Fisheries Human Resource:
Gaps and Requirements of Southeast Asia

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SEAFDEC conducted a survey of the Existing Human Resources and Expertise in the ASEAN countries in order to review the available human resources in fisheries in the region, and identify the gaps and areas where human resources may be limited and would be required in the future. The survey was also envisaged to support human resources development (HRD) in fisheries by building and enhancing the capacity of fisheries officials, government officials engaged in fisheries activities, as well as other stakeholders, while recognizing that it is through HRD that the contribution of fisheries to food security could be sustained and further enhanced. The survey specifically aims to determine the availability of expertise in various disciplines of fisheries in the fisheries-related agencies and institutions in the ASEAN countries; and identify the areas where fisheries human resources are limited and where further HRD activities may be required in the future.

Fisheries is one of the most important sectors contributing to socio-economic developments in the Southeast Asian region. While moving towards global competitiveness, countries in the region have been confronted with challenges threatening the sustainable development of fisheries resulting from irresponsible utilization of the fishery resources, increases in trans-national and trans-sectoral issues, stringent requirements for safety, quality and traceability of fish and fisheries products in the world market, as well as other emerging issues including the impacts of climate change to fisheries and aquaculture. In view of such challenges, the availability of human resources in the relevant fisheries disciplines is very crucial for the efforts of the countries to address such challenges. SEAFDEC and the ASEAN had always recognized the importance of human resources in the sustainable development of fisheries. As a matter of fact, the Resolution for Sustainable Fisheries for Food Security adopted during the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium: "Fish for the People" organized in 2001, specified the need to: "Acknowledge the need for enhanced human resource capabilities at all levels and encourage greater involvement by stakeholders to facilitate consensus and compliance in achieving sustainable fisheries" and "Mobilize regional technical cooperation to reduce disparities and promote solidarity among ASEAN Member Countries". In order to ensure the long-term availability of human resources for sustainable development of fisheries, it is necessary to review and have a clear picture of the current availability and gaps of relevant expertise, as well as the future challenges and other relevant information necessary to address such gaps and requirements of the region as a whole.

Survey of Existing Human Resources and Expertise in the Southeast Asian Region

Starting in early 2010, SEAFDEC initiated the survey on the "Existing Human Resources and Expertise in Fisheries in the ASEAN Member Countries" through questionnaires distributed to ASEAN countries to determine the existing human resources and expertise in fisheries-related governmental agencies, governmental universities/academes, private sectors and private universities and the academe. The questionnaire primarily focused on eight disciplines of fisheries, namely: fisheries biology, capture fisheries, fisheries management, aquaculture, fisheries post-harvest, laws and legislations, cross-cutting issues, and others, with more detailed disciplines under each scope. The inputs from the countries indicated in the returned questionnaires were compiled and analyzed by the Members of the Regional Fisheries Policy Network (RFPN) stationed at the SEAFDEC Secretariat in Bangkok, Thailand.

Brunei Darussalam

Brunei Darussalam has higher number of expertise in capture fisheries than in other areas. The most number of experts are in the 45-54 years old age range followed by 35-44 years old, where the experts were mostly men. However, for the younger age group of 25-34 years old, there were more women. Although in general, the available experts in fisheries were mostly men (> 74%) and in certain areas such as fisheries biology and capture fisheries, almost all experts were men, it should be noted that in Brunei Darussalam both men and women have similar working opportunities. The higher number of men than women may be due to their preference and the nature of some activities which could be more suitable for men than for women.

From the questionnaire survey, it could be gleaned that the expertise available in the country would not be sufficient to address the challenges and conditions of the fisheries industry (**Table 1** and **Fig. 1**). In particular, from the results of the survey it was indicated that climate change is a very

Table 1. Number of experts[1] in each discipline by gender and age group, Brunei Darussalam

Discipline	Gender		Total	Age Group				
	M	F		< 25	25-34	35-44	45-54	≥ 55
1. Fisheries Biology	11	1	12	0	0	4	7	1
2. Capture Fisheries (marine and inland)	29	0	29	0	0	11	18	0
3. Fisheries Management	10	7	17	0	0	7	10	0
4. Aquaculture	5	9	14	0	5	2	7	0
5. Post-harvest and trade	2	4	6	0	2	0	4	0
6. Laws and Legislation	2	0	2	0	0	0	2	0
7. Cross-cutting Issues	11	3	14	0	0	6	8	0
8. Others	9	7	16	0	0	6	10	0
Total	79	31	110	0	7	36	66	1

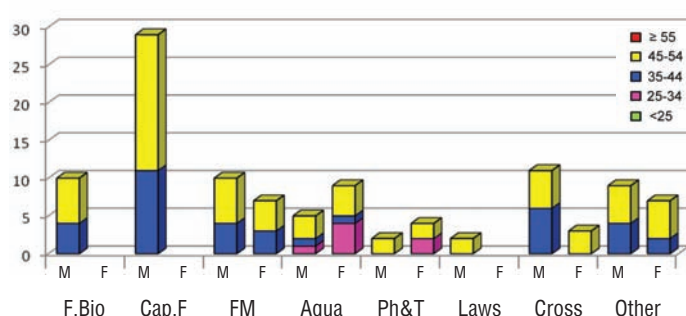[1] At the Department of Fisheries and University of Brunei Darussalam

Fig. 1. Number of experts by age group, gender and discipline, Brunei Darussalam

critical concern of the country but there are no expertise in such area in the country. In addition, there are also other fisheries disciplines where there is a need to further enhance the available expertise to enable the country to confront the emerging challenges especially in fisheries physiology, ecology, population dynamics, among others.

Cambodia

The Kingdom of Cambodia has an area of 181,035 km^2 and has two water ecosystems rich in fisheries biodiversity, the inland and marine waters. The inland ecosystems of Cambodia include the unique and beneficial hydrological system of the Mekong River and its tributaries, and the Tonle Sap Great Lake watershed, which together form a huge natural wetland covering about 20% of the country's total territory during the peak flood period in the rainy season. As for its marine waters, Cambodia has a small coastline of only about 435 km. The fishing activities in Cambodia's Exclusive Economic Zone (EEZ) comprise two main groups: coastal and commercial fisheries. There are four provinces of the country that border the sea: Koh Kong, Sihanoukville, Kampot and Krong Kep. The Fisheries Administration (FiA) of Cambodia supports the long-term human capacity development plan to ensure the availability of human resources in fisheries in the future for the sustainable development of fisheries, food security and food safety. The FiA has identified experts based or through their performance and specialization (**Table 2** and **Fig. 2**).

From the statistics on HRD of the FiA, there were 150 experts where female experts comprised only 8%. In the eight disciplines in fisheries, only few women were employed, *i.e.* in the field of fisheries biology (33%), fisheries management (50%), and post-harvest (17%). The women experts belonged to the 55 years old age range or 50% of the female staff, 45-54 years old (17%), 35-44 years old (25%) and 8% in the 25-34 years old group. The results further indicated that women were not involved in fisheries management, aquaculture, law and legislation and others. In this regard, it would be necessary for the FiA to encourage more women to be involved in each discipline of fisheries. In terms of the age ranges of the experts, 50% were over 55 years old, 35% belonged to the 35-44 years old group, 9% in the 25-34 years old range, and 6% in the 45-54 age group. Moreover, there is also comparatively higher number of experts in fisheries management followed by aquaculture and capture fisheries. However, most of the available experts are more than 55 years old.

Indonesia

The Ministry of Marine Affairs and Fisheries (MMAF) or Kementerian Kelautan dan Perikanan is the principal agency responsible for marine fisheries sector planning, management and administration in Indonesia. The Ministry comprised five Directorate Generals, namely: Aquaculture; Capture Fisheries; Marine, Coastal and Small Islands; Marine and Fisheries Resource Surveillance and Controlling; and Fisheries Product Processing Marketing; three Agencies, namely: Marine Affairs and Fisheries Research; Human Resource Development; and Fish Quarantine, Quality Control and Fish Product Safety; the Secretariat General; the Inspector-General; and Advisory Staff providing expertise to the Minister in specific fields. The information on the existing human resources and expertise in the MMAF provided to SEAFDEC may still be insufficient in terms of the actual number of experts as it did not cover all the technical directorates (*e.g.* Directorate General of Aquaculture).

Table 2. Number of experts in each discipline by gender and age group at the FiA, Cambodia

Discipline	Gender		Total	Age Group				
	M	F		< 25	25-34	35-44	45-54	≥ 55
1. Fisheries Biology	10	4	14	0	0	7	0	7
2. Capture Fisheries (marine and inland)	24	0	24	0	0	10	2	12
3. Fisheries Management	46	6	52	0	10	14	2	26
4. Aquaculture	30	0	30	0	0	11	4	15
5. Post-harvest and trade	6	2	8	0	1	2	1	4
6. Laws and Legislation	0	0	0	0	0	0	0	0
7. Cross-cutting Issues	20	0	20	0	2	8	0	10
8. Others	2	0	2	0	0	1	0	1
Total	138	12	150	0	13	53	9	75
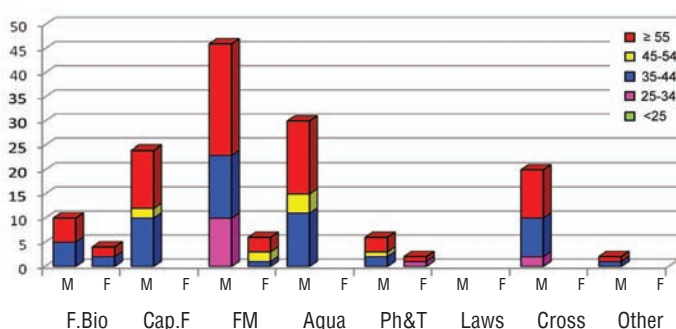
Fig. 2. Number of experts by age group, gender and discipline, Cambodia

The data presented are only the rough estimates as the result of survey does not fully represent the whole profile of Indonesian fisheries experts. Thus, of the more than 10,000 staff of MMAF, only 1,185 experts (12%) in various fisheries-related disciplines were verified, comprising 762 males and 423 females (**Table 3** and **Fig. 3**).

As indicated in **Table 3**, although in the overall the male experts seemed to be dominant in all fields of expertise (ratio of male to female is 1.8:1.0), the female experts also play an important role in some working areas such as post-harvest and trade, fisheries management and fisheries technology extension and transfer. The survey also revealed that there were almost four times as many males than

females engaged in the capture fisheries (ratio is 3.8:1.0), indicating broad ranges of their tasks and functions. Moreover, there seems to be lack of gender-technical expertise in the fields of aquaculture, fisheries biology, law and legislation, and cross-cutting issues (**Fig. 3**).

Results of the survey also indicated that the highest number of experts belongs to the 25-34 years old age group (474) followed by the 45-54 (319), the 35-44 (292), over 55 years old (56), and the least number in less than 25 years old group (44). Furthermore, there is more concern in the field of Fisheries Biology because 20 experts would be
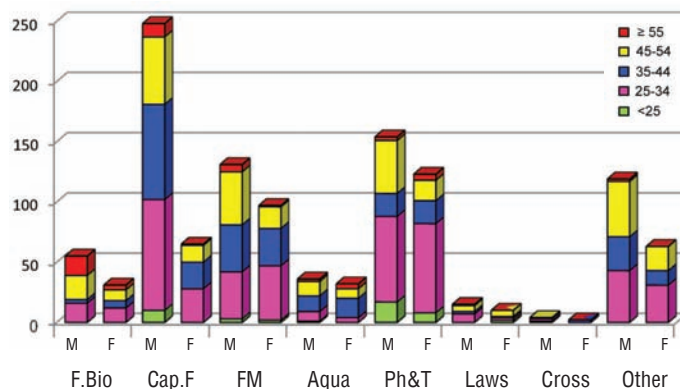

Fig. 3. Number of experts by age group, gender and discipline, Indonesia

Table 3. Number of experts in each discipline by gender and age group at the MMAF, Indonesia

Discipline	Gender		Total	Age Group				
	M	F		< 25	25-34	35-44	45-54	≥ 55
1. Fisheries Biology	55	31	86	0	28	9	29	20
2. Capture Fisheries (marine and inland)	248	65	313	10	120	101	70	12
3. Fisheries Management	131	97	228	5	84	70	62	7
4. Aquaculture	36	32	68	1	12	29	20	6
5. Post-harvest and trade	154	123	277	25	145	38	61	8
6. Laws and Legislation	15	10	25	2	9	3	10	1
7. Cross-cutting Issues	4	2	6	1	2	2	1	0
8. Others	119	63	182	0	74	40	66	2
Total	762	423	1185	44	474	292	319	56

Table 4. Number of experts in each discipline by gender and age group in Lao PDR

Discipline	Gender		Total	Age Group				
	M	F		< 25	25-34	35-44	45-54	≥ 55
1. Fisheries Biology	1	0	1	0	0	0	1	0
2. Capture Fisheries (marine and inland)	3	0	3	0	0	1	2	0
3. Fisheries Management	4	0	4	0	0	1	3	0
4. Aquaculture	38	12	50	0	22	18	8	2
5. Post-harvest and trade	0	0	0	0	0	0	0	0
6. Laws and Legislation	0	0	0	0	0	0	0	0
7. Cross-cutting Issues	0	0	0	0	0	0	0	0
8. Others	0	0	0	0	0	0	0	0
TOTAL	46	12	58	0	22	20	14	2
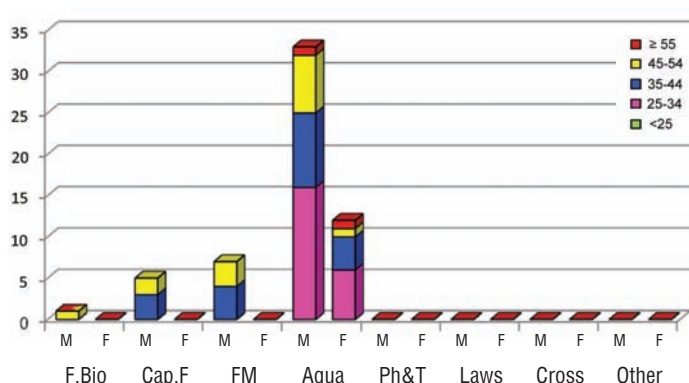
Fig. 4. Number of experts by age group, gender and discipline, Lao PDR

approaching retirement age (over 55 years old), and thus, more young experts should be encouraged to be involved not only in this discipline but in various fields of expertise.

Lao PDR

It was recognized that Lao PDR lacks well-trained and experienced personnel at all levels and in all sectors (**Table 4** and **Fig. 4**), posing a serious concern on the country's development. Moreover, as efforts are made to develop its human resource base, the demand for qualified, skilled or appropriately trained personnel, particularly managers, is ever increasing in view of the country's rapid economic development. Thus, there is an urgent need to make sustainable improvements in both the number of trained personnel and the quality of training to be provided.

As shown in **Table 4**, the highest number of experts was in aquaculture followed by fisheries management and capture fisheries, while most of the experts are available in the age range between 25-34 and 45-54 years old. Therefore, for the sustainable development of its fishery resources, the country should put more focus in its development efforts on formal and non-formal education, as well as in vocational skills training. Human resource development activities should also be closely linked with the future needs and requirements of both the public and private

sectors. Strengthened human resource capacity in all stages of development activities in Lao PDR would reduce its dependence on external technical assistance.

Malaysia

In Malaysia, full retirement age for all government servants is 58 years old. But optional retirement is also possible at any time between the 55 and 56 years old or under as recommended by the medical board. Planning and review of human resources in fisheries are in line with the organization's goals, missions, visions and values for 10, 15 years, and so on. The process involved identifying the areas or disciplines, activities, the number of staff to be hired, training, salary rates, operational budget, working environment, benefit, and health among others.

The human resource information based on the questionnaire survey comprised those from the Department of Fisheries Malaysia (DOFM) and universities in the country, namely: University of Malaya, University Malaysia Terengganu, University Sains Malaysia, and University Perguruan Sultan Idris Malaysia. The Department of Fisheries Malaysia included its support staff as experts while the universities considered only the academic staff. The study also considered the fact that one person may have more than one area or subject of expertise.

The results of the survey indicated that there were 1,198 experts in fisheries-related disciplines at the DOFM and in the four participating universities in Malaysia as shown in **Table 5** and **Fig. 5**, of which 76% (911 experts) were male and only 24% (287) were female. The sub-areas with the highest number of experts were Fisheries Management (504 experts) and Aquaculture (328 persons). There was no female expert available in Law and Legislation at the DOFM. Although Fisheries Management had the highest number of experts but the ratio between male and female experts was high at 17:3.

Table 5. Number of experts in each discipline by gender and age group, Malaysia[1]

Discipline	Gender		Total	Age Group				
	M	F		< 25	25-34	35-44	45-54	≥ 55
1. Fisheries Biology	61	35	96	1	17	20	13	45
2. Capture Fisheries (marine and inland)	89	11	100	0	43	11	25	21
3. Fisheries Management	422	82	504	0	193	140	133	38
4. Aquaculture	241	87	328	0	179	31	45	73
5. Post-harvest and trade	63	59	122	0	37	60	19	6
6. Laws and Legislation	13	2	15	0	0	2	7	6
7. Cross-cutting Issues	15	7	22	0	7	0	7	8
8. Others	7	4	11	0	1	5	3	2
Total	911	287	1198	1	477	269	252	199

[1] At the Department of Fisheries Malaysia and universities in Malaysia
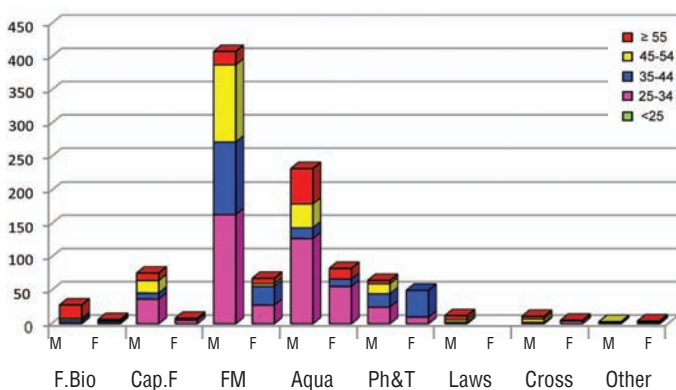
Fig. 5. Number of experts by age group, gender and discipline, Malaysia

The result of the survey however, was not representative of the whole scenario of Malaysian fisheries experts due to poor response from the institutions. As a result, this study could not conclude whether Malaysia has sufficient number of fisheries experts or not. Nevertheless, more accurate information about the total number of academic staff in universities could be collected if the questionnaire was made as simple as possible. In addition, more detailed information could also be collected from other departments such as Ministry of Science, Technology and Innovations (MOSTI) which compile all information regarding the researchers (government department and universities). Moreover, it should be noted that those in the age range between 25 to 34 years old are still new to be considered as experts in certain fisheries disciplines, and that management should also consider the cases of sudden death, resignation, and health conditions of skilled employees in order to make the organization work properly.

Myanmar
The fishery sector is considered as the most important sector after agriculture to realize the protein requirements of the people of Myanmar and to attain food security as well as afford opportunity for employment to a large number of fisheries/coastal and rural communities. The country's livestock and fisheries sector contributed 7.5% to national GDP in 2008-2009 fiscal years. Myanmar needs many experts who can contribute knowledge, information, and skills on the various fields/areas of fisheries. The Department of Fisheries (DoF) of Myanmar is the only government institution responsible for fisheries in Myanmar and has the highest number of fishery experts among government and private organizations (**Table 6**). Fishery experts are also available in private agencies such

Table 6. Number of experts in each discipline by gender and age group, Myanmar[1]

Discipline	Gender		Total	Age Group				
	M	F		< 25	25-34	35-44	45-54	≥ 55
1. Fisheries Biology	18	10	28	0	2	5	11	10
2. Capture Fisheries (marine and inland)	20	3	23	2	1	2	5	13
3. Fisheries Management	64	8	72	0	3	3	50	16
4. Aquaculture	179	70	249	4	65	101	55	24
5. Post-harvest and trade	7	31	38	1	4	21	6	6
6. Laws and Legislation	21	2	23	0	0	5	8	10
7. Cross-cutting Issues	1	6	7	0	0	4	2	1
8. Others	12	0	12	0	2	0	1	9
Total	322	130	452	7	77	141	138	89

[1] At the Department of Fisheries of Myanmar, government universities in Myanmar and the private sector of Myanmar
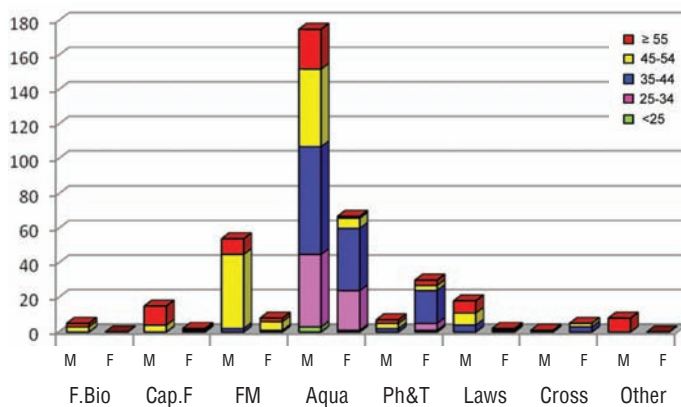
Fig. 6a. Fig. 6a. Number of experts by age group, gender and discipline, Department of Fisheries of Myanmar
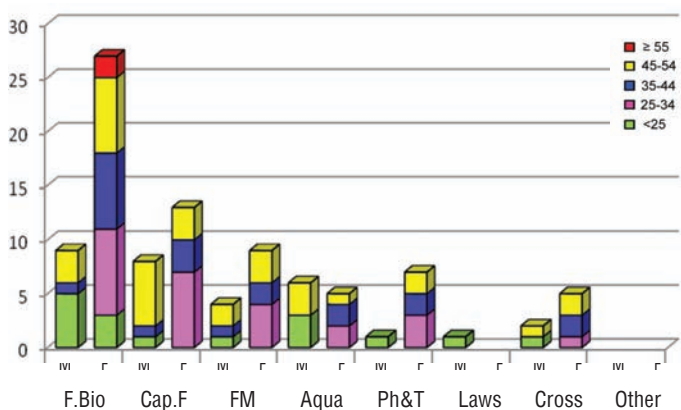

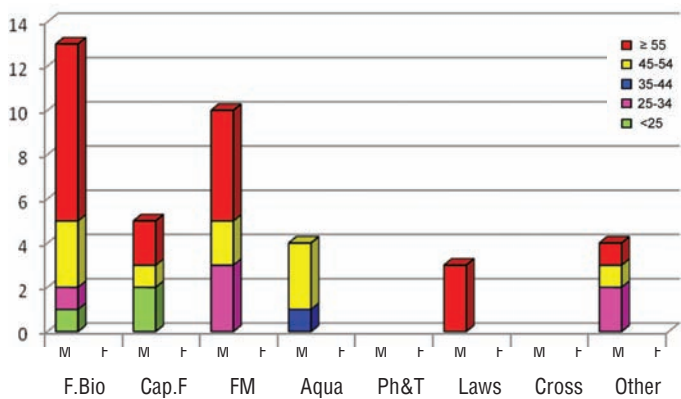Fig. 6b. Number of experts by age group, gender and discipline, government universities of Myanmar

Fig. 6c. Number of experts by age group, gender and discipline, private sector of Myanmar

as the Marine Science Association Myanmar (MSAM), Biodiversity and Nature Conservation Association, and government universities as shown in **Fig. 6a**, **Fig. 6b**, and **Fig 6c**.

The results of the study indicated that at the Department of Fisheries (DoF) of Myanmar there were more male (71%) experts than female (29%). In private agencies only male fisheries experts were available while more women were found in government universities than men, which could be due to the nature/field of work and working environment. In Myanmar, gender does not influence the availability of expertise in the various fields of fisheries. Aquaculture had the highest number of available expertise and the lowest was in area on cross-cutting issues. The DoF had the most number of expertise in the areas of aquaculture, fisheries management and post-harvest and trade while the government universities had more experts in fisheries biology, and the private agencies have experts in the fields of fisheries biology and fisheries management. However, there were less or insufficient number of "younger" fisheries experts in all areas except in aquaculture. Most of the government universities of Myanmar do not have specific course on fisheries, but fisheries subjects are included only in degrees majoring in Zoology as minor subject. Therefore, there is really a scarcity of human resources in terms of fisheries experts and qualified staff to teach fisheries subjects in government universities.

In terms of age groups, the highest number of experts belonged to the 35-44 age group followed by the 45-54 age groups in the DoF and government universities. On the other hand, private organizations have higher experts belonging in the > 55 and 45-54 age groups. In the DoF, experts were available in all areas and age ranges from 35-44, 45-54, and >55. However, in the areas of fisheries biology, fisheries management, law and legislation, cross-cutting issues and other (fisheries extension and technology transfer), the DoF lacks young experts (<25 and 25-34 aged groups). While there was no information on fishery experts in government universities in the field of fisheries management, post-harvest and trade, laws and legislation, in private agencies, most fisheries expertise were in the 45-54 and >55 age groups with the highest number in the >55 age group in various fields of fisheries except for post-harvest, trade, and cross-cutting issues.

Myanmar does not have specific fisheries institutions or training department in its educational system. In the DoF, it is necessary that expertise be developed through training in advanced technology at all fisheries areas. Therefore, the DoF of Myanmar is requesting international and regional organizations (*e.g.* FAO, ASEAN, SEAFDEC, and NACA) and the other Member Countries of SEAFDEC who are leading in fisheries technology to support the country's technology development and seriously consider providing assistance especially in the areas of aquatic genetic, stock assessment, ecosystem approach to fisheries and aquaculture, fisheries management, and capture fisheries (marine and inland) to fill up the human resources development gaps and requirements, as well as to build up the capacity of the young generation of staff to develop their expertise in fisheries. The government universities and private agencies reported that currently, their available fisheries expertise on the areas of climate change and fisheries, fisheries information and statistics, conservation

and management of aquatic resources, integrated fisheries management, ecosystem approach to fisheries, fisheries for food security, livelihood and poverty alleviation and socio-economic of fisheries were not sufficient and urgently need to be strengthened through human capacity building.

Philippines

The Philippine Bureau of Fisheries and Aquatic Resources (BFAR) of the Department of Agriculture (DA) is the lead agency mandated to manage, conserve, and protect the country's fishery resources. At present, the country's fishery sector employs over 1 million fishers and fish farmers mostly in the rural areas. Considering its long coastline that stretches over 36,000 km as well as the abundance and vastness of the country's marine resources, BFAR lacks the manpower compliment in terms of human resources to address the many problems confronting the fishery sector. Relevant skills and knowledge have to be acquired through

Table 7. Number of experts in each discipline by gender[1] and age group[2], Philippines

Discipline	Gender		Total	Age Group				
	M	F		< 25	25-34	35-44	45-54	≥ 55
Fisheries Biology	180	136	316	8	42	22	98	18
Capture Fisheries (marine and inland)	276	46	322	0	27	44	101	45
Fisheries Management	237	117	354	2	46	16	127	36
Aquaculture	286	186	472	0	76	35	171	36
Post-harvest and trade	52	172	224	0	33	19	63	31
Laws and Legislation	30	12	42	0	4	2	9	4
Cross-cutting Issues	149	137	286	0	40	30	113	29
Others	71	63	134	0	17	12	34	10
Total	1281	869	2150	10	285	180	716	209

[1] At the Bureau of Fisheries and Aquatic Resources (BFAR) of the Department of Agriculture, and government universities in the Philippines
[2] Only for BFAR
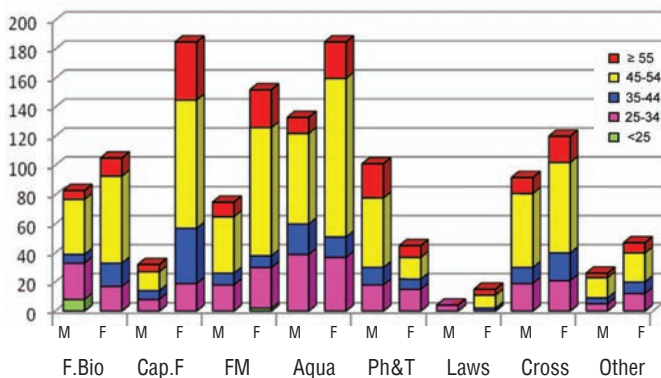
Fig. 7a. Number of experts by age group, gender and discipline, BFAR in the Philippines
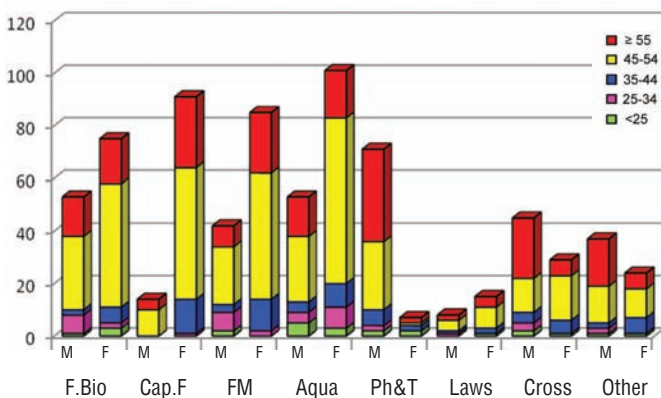
Fig. 7b. Number of experts by age group, gender and discipline in Philippine universities

the development of expertise in various areas particularly in the field of fisheries essential in formulating appropriate strategies to address various threats to food security and the people's livelihoods brought about by the changing climate. Although the responses to the questionnaire survey came from less than one-half of the intended respondents, the results indicated that there were more males (1,281) than females (869) involved or employed in fisheries in the Philippines (**Table 7**). A significant number of males were involved in aquaculture, capture fisheries and fisheries management which could be attributed to the physical demands in these particular areas of fisheries. On the other hand, the opposite can be observed in the post-harvest and trade sectors where females seemed to outnumber the males while the area on Laws and Legislation in Fisheries had the least number of experts both males and females.

As far as BFAR is concerned, the involvement of age group 45-54 years old is relatively high in the fields of aquaculture followed by fisheries management, cross-cutting issues, capture fisheries, and fish biology (**Fig. 7a**). This is followed by age group 25-34 years old in all fields except in capture fisheries. It should be noted that except for few experts in Fisheries Biology and Fisheries Management, there are no experts from the age group <25. Notably, the field of Fishery Laws and Legislations accounts for the lowest involvement of experts from all the age groups.

Compared to that of BFAR, in government universities many experts in the age group of 45-54 years old dominated the various fields except for the post-harvest area where age group >55 years old was dominant (**Fig. 7b**). It is interesting to note that although the next distinct group is the age group >55 years old, and since this is the age group where most experts would be retiring (the optional retirement age of civil servants in the country is 65 years old), there is a wide gap between senior staff and the younger age group.

The results of the survey further indicated that there was not enough manpower and technical expertise in BFAR to conduct research, training, and handle different interventions and challenges on fish production and on climate change. This had inhibited BFAR from proactively addressing the emerging issues on climate change. Shortage is partly blamed on the current government policy that inhibits recruitment of additional personnel. On the other hand, many government universities maintained that they have sufficient expertise or competencies most of whom are PhD and Master's degree holders in the various fields of fisheries. However, there were also few universities which conveyed the apprehension that more of what is remaining from their expertise would soon be retiring and some are also due to retire in the next 4-5 years thus, there is a need to tap or "entice" new and younger recruits.

Most respondents from BFAR asserted on the insufficiency or depletion of experts in certain disciplines and thus, requested to avail of opportunities for further training and education. However, the educational institutions on the other hand, were keen on providing more opportunities in terms of scholarship programs, training and seminar workshops for their faculty and the recruitment of young personnel, and financial aid for instructional and research programs of the universities. Moreover, the need for open admission to programs of Member Countries, sponsored by SEAFDEC, should be given consideration in the formulation of policies. Furthermore, SEAFDEC was requested to provide continuous updates on fisheries

development especially on the latest advancements in aquaculture, post-harvest technologies and capture fisheries, through strengthened linkages among SEAFDEC Member Countries in human resource enhancement such as training programs, scholarships, collaborative activities, and capacity building.

Singapore

For Singapore, the priority scopes of fisheries focused in the areas of post-harvest and trade, aquaculture, capture fisheries, fishery information and statistics, food security and poverty alleviation, and climate change. Although human resources with expertise were available in these disciplines, the country in general still confronted with the situation of lack of manpower and expertise in fisheries. The results of the questionnaire survey showed that both men and women fisheries experts were available in Singapore although in the areas of capture fisheries and fishery management the experts were all men (**Table 8**). There were gaps of expertise in the areas of importance, particularly on international cooperation and marine affairs, and climate change.

It should however be noted that, with increase use of technologies, changes in laws and regulations for fisheries
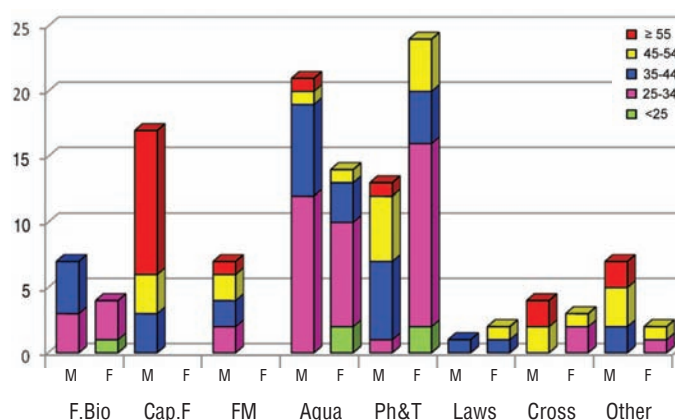

Fig. 8. Number of experts by age group, gender and discipline at the Agri-Food & Veterinary Authority of Singapore

Table 8. Number of experts in each discipline by gender and age group, Singapore

Discipline	Gender		Total	Age Group				
	M	F		< 25	25-34	35-44	45-54	≥ 55
Fisheries Biology	7	4	11	1	6	4	0	0
Capture Fisheries (marine and inland)	17	0	17	0	0	3	3	11
Fisheries Management	7	0	7	0	2	2	2	1
Aquaculture	21	14	35	2	20	10	2	1
Post-harvest and trade	13	27	40	2	15	10	12	1
Laws and Legislation	1	2	3	0	0	2	1	0
Cross-cutting Issues	4	3	7	0	2	0	3	2
Others	7	2	9	0	1	2	4	2
Total	77	52	129	5	46	33	27	18

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management, emerging requirements for environmental sustainability aquaculture and fishery practices, and requirements for safety and traceability of seafood products, there are even more needs for human resources to address these emerging challenges and requirements. Thus, in response to emerging challenges, Singapore identified the areas where expertise should be strengthened in the future, *e.g.* aquatic animal health, bio-security in aquaculture, fisheries post-harvest; international fisheries laws and regulations; international cooperation and marine affairs; fishing vessel/gear technology; on-board fish handling technologies; advanced open water technologies for marine and food fish; assessments of impact of large scale operations on the environment; fisheries information and statistics, fisheries extension and technology transfer.

Thailand

Thailand comprises 77 provinces, 23 of which are surrounded by the two main fishery areas, the Gulf of Thailand with a coastline of approximately 2,700 km and the Andaman Sea with 865 km. Marine fisheries is very important for the Thai economy and it is a main source of the world food fish supply. The Department of Fisheries (DOF) of Thailand reported that the aquatic production of Thailand in 2008 was around 3.2 million metric valued at about Baht 3,595.5 million while the country's export of fisheries products in 2007 was around 2.0 million metric tons valued at about Baht 5,966.0 million. About 76.6% of its aquatic production came from marine resources while 23.4% came from inland water resources. Two main organizations are involved in the country's fisheries development; the DOF and the Department of Marine and Coastal Resources (DMCR) with the Thai Royal Navy, Marine Department and Marine Police Division, as supporting agencies.

Results of the survey indicated that in Thailand gender is not much of a concern in fisheries. However, the data showed that the number of males involved in fisheries was higher than the women both at the DOF and government

universities, especially in fisheries management and aquaculture (**Table 9**). Specifically, the number of women experts was higher than that of men only in the post-harvest and trade and in the cross-cutting issues for the DOF but only in post-harvest and trade for the universities. Such discrepancy could be closely related with the processing of fisheries products which customarily requires women's capability.

At the DOF, experts are available in the age range of between 25 to more than 55 years old and the highest number of experts was in the age group between 35-44 years old. As shown in **Fig. 9a**, DOF had the highest
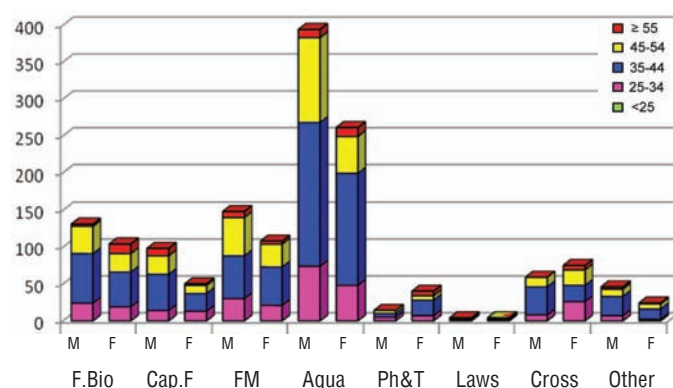
Fig. 9a. Number of experts by age group, gender and discipline at DOF of Thailand
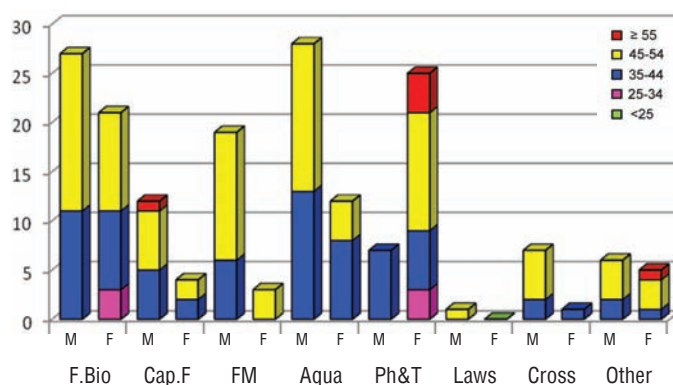
Fig. 9b. Number of experts by age group, gender and discipline in universities of Thailand

Table 9. Number of experts in each discipline by gender and age group, Thailand

Discipline	Gender		Total	Age Group				
	M	F		< 25	25-34	35-44	45-54	≥ 55
Fisheries Biology	158	125	283	0	46	133	88	16
Capture Fisheries (marine and inland)	110	54	164	0	27	80	44	13
Fisheries Management	182	96	278	0	51	116	99	12
Aquaculture	422	273	695	0	122	366	184	23
Post-harvest and trade	25	61	86	0	15	39	22	10
Laws and Legislation	5	4	9	0	2	2	4	1
Cross-cutting Issues	66	76	142	0	34	63	39	6
Others	52	29	81	0	9	43	24	5
Total	1020	718	1738	0	306	842	504	86

number of expertise in aquaculture while the number of expertise was quite high in fisheries management, fisheries biology and capture fisheries. However, the DOF also lacked the expertise in laws and legislation.

For the government universities, although the results could be limited because some universities did not return the questionnaires, the collated data indicated that experts were available in the age ranges between 25 to more than 55 years old and the highest number of experts was in the age group between 45-54 years old (**Fig. 9b**). In terms of areas of expertise, the highest number of experts was in fisheries biology followed closely by aquaculture and post-harvest and trade. While there was also lack of expertise in law and legislation because such experts had knowledge only in the international cooperation and marine affairs, the existing experts in this discipline were in the age range between 45-54 years old. This gap should be considered urgent and needs immediate attention. Moreover, the sampled universities also had few numbers of experts in the cross-cutting issues and in fisheries extension and technology transfer.

Conclusion and Recommendations

Although the survey received partial inputs only, the trend seemed to suggest that in the ASEAN countries, there are shortages in human resources especially in the governmental offices in the important disciplines of fisheries. The gaps and shortage are summarized in **Box 1**.

Therefore, it can be observed in **Box 1** that there are areas where expertise could be insufficient in several countries, especially in such disciplines as Plant Taxonomy, Physiology, Genetics, Population dynamics, Ecology, Limnology, Oceanography, Stock Assessment, Fishing ground/resources exploration, Ecosystem approach to

Box 1. Gaps and shortage of expertise in the Southeast Asian region	
Brunei Darussalam	• Climate change and fisheries (Not high priority areas) • Plant Taxonomy • Genetics • Limnology • Products Certification and Labelling
Cambodia	• Plant taxonomy • Physiology • Limnology • Fishing ground/ resource exploration • Fisheries navigation and engineering • On-board fish handling technologies • Fisheries socio-economics/bio-economics* • Grow-out technologies • Feed and Nutrition • Backyard and traditional fish processing • Product quality monitoring and control • Products certification and labeling • International cooperation and marine affairs • International fisheries laws and regulations

Indonesia	• Physiology • Population Dynamics • On-board fish handling technologies • Backyard and traditional fish processing • Product residual monitoring and analysis • Products certification and labeling • International fisheries laws and regulations
Lao PDR	• Plant taxonomy • Physiology • Genetics • Population Dynamics • Ecology • Limnology • Ecosystem approach to fisheries • Conservation and management of aquatic resources • Fisheries socio-economics/bio-economics • Post-harvest and trade (every subjects) • Laws and Regulation (every subjects) • Fisheries information and statistics • Fisheries for food security, livelihood and poverty alleviation • Climate change and fisheries
Malaysia	• Plant taxonomy* (expertise available in academe) • Limnology* (expertise available in academe)
Myanmar	• Plant taxonomy • Physiology • Genetics • Population dynamics (expertise available in academe) • Ecology (expertise available in academe) • Oceanography • On-board fish handling technologies • Stock assessment* • Ecosystem approach to fisheries • Fisheries socio-economics/bio-economics* • Fish processing factory/plants • Backyard and traditional fish processing • Products certification and labeling • Fisheries for food security, livelihood and poverty alleviation • Climate change and fisheries
Singapore	• International cooperation and marine affairs • Climate change and fisheries • Oceanography * • Stock Assessment * • Fishing ground/resources exploration * • Fishing Vessel/gear technology * (Not high priority areas) • Plant taxonomy • Population dynamics • Limnology • Integrated Fisheries Management • Fisheries-socio-economics/bio-economics

*   Possible shortage in the near future

fisheries, Fisheries socio-economics/bio-economics, Products certification and labeling, Climate change and fisheries, International fisheries laws and regulations, International cooperation and marine affairs. Thus, in order to enhance the capacity of existing human resources and ensure the availability of human resources in fisheries in the future, actions at the national and regional levels had been recommended as shown in **Box 2**.

Furthermore, based on the questionnaires and the feedback from the ASEAN countries, the enumerators as well as the

respondents encountered some difficulties (**Box 3**) during the survey, which should be taken into consideration especially when pursuing similar survey in the future.

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