels of educational system with international standards.

At the closing briefing meeting, the team provided a table showing the needs and issues identified during the kick off meeting and those that emerged during the site visits and interviews. The participants were asked to discuss in small groups to (1) identify any additional needs and issues that were not listed and

(2) make a ranking of priorities. The closing meeting was attended by representatives from the universities, MHE and MLFRD.

For marine and inland capture fisheries, the participants identified quality, market access, stock management, reduction of environmental impact, co-management and conservation management to be the most important needs. However, none of these was clearly ranked as a top priority. For aquaculture, farming high value species was clearly identified as the top priority, followed by market access and the promotion of indigenous species.

In the ranking exercise, the needs for policy makers included the ecosystem-based approach, cooperation between government departments on practical laws, and a policy based on sustainability and not on productivity. No clear prioritisation for the se was given. This was not the case for the identification and prioritisation of knowledge needs, where the revision of the curricula emerged as the top priority, followed by the establishment of a Faculty of Fisheries Sciences and by international cooperation.

Appendix 5 provides an overview of all issues and needs identified per sector and the ranking of priorities as carried out during the closing briefing meeting.

From the discussion, it was concluded that the following components are key for the development of a vision for sustainable and economically viable fisheries and aquaculture in Myanmar.

- development of an ecosystem-based approach to aquaculture and fisheries management;
- developing an effective fisheries (co-) management system;
- increasing international market access by producing good quality, high value species;
- increase cooperation between government departments;
- increase cooperation between public and private sector.

3.3.2 Needs of private sector in Myanmar

During the trade mission and the K2K mission, the team visited a number of private companies. Based on the visits and discussions, an analysis was made of the needs of the Myanmar private sector in support of its economic development.

Marine fishing companies

Production of seafood is for local consumption but also for export. At the moment, China and Singapore are important markets and sales are in bulk and at relative low prices.

The fishing companies and jetties identified the following needs:

- EU and US export approval;
- improved market export prices;
- management of the fisheries to ensure stock reproduction;
- improvement of at-sea control and enforcement system

Aquaculture (fresh water) sector

The main bottlenecks for both small farmers and for vertically integrated farms are: (a) fish diseases (parasites; *Streptococcus*) during the dry season, (b) water scarcity & quality (turbidity, oxygen levels, algal blooms) during the dry season, (c) introduction of high value species & promoting indigenous species, (d) post harvesting technologies, market access to EU and US (including compliance with regulations) and (e) climate change adaption. In general these bottlenecks imply that production is far from optimal and therefore profitability in aquaculture can be drastically increased.

The interviewed fish farmers indicated that they are eager to increase exports to the EU and the US with a specific focus on tilapia.

Freshwater fish farmers of Myanmar have great experience in integrated aquaculture systems in large to very large ponds. In 2007, they tried to grow tilapia to plate size for the export market. These attempts proved unsuccessful. The main reasons mentioned were: (1) inbred all male tilapia from Thailand due to the use of one line for the males and the females, and (2) price competition from Chinese tilapia growers subsidised by their government.

It is clear to fish farmers that monoculture of tilapia needs a different approach to fish ponds and fish stock management. Knowledge needs identified were:

- aquatic ecology/limnology;
- water management: quantity and quality;
- hatchery and nursery management;
- recirculation technology;
- broodstock management;
- stocking strategies;
- tilapia ethology;
- tilapia feeds;
- disease prevention and recognition;
- hygiene.

Myanmar processors

The fish and shrimp processors visited during the mission are EU and US approved and under control of the authorities of the governments. The main need identified was the development of an export market, for which a steady supply of larger fish is needed. The processors considered tilapia and pangasius to be the main opportune species considering there is already a market for them.

3.3.3 Needs of Dutch companies

During the trade mission and the K2K mission, Dutch companies who are interested in doing business in Myanmar found that there are a lot of opportunities for export of fresh water and marine fish products from Myanmar. The European market can be interesting for the Myanmar fishing industry and trade companies. To meet the requirements for the European markets necessary improvements must be made.

For the fresh water aquaculture, these include:

- use of two lines within YY-technology for the production of tilapia (see Box 1);
- ensure a constant supply of good quality tilapia;
- improve pond management to tackle disease issues and fish mortality;
- seek internationally acknowledged certification of responsible farming practices;
- develop aquaculture around a green and sustainable image.

Box 1: One vs. two line YY technology

In Myanmar, tilapia farmers only use one line for the XY-males and the XX-females. This system provokes inbreeding. When using TWO lines, as within the YY-technology - one YY line (YY-males + YY-females) and one mixed line for the XX-females -, it will give a better performance (stronger, faster growing, better food conversion) of their offspring than being expected from the initial parents. We call this effect heterozis or hybrid vigour.

For the marine fisheries, the following improvements are considered necessary by (potentially future) Dutch trade partners:

- on board quality improvements: storage cooling / freezing on board;
- fishing gear improvements aimed at reducing by-catches of small shrimp and fish and other marine organisms;
- improve labour conditions on board;
- electronic landings registration system;
- introduction of an effective fishery management system that ensures the long term sustainability of the fish stocks.

In addition to improvements in the aquaculture and fisheries sectors, the Dutch companies also identified a number of needs related to the improvements of competencies and skills of Myanmar employees involved in setting up and maintaining trade connections. These include:

- a high level of spoken English proficiency;
- strong presentation skills;
- good knowledge of the international market demands for fish products.

3.4 Practical knowledge for a sustainable sector

The development of a strong export market to the EU and USA is a key objective of Myanmar's government and its private sector. "Obtaining EU approval" was heard as an objective of all companies we visited. This is also the case for the Myanmar Fisheries Federation and the DoF. Myanmar authorities should be aware that obtaining EU (or USA) approval in itself will not guarantee a successful export programme.

First, consumer awareness of negative environmental impacts of fisheries and aquaculture is increasing in the EU, USA and Australia as well as increasingly in south East Asian countries like Japan (MSC, 2014). Retailers in these regions generally demand 'proof of sustainability' from their suppliers. This has resulted in a strong increase in certified or labelled seafood products. Some global retail leaders even have a strict private policy that only fish products carrying the Aquaculture Stewardship Council (ASC) or Marine Stewardship Council (MSC) label are sold on their shelves. It is therefore expected that when Myanmar seeks to export in aquaculture or capture fisheries products, buyers will ask questions about the environmental status of production. The same is to be expected for social issues, such as labour conditions on farms or on fishing vessels because socially responsible production (Fair Trade) are nowadays part of the mind-set of fish buyers as well.

Second, the focus for freshwater aquaculture development is very much on tilapia (and potentially pangasius). It is important to note that the international markets for these species are already saturated and will therefore be hard to compete. To find a niche market a Cost Leadership Strategy could be followed. A Cost Leadership Strategy aims to produce a product at the lowest possible costs (Porter, 1985). In the case of tilapia in Myanmar, it would focus on producing in a more cost efficient way than other tilapia from Southeast Asia. Alternatively, a Differentiation Strategy (Porter, 1985) could be followed to increase the value of the product, in this case by finding niche markets. As Myanmar is at present one of the smallest tilapia producers in Southeast Asia, it is not likely that its tilapia can compete with competitors such as China (highly subsidised production), Indonesia, the Philippines and Thailand. Therefore a Differentiation Strategy is likely the preferable option, also in view of current developments in the US and EU markets. In this context is relevant to note that sex reversal by using hormones may be banned in more states in the US. In the EU, there is increasing attention for the use of antibiotics and potential consequences for human health. This might offer an interesting niche for Myanmar.

There are international market opportunities for tilapia that is produced in a more sustainable and 'green' manner. A growing group of consumers is willing to pay for a responsibly produced, higher quality product. Certification or labelling by an internationally renowned scheme such as Aquaculture Stewardship Council (ASC) can be an important aspect of this.

In view of the 'virgin image' of Myanmar as a relatively recent emerging country, the country is still able to create its own 'green and sustainable' image from scratch. With such an image, Myanmar may take a strong competitive position for export to the US and EU. The needs identified by public stakeholders from Myanmar and private stakeholders from Myanmar and The Netherlands fit very well with the development of such a green image. The enthusiasm of the Myanmar stakeholders displayed to meet this challenge in combination with (a) the opportunities provided to the universities by the national education reform policy, (b) the interest in Myanmar by programmes from amongst other the EU, USA and Australia, (c) the ongoing work of World Fish MYFISH project, (d) the fast development of internet access in the country and (e) the interest of the Dutch private sector to work with Myanmar partners are strong drivers to develop the necessary capacity and knowledge infrastructure for the development of a sustainable fish sector.

A first opportunity to build capacity around these themes was given in three basic workshops during the K2K mission. One workshop focussed on governance for sustainable fisheries, the second on experiences with innovations in and knowledge sharing on more sustainable fishing gears in The Netherlands, and the third on tilapia hatchery management, quality control and the prevention of fish disease. The workshops were all well and actively attended, illustrating once again the enthusiasm and willingness of public and private stakeholders in Myanmar to work towards a sustainable and competitive seafood sector. Workshop reports are provided in Appendix 3.

3.5 Future capacity building

During the 2K2 mission, it became clear that there was substantial interest from university professors and representatives from the MHE to develop more competency based curricula. The Netherlands Fellowship Programme (NFP) for Tailor-Made-Training (TMT) Programme could offer opportunities for the future. This programme managed by NUFFIC on behalf of the Netherlands government provides an opportunity to develop the necessary capacity and knowledge infrastructure at the universities. A tailor-made training course is designed to meet specific needs of a requesting organisation. The TMT focusses on:

- market based professional competency profile descriptions and learning goal formulation, including a market needs assessment and assistance of the experts for the final common report with profile descriptions;
- development of students' competency oriented curricula and course descriptions, including a feedback workshop at each of maximum seven universities.

In addition, setting up concrete cooperative projects involving universities, companies and the authorities can provide a concrete platform for hands on capacity building. During an earlier EU scoping mission and in the aftermath of the 2015 Dutch trade mission preceding the 2K2 mission, a number of opportunities for potential public-private partnership pilot were identified. These include:

1. the development of two sustainable and inclusive business models for freshwater and marine aquaculture supply chains (tilapia and *P. monodon* shrimp), linking smallholder farmers to the business cases of larger companies, which will act as the drivers for change;
2. the development of one integrated pilot for marine shrimp fisheries focussing on enhancing sustainability and quality to enter the export market.

4. Conclusions and recommendations

4.1 Introduction

The K2K mission was tasked to analyse Myanmar's aquaculture and fisheries knowledge infrastructure and define gaps that may hinder building a sustainable sector. Here we briefly discuss the findings presented in chapter 3 in the context of developing an ecologically and economically sustainable sector that is also competitive in an international market context.

We close the chapter with a number of recommendations. In developing these, we were guided by some of the recommendations following from the *Second Policy Dialogue on Empowering Higher Education – A Vision for Myanmar's Universities* as reported by the British Council (2013):

- ✓ *Can't change everything! Setting priorities and focus on what is feasible – agree on a common VISION;*
- ✓ *Approach: Top down, bottom up or both? The vision should be drafted as part of a consensus building process;*
- ✓ *Need to find Myanmar solutions to Myanmar problems;*
- ✓ *Learning from the experience of neighbours and other countries.*

4.2 Conclusions

The current set up of the university education in Myanmar results in some mismatch between supply and demand on the labour market. The knowledge infrastructure is very much supply oriented and less oriented at the demands of the labour market. This means that students are not necessarily trained to develop the skills and competencies required for (sustainable) economic growth in Myanmar. At present, graduated students are simply not prepared for their jobs in private sectors or at governmental agencies. With the new education law being introduced, universities will get more autonomy which offers an opportunity to address this gap.

The management of the universities, however, seem to have no intention of changing their curriculum drastically. This contrasts with the needs identified by government stakeholders and the private sector. Considering that the natural resources are the basis of a sustainable economy and secure part of the staple diet of Myanmar people, they suggest that a more ecosystem-based approach to aquaculture and fisheries and a well-functioning fisheries governance system (including control and enforcement) are crucial. Moreover, to develop the desired export market for fish, quality improvements are needed.

Working with the private sector and establishing close links - or as one interviewee pointed out: "from education to practice and from practice to education" – is generally seen as the way forward. Policy-makers, the private sector and most individual professors we spoke with during our visit, therefore consider the redesign of curricula as a priority in support of these needs. The needs of 'the world of work' are hence not coherent with the views on changes to the curricula held by the larger university management.

The most urgent knowledge and capacity needs identified by public and private stakeholders include:

- developing fisheries, aquaculture, seafood processing masters specialisations that connect to business and societal needs;
- gaining experience in the field with businesses, governments and stakeholders;
- improving knowledge and understanding of research methods;
- improving students' oral proficiency in English;
- introducing skills and competency based education;

- strengthening pedagogic training for lecturers and professors;
- aligning with the international education system, its levels and standards.

The above needs should be placed in the context of the development of a common vision on the development of sustainable and economically viable aquaculture and fisheries sector in Myanmar. There is a five year plan ending in 2020 but this appears to be formulated in very general terms. A first step in support of the development of such a vision was done in the group discussions during the opening and closing meeting of the K2K visit. The participants identified the following components to be priority in such a vision:

- development of an ecosystem-based approach to aquaculture and fisheries management;
- developing an effective fisheries (co-) management system;
- increasing international market access by producing good quality, high value species;
- increase cooperation between government departments;
- increase cooperation between public and private sector.

With the new education law being introduced, universities will get more autonomy which offers an opportunity to address this gap. The management of the universities, however, seem to have a clear intention to make substantial changes to their curricula. This contrasts with the needs identified by government stakeholders and the private sector.

Stakeholders feel that a more ecosystem-based approach to aquaculture and fisheries and a well-functioning fisheries governance system (including control and enforcement) are crucial. This because natural resources are the basis of a sustainable economy and secure part of the staple diet of Myanmar people. Moreover, to develop the desired export market for fish, quality improvements are needed. Working with the private sector and establishing close links - or as one interviewee pointed out: "from education to practice and from practice to education" – is generally seen as the way forward. Policy-makers, the private sector and most individual professors we spoke with during our visit, therefore consider the redesign of curricula as a priority in support of these needs. The needs of 'the world of work' are hence not coherent with the views on changes to the curricula held by the larger university management. In order for a transition to a more demand oriented knowledge infrastructure that is able to support the development of a sustainable fish sector to be effective, this discrepancy has to be addressed.

The wish to develop a more ecosystem-based approach to aquaculture and fisheries and a well-functioning fisheries governance system (including control and enforcement) should also be put in the context of the objective to develop a strong export market to the EU and USA, which is a key objective of Myanmar's government and its private sector. Considering the on-going international developments with respect to environmentally and socially responsible seafood products, the Myanmar government and private sector should be aware that their future buyers will have demands beyond those that are legally required from a hygiene and quality perspective.

In the final paragraph, we provide a number of recommendations in support of capacity building and the improvement of the knowledge infrastructure.

4.3 Recommendations

Based on our findings, we propose 5 recommendations in support of future capacity-building for a sustainable and economically viable aquaculture and fisheries sector in Myanmar:

1. Develop a common vision for aquaculture and fisheries in Myanmar
2. Start specialisations in fishery, aquaculture and seafood sciences

3. Development of vocational training
4. Improve English proficiency
5. Working with the private sector in developing vocational and higher education curricula

1. *Develop a common vision for aquaculture and fisheries in Myanmar*

Effective capacity building will strongly benefit from a common vision on aquaculture and fisheries. Knowing the point on the horizon where Myanmar would like to be in 10 or 15 years from now and agreeing on actions and measures to achieve this will help to develop the knowledge infrastructure necessary to reach the milestones that are part of the roadmap to achieve the objective. We recommend the organisation of Policy Dialogue Meetings to further develop the current five year plan for fisheries and aquaculture including the identification of actions and 'owners of the actions'.

2. *Start specialisations in fishery, aquaculture and seafood sciences*

Myanmar stakeholders have identified a number of urgent needs for education. These include more international exposure of staff and students, specialisations in disciplines, profile and strategy development, cooperation between universities, a revised curriculum, a new faculty of fisheries science and a professional school of fisheries. This is an ambitious list of needs that cannot be implemented simultaneously. To be able to serve society in the short term, the team recommends starting a dedicated MSc programme of 4 semesters with a supplementary internship. The modules in the first semester of the MSc could be identical for all universities involved aiming to develop an MSc in fishery, aquaculture and seafood sciences. The second semester definitely needs to be different for the specialisation in seafood science that will focus on quality control from catch/production to product processing. Given the presently limited local expertise we advise to develop the specialisations each at a different university to increase efficiency and effectiveness and to become outstanding.

The team recommends the Ministry of Higher Education to support the development of MSc specialisations in the following domains:

- sustainable fisheries management;
- fresh water and marine aquaculture;
- fish diseases;
- river management and biodiversity conservation;
- water quality management;
- seafood processing and quality.

The students could be offered elective courses in, for example: communication for extension; participatory research methods; governance by stakeholders; entrepreneurship; cost benefit analysis. Some of the mentioned MSc specialisations require to be led by other departments than Zoology, and others might need the involvement of universities other than those of Science and Technology. In general the MSc require the establishment of a strong link with future fisheries institutes and industry for the internships after the 2nd semester. The 4th semester would be dedicated to a thesis.

To define the curricula for these MSc programmes in Myanmar, five steps should be carried out:

- i. Training of Trainers (ToT) in defining market needs based professional competency profile descriptions, including a stakeholder consultation; one of the results of this ToT is the methodology for the market surveys. Three professors/lecturers of the selected seven universities/department should participate;
- ii. a market needs assessment amongst the relevant future employers of the students and graduates to confirm the need for the aforementioned MSc's. This assessment should be led / carried out by the trained professors / lecturers;

- iii. a workshop to describe the professional competency profiles required according to the market needs assessment. Three professors/lecturers of the selected seven universities /departments should participate. This workshop should end with a session with the future employees of these future MSc graduates to receive their feed-back on the propositions;
- iv. a ToT in defining learning goals, and designing competency oriented curricula and student' competency oriented module/course programs. Three professors/lecturers of the selected seven universities /department should participate. This ToT can directly follow upon the workshop above, described in step 3;
- v. on-site support of the above mentioned professors/lecturers in the selected universities to broaden the skills-basis for above steps. This support should be given during a workshop in defining learning goals, and designing competency oriented curricula and student' competency oriented modules.

All workshops should use 'student' oriented teaching methods in order to get the participants exposed to and trained in such methods.

We recommend the departments aiming to start an MSc in fisheries, aquaculture and seafood sciences to submit an application to the NUFFIC NFP for this TMT Programme. A TMT has to be carried out by a Dutch training provider. Proposals may be written jointly. (www.nuffic.nl/en/library/detailed-information-about-the-nfp-tailor-made-training-programme.pdf). The NUFFIC TMT has a maximum grant limit of 200,000 euro. K2K team member Wageningen UR proposes to assist the application. Following a successful application, a TMT will be held in Myanmar. The workshop will be led by experts from Wageningen UR and Vietnam, and involve 2 to 3 professor/lecturer from each of the selected Myanmar' universities. The latter will then be able to train her peers.

3. Development of vocational training

Next to the MSc's, in cooperation with the DoF and the professional field, Myanmar should develop vocational training that might become a professional BSc. There are opportunities here with NUFFIC and GIZ.

4. Improve English proficiency

To prepare for international exposure through MSc, research internships, training or workshops, the universities should offer their (junior) lecturers classes in English communication (listening, speaking). All staff having a local MSc or PhD should demonstrate sufficient level of English through a test, before being admitted for international exposure.

5. Working with the private sector in developing vocational and higher education curricula

To make Myanmar's educational system on aquaculture and fisheries meet the needs of the private sector and society at large, the private sector should be involved in the development of the curricula and research programmes. Experiences from all over the world show that public-private partnership models to address problems and work towards sustainable solutions can be highly effective. Establishing effective partnerships will offer great opportunities to develop capacity for sustainable aquaculture and fisheries development. Hands on capacity building in such partnerships between the Myanmar universities, government and the national private sector can be an effective, fast track way to achieve concrete socio-economic and learning goals. By teaming the needs of companies, research and vocational institutions and the government, 'on the job' experiences can be gained to inform the further development of the knowledge infrastructure for the development of a sustainable and economically viable aquaculture and fisheries sector in Myanmar.

During the EU scoping mission and in the aftermath of the Dutch trade mission preceding the K2K mission, three cooperation opportunities were identified.

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Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2015. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 1th of April 2017 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

Justification

Rapport ~number~

Project Number: ~number~

The scientific quality of this report has been peer reviewed by a colleague scientist and the head of the department of IMARES.

Approved: Edward Schram
Aquaculture researcher

Signature:

Date: 11 May 2015

Approved: John Schobben
Head of the Fish Department

Signature:

Date: 11 May 2015

Appendix 1: K2K team members

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Appendix 2: List of meetings and site visits

2 February 2015

- Meetings at the Department of Fisheries as part of the Trade Mission. Attendants included His Excellency the Minister for Fisheries, representatives of the Department of Fisheries and the Department of Higher Education, representatives of Myanmar Fisheries Associations, the participants in the Dutch Trade mission, and representatives of the European Commission.
- Meetings at the Myanmar Fishing Federation as part of the Trade Mission. Attendants included His Excellency the Minister for Fisheries, representatives of the Department of Fisheries and the Department of Higher Education, representatives of Myanmar Fisheries Associations, the participants in the Dutch Trade mission, representatives of the European Commission, and representative from Duane Morris.
- Site visit to jetty and fish sale market.

These visits took place as part of the Trade Mission programme.

3 February 2015

- Site visits to fresh water sector. These included: 1 DoF laboratory, 2 fresh water fish farms, 1 feed mill, 1 commercial hatchery, 1 processing company.
- Company visits to jetties, fishing companies and processors

These visits took place as part of the Trade Mission programme.

4 February 2015

- Meeting at DoF. The team was welcomed by the DDG's of DOF and of Direction of Higher Education of Southern Myanmar (DHE). Other participants included DOF's head of training and professors from various universities. The K2K team presented the on-going research in fisheries and aquaculture at Wageningen UR, and the educational approach of Wageningen University. The latter included examples on the MSc Marine & Aquaculture Management, and the methodological support provided to Vietnamese universities in designing curricula that provide the student with the competencies needed by the future employees.
- Site visit to DOF's Institute of Fisheries Technology, Yangon.
- Further opportunities to discuss knowledge needs and infrastructure at Trade Mission network reception.

5 February 2015

- Visit to the laboratory of the Zoology department of the University of Yangon.
- Meeting at DHE for Southern Myanmar. Participants included representatives from the DEH and university professors, in particular from the University of Yangon.
- Meeting at West Yangon University. Group meeting with Rector and professors from all university departments. The visit included a tour of the microbiology laboratory.
- Meeting at Dagon University. Group meeting with Rector, co-rector and some professors from several university departments.

6 February 2015

- Visit to Maubin University. Besides a meeting with the Rector, several co-rectors and a huge number of professors, the team also had the opportunity to meet BSc, MSc and PhD students of Zoology, and to visit the facility for practicals in aquaculture.

- Visit to DoF hatchery which is supported by MYFISH, an AUSAID project carried out by World Fish. The team was accompanied by 3 zoology professors of universities of Maubin, Mawlamyint, and Yangon.
- Workshop: Governance for sustainable fisheries
- Workshop: Dutch fisheries: challenges and innovations
- Workshop: Tilapia hatchery management and quality control

7 February 2015

- Presentation of preliminary results at DoF. Participants: representatives from MoE, MLFRD, universities and World Fish.

Appendix 3: Workshop reports

Workshop 1: Governance for sustainable fisheries

Dr Nathalie Steins of Wageningen University & Research gave a workshop on Governance for Sustainable Fisheries. The workshop was attended by over 25 representatives from universities, MFF and DoF. After setting the context for the need for sustainable fisheries through an interactive fish game, the workshop gave a basic introduction to key concepts in the management of fish stocks. The relation between fishing pressure and stock biomass was explored and put in relation to achieving maximum yield. Management tools regulating access to the fishery and the need to involve stakeholders in the management cycle were discussed. The workshop also focussed on the role of the market in driving sustainable fisheries and aquaculture. Retailers in Europe, USA, Australia but also China and Japan are increasingly demanding proof of sustainable production; this goes beyond environmentally sustainable but also includes social issues like good labour conditions. Labels for environmentally sustainable fisheries and responsible aquaculture such as Marine Stewardship Council (MSC) and Aquaculture Stewardship Council (ASC) were highlighted as preferred labels in the markets for which also capacity building and funding support are available. In this context, the concept of Fisheries Improvement Projects (FIPs) was introduced. FIPs are deliberate, managed and sustained efforts to improve the environmental performance of a fishery and are mostly carried out as partnership projects between industry, science, governments and NGOs. They start with a gap analysis which then forms the basis for a clear route map to sustainability. FIPs allow for identification of clear targets. They bring partners together to work towards clearly defined goals in a stepwise approach to achieving a sustainable fishery. Toolboxes for FIPs and (funding) support are available through a number of organisations, such as MSC, ASC, Sustainable Fisheries Partnership but also through capacity building programmes of World Fish, Solidaridad and Wageningen UR.

During the workshop, there was a lively debate amongst the participants on the application of FIPs and the development of sustainable fisheries management in Myanmar. The data of landings at the jetties in Myanmar provide important information for a basic stock assessment and could serve as a basis for setting management targets and a management strategy. When starting with FIPs, it is important to start small to keep it manageable and use the FIP to build capacity and experience. A potential FIP candidate project could be the tiger prawn fishery. Working with one jetty and a number of boats, a partnership projects between the Myanmar and Dutch private sector, government and universities with external capacity building support could be set up to analyse the gaps in meeting international sustainability criteria and improving quality of the product. The international Marine Stewardship Council criteria could serve as a basis for a gap analysis and a step by step action plan to address prioritised areas where improvement is needed. Representatives from MFF pointed out the needs to get a close relationship with the universities while universities pointed out the need for more practical experience in the curriculum. A field visit from the universities (professors and students) and representatives from DoF to one of the jetties was suggested as first practical step to establish and strengthen this relation. It would allow the students to get a practical insight in how the jetties operate and together with the fishing companies they could look into research questions and assignments (e.g. mapping the development in landings patterns over the years; conducting a market analysis; gap analysis for environmental sustainability). This would benefit capacity building at all levels. A similar approach could be taken for aquaculture.

Workshop 2: Dutch fisheries: challenges and innovations

Kees Taal (senior researcher Wageningen University & Research), Anton Dekker (fleet manager Cornelis Vrolijk fishing company) and Jacco Numan (Primstar BV fishing company) gave a workshop on challenges and innovation in the Dutch marine fisheries.

The workshop was held at Shwe Zu Ye Hein jetty. A presentation was given to some 20 owners of Myanmar fishing companies, managers of the jetty, traders in fish, lecturers and researchers. Some examples of challenges for the Dutch fishery sector were given. These were also partly applicable to the Myanmar sector. The Dutch approach to deal with challenges for the fishery sector was presented and common issues were discussed. The approach includes close cooperation between fishing companies, research, NGOs and government. So called Knowledge Groups of fishermen where issues are discussed and experiences to address these issues are shared, play a key role. Special attention was given to fishing methods and gear (nets), research of fish stocks, cooling/freezing opportunities on board, markets and export of fish and cooperation opportunities between fishermen and researchers.

Workshop 3: Tilapia hatchery management, quality control and disease prevention

Eric Bink and Hanneke van den Dop gave a workshop about the management of a modern tilapia hatchery. The first part of the workshop was about recirculation systems in a modern tilapia hatchery and nursery. The working of such systems was explained and the importance of the use of such systems in the first 6 weeks of the tilapia larvae. During these first 6 weeks the whole body of the fish has to be build up; hormone system, enzyme system, organs AND the immune system. The latest is very important to have full control over the larvae and recirculation systems are ideal in this phase of fish life.

In the second part, the focus was on feed and feeding, genetics and the YY-technology, broodstock management.

The third part was on signals of fish unease, recognition of diseases and prevention.

Three videos were shown:

1. Til-Aqua International hatchery in the Netherlands;
2. A modern hatchery and nursery in Ghana, Africa;
3. A modern African Catfish hatchery in The Netherlands and induced spawning.

Appendix 4: Actions Myanmar's Department of Higher Education programme

Myanmar's Department of Higher Education programme of the 30.3 2011 to 1.3 2012 listed a long list of actions:

- To upgrade the quality and the socio-economic status of educational personnel
- To provide scholarships, stipends and awards both locally and internationally
- To promulgate relevant laws for the participation and contribution of private sectors in education To collaborate with local and international organizations including the UN, NGOs and INGOs
- To upgrade education standard to international level
- To review and revise the curricula of universities, degree colleges and colleges to be on parity with international standard
- To transform the existing administration and management system of universities into modern one. (till the establishment of autonomous universities)
- To transform higher education institution libraries into online libraries networking with prestigious universities of the world
- To set up Internet access and networks
- To improve the standards of present universities, colleges, and high, middle and primary schools
- To enact the education laws and rules and sartorial laws
- To transform some existing universities into autonomous universities
- To establish private universities after laws and rules and regulations are promulgated
- To use bilingual (English/Myanmar) as a medium of instruction in undergraduate classes
- To set up Faculties, combined with related academic departments
- To keep up Quality Assurance System
- To collaborate with Intentional Universities and Educational Institutions
- To establish Partner Universities
- To establish offices in Universities for International Relationship

Appendix 5: Results of group discussion on future needs

At the closing meeting of the K2K mission, a group discussion was held focussing on future needs for a sustainable and socio-economically viable aquaculture and fisheries sector. This meeting was attended by representatives from the universities, MHE and MLFRD. Tables A to D below give an overview of the issues and needs identified as well as the prioritisation that was given to them.

Table A: Issues and needs for marine and inland fisheries

Topic (in order of mentioning)	Ranking*
Climate change adaptations	0
Quality	1
Stock management	1
Environmental impact	1
Ecosystem based approach	1
Gear optimisation	0
Invasive species	0
Market access	1
Assessment of marine species diversity	0
Catch quantity CPUE	0
Export quantity and quality	0
Post harvesting technology	0
Co-management fisheries	1
Rehabilitation of habitat	0
MSY (Maximum Sustainable Yield)	1
Adding value to products	0
Conservation management framework	1

* Expresses the number of times the topic was identified as 'most important' by participants

Table B: Issues and needs for aquaculture

Topic (in order of mentioning)	Ranking*
High value species	3
Market access	2
Post harvesting technology	1

Promote indigenous species

* Expresses the number of times the topic was identified as 'most important' by participants

Table C: Issues and needs for policy makers

Topic (in order of mentioning)	Ranking*
Institutional capacity building	0
Ecosystem based approach	1
MSY (Maximum Sustainable Yield)	0
Stakeholder collaboration	0
Cooperation between gov. departments on practical laws	1
Law enforcement & control	0
Policy not based on production but sustainability	1
Align with international agreements	0
Linking government, university and industry stakeholders	0

* Expresses the number of times the topic was identified as 'most important' by participants

Table D: Needs for knowledge and education

Topic (in order of mentioning)	Ranking*
Revise curriculum	4
Faculty Fishery Science	1
Professional School of Fisheries	0
International collaboration	1
Integration departments universities	0
Post harvesting technology	0

* Expresses the number of times the topic was identified as 'most important' by participants

To explore
the potential
of nature to
improve the
quality of life



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IMARES (Institute for Marine Resources and Ecosystem Studies) is the Netherlands research institute established to provide the scientific support that is essential for developing policies and innovation in respect of the marine environment, fishery activities, aquaculture and the maritime sector.

The IMARES vision

'To explore the potential of marine nature to improve the quality of life'

The IMARES mission

- To conduct research with the aim of acquiring knowledge and offering advice on the sustainable management and use of marine and coastal areas.
- IMARES is an independent, leading scientific research institute.

IMARES Wageningen UR is part of the international knowledge organisation Wageningen UR (University & Research centre). Within Wageningen UR, nine specialised research institutes of the DLO Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment.

