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Organization of the
United Nations

REGIONAL CONSULTATIVE WORKSHOP

Strengthening Aquaculture Governance for Sustainable Development
in Asia-Pacific

Bangkok, Thailand, 2021



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REGIONAL CONSULTATIVE WORKSHOP

Strengthening Aquaculture Governance for Sustainable Development in Asia-Pacific

Bangkok, Thailand, 5-6 November 2019

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Preparation of this document

This publication is a product of the FAO-supported regional consultation on strengthening aquaculture governance for sustainable development in Asia-Pacific. The consultation consisted of two major activities, namely country assessment studies on aquaculture governance and a regional consultative workshop, jointly implemented by the Network of Aquaculture Centres in Asia-Pacific (NACA) and the FAO Regional Office for Asia and the Pacific in 2019. The workshop was held in Bangkok, Thailand from 5 to 6 November 2019.

The publication presents the background, objectives, consultation process, main conclusions, and recommendations from the consultation. Also included in the publication are the detailed outputs of the regional consultative workshop and the country assessment study reports.

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Summary

Aquaculture in Asia has contributed more than 90 percent of the global production over the past three decades and has played important roles in food security, poverty alleviation, livelihood enrichment, employment, and overall economic development in many Asian countries. Despite being a longstanding tradition in Asia, it is only in the past four or five decades that aquaculture has rapidly grown into a prominent food production sector. So far, good aquaculture governance has not been adequately implemented in many Asian countries. The fast growth has given rise to some of the most challenging sustainability issues such as low efficiency of resource utilization, negative environmental impacts, aquaculture diseases and food safety risks that in turn constrain further growth of the sector in sustainable manner. Aquaculture governance needs to be strengthened to effectively address these issues to sustain the much-needed growth of aquaculture to meet the increasing demand for aquatic food by a growing global population.

Aiming to build regional capacity in aquaculture governance, FAO and NACA jointly implemented a regional consultation in collaboration with NACA member governments to assess the status of aquaculture governance in Asia, share experiences and lessons learned in aquaculture governance among countries, and recommend strategies and actions for further improvement. The consultation consisted of two major activities: country assessment studies and a regional consultative workshop. The country assessment studies were carried out by seven national experts in seven selected countries including Cambodia, China, India, Indonesia, Malaysia, Thailand, and Viet Nam. The consultative workshop was conducted in 5-6 November 2019 in Bangkok, attended by 33 participants including experts and government officers from 15 Asian countries and representatives from FAO, NACA and the Asian Institute of Technology. The findings of the assessment studies were presented to the workshop, and participants then worked on identifying gaps, constraints, and challenges in aquaculture governance in the region and put forward recommendations for further improvement.

It was evident that significant progress has been made in aquaculture governance in the region as indicated by:

- i. the availability in most aquaculture producing countries of policies, laws, regulations, standards, guidelines that govern important aspects of aquaculture including use of natural resources, registration and licensing of aquaculture operations, feed and seed supply and quality, drug and chemical use, aquatic food safety, environmental impact control, biosecurity, biodiversity preservation, and labour rights protection;
- ii. the establishment of institutional and administrative frameworks and mechanisms for implementation of aquaculture governance;
- iii. the recent update and amendment of relevant fisheries laws in many countries such as Cambodia, China, Thailand, and Viet Nam to better cover aquaculture governance; and
- iv. the overall improved environmental performances of aquaculture and aquaculture food safety levels across the region.

Both internal and external factors have been driving the progress in aquaculture governance. The primary factor was the fast growth and expansion of aquaculture in the past four to five decades that transformed aquaculture into a major avenue of food security, which in turn requires better governance to optimize resource use and improve the sector's sustainability. Nevertheless, progress in aquaculture governance in certain areas is largely driven by external factors. For example, the increasingly stringent requirements for food safety by export markets have promoted regulations on aquaculture food safety and product traceability in the region and led to banning the use of antibiotics and certain chemicals in aquaculture.

There was considerable disparity in aquaculture governance among countries across the region. The governance coverage and its effectiveness in general varied with the degree of advance in aquaculture development. In addition, in contrast to the comprehensiveness of laws and regulations established in many countries, the enforcement of the laws and regulations is relatively weak.

The constraining factors affecting aquaculture governance included incomplete or incomprehensive governance coverage on certain governance areas, inconsistency in legislation processes and policies and regulations, lack of financial and human capacity for effective enforcement, lack of effective coordination among relevant agencies and different administrative lines, slow update of laws and regulations in response to emerging issues and modern concepts of sustainable development, lack of efficient monitoring and surveillance mechanisms for enforcement, and insufficient support to small-scale farmers.

It was recommended that (i) aquaculture should be further integrated into the overall national food production and nutrition security strategies with policy developed to prioritize aquaculture development; (ii) current laws and regulations should be periodically reviewed and updated with legislative procedures and processes being more harmonized, inclusive, and scientifically based; (iii) key responsible agencies such as the department of fisheries should be strengthened; (iv) capacity for aquaculture governance should be built with more resource input and human capacity development; (v) collaboration and cooperation among government agencies should be strengthened; and (vi) small-scale farmers should be empowered for better compliance of farming practices with regulations and standards.

Background of the regional consultation

Aquaculture in the region

Asian aquaculture has grown fast in the past four decades with an annual growth rate of about 8 percent during the years 1978 to 2018, contributing over 90 percent of the world's aquaculture production since 1993 and playing important roles in food security, human nutrition, livelihood enrichment and overall economic development in many Asian countries. The total volume of Asia-Pacific aquaculture reached 105 million tons with a value of over USD 223 billion in 2018 (FAO, 2020a). Per capita fish consumption in Asia increased from 10 kg in 1977 to 25 kg in 2018 and this constituted about 30 percent of total animal protein intake. Aquaculture contributed 60 percent of food fish supply in 2018 in Asia, but only 10 percent in 1977 (FAO, 2020b), and generated some 19.6 million jobs in the primary production sector in 2018 plus an additional almost equal number of jobs in related manufacture, construction and service industries (FAO, 2020c).

The rapid development of aquaculture in Asia has taken place over the past few decades, and the industry is relatively new. Thus, good governance has yet to be adequately implemented in many Asian countries, as indicated by for example the absence of required laws and regulations, and poor enforcement of existing laws and regulations. Good governance is fundamental and crucially important to tackle many of the challenging issues that impair the sustainable development of aquaculture, such as negative environment impacts, low efficiency of resource utilization, animal diseases and threats to food safety.

With the increase of the world population and improving living standards because of overall economic growth, fish consumption will continue to increase. With most wild fish stocks being fully exploited or overexploited, continuous aquaculture growth will be the major approach to meeting the increasing demand for food fish. The aquaculture sector is expected to contribute more to food security, nutrition, livelihoods, and overall socio-economic development. However, it is impossible to achieve the sustainable growth of aquaculture without improving its governance.

Need for improved governance

The Thirty-fifth Session of the Asia-Pacific Fishery Commission identified the lack of effective governance as a major threat to sustainable aquaculture growth thus jeopardizing its likelihood of making a greater contribution to the achievement of the Sustainable Development Goals (SDGs) of ending poverty and hunger and achieving food security and improved nutrition. The Commission recommended to the Food and Agriculture Organization of the United Nations (FAO) at its Thirty-fifth Session that a regional assessment of existing laws and regulations governing aquaculture and their enforcement should be carried out with some urgency and that a regional consultation on strengthening the governance of aquaculture be arranged at the earliest opportunity. The Regional Consultation on Strengthening Aquaculture Governance for Sustainable Development in Asia-Pacific was therefore proposed by FAO and jointly implemented by FAO and the Network of Aquaculture Centres in Asia-Pacific (NACA) in collaboration with NACA member governments. The regional consultation is an important regional activity under the FAO Regional Initiative on Blue Growth in Asia-Pacific, which started in 2014.

Goal, objectives and outputs of the consultation

The goal of the regional consultation workshop is to promote the sustainable growth of aquaculture so that it might make a greater contribution to food security and nutrition, poverty alleviation and overall socio-economic development through improved governance of the aquaculture sector in the Asia-Pacific. The objectives were: (i) to assess aquaculture governance in seven selected countries in Asia in terms of governance framework, policies and regulations, governing mechanisms, efficiencies and effectiveness, gaps and challenges; (ii) to share the experiences and lessons learned in aquaculture governance among countries; and (iii) to recommend strategies and actions to improve aquaculture governance in Asia. The main outputs of the regional consultation were a set of clear recommendations to strengthen the governance of the sector to ensure its long-term sustainability.

The regional consultation

Preparation

The regional consultation was initiated by the fisheries team of FAO Regional Office for Asia and the Pacific (RAP) under the FAO Regional Initiative on Blue Growth and approved by the RAP management for funding allocation. An FAO Letter of Agreement was signed with NACA who agreed to organize the regional consultation with FAO technical and financial support.

The consultation programme was prepared jointly by FAO and NACA, consisting of two main activities: country assessment studies on aquaculture governance and a regional consultative workshop. The implementation of the activities was managed by NACA in consultation with the responsible FAO technical officer.

Country assessment studies

The assessment studies on aquaculture governance was carried out in seven selected countries with the financial and technical support of FAO and NACA. The countries selected, namely Cambodia, China, India, Indonesia, Malaysia, Thailand, and Viet Nam, have different levels of aquaculture development. A national expert from each country was nominated by relevant government authorities at the invitation of NACA to lead the assessment study. The FAO responsible officer, Mr Miao Weimin, developed a detailed outline for the country assessment study. The NACA responsible officer, Mr Yuan Derun, and an international expert, Mr Wang Qingyin reviewed the draft reports prepared by the national experts.

The consultative workshop

The workshop was convened on 5 and 6 November 2019. Thirty-three high level government officials and experts from 15 countries, FAO, NACA, and the Asian Institute of Technology (AIT) participated in the workshop. The country participants included national experts recommended by their governments who undertook the country assessment studies as well as government-nominated participants for the workshop.

The workshop consisted of three main sessions – the opening and introductory session, plenary sessions and working group sessions – designed to achieve the objectives and deliver the expected outputs.

Opening and introductory session

The workshop was opened by Ms Yao Xiaojun, the FAO Regional Programme Leader for Asia and the Pacific. In her remarks, Ms Yao highlighted the great contribution of aquaculture development to food security and nutrition, livelihoods and job opportunities and overall socio-economic development in the Asia and Pacific region in the past decades. She also emphasized the need to maintain the sustainable growth of aquaculture in meeting the increasing demand of the people for food fish and the attainment of several important sustainable development goals (SDGs) in the coming decade.

She pointed out that further growth of the aquaculture sector will depend largely on the improved governance of the sector. Finally, she reaffirmed FAO's commitment to support its members in achieving the sustainable growth of aquaculture and anticipated effective deliberations and fruitful results of the regional consultative workshop.

Dr Huang Jie, the Director-General of NACA delivered a warm welcome to all the participants attending the consultative workshop, which he believed would contribute significantly to the sustainable growth

of the aquaculture sector in the region. He pointed out that the Asia-Pacific region is the backbone of the global aquaculture industry. Sustainable growth of aquaculture will contribute to both regional and global food security and nutrition. He highlighted that the aquaculture industry in the region has made significant progress in improving governance for the sustainability of the sector.

Meanwhile, countries in the region vary greatly in terms of legislative framework for aquaculture sectoral development and governance practices. The regional consultation will enable the sharing of knowledge and practices on aquaculture governance by participating countries. Dr Huang extended his gratitude to FAO for supporting such an important regional process involving most NACA members.

The FAO responsible officer introduced the background of the regional consultation. He also further elaborated on the objectives and expected outputs of the regional consultation.

Plenary sessions and presentation of country assessment studies

Two plenary sessions were conducted in the workshop. During the first plenary session, national experts from Cambodia, China, India, Indonesia, Malaysia, Thailand, and Viet Nam presented country assessment studies on aquaculture governance in their respective countries. The country reports are presented in Annex IV.

The second plenary session was convened for a representative of each working group to present the outputs from the working group sessions.

Working group sessions

Two working group sessions were convened. Participants from 15 countries were divided into two working groups. The first working group session focused on the identification of gaps, issues and challenges in aquaculture governance in all the participating countries. The other working group session focused on developing recommendations on strategies and actions for strengthening and improving aquaculture governance in the region.

Consultation conclusions and recommendations

The major objective of the regional consultation workshop was to evaluate the status of aquaculture governance in the region based on the country studies that were conducted before the workshop and on inputs provided by the participants during the workshop sessions. This would then lead the participants to put forward recommendations on strategy and actions to strengthen the governance of the aquaculture sector in the region in terms of achieving sustainability and making greater contributions to food security and nutrition, poverty alleviation and other relevant SDGs.

Conclusions

Based on the interventions during the regional consultation and the country studies, the following conclusions can be drawn on the governance of aquaculture in the region.

Significant progress has been made in aquaculture governance in the region

The regional consultative workshop and the country assessment studies found that all the countries that participated in the workshop have made significant progress in strengthening aquaculture governance. This is evidenced by three main achievements:

- (i) All the 15 countries that participated in the consultation have established rather comprehensive legal and regulatory frameworks to govern the development of the aquaculture sector. The workshop identified 11 major areas of aquaculture governance. Four out of 15 participating countries have the full coverage (100 percent) in their legislative and regulatory framework. The coverage of aquaculture governance areas ranges between 63 percent to 91 percent. The average coverage is 88 percent.
- (ii) The important areas for aquaculture governance are well covered by laws and regulations. All the countries have existing laws/regulations to govern resource uses, registration and licensing, environment impact control, biodiversity protection, aquaculture traceability, aquaculture seed quality and child labour use. The legislative and regulatory coverage of food safety/drug use, working conditions, feed quality standard and aquatic animal welfare ranges between 87 percent to 33 percent.
- (iii) Many participating countries such as Cambodia, China, Thailand, and Viet Nam have recently updated their national fisheries laws so that they now cover aquaculture governance.

Some areas related to aquaculture are governed by other general laws and regulations

It was found that although the countries in the region have promulgated specific laws and regulations targeting aquaculture governance, some areas of aquaculture are still governed by other general laws and regulations, such those dealing with working conditions, child labour use and food safety.

Effectiveness of enforcement of laws and regulations is relatively low

In contrast to the comprehensiveness of laws and regulations established for governing aquaculture development, the enforcement of the laws and regulations on the ground is relatively weak. For 11 identified aquaculture governance areas, the overall effectiveness of enforcement of present laws and regulations is only 3.3 (full score 5) on average, which ranges from 1.7 (lowest) for animal welfare to 4.1 (highest) for child labour use.

Different areas of aquaculture governance are often under the responsibility of different line ministries and authorities

Different areas of aquaculture governance are often under the responsibility of different line ministries and authorities. This causes difficulty in effective enforcement. The development needs of the aquaculture sector are not be fully recognized, particularly in terms of water and land resource allocation and governance.

There is disparity in aquaculture governance among the countries across the region

In general, aquaculture governance has been significantly strengthened in the region, but there is clear disparity across the countries, particularly in the effectiveness of enforcement of aquaculture regulations covering different areas. With the full score of 5 measuring the effectiveness of governance, countries with advanced aquaculture development scored above 3.5 (average of all identified 11 areas). In contrast, the countries in the early stage of aquaculture development scored below 3 with the lowest score being 1.7.

Improvement in aquaculture governance has been driven by different factors

The improvement in aquaculture governance has been driven by different factors. The expansion of the aquaculture sector requires better governance and regulation to ensure its overall environmental and socio-economic benefit. For instance, many countries in the region have tightened control of converting agricultural land into fishponds and many countries have established environment-related regulations for aquaculture.

Nevertheless, aquaculture governance improvements in certain areas are largely driven by external factors. The increasingly high food safety and quality standards for imported aquatic products has promoted regulations on food safety and product traceability in aquaculture in the region, particularly the banning of the use of different antibiotics and chemicals.

Major issues and gaps in aquaculture governance

Although recognizing the significant progress in improving the governance of aquaculture in the region, the consultative workshop also identified the major issues and constraints in aquaculture governance in both the existing legislative and regulatory instruments and the related legislative procedures.

Development/update of aquaculture legislative framework and regulatory instruments

The consultative workshop identified some major gaps and constraints in the national process for development and update of aquaculture-related legislative and regulatory instruments, which included:

- i. there is lack of consistency between federal and state laws and regulations related to aquaculture governance;
- ii. legislation (sub-laws) for allocating natural resources for aquaculture development often need approval from other relevant agencies/local governments, and the process is influenced by the authorities of competing sectors;
- iii. there is lack of consistency in government policy — low priority of aquaculture development compared with other sectors, such as tourism;

- iv. present aquaculture legislative and regulatory instruments are not always comprehensive enough to adequately address food safety, feed ingredients, drug/chemical use, traceability/certification, aquaculture seed quality assurance;
- v. the existing legislative procedures and processes are often not inclusive enough to ensure participation of stakeholders at different levels;
- vi. the provisions of existing aquaculture legislations/ regulations do not always fit into the modern concepts of sustainable fisheries and aquaculture management;
- vii. there is a lack of a solid science and knowledge base to support the development regulatory instruments; and
- viii. there is lack of exchange and knowledge sharing on aquaculture legislation and regulations across the countries in the region.

Enforcement

In addition to the issues and constraints in national processes for the development and update of aquaculture-related legislative and regulatory instruments, the consultative workshop also identified some significant gaps in the enforcement of existing laws and regulations governing the aquaculture sector in the participating countries:

- i. the enforcement of respective laws and regulations concerning aquaculture is often under the authority of different government agencies and there is a lack of effective institutional arrangements and coordination at national and local levels;
- ii. there is lack of effective monitoring, surveillance and control capacity on compliance with respect to aquaculture laws and regulations;
- iii. there is lack of human capacity, institutional mandate and financial resources at local level to enforce the Acts/Laws concerning aquaculture governance;
- iv. overlap and conflict of interest among different government regulating agencies often creates confusion for the stakeholders;
- v. existing laws and regulations on aquaculture often lack clearly defined punishments for violations and non-compliance, which results in difficulty in actual enforcement; and
- vi. the aquaculture sector is dominated by a large number of small-scale farmers, who often have limited awareness and weak ability to comply with management regulations.

Recommendations

Apart from identifying the issues, constraints, and gaps with respect to aquaculture governance in the region, the consultative workshop also put forward some recommendations for strengthening the governance of the sector to ensure its long-term sustainability.

- i. Harmonized and inclusive legislative procedures and processes for the development of new and update of existing laws and regulations concerning aquaculture at national level should be established.
- ii. Existing national regulations and technical standards on aquaculture should be reviewed and updated periodically according to the changing externalities and sectoral development needs.
- iii. The position of national aquaculture management authorities, such as the Department of Fisheries, should be strengthened for more effective governance of aquaculture.

- iv. The collaborations and coordination between different government agencies should be strengthened to improve the governance of the aquaculture sector at national and local levels.
- v. The enforcement of existing laws and regulations concerning aquaculture governance and identification of necessary measures to improve it should be reviewed.
- vi. Regulations and standards on fish seed quality and aquafeed quality and safety, including seed certification and hatchery accreditation systems should be strengthened.
- vii. Research and knowledge generation should be strengthened to support aquaculture governance.
- viii. Capacity development for effective enforcement of laws and regulations on aquaculture, including the education and training of government officials engaged in aquaculture governance at national and local levels, should be strengthened.
- ix. Positive aquaculture governance experience among countries in the region should be transferred to all countries through human resource development.
- x. Raising awareness of all aquaculture supply chain actors regarding the relevant provisions of the laws and regulations on aquaculture should be strengthened.
- xi. Small-scale farmers should be encouraged and assisted to comply with relevant regulations and standards such as Good Aquaculture Practices (GAPs) by providing incentives.
- xii. Sharing aquaculture legislation development and governance practices across the countries in the region should be encouraged and promoted.

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ANNEX I Consultative workshop programme

Regional Consultative Workshop on Strengthening of Aquaculture Governance for Sustainable Development in Asia-Pacific

Bangkok, 5-6 November 2019

Workshop programme

5 November 2019

Opening and introduction	
09:00 to 09:30	Opening session: <ul style="list-style-type: none">• Welcome remark by Dr Huang Jie, Director-General of NACA• Opening remark by Assistant Director-General, FAO RAP
09.30 to 10.00	Group photo & coffee break
10:00 to 10:10	Introduction: Consultation on strengthening governance of aquaculture for sustainable development in Asia and related country review studies
Session I: Country review studies on aquaculture governance	
10:10 to 11:10	Country presentations Cambodia, China, India
11:10 to 11:20	Break
11:20 to 12:20	Country presentations Indonesia, Malaysia, Viet Nam
12:20 to 13:30	Lunch break
13:30 to 13.50	Country presentations Thailand
13:50 to 14:20	Presentation on the regional synthesis

5 November 2019

Session II: Group work

- Identification of gaps, issues, challenges in aquaculture governance
- Recommendations on strategies and actions for strengthening and improving aquaculture governance

14:20 to 14:30	Introduction to the group work
14:30 to 15:30	Group work
15:30 to 15:50	Coffee break
15:50 to 17:30	Group work (continued)
17.30 to 17.45	Wrap-up session for day 1

6 November 2019

Session II: Group work

- Identification of gaps, issues, challenges in aquaculture governance
- Recommendations on strategies and actions for strengthening and improving aquaculture governance

08:30 to 09:30	Group work (continued)
09:30 to 10:30	Workshop wrap-up session and closing

ANNEX II List of participants of the consultative workshop

Regional Consultative Workshop on Strengthening of Aquaculture Governance for Sustainable Development in Asia-Pacific

Bangkok, 5-6 November 2019

Workshop participants

Cambodia	
1.	Mr Chin Da Deputy Director Department of Aquaculture Development Fisheries Administration Cambodia
2.	Mr Sopha Lieng Director Department of Community Fisheries Development (CFDD) Fisheries Administration (FiA) No 186, Preah Norodom Blvd. Sangkat Tonle Bassac Khan Chamcar Morn, Phnom Penh, Cambodia
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3.	Mr Qingyin WANG President of China Society of Fisheries Former Director-General and Senior Researcher Yellow Sea Fisheries Research Institute (YSFRI) Chinese Academy of Fishery Sciences (CAFS) Qingdao, China
4.	Mr Fuli Liu Yellow Sea Fisheries Research Institute Chinese Academy of Fishery Sciences No. 106, Nanjing Road, Qingdao, 266071, China
India	
5.	Mr Kuldeep K. Lal Director National Bureau of Fish Genetic Resources Canal Ring Road, PO Dilkusha, Lucknow-226002 UP, India
6.	Mr Shinoj Parappurathu Senior Scientist Socio-economic Evaluation and Technology Transfer Division, ICAR-Central Marine Fisheries Research Institute (CMFRI) (Ministry of Agriculture and Farmers' Welfare, Government of India) Ernakulam North P.O., Kochi- 682 018, Kerala, India

Indonesia	
7.	Mr IBM Suastika Senior Researcher National Broodstock Center for Shrimp and Mollusks Karangasem, Bali, Indonesia
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Iran (Islamic Republic of)	
9.	Mr Hossein Ali Abdolhay Associate professor Head of Aquaculture Department Iranian Fisheries Organization (IFO) No.236, Fatemi West Ave., Tehran, the Islamic Republic of Iran
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29.	Mr Yuan Derun Senior Programme Officer Sustainable Farming Systems Programme Education and Training Programme Network of Aquaculture Centres in Asia Pacific (NACA)
30.	Mr Simon Wilkinson Communication Programme Manager Network of Aquaculture Centres in Asia-Pacific (NACA)
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Annex III: Outputs of group work sessions

Work group tasks and arrangements

Participants were divided into two groups. The first group included participants from Cambodia, China, India, Indonesia, the Islamic Republic of Iran, Lao People's Democratic Republic, Malaysia and Maldives, and the participants of the other group were from Myanmar, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand, and Viet Nam.

Groups were requested to:

- i. assess aquaculture governance in all the participating countries – this was a country scoring exercise on the availability of laws/acts/ covering different areas of aquaculture governance and the effectiveness of implementation;
- ii. identify the major gaps and constraints in the governance of aquaculture in the region in terms of comprehensiveness of laws, acts and other regulatory instruments for safeguarding the sector's development and gaps in effective enforcement of current laws and regulations governing aquaculture; and
- iii. recommend strategy and priority actions to strengthen aquaculture governance at regional and country levels.

The outputs of group work were presented and discussed in a plenary session.

Summary of group work outputs

Availability of legislative instruments (laws/acts/norms/to regulate different aspects of aquaculture) for various areas of governance

	Resource use*	Registration/ licensing of operations	Environment impact control**	Biodiversity protection	Food safety		Traceability/ certification	Aquaculture seed	Working conditions	Child labour use	Animal welfare	YES	NO	Availability (%)
					Feed ingredients	Drug/ chemical use								
Cambodia	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	11	0	100
China	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	11	0	100
India	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	11	0	100
Indonesia	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	No	10	1	90.9
Iran (Islamic Republic of)	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	11	0	100
Lao														
People's Democratic Republic	Yes	yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	No	10	1	90.9
Malaysia	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	11	0	100
Maldives	Yes	yes	Yes	Yes	No	yes	Yes	Yes	Yes	Yes	No	9	2	81.8
Myanmar	Yes	yes	Yes	Yes	No	In progress	Yes	Yes	Yes	Yes	No	8	3	72.7
Nepal	Yes	yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No	7	4	63.6
Pakistan	Yes	yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	9	2	81.8
Philippines	Yes	yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	No	10	1	90.9
Sri Lanka	Yes	yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	No	10	1	90.9
Thailand	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	10	1	90.9
Viet Nam	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	10	1	90.9
YES	15	15	15	15	11	14	15	15	15	15	5			
NO	0	0	0	0	4	1	0	0	0	0	10			
Availability (%)	100	100	100	100	73.3	93.3	100	100	100	100	33.3			89.7

Note: * Resources include land, water, lakes, reservoirs, rivers, coastal waters. **Such as laws, regulations and standards for environmental impact assessment, effluent control.

Effectiveness of aquaculture governance rated with the rating scale from 1 (least effective) to 5 (most effective)

	Resource use	Registration/ licensing of operations	Environment impact control	Biodiversity protection	Food safety		Traceability/ certification	Aquaculture seed	Working conditions	Child labour use	Animal welfare	Average score
					Feed ingredients	Drug/ chemical use						
Cambodia	3	4	4	4	3	3	4	3	3	4	3	3.5
China	5	5	5	4	4	5	4	4	4	5	3	4.4
India	3	4	4	5	4	5	3	4	5	5	3	4.1
Indonesia	3	4	3	4	5	4	4	4	3	4	1	3.5
Iran (Islamic Republic of)	4	4	4	5	4	5	4	5	4	5	4	4.4
Lao People's Democratic Republic	4	3	4	4	4	4	4	4	3	3	1	3.5
Malaysia	3	3	3	4	4	5	3	4	4	5	3	3.7
Maldives	2	3	3	3	2	2	2	2	3	5	1	2.5
Myanmar	3	3	2	2	2	2	2	3	2	2	1	2.2
Nepal	3	2	1	3	2	2	1	1	1	2	1	1.7
Pakistan	5	3	2	1	2	2	3	1	2	3	1	2.3
Philippines	4	3	3	3	3	3	3	3	3	3	1	2.9
Sri Lanka	3	4	4	4	3	4	3	4	3	4	1	3.4
Thailand	4	4	4	3	5	4	4	4	3	3	1	3.5
Viet Nam	4	3	3	3	3	4	4	4	3	3	1	3.2
Average score	3.5	3.5	3.3	3.5	3.3	3.6	3.2	3.3	3.1	3.7	1.7	3.2

Issues and constraints in aquaculture governance and recommendations

Group I: Cambodia, China, India, Indonesia, Iran (Islamic Republic of), Lao People's Democratic Republic, Malaysia, Maldives

Major gaps and constraints	Recommendations
<p>Development of aquaculture legislative framework and regulatory instruments</p> <p><u>Government attention</u></p> <ul style="list-style-type: none"> i. Legislation (sub-laws) to define potential aquaculture zones requires approval from other relevant agencies/ local government. ii. Development space of aquaculture is compressed by competitive sectors from other industries. iii. Aquaculture legislation formulated may not comprehensive enough with regard to food safety, feed ingredients, drug/chemical use, traceability/certification, aquaculture seed quality assurance. iv. Not enough financial support to research. v. Need to have good collaboration and international cooperation such as NACA/FAO/ASEAN/SEAFDEC. vi. Government needs to accommodate participatory approach and action by local/region level association. <p><u>Process</u></p> <ul style="list-style-type: none"> i. Missing coordination among agencies on control of effluent produced by industrial and agricultural development (including aquaculture activities) affects aquatic resources. ii. Time lag of regulation implementation is too long and there is need to accelerate implementation of the proclaimed regulations in state/province/local level after proclamation of the Acts/Regulations/Laws. iii. Coordination among multiple agencies for aquaculture development is neglected. iv. Aquatic product quality and safety certification is weak. v. Management of production and performance of quality seed conforming to designated standards is not sufficient. vi. Institutional mechanism on aquatic animal emerging disease management and biosecurity are underdeveloped and weak at region, national and local level. <p><u>Enforcement</u></p> <ul style="list-style-type: none"> i. Lack of human capacity, mandate, and financial resources at local level to enforce the Act/Law made. ii. Coordination mechanisms among the agencies (e.g. different ministries, different administrative levels) to enforce laws and regulations on aquaculture matters are ineffective. 	<p>Country strategy and priority actions</p> <ul style="list-style-type: none"> i. Adopt and refine aquaculture legislation of leading aquaculture countries in the region to apply locally ii. Transfer regional aquaculture governance experience to the countries of the region through human resource development. iii. Prioritize the emerging issues in government policies for regulation accomplishment and implementation at local and national level. <p>Regional strategy and actions to support the country governments to strengthen aquaculture governance for sustainable growth</p> <ul style="list-style-type: none"> i. Share the experience of aquaculture legislation development and implementation of leading regional aquaculture countries with the less-aquaculture developed countries in the region. ii. Strengthen seed certification and hatchery accreditation including regulatory bodies. iii. Develop a strategic plan for improving genetic exchange between farms and hatcheries. iv. Promote international cooperation for capacity development.

Group II: Myanmar, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand, and Viet Nam

MYANMAR			
<p>Institutions for enforcement at national and local levels</p> <p>The Department of Fisheries is the primary agency responsible for fisheries management, comprising 2 469 staff at the union, state/region, district and township levels. There is limited capacity for monitoring, surveillance and management activities in fishing areas.</p> <p><u>Responsible ministries</u></p> <p>Ministry of Resources and Environmental Conservation. Ministry of Labour, Immigration and Population. Ministry of Commerce. Ministry of Home Affairs.</p>	<p>Issues in enforcement</p> <p>Weak in legal support and lack of human capacity and funding for enforcement, leading to weak enforcement and lack of compliance with laws and regulations.</p>	<p>Gaps and constraints</p> <p>Insufficient government attention given to</p> <ul style="list-style-type: none"> • food safety • conservation of biodiversity • sustainable fisheries management. <p>Inclusive and climate-resilient growth in aquaculture is insufficiently promoted.</p>	<p>Recommendations</p> <ol style="list-style-type: none"> Enhance law enforcement through cooperation of multi stakeholders. Update relevant laws by reviewing the policy and existing laws first based on research, public participation and other prevailing factors to maintain sustainability.
NEPAL			
<p>Issues</p> <ol style="list-style-type: none"> Policies and Acts not in line with federal system. Ownership and user rights for waterbodies unclear. Large area suitable for developing aquaculture facilities but slow rate of expansion. Huge gap between potential yield and actual yield. Poor technical understanding of aquaculture. Fisheries monitoring, control and surveillance capacity is very poor. Improper and inadequate Institutional arrangements. 		<p>Recommendations</p> <ol style="list-style-type: none"> Approve comprehensive fisheries policy and fish seed act . Facilitate access to waterbodies for aquaculture with policy support. Establish a fisheries development division. Strengthen fisheries research and education. 	

SRI LANKA

Strategies	Enforcement institutions	Gaps, issues, and challenges	Recommendations for improving governance
<p>i. The NAQDA Act No. 53 of 1998 has been amended by Act No. 23 of 2006 and the Fisheries & Aquatic Resources Act No. 02 of 1996 has been amended by Act No. 22 of 2006 in order to transfer the powers related to aquaculture to NAQDA.</p> <p>ii. Preparation of new regulations to improve aquaculture.</p>	<ul style="list-style-type: none"> Ministry of Fisheries & Aquatic Resources Development. Ministry of Environment Central Environmental Authority. National Aquaculture Development Authority. District Aquaculture Extension Office. Coastal Aquaculture Extension & Monitoring Unit under National Aquaculture Development Authority. Department of Fisheries & Aquatic Resources. <p>Coordination mechanisms</p> <ul style="list-style-type: none"> Coordination through District Aquaculture Extension Office, Coastal Aquaculture Extension & Monitoring Units under National Aquaculture Development Authority. A technical committee has been established with the related institutions for aquaculture management, especially for issuing licenses. 	<p>i. Unclear mention of fines for violations of some regulation.</p> <p>ii. Licensing powers of the boats used for aquaculture activities are not mentioned in the Act.</p> <p>iii. Land allocation issues.</p> <p>iv. Investment issues.</p> <p>v. Conflicts with other development activities.</p> <p>vi. Fish feed issues.</p> <p>vii. Market issues.</p>	<p>i. Introduce management information systems for planning development management & reporting.</p> <p>ii. Develop human resources required for governance.</p> <p>iii. Strengthen farmer cooperatives</p> <p>iv. Expand and intensify aquaculture through environmentally friendly approaches.</p> <p>v. Promote the culture of indigenous species, and new exotic species in compliance with the Food and Agriculture Organization (FAO) Code of Practice for the Introduction of Aquatic Species.</p> <p>vi. Promote the establishment of public-private partnerships (PPPs) for investment in the sector.</p> <p>vii. Promote equal opportunities for women's participation in the activities of the sector.</p>

PAKISTAN

Issues

- i. The existing fisheries legislation/ regulations have no provision of modern concept of sustainable fisheries and aquaculture management.
- ii. There is no provision of fisheries and aquaculture management plan (national/ provincial) for sustainable management of fisheries resources.
- iii. Public sector fisheries and aquaculture institutions have no capacity to monitor, regulate fishing activities under their jurisdiction.
- iv. There is inadequate capacity in terms of knowledge about the modern concept of fisheries management and international fisheries instruments.
- v. Inadequate capacity to fulfil the country's international obligations.
- vi. Inadequate funds provided for fisheries sector.
- vii. Inadequate fisheries research on modern concepts of sustainable and ecosystem-based fisheries management.

PHILIPPINES

Issues

- i. Policy and laws in aquaculture are constantly reviewed and updated, however the enforcement is sometimes considered as passive and is gravely affected by corruption.
- ii. Overlap and conflict of several government regulating agencies which confuses the stakeholders.
- iii. Lack of government subsidy and support to aquaculture fish farmers.

Recommendations

- i. Review nforcement and be assign it to specific government agencies wherein checks and balances exist.
- ii. Prioritize the creation of a Department of Fisheries.
- iii. Enhance government support to stakeholders through subsidies, reduction of tariffs for imported raw materials for feeds, creation of infrastructures.
- iv. Provide support using scientific information and strengthen aquaculture/fisheries cooperatives in the country.

THAILAND

Issues

Thailand has technical standards and guidelines supporting the implementation of laws and regulations for GAP, but there are some difficulties for small scale farms to comply with.

Some of the Good Aquaculture Practices (GAP) and standards of Thailand

GAP for hatcheries of disease free Pacific white shrimp (TAS 7432, mandatory)
 GAP for marine shrimp farms (TAS 7401, voluntary)
 GAP for marine shrimp hatcheries and nurseries (TAS 7422, voluntary)
 GAP for marine finfish farms (TAS 7429, voluntary)
 Organic Agriculture, Part I: The Production, Processing, Labeling and Marketing of Produce and Products from Organic Agriculture (TAS 9000, voluntary)
 GAP by Department of Fisheries (for shrimp and tilapia) (voluntary)
 Code of Conduct by Department of Fisheries (for shrimp) (voluntary)

Recommendations

- i. Encourage farmers to comply with food safety standards first then help them to become GAP farmers. DOF to take the lead.
- ii. Provide provincial and national level training for DOF officers and farmers on food safety standards and GAP. DOF is to take the lead.
- iii. Exempt farmers who applied for food safety standards and GAP farm certification from collecting sampling fees in their first year.
- iv. Promote collaboration between agencies inside Ministry of Agriculture and Cooperatives such as DOF, ACFS, etc. in terms of standardization.

VIET NAM

Issues

- i. Dominated by small-scale farms
 - a. Low technical knowledges and production arrangements.
 - b. Limited awareness and weak compliance with management regulations and planning.
 - c. Limited access to extension services and credit.
- ii. Lack of stability of aquaculture planning
- iii. Lower priority for aquaculture development compared to, for example, tourism.
- iv. Poor infrastructures and logistic services for aquaculture
 - a. Irrigation and wastewater treatment systems.
 - b. Seed and feed production.
 - c. Aquatic medicine and veterinary services.
- v. Increased risks of environmental pollutions and climate change impacts
 - a. Increasing environment pollution induced by socio-economic development activities.
 - b. Increasing impacts of climate change and sea level rise.
 - c. Increased virulence of pathogens and animal diseases.
 - d. Reduced ecosystem productivity and biodiversity.
 - e. Increased damages of infrastructure, aquaculture farm facilities.
 - f. Increased salinity intrusion.
- vi. Lack of vertical and horizontal linkages
 - a. Production cooperatives.
 - b. Value chain linkages.

Recommendations

- i. Review existing national standards and technical regulations on aquaculture.
- ii. Raise awareness of the provisions of the law for all actors in aquaculture supply chain.
- iii. Promote development of aquaculture cooperatives and value chain linkages.
- iv. Promote public-private partnership (PPP) models at national and provincial scale.
- v. Promote research activities on: (a) policy research; (b) production models (cooperative, value chain linkages, inclusive business models etc); (c) seed production and grow-out culture technologies in terms of biosafety, food safety, climate change adaptation.

ANNEX IV Country assessment studies

Annex IV-1 Aquaculture governance in Cambodia

Thay Somony

1. Overview of aquaculture governance

The three main challenges confronting aquaculture development in Cambodia are: sustainable growth, environmental stewardship, and the equitable distribution of benefits. An effective response to these challenges requires the coherent interplay of private investment and stewardship of public goods, the fostering of good governance and the adoption of science-based better practices (The World Bank, 2007).

The National Strategic Plan for Aquaculture Development 2016 to 2030 of Cambodia mainstreams aquaculture into the country's policy and planning instruments such as poverty reduction strategies, investment policies, and rural development strategies (contained in the National Strategic Development Plan 2014 to 2018 and the Strategic Planning Framework for Fisheries 2015 to 2024).

The strategic development plan for aquaculture seeks to create an enabling environment for the sector's development. More specifically, it aims to foster an attractive investment climate for investors in enterprises along the value chain (from input production and supply, farming, processing, trading including institutional buyers of aquaculture products such as hotels and restaurants). The strategy lays down opportunities for inter-agency coordination to deal with the dynamic nature of a growing industry where public authority is dispersed across sectors, agencies, and disciplines.

The participatory process that prepared the aquaculture development strategic plan has to a limited extent built awareness, forged a shared public-private vision and built partnerships among government agencies, the private sector, farmer groups and civil society organizations. The results so far have been encouraging. The wide participation of stakeholders is advocated for governance in the aquaculture strategy, and priority will be given to establishing participatory, enabling, and effective governance mechanisms.

2. Introduction to the aquaculture sector

Along with rice, fish lies at the heart of the Cambodian rural economy and is a crucial element in food security and good nutrition. Drawing on a survey of 1 200 households, a recent study estimated per capita fish consumption in Cambodia at 52.4 kg/year and found that fish and aquatic resources provide 76 percent of animal protein intake, 37 percent of iron and 28 percent of fats for the population (Hortle, 2007 and IFRDI, 2013). Aquatic resources comprise 18 percent of total food intake, second only to rice. Fish is therefore critical to ensuring food security, especially that of the rural poor. It is also an important source of income for fishers, fish farmers and the people along the fish value chain. Now it generates a modest revenue for the national economy although the national aspiration is to attain competitiveness and increase exports of farmed fish products.

The primary source of fish is wild capture fisheries of the Tonle Sap (Great Lake), the Mekong River, the Tonle Sap River and the Brassac River and their associated floodplains. These are estimated to yield 910 153 tonnes of fish and other aquatic organisms. Although aquaculture contributed only 254 048 tonnes to the total supply in 2018, its relative contribution has been increasing every year (Table 1).

Table 1 Fisheries and aquaculture production in Cambodia (tonnes) for the years 201–2018

	2011	2012	2013	2014	2015	2016	2017	2018
Inland production	445 000	509 000	550 000	505 005	487 905	509 350	527 795	535 005
Marine production	91 000	99 000	100 000	120 250	120 500	120 600	121 025	121 100
Aquaculture	72 000	74 000	80 000	120 000	143 141	172 500	207 443	254 048
Total	608 000	682 000	730 000	745 255	751 546	802 450	856 263	910 153

Data source: Fisheries Administration, Ministry of Agriculture, Forestry and Fisheries (2019)

The increasing demand for farmed fish is driven by a growing population and higher living standards. It is abetted by the probable decline in wild capture fisheries, which is associated with habitat loss, increased use of chemicals in agriculture, and the disruption of natural aquatic systems and their seasonal cycles by dams, reservoirs and irrigation projects (Baran *et al.*, 2001; Baran, 2005; Hortle and Bamrungrach, 2015; Ngor *et al.*, 2018). These pressures are likely to increase in the future, along with those associated with climate change.

Aquaculture has an ancient history in Cambodia, closely related to the country's abundant capture fisheries. Cage culture of higher value fish using lower value fish as feed has been undertaken for centuries and has served both as a storage mechanism (utilization of seasonally abundant fish) and as a means of adding value to a cheap and abundant resource. Low value so-called “trash” fish from freshwater and marine resources continues to be an important input to the rapidly growing aquaculture sector. The availability of this high quality but low-cost feed resource is seen as a significant strength and opportunity for aquaculture in Cambodia. However, the resource is not unlimited and because of climate variability and other forces, its availability has been erratic. It thus needs to be used efficiently and managed sustainably so it can contribute to sustaining the many small-scale and medium-scale farms still highly reliant on it for feed. This partial dependence of aquaculture on capture fisheries is a key issue for aquaculture development globally, but more so in Cambodia where the link is particularly close.

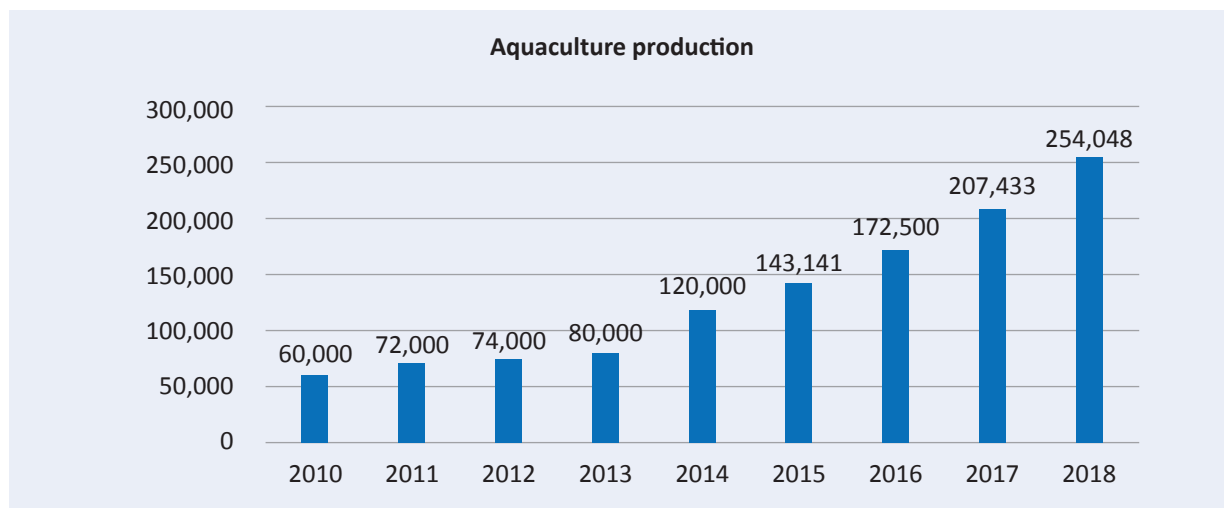
Aquaculture development in Cambodia is now showing signs of accelerated growth and thus at a critical stage when growth has to be orderly to avoid social and environmental impacts that can be very costly to mitigate.

Aquaculture has the potential to meet the likely future shortfall in supply of high-value species as well as the abundant lower-cost species, to generate employment for men and women, and to increase value added and export earnings for the country (Joffre *et al.*, 2019). It also offers an opportunity for employing the youth who will soon enter the labour force. There is a need to facilitate the development of more profitable and sustainable aquaculture enterprises, at the same time conserving valuable fisheries resources, and maximizing the contribution to nutrition and poverty alleviation (MAFF, 2017). This has to be done taking into account the opportunities and constraints associated with the increasing wider economy of Cambodia, and the sector's ability to compete with the more developed aquaculture industries of neighbouring countries.

2.1 The aquaculture systems

Aquaculture contributed 254 048 tonnes to the total fish supply in 2018; the share has increased yearly since 2010 (Figure 1).

Figure 1 Aquaculture production in Cambodia 2010–2018



Data source: Fisheries Administration, Ministry of Agriculture, Forestry and Fisheries (2019)

Small aquaculture producers are the main stakeholders in the aquaculture sector with more than 85 000 households engaged in some form of fish farming.

2.1.1 Freshwater aquaculture

In Cambodia, several major types of freshwater fish production systems co-exist, namely integrated rice–fish farming, homestead pond culture, cage and pen culture and intensive pond culture. The culture of frogs and crocodiles is considered as freshwater aquaculture.

Integrated rice–fish farming is not widespread but is one of the most promising systems in Cambodian aquaculture. It adds value to the water, increases the intensity of the production system, and can improve rice yields. Another advantage is it enables a safe product because the use of pesticides and herbicides is not compatible with this farming system. The main cultured species are tilapia (*Oreochromis niloticus*) and common carp (*Cyprinus carpio*), sometimes mixed with striped catfish (*Pangasius hypophthalmus*), silver barb (*Barbonymus gonionotus*) and giant freshwater prawn (*Macrobrachium rosenbergii*). It relies on low-density stocking and limited use of inputs. If carried out properly, fish production in these systems could reach 300 kg/ha. The rice also benefits from the presence of the fish as the fish naturally fertilize the paddy and prey on pests.

This system is different from rice–field fisheries, which is the most commonly practiced extensive production system and a bridge between capture fisheries and aquaculture. Rice–field fisheries are part of floodplain fisheries, which are traditional and widespread in Cambodia. The system depends on maintaining the connectivity of the floodplains and the major waterbodies. Up to 70 species of fish may be found in rice fields and caught mostly with traps, nets and lines.

The rice–field fisheries in Cambodia are described variously in the research reports and development projects of the International Rice Research Institute (IRRI), the Cambodian Agricultural Research and Development Institute (CARDI), the Japan International Cooperation Agency (JICA), the WorldFish Centre, and various non-government organizations (NGOs) such as the Aid Exchange and

Development Association (AIDA) and the Agriculture Technology Services Association (ATSA). Their initiatives were designed to enhance rice–field fisheries through a variety of means including more effective management of small refuge ponds or community ponds, stocking with wild or hatchery-produced fingerlings, and combinations of stocking and improved management.

Small-scale homestead pond aquaculture was introduced in Cambodia in the 1960s and since the 1990s has received substantial support from donors and NGOs. It was promoted as an option to diversify farm incomes and improve fish supply to local markets while reducing dependence on capture fisheries. Production systems range from relatively small (80 m² to 500 m²) and low-input systems using farm products (rice bran, duckweed, etc.). The systems range from polyculture of “low requirement” species (carps, barbs, tilapias, climbing perch), to semi-intensive systems in medium-sized culture areas (0.1 ha to 0.2 ha), with the introduction of striped catfish (*Pangasius hypophthalmus*) fed with fishmeal or pelleted feed or a mix of these.

Cage and pen culture takes place in the Tonle Sap (Great Lake) and on the Mekong River. They are mostly small-scale and informal operations. The main species are *Pangasionodon hypophthalmus* (striped catfish), *Hemibagrus wyckioides* (redtail catfish), tilapia (*Oreochromis niloticus*), *Clarias* spp. (walking catfish), *Puntius* spp. (silver barb), and *Leptobarbus hoevenii* (Hoevens carp).

There may be a potential to develop aquaculture in pens although it has not been tried and should be carefully studied because pens, other than their potential environmental impacts, can hinder navigation which could fuel conflicts between fishers and pen owners.

Snakehead culture was banned between 2004 and 2016 because of concerns with over-exploitation of wild fingerlings for both stocking and feeding. Nonetheless snakehead (*Channa striata*) cage culture (monoculture) is still thought to account for 50 percent of the total aquaculture production. It includes small-scale family-run systems practiced by fishers, as a form of “live-savings” – a supplement to wild catch and for sale. Striped and walking catfish cage culture relies on the use of pellets, by-catch or so-called “trash fish” and/or fishmeal. Depending on the level of intensification, it can be grown under intensive monoculture or in polyculture with tilapia or carps or both.

Intensive specialized and commercial fish farming is rapidly growing, driven in part by expatriate Vietnamese farmers seeking better water quality, less disease, lower wages and cheaper feed ingredients. Farms are typically full-time family businesses or medium-scale enterprises employing several workers. Favoured species are striped and walking catfish (*Pangasionodon hypophthalmus*, *Clarias batrachus*) cultured in ponds or cages. This type of aquaculture takes place mainly around Phnom Penh and in Kandal Province, where most fish is sold in the urban market (some are reportedly exported to Viet Nam for processing and re-export).

Prawn farming. Culture of *Macrobrachium rosenbergii* is practiced in extensive systems in Takeo Province, relying on hatchery seed and formulated feed. The typical production cycle is 100 kg/ha. A public hatchery is producing postlarvae but the seed is mostly for enhancement (re-stocking) programmes of rivers. Some small-scale hatcheries and grow-out farms are operating. Overall, however, the quality of seed from these hatcheries is poor.

There is a potential to grow *Macrobrachium* in an integrated rice–fish system but it has yet to be trialled in Cambodia. There is an opportunity to export freshwater prawn (which has a high market value) but it would require meeting the quality required by the market. Moreover, the ability to compete with neighbouring countries in the international market should be considered before embarking on a nationwide promotion of prawn farming.

Frog culture. There are two main frog farming systems in Cambodia: in hapa (inverted net) and concrete tanks. The two main species, *Rana tigerina* and *Rana rugulosa*, are cultured in several provinces of Cambodia such as Siem Reap, Banteay Menachey, Kompong Cham, and Kompong Thom. They can be fed both pellet feed and home-made feed (earthworms, crickets), and are easy to culture in the Cambodian environment. Frog farming could be viewed as a pro-poor activity as it requires little space and investment. The domestic market appears to be quite important and growing. Some of the outputs are exported to Viet Nam and Thailand.

Crocodile farming is mainly geared for export to neighbouring countries. Crocodile farming has expanded rapidly in recent years, from 4 816 heads in 1993 to 307 000 in 2016. This system encompasses a few large-scale farms registered by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) for exporting and a large number of small, family-based ventures with few animals, purchasing baby crocodiles and feeding them with by-catch or what is commonly referred to as “trash fish”, animal by-products from home consumption, and any wildlife available in their surroundings (snakehead, river rat, chicken, tilapia). Family farms will require control in terms of the source of baby crocodiles and the feed used.

Zones with inland aquaculture potentials can be grouped under three types of geographical areas linked with water characteristics and use:

- i. the area of Tonle Sap and its surroundings, with important agriculture–fishery potentials especially rice–fish farming but also pond farming (in rainfed areas) and cage culture (immediate periphery of the lake);
- ii. the Mekong floodplain areas with high population density and a significant rice production but a relatively limited aquaculture activity despite the potential of rice–fish farming; and
- iii. the surroundings of Phnom Penh and Kandal Province, which host intensive culture systems, with commercial aquaculture farms mainly based on large ponds.

2.1.2 Coastal and marine aquaculture

Marine shrimp farming has not recovered from the white spot disease outbreak and is currently not developed. It is however benefitting from FAO assistance. A medium-scale enterprise started pond culture of *Penaeus vannamei* in Koh Kong Province in 2016.

Mud crab (*Scylla serrata*) fattening is being supported by a Czech NGO People in Need (PIN) and still relies on wild broodstock. It has a high market value especially when sold as soft-shell crab. There is also restocking of blue swimming crab (*Portunus pelagicus*) as Cambodia has the skilled personnel to produce postlarvae for restocking purposes.

Culture of green mussel (*Perna viridis*/*Mytilus smaragdinus*) on poles is carried out in Koh Kong Province.

Marine finfish culture targets mainly restaurants and is in competition with imported finfish from neighbouring countries. Groupers (*Epinephelus* spp.), snappers (*Lutjanus malabaricus*) and seabass (*Lates calcarifer*) are fattened in net cages. Juveniles are caught from the wild. Projects from JICA and China are supporting these enterprises. A large-scale marine fish farm project in Preah Sihanouk Province is in the pre-development stage.

Artemia can be produced in salt ponds during the rainy season (tests started in 2015, under European Union funding) to be used as live feed for the juvenile stage of *Machrobrachium* and marine finfish. Export of artemia cyst is a possibility. Quality and reliability of supply will have to be assured to be able to compete with other countries already ahead in the market.

2.2 Supply of seed, feed, other inputs, and advisory services

Seeds are provided by government and private hatcheries. There are currently 12 public hatcheries, of which four are functioning (National Research and Aquaculture Development Institute (NARDI), Freshwater Aquaculture Research and Development Center (FARDeC), Marine Aquaculture Research and Development Center (MARDeC) and Teuk Veal Fish Station). This is partly because of the lack of financing for research and a shortage of personnel as a consequence of the decentralization of the Department of Aquaculture Development (DAD). The Fisheries Administration (FiA) currently lists 294 private hatcheries and nurseries, mostly small scale.

Seed production has seen a rapid growth from the early 2000s (when 20 million pieces of seed was the estimated output) to 2018 when some 210 million pieces were produced. However, 55 percent of the country's seed requirement is still imported, mostly from Viet Nam and some from Thailand. Cambodian hatcheries supply 32 percent and wild catch make up the remaining 13 percent. About 87 percent of the domestic hatchery production comes from private hatcheries. Some species, such as snakehead and pangasius seeds, are imported and from the wild. Carps, African catfish and tilapia seed are mostly from small-scale hatcheries.

There is as yet no industrial aquafeed factory in Cambodia. (One company is being assisted by a project funded by the American Soybean Association to expand into an industrial scale feed factory). Formulated feed is imported from Viet Nam. Many producers rely on local home-made feed. Some farmers mix the commercial feed with rice bran, fermented "trash fish" (more correctly by-catch), and vegetable materials such as morning glory or swamp cabbage, which grow abundantly in swamps and water channels.

The extension service for aquaculture is limited and provided by FiA staff, NGOs and project contractors. Project-based extension, which depends on external funding, lacks continuity and sustainability. And these are often targeted at specific commodities or problems. For the extension programme to be coherent and sustained, the strategic plan for aquaculture contains the proposal to establish a National Aquaculture Information and Extension Centre either under the existing Administration and Extension Office of DAD or housed in a university.

3. Legislation (laws and regulations)

The old Fisheries Law of 1987 (amended in 2006) mainly focuses on capture fisheries although Articles from 53 to 58 have provisions for aquaculture (FiA-MAFF, 2007).

Art 53 states that all Cambodian citizens can obtain from FiA the following aquaculture permissions:

- i. 1 pond of 5 000 m²
- ii. 1 pen of 2 000 m²
- iii. 1 cage of 15 m²

Farmed animals such as crocodile, frog, snake, turtle, serpent and other aquatic organisms need authorization from the Ministry of Agriculture, Forestry and Fisheries (MAFF).

Art 54 states that for mariculture activities, one needs the authorization of FiA for small-scale fish projects. For other animals an authorization from MAFF needs to be obtained.

Art 55 concerns ornamental fishes and follows the above-mentioned regulation for small-scale production requiring FiA authorization. MAFF authorization is required for other species.

Art 56 states that all applicants need to respect the articles 53 to 55 of the FiA, respecting all regulations of the head of FiA, and need to be registered in the logbook of the FiA.

Art 57 states that all aquaculture and mariculture operations shall maintain the quality of land, water, aquatic biodiversity and environment, and shall not discharge any material or toxic substances or perform any other act as stipulated in Article 22 of this law.

Art 58 states that importing any aquatic fauna or flora can take place when permission is granted by the head of the FiA, after quality control and analysis of specimen by the Fisheries Administration Laboratory has been performed.

A new draft revised Fisheries Law is being discussed at the cabinet level, with technical advice from the Fisheries Legal Working Group of FiA who are members of the Technical Working Group on Fisheries. It is expected to be enacted shortly. A whole chapter is dedicated to aquaculture with general provisions on inland aquaculture and mariculture authorizations, water quality and discharge of waste and effluent, and import, export and transport of live or fresh fish as well as processed fish products.

3.1 Authorization system

The Fisheries Management and Administrative Law provides that to establish a pond area of more than 0.5 ha (inland, coastal and wetlands) or a cage size of more than 15 m³ (inland waters), a permit must be obtained from the competent authority.

For ponds from 0.5 ha to 2 ha and cages from 15 m² to 200 m², licenses can be issued by Provincial-Urban Fisheries Authorities (with the approval of the Provincial-Urban Department of Agriculture). For ponds over 2 ha or cages over 200 m², licenses shall be issued by FiA and sent for approval to the Ministry of Agriculture, Forestry and Fisheries.

The new draft Fisheries Law requires a license to be issued by the FiA that takes into account the particular species of aquatic animals being cultured (such as crocodiles, tortoises, freshwater turtles and non-poisonous snakes, frogs or eels, and sea turtles), mentioning the size of the area or cage, or the quantity of specimens for which a license is required.

3.2 Environmental impact assessment (EIA)

The new Environmental and Natural Resources Management Codes (2019), the Law on Environmental Protection and Natural Resources (1996) and the Sub-Decree on Environmental Impact Assessment Process (1999) of the Ministry of Environment, provide the legal framework for the environment impact assessment (EIA) of any activity in sensitive areas.

Applications for local projects shall be filed either with the Provincial–Urban Environmental Department or with the authorized Provincial–Urban Authorities. The final decision is vested in the Royal Cambodian Government. Both new projects and existing and ongoing activities are subject to EIA. According to the requirements set in the Annex to the Sub-Decree, applicants shall first submit an initial environmental impact assessment (IEIA) report and a pre-feasibility study to the Ministry of Environment (or to the competent Provincial–Urban Authority).

After submission, the Ministry (or the competent Provincial–Urban Authority) shall give its opinion within 30 working days. Reports shall include the description of the environmental management plan defined for the project (FAO, 2020).

3.3 Water and wastewater

The Sub-Decree on Water Pollution Control (1999), which is applicable to all pollution sources, provides that the discharge or transport of wastewater requires an effluent discharge permit from the Ministry of Environment. Sources of pollution are classified into two categories: activities falling under Category I, including fish product processing, require a discharge permit if their effluents exceed 10 cubic metres per day; those in Category II, such as shrimp farming, shall in all cases apply for an effluent discharge permit. The Sub-Decree also establishes water quality standards to protect public waters. The new draft Fisheries Law requires aquaculture farmers to maintain land, water and environmental quality, as well as aquatic biodiversity, and prohibits the discharge of toxic waste matter in the fisheries domain.

3.4 Fish movement

The Sub-Law on Transportation of Fisheries Products (1988) establishes a licensing system for the movement of live or fresh fish and processed fish products. Applications shall be filed with the District Fisheries Authority, the Provincial–Urban Fisheries Authority or the Department of Fisheries depending on the origin and the destination of the load. Licenses for the export of live or fresh fish and processed fish products are granted by the Ministry of Commerce.

The ongoing revised Fisheries Law makes provisions on the documentation required for the import, export and transport of live or fresh fish and for processed fish products. It prohibits the import, export, trade, transport and processing of endangered species.

The import of non-native species is subject to a “special permission” to be granted by the FiA. According to the draft law, the import of live or fresh fish and processed fish products requires:

- i. a license to be issued by the FiA;
- ii. an export license from a CITES management authority of the exporting country for endangered species;
- iii. an import license issued by a CITES authority of Cambodia for endangered species;
- iv. a health certificate from the competent authority in the exporting country; and
- v. a health certificate from the Cambodian Fisheries Administrative Laboratory.

The export of live or fresh fish and processed fish products requires:

- i. a certificate to be issued by the FiA;
- ii. an export license issued by a CITES authority of Cambodia for endangered species; and
- iii. a health certificate from the Cambodian Fisheries Administrative Laboratory.

Lastly, the transport of live or fresh fish and processed fish products must be carried out under the supervision of the Fisheries Administrative Laboratory (FAO, 2020).

3.5 Disease control

There is no provision specific to aquaculture species and products. However, the Draft Sub-Decree on Sanitary Inspection of Animals and Animal Products (2002) puts in place a sanitary inspection system for the import, export and transit of all animal species, animal products, animal feed, and means of

transport, premises and related equipment. Furthermore, emergency provisions are made to contain the spread of epidemic diseases. The Sub-Decree also provides for the establishment of sanitary checkpoints and quarantine facilities. MAFF and the Department of Animal Health and Production are responsible for monitoring and inspection at checkpoints and for quarantine (FAO, 2020). Work is in progress in the FiA to finalize the draft proclamation on fisheries product hygiene.

Disease is a major problem in aquaculture in Cambodia. Although diseases are not as serious as in other countries (fish diseases in Cambodian aquaculture are generally not severe or prevalent or frequent), outbreaks have had relatively heavy impacts on the income and food security of many small-scale and small family farms. On the recommendation of FiA and MAFF the Royal Government of Cambodia approved the establishment in 2018 of the new Fish Health and Disease Management Office at the Department of Aquaculture Development. To minimize the occurrence and spread of disease outbreaks and promote the expansion of aquaculture production, these five measures are required (Hou, Khan and Thay, 2019):

- i. improvement, amendment, and enforcement of the regulations, laws, standard operating procedures (SOPs) and other relevant documents for responsible management to establish the aquatic emergency preparedness and response systems for effective management of transboundary disease outbreaks in Cambodia;
- ii. capacity building of aquatic animal health management officers on technique and skills for monitoring and disease surveillance;
- iii. development of national guidelines on good aquaculture practice (GAP), biosecurity practice, control of invasive species, and management of chemical and organic residues;
- iv. establishment of a laboratory for aquatic animal health monitoring, diagnosis and analysis, extension services, and sufficient funding for research; and
- v. strengthening the collaboration among central officers, provincial officers, researchers, farmers' networks, ASEAN Member States and NGOs to share experiences and technical expertise in aquatic animal health management.

Cambodia needs to build its capacity for laboratory analysis and develop SOPs to strengthen its emergency preparedness and response systems for transboundary disease outbreaks in the country and neighbouring countries. The European Union-funded CaPFish Aquaculture Project (2019 to 2023) is at present a very important programme on inland aquaculture in Cambodia. One of its expected results (under sub-component 5) is "... managing the negative impacts of aquaculture production on the environment." The project seeks to improve, upgrade or enhance the systems for managing and monitoring diseases, chemical and organic residues and invasive species. It is expected that the government will be able to set up an effective aquatic emergency preparedness and response system under this project (Khan, Chhorn and Thay, 2019).

3.6 Food safety

There are no provisions specifically for aquaculture. However, as declared by the Ministry of Agriculture, Forestry and Fisheries in the Progress Report "Natural resources management" (2002), the Department of Fisheries drafted the Proclamation on Fisheries Product Hygiene. The transport of processed fish products is subject to a licensing system, as described under the provision on fish movement (FAO, 2020).

It is interesting to consider that fisheries and aquaculture (including seed and feed production) are considered primary production and the rest of the fisheries product chain fall under the Hazard Analysis and Critical Control Point (HACCP) principals.¹ Very few industrial processing plants and supermarkets apply (partially or entirely) these principles along the Cambodian fish value chain. In the primary production node of the value chain, the mandatory good practices are scarcely applied (UNIDO and FiA-MAFF, 2015). Food safety principles, infrastructure and facilities, standard operating procedures, sanitary standard operating procedures, good handling practices, pest prevention and storage procedures need to be introduced into the Cambodian fisheries chain. The international hygiene procedures, if well applied, could provide significant benefit to the health and nutrition of the people. Moreover, post-harvest losses would be minimized bringing more financial benefit to farmers, processors and the sector in general.

The different Cambodian competent authorities involved in food and feed safety² do not strictly comply with the international guidelines and procedures and their personnel need to be trained to address this important shortcoming along the fish value chain.

4. Institutional framework and mechanisms governing the aquaculture industry at the national and local levels

4.1. Institutional framework

The Fisheries Administration (FiA) under the Ministry of Agriculture, Forestry and Fisheries is responsible for the management and development of fisheries and aquaculture. FiA comprises seven departments and two research institutes; in the provinces the Fisheries Administration Cantonments (CFiA) are responsible for sector management and development.

The Fisheries Administration (FiA) has the following responsibilities:

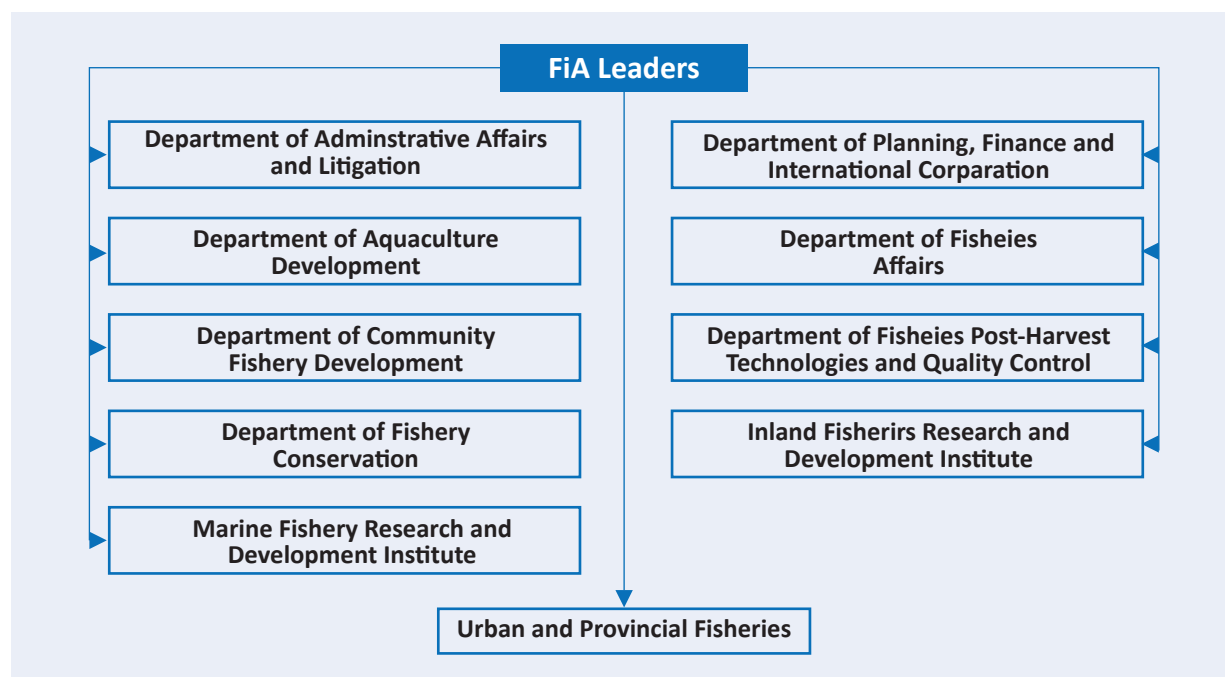
- i. to prepare fisheries resource inventories, assess potential and follow up the development of fisheries resources and aquaculture;
- ii. to enact laws, regulations and orders for fisheries protection and improvement and the management of fisheries resource exploitation and monitor their implementation;
- iii. to prepare plans for fisheries zones management, fisheries conservation and set up fisheries resource development policies and measures to ensure environmental protection;
- iv. to conduct scientific research on fisheries and aquaculture and document the findings;
- v. to inspect and manage all activities of fisheries resource exploitation and aquaculture; and
- vi. to support and encourage any person who initiates research on fisheries resource protection and/or promotes aquaculture.

¹ <https://food.unl.edu/seven-principles-haccp>

² Six ministries are involved in food and feed quality control: (i) Ministry of Agriculture, Forestry and Fisheries (MAFF); (ii) Ministry of Commerce (MOC), through the General Department of Import and Export Inspection and Fraud Repression (CAMCONTROL); (iii) Ministry of Industry and Handicraft (MIH); (iv) Ministry of Health (MOH); (v) Ministry of Tourism; and (vi) Ministry of Economy and Finance (MEF). The first four Ministries are the most directly involved in the food regulatory framework whereas the others hold a secondary role.

The management structure for the fisheries sector is illustrated in Figure 2.

Figure 2 Structure of the Fisheries Administration



The organic bodies of MAFF that are responsible for aquaculture management are FiA and its Department of Aquaculture Development (DAD) and the Fisheries Administration Cantonment (CFiA). DAD works with CFiA, which enforces the legislation and the implementing rules and regulations at the provincial level.

Good governance of aquaculture is a necessary condition for developing this sector to fully realize its potential and ensure its orderly and sustained growth. Aquaculture governance requires setting up and implementing policies, strategies and plans, laws and regulations, administrative and institutional arrangements to lead the development and growth of the sector. Its purpose is to promote sustainable aquaculture that is economically profitable, environment-friendly and socially equitable. For good governance, the DAD under the supervision of the FiA plays an important role in developing the mechanisms for the orderly and accelerated development of the aquaculture sector at a national level. At the local level, the responsibility falls on the Fisheries Administration Cantonment (CFiA) in each province, which implements directly all aquaculture development activities at the local level and collaborates closely with national agencies with mandates in aquaculture, local stakeholders, and farmers. These are some of the important principles and measures of good aquaculture governance (Hishamunda, Ridler and Martone, 2014):

- i. encourage the development of different kinds and scales of aquaculture in both freshwater and marine areas;
- ii. incorporate multiple and often competing objectives to achieve the optimum utilization of resources, sustainable livelihoods and reconciliation of the competing priorities and interests of different groups;
- iii. bring all the short-term time horizons of private individuals into line with the intergenerational time horizons of society, i.e. continuity and sustainability;
- iv. ensure consistency, transparency and fairness of decision making and implementation;

- v. promote legitimacy by reflecting accepted norms of equity and controlling harmful opportunistic behaviours (i.e. free-riding, rent-seeking and corruption);
- vi. provide certainty to aquaculture stakeholders and contain the level and distribution of transaction costs;
- vii. adopt an ecosystems approach to aquaculture (EAA) development; and
- viii. develop fish processing and packaging by encouraging large-scale investments and improving aquaculture infrastructure to increase competitiveness and improve market access.

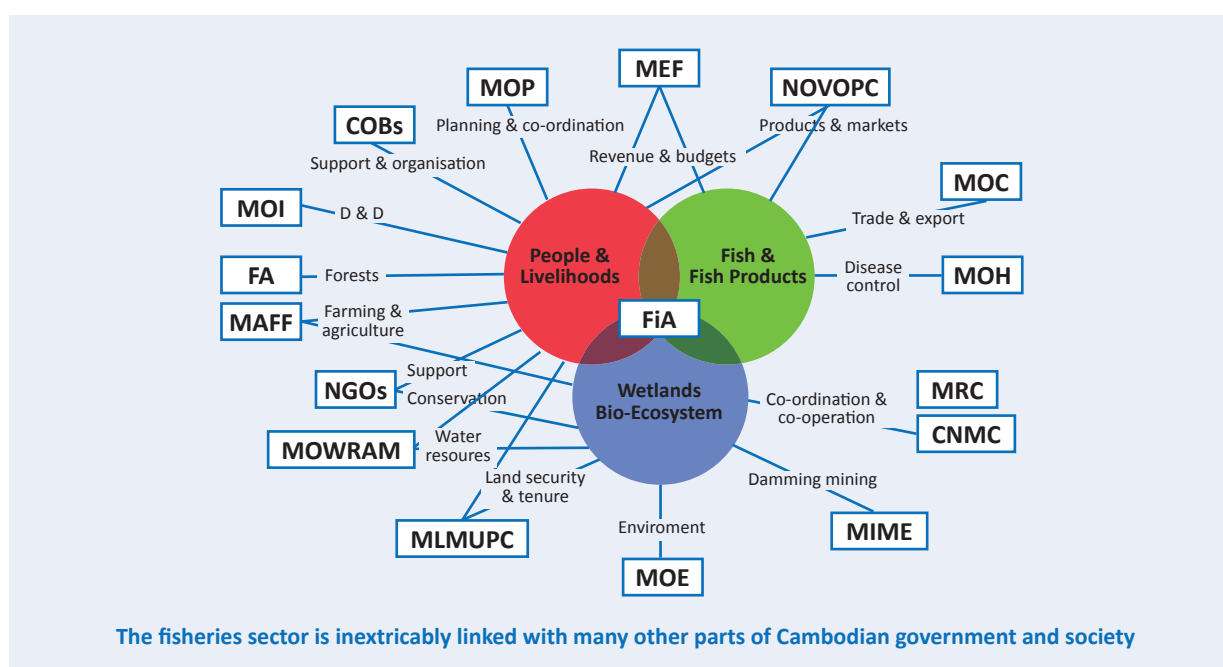
With the decentralization and de-concentration policy, subnational structures are being revised. Starting with fiscal year 2017, FiA Cantonment staff have been placed under the former Provincial Department of Agriculture (PDA), which is now the Provincial Department of Agriculture, Forestry and Fisheries (PDAFF) and upgraded as Full Budget Entities. Extension services are expected to be better managed at this level. The offices of the Fisheries Administration Cantonment are responsible for promoting, overseeing and regulating the development of fisheries in each province.

Other agencies involved in aquaculture management, to various extents and in various areas, include:

- i. Ministry of Commerce (including CamControl, which is the Cambodia Import-Export Inspection and Fraud Repression General Directorate)
- ii. Ministry of Environment (e.g. use of chemicals, water use)
- iii. Ministry of Health (e.g. food safety)
- iv. Ministry of Industry and Handicraft (e.g. feed)
- v. Ministry of Tourism (e.g. food in restaurants)
- vi. Ministry of Education, Youth and Sport (e.g. degree programmes in aquaculture)
- vii. Ministry of Women's Affairs (e.g. anemia).

Figure 3 shows the linkages among various actors in the Cambodian fisheries sector.

Figure 3 Linkages in the Cambodian fisheries sector



Legend: CBOs: community-based organizations. CNMC: Cambodian National Mekong Committee. FA: Forestry Administration. MAFF: Ministry of Agriculture, Forestry & Fisheries. MEF: Ministry of Economy & Finance. MIME: Ministry of Industry, Mines & Energy. MLMUPC: Ministry of Land Management, Urban Planning & Construction. MOC: Ministry of Commerce. MOE: Ministry of Environment. MOH: Ministry of Health. MOI: Ministry of Interior. MOP: Ministry of Planning. MOWRAM: Ministry of Water Resources and Meteorology. MRC: Mekong River Commission. NGOs: non-governmental organizations. NOVOPC: National One Village One Product Committee.

There are significant overlaps in mandates and in some cases duplication of responsibilities. At the very least it can be a waste of public resources and a source of confusion. More seriously, they impose additional effort and transaction costs to the farmers, input producers and traders, who might just choose to ignore the requirements (e.g. registering or obtaining permits) and then are penalized for it.

4.2 Research and higher education

There are four institutes/centres conducting research in Cambodia, of which three are specialized in freshwater aquaculture research and development.

- i. The **Freshwater Aquaculture Research and Development Centre (FARDeC)**, also known as Bati (previous name of the centre), is located in Prey Veng Province. It conducts research and development on freshwater fisheries species (carp, tilapia, snakehead, freshwater prawns, catfish (*Pangasius* spp.), etc.) and it also acts as a broodstock centre. Twenty-four employees work in the centre, of which four are on fixed-term contracts.
- ii. The **National Research and Aquaculture Development Institute (NARDI)** based in Kandal Province. It has two research divisions. Most of the applied research undertaken has been concentrated on breeding techniques, broodstock improvement, seed production, nutrition, fish health, and production technologies in ponds, cages and rice fields. NARDI keeps the following species to preserve the broodstock: silver barb (*Puntius gonionotus*), tilapia (*Oreochromis niloticus*), sultan fish (*Leptobarbus hoevenii*), striped catfish (*Pangasius hypophthalmus*), walking catfish (*Clarias* spp.), prawn (*Macrobrachium rosenbergii*), red tailed tinfoil (*Barbonymus altus*) and four carp species. NARDI manages the Chrang Chamres Fisheries Research Station, under FiA's jurisdiction. Twenty-five employees work in the centre, seven are on fixed-term contracts.
- iii. The **Teuk Veal** Fish Station, located in Siem Reap Province produces seeds of tilapia (red and black) (*Oreochromis niloticus*), silver barb (*Puntius gonionotus*), and to a lesser extent common carp (*Cyprinus carpio*), walking catfish (*Clarias* spp.) and Indian carp (*Gibelion catla*). This fish station doesn't receive any funding from the FiA, except for the salaries of the six permanent employees and three employees on fixed-term contracts.
- iv. The **Marine Aquaculture Research and Development Center (MARDeC)**, based in Preah Sihanouk, focuses on fish seed production and fish culture of key marine aquaculture species (grouper, seabass, crab, etc.) with an emphasis on Asian seabass. Seventeen employees work in the centre, one is on a fixed-term contract.

Applied research is carried out by the National Research and Aquaculture Development Institute (NARDI), Freshwater Aquaculture Research and Development Center, Marine Aquaculture Research and Development Center, Prek Leap National College of Agriculture, Kampong Cham National School of Agriculture and the Royal University of Agriculture.

Diploma and bachelor degrees in fisheries sciences with a major in aquaculture are offered by the agriculture universities in Cambodia (Table 2). DAD is coordinating the programmes in aquaculture

extension, education and research with the aquaculture research centres and institutes and agriculture universities. Every year, in each of these three educational institutions, 20 students enrol in a bachelor's degree course in aquaculture.

Table 2 Educational Institutions offering degree courses in aquaculture

College	Number of students per year	Type of curriculum		Number of teachers	Presence of a research lab
		Bachelor (numbers)	Certificate/ Associate Degree Diploma		
Royal University of Agriculture	2014 to 2017: 87 (30 females)	2014 to 2017: 87 (30 females)		16 (9 full-time and 5 part-time)	The research lab can conduct water quality analysis as well as phytoplankton and zooplankton analysis
Prek Leap National College of Agriculture	20		11 (Associate Degree)	22 (15 staff members and 7 from other institutions)	The research lab can conduct analysis of water quality, feed protein, fish disease, phytoplankton and zooplankton
National College Kampong Cham	(data not available)				

The Technical Aquaculture Working Group (TWGF) provides advice to the Cambodian Government through the development partners. The Sub-group on Aquaculture as a part of TWGF facilitates meetings with partners involved in aquaculture.

4.3 Implementation mechanisms for laws and codes

4.3.1 Technical standards and guidelines supporting the implementation of laws and regulations

The FiA and MAFF issued the GAP Order and three proclamations to support the application of the Fisheries Law in aquaculture. These have been enacted:

- i. Good Aquaculture Practices Order by the FiA. Issued on 15 August 2012 following the ASEAN GAqP Guideline, the Order covers: (i) establishment of aquaculture farms; (ii) selection of aquatic species for culture; (iii) selection of aquatic species for breeding; (iv) feeds and feeding management; (v) aquaculture farm management; (vi) transportation of aquatic animals; (vii) good hygiene practices; and (viii) the uses of hormones, drugs and chemical substances.
- ii. MAFF Proclamation on Ornamental Aquatic Animals Management issued on 3 October 2014.
- iii. MAFF Proclamation No. 325 on Snakehead Culture Management issued on 7 June 2016.
- iv. MAFF Proclamation No. 430 on the Management of Crocodile, Soft-shelled Turtle, Turtle, Frog, Eel and Water Snake Farming issued on 6 July 2016.

4.3.2 National Residue Monitoring Plan of Veterinary Medicine and Environmental Contaminants (NRMP)

The risk on people's health of high levels of residues and contaminants prompted the government to prepare the National Monitoring Plan for Residues of Veterinary Medicines and Environmental Contaminants (NRMP). The Plan is implemented by FiA and CFiA personnel and external experts working in these groups:

- i. Residue monitoring management committee
- ii. Residue monitoring team
- iii. Inspection and sampling team
- iv. External accredited laboratory services

In September 2015 the second European Union (EU)-supported mission of the "TA Support to Develop and Implement a National Residue Monitoring Plan for Aquaculture Products" was performed by an international food safety expert. The mission developed proposals for an actual field sampling plan and budgets for related residue testing in 2016 including the standard operating procedures (SOPs) in accordance with EU guidelines. Three FiA officers were trained in the use of the SOPs. These procedures should be integrated with the programme for promoting and inspecting GAqP (good aquaculture practices).

The EU-supported mission stated that there is an urgent need to define and enforce maximum residue levels (MRL) in line with Codex or major trade partners. The NRMP must be seen as a pilot project to be expanded in the future. It recommended the enactment of new legislation and its enforcement to control the authorization, distribution, prudent and practical application of veterinary medicines, feed and other inputs.

The NRMP is considered to be incorporated into the GAqP which is already implemented by DAD beginning early 2015 (ten farms in 2015 and another ten farms in 2016). The EU-supported mission highlighted that it is important to set up and enforce the national legislation before starting to implement NRMP for aquaculture. The NRMP is seen as one part of the application of GAqP (developed with ASEAN and Australian International Development Agency (AusAID) cooperation). The NRMP procedures are part of the more detailed manual that the competent authorities need for the application of GAqP. It must contain all the needs of the inspection body for microbiology, parasitology and other risks in aquaculture.

Currently there are eight testing laboratories in the country, of which only one is accredited and none is directly relevant to aquaculture:

- i. CAMCONTROL Testing Laboratory, Ministry of Commerce (MOC)
- ii. Industrial Laboratory Center of Cambodia (ILCC), which is accredited by the Ministry of Industry and Handicraft (MIH)
- iii. National Agriculture Laboratory, Ministry of Agriculture, Forestry and Fisheries (MAFF)
- iv. National Health Products Quality Control Center, Ministry of Health (MOH)
- v. Feed Quality Control Laboratory (MAFF)
- vi. National Veterinary Research Institute (MAFF)
- vii. Metrology Laboratory, Ministry of Mines and Energy (MIME)
- viii. Environmental Laboratory, Ministry of Environment (MOE)

There are a few private laboratories, none of which is accredited.

4.3.3 FiA inspection at provincial level

The information collected during the field operation shows that FiA provincial officers visit the processing establishments, landing centres, fishing vessels, aquaculture facilities, feed factories, hatcheries, without controlling the food/feed safety requirements (GAqP and HACCP). Actually, the inspectors/officers do not use any inspection manual with annexed checklists to work in a systematic manner. Manpower is a problem as FiA officers can be very busy with work to combat illegal, unreported and unregulated (IUU) fishing. The actors along the fisheries value chain are aware of the need for proper documentation of the food and feed safety aspects of their facilities (UNIDO and FiA-MAFF, 2015).

4.4 List of Cambodian laws, proclamations, regulations and decrees related to aquaculture

The following list is drawn from FAO (2020):

- i. Proclamation on Fisheries Product Hygiene
- ii. Draft Sub-Decree on Sanitary Inspection of Animals and Animal Products (2002)
- iii. Draft Water Law
- iv. Fisheries Management and Administration Law (1987)
- v. Proclamation on Competent Authorities in Issuing Permission to do Fisheries in Open Water, Aquaculture, Fish Processing and Special Permissions (1989)
- vi. Sub-Law on Transportation of Fisheries Products (1988)
- vii. Law on Environmental Protection and Natural Resources (1996)
- viii. Sub-Decree on Environmental Impact Assessment Process (1999)
- ix. Law on Land (2001)
- x. Law on the Establishment of the Ministry of Agriculture, Forestry and Fishing (1996) Sub-Decree on the Organization and Functioning of the Ministry of Agriculture, Forestry and Fisheries (2000).
- xi. Proclamation on Demarcation of Inland Fishing Lots and Fish Sanctuaries (1989)
- xii. Regulations on the Creation and Designation of Protected Areas (1993)
- xiii. Sub-Decree on Water Pollution Control (1999)
- xiv. Law on Fisheries 2006

4.5 International agreements, conventions, codes, and instruments

Cambodia, as a member of the Association of Southeast Asian Nations (ASEAN), has adopted the Association Code of Conduct. The Code includes the followings guides:

- i. Manual of ASEAN Good Shrimp Farm Management Practices (1988)
- ii. FAO Manual on Practical Guidelines for the Development of High Health *Penaeus monodon* Broodstock
- iii. Harmonization of Hatchery Production of *Penaeus monodon* in ASEAN Countries

Cambodia is a member/signatory of the following international and regional agreements, conventions and organizations:

- i. World Trade Organization (WTO)
- ii. Association of Southeast Asian Nations (ASEAN)(1983)
- iii. ASEAN Free Trade Area (AFTA)
- iv. Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)
- v. Convention on Biological Diversity (CBD)
- vi. Southeast Asian Fisheries Development Centre (SEAFDEC)-ASEAN, Code of Conduct for Responsible Fisheries
- vii. International Organization for Standardization (ISO)
- viii. ASEAN Framework Agreement on Mutual Recognition Arrangement
- ix. United Nations Convention on the Law of the Sea (UNCLOS)
- x. Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1997
- xi. The RAMSAR Convention
- xii. Southeast Asian Fisheries Development Centre (SEAFDEC)
- xiii. Agreement on the Network of Aquaculture Centres in Asia-Pacific (NACA) (1988)
- xiv. Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin (1995).

5. Gaps, issues and challenges in aquaculture governance

Cambodia has a large scope for expanding aquaculture production. It is still below its potential in comparison with the other ASEAN countries that have witnessed the strong and sustained growth of their aquaculture sectors over the past 15 years. Cambodian aquaculture faces numerous constraints to its development including lack of and/or poor quality fingerlings, competition between capture fisheries and aquaculture over the existing stock, insufficient and lack of control of the quality of aquaculture feed (which is currently mostly imported), large and now increasingly unpredictable changes in the hydraulic system as a result of climate change and the increasing number of hydraulic infrastructures on the Mekong River, environmental stress as a result of the exploitation and use of the small fish, inequitable share of the benefits among the actors in the value chain, lack of competitiveness of the sector in comparison with neighbouring countries, limited knowledge of the production, technology of more commercial aquaculture species, lack of investment incentives for aquaculture development, weak management and poor allocation of the land and water resources for poor smallholders.

The relatively low competitiveness of the sector in comparison with the neighbouring countries highlights the urgency to work on the development of more culture species, the improvement of production systems, the local production of quality feed, and the improvement in the quality of seed through genetic improvements. In addition, producers have to be organized into strong clusters or, preferably, formal associations. An efficient value chain with a focus on efficient processes, quality inputs, quality farm products, and value-added products can contribute to greater competitiveness.

In terms of marketing, the current trading system is fragmented with a range of middlemen from farms to consumers, with most transactions on an informal basis and the prevalence of small players.

Producers are often indebted to traders who impose a fixed price or manipulate prices (producers often do not have ready access to market price information).

Moreover, during the fishing season, the aquaculture sector competes with capture fisheries during its peak fishing season as there is a local preference for wild fish.

Aquaculture sector governance for inclusive and equitable aquaculture development comes under the mandate of more than one ministry but inter-ministerial co-ordination is weak. In addition, consultation between government authorities and other stakeholders is limited to the meetings of the Fisheries Technical Working Group and its Aquaculture Sub-group. Aquaculture producers and the private industry sector are not sufficiently organized and structured to take an effective part in stakeholder consultations.

Regarding gender aspects, although there is already an existing working group for gender and child labour in the fisheries sector, there is still a need to build the capacity of FiA staff at national and subnational levels on this issue. An FiA gender strategy would be a good start to integrate gender considerations within the agency and in the management of the fisheries sector.

6. Recommendations for strengthening aquaculture governance at national and local levels

6.1 Strengthening FiA management capability and practices

It is necessary to assist in the effective implementation of the National Aquaculture Development Strategy (NADS) by translating the NADS into medium term comprehensive operational plans and by further improving the regulatory framework. It is also necessary to build up an expenditure framework and coherent budgeting. This will include development of communal plans and district plans to develop small-scale aquaculture, fishing and fish processing. Activities should include actions at the local level, such as a land registration procedure to assure security of land tenure and thus security of investments in land use and development.

Activities should also focus on the improvement of statistical and information systems and on the production of regular, reliable and credible reports on the national aquaculture sector for better planning.

6.2 Sector organization

Support for the formation of professional organizations within the sector (e.g. according to strategic value chains and/or based on the existing cluster approach) is necessary. Thereafter strengthening these organizations, conducting regular consultations on policies and action plans as well as research needs can be achieved. These can be carried out through the TWG-Fi's Aquaculture sub-group (which could be enlarged), a scientific and ethics committee, and an innovation platform.

6.3 Farmer clusters and associations

The organization of farmer associations should be promoted. The precursor will be informal but well organized farmer clusters for more efficient sector management. Organizing and professionalizing the associations (training will have to be provided on technical and management skills) will entail a concerted and lengthy effort. For a start, hatchery operators have been encouraged and supported to form networks. It is envisaged that these networks will eventually be organized into a formal national fish hatchery association. This will facilitate the development, promotion and adoption of better management practices, compliance with rules and regulations, and adherence to codes and

standards, organized water management, input procurement, and marketing. There are a few farmers' associations organized by NGOs although there are indications of farmers' interest in forming more clusters and organizing more formal associations. A nationwide effort to organize and professionalize farmer associations will take time and plenty of resources, not to mention capacity building in FiA, CFiA, and DAD. It will also have to be facilitated by close partnership with NGOs that have a strong presence in the local areas.

6.4 Labour monitoring

It will be necessary to assess and monitor labour conditions in the aquaculture sector and thereafter raise awareness of workers' rights, decent labour conditions and employment regulations and employers' obligations. This would require collaboration with the General Department of Labour of the Ministry of Labour or with specialized civil society organizations.

6.5 Further steps: focusing on and strengthening overall capacity for governance: the other mechanisms

To recapitulate, Cambodia's national policy framework for aquaculture is geared to achieving the following social, economic and environmental outcomes:

- i. food and nutrition security;
- ii. poverty alleviation;
- iii. livelihood diversification, enhancement and security;
- iv. environmental sustainability, social stability, and economic development;
- v. equal opportunities in the access to livelihood assets (for example between men and women, rich and poor, among social classes, among ethnic groups);
- vi. increased capacity to use livelihood assets;
- vii. fair allocation and sustainable use of the public domain (land, rivers, lakes, reservoirs, sea areas and underground freshwater supplies);
- viii. strengthened capacity to manage risks (reduce vulnerabilities/increase adaptive capacities/strengthen social and ecological resilience);
- ix. balance between smallholder and large-scale aquaculture;
- x. clear definition of the roles of the public and private sectors;
- xi. sector leadership and coordination;
- xii. adequate allocation of public resources especially funds for the management of aquaculture development; and
- xiii. coherence with other policies and strategies such as those on poverty alleviation, agricultural and industrial development, water and land use, rights of minorities and indigenous peoples, as well as with regional priorities such as those of ASEAN, SEAFDEC, NACA and subregional priorities specifically those of the Mekong River Commission.

To achieve these outcomes the government has so far been relying mostly on the command and control mechanisms of governance (the regulatory and administrative regime) to implement the policies, legislations, rules, regulations, codes, and guidelines that apply to aquaculture. Cambodia's next move should be the enhancement of the overall governance of the sector by developing the capacity for market instruments, self-regulation or voluntary management and stakeholder participation to play a greater part aquaculture governance.

6.5.1 Market instruments

Market instruments set standards of compliance for the quality of a product and/or the manner in which it is produced for the purpose of better market access and on the expectation of a higher price: examples are product and process certifications, eco-labels, and social labels. An eco-label or a social label takes into account the attributes of the products other than price, quality and safety. These other attributes relate to environmental, economic, social and ethical values such as fair trade, support to small and poor farmers, fair treatment of workers, discouraging child and forced labour, maintaining equilibrium of ecosystems and health-related properties such as being organic. Another market instrument is the polluter pays principle: either the producer bears the cost of polluting (by paying a tax on emissions) or not polluting the environment (by paying for the construction and maintenance of a treatment facility). Either measure affects profitability so that its purpose is to induce firms and farmers to be environmentally and socially responsible.

6.5.2 Self-regulation or voluntary management

Because of the difficulty and cost of regulating aquaculture activities, increasing importance should be given to self-regulatory and voluntary management schemes. Their practical application is in the adoption of best management practices, codes of conduct and codes of practices by an industry group such as seed or feed manufacturers and, preferably, by organized farmers. Voluntary management eliminates or reduces the need for government's surveillance and monitoring of compliance and imposing penalties for violation of rules and regulations, which add to the cost of governance. They also minimize irresponsible practices (i.e. corruption) by the regulator and/or the regulated.

6.5.3 Stakeholder participation

This is based on the principle that the state is one of the major stakeholders but not the dominant stakeholder. Stakeholder participation assumes that the pool of information and experiences from all the primary stakeholders makes it easier to develop, decide on and implement policies and plans so that there is consensus rather than stalemate or conflict, greater support for decisions agreed through consensus, and little or no political interference. So far, there is increasing but as yet limited stakeholder participation in the formulation of policies and especially the implementation of laws and regulations. The government envisage – following the formation and/or strengthening of professional organizations (as mentioned earlier) – the formation and/or strengthening of the other groups of stakeholders i.e. farmers' associations, women's associations, producers and suppliers of inputs (seed especially), as well as traders and processors and other actors, especially NGOs, along the aquaculture value chain so that they can participate meaningfully as partners with the government in policy and programme formulation and in the orderly and progressive management of the aquaculture sector.

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Annex IV-2 Aquaculture governance in China

Wang Qingyin and Liu Fuli

1. Aquaculture development in China

China is well known as the world's major producer of aquaculture products. The origins of aquaculture in China are lost in antiquity but may be traced back at least to the late Yin and the earlier Zhou Dynasty (before 1100 BC). The earliest work on fish raising in China named "Fan Li on Pisciculture" recorded the experience of fish raising 2500 years ago. The earliest archaeological evidence for rice–fish farming is some clay models from the Han dynasty (25 AD to 220 AD), and a written record of water chestnuts and common carp grown in rice fields in Sichuan Province from the Wei Dynasty (220 AD to 265 AD). After the founding of the People's Republic of China, the aquaculture industry developed rapidly in China because of the implementation of numerous fishery policies such as "Developing aquaculture and capture fishery simultaneously" and "Aquaculture is a priority". Aquaculture became one of the fastest growing agriculture sectors in China. The aquaculture outputs increased from less than 100 000 tonnes in 1950 to 3.63 million tonnes in 1985, and to 49.06 million tonnes in 2017, accounting for 8 percent, 45 percent, and 76 percent of the total fishery production, respectively. Since 1990, China has been the top producer of aquatic products in the world, accounting for about 60 percent of the world's total aquaculture outputs in recent years. Not only has aquaculture made important contributions to ensuring the supply of aquatic products, optimizing the dietary composition of the people, and ensuring food safety, but also promoting labour employment and increasing competition in agricultural exports. Aquaculture is playing an important role in promoting the transformation of the fishery sector, reducing CO₂ emissions, and alleviating eutrophication in waters.

1.1 Current status and characteristics

Science and technology are the key driving forces for the development of aquaculture. The technology of genetic breeding plays an important role in the breeding of new varieties. By the end of 2018, there were 215 new varieties certified and cultured in China. The prevention and control technologies related to aquaculture diseases have also been steadily advancing, e.g. fish vaccines, Chinese herbal medicines and micro-ecological preparations have been successfully developed. The nutritional needs of major aquaculture animals have been extensively studied, and a series of feed and additive formulas have been developed. The annual yield of formulated feed for aquaculture reached 20 million tons in China during the last five years. Aquaculture facilities and techniques have been continuously improving including equipment for water quality regulation, circulating water treatment systems, deep water anti-wind cages and large-scale aquaculture installations.

The high diversity of farming modes and species supports the steady development of aquaculture in China. Freshwater aquaculture includes ponds, reservoirs, lakes, rice fields, and river ditch farming, whereas mariculture includes ponds, rafts, land-based factories, cages, bottom sowing in tidal flats, and deep-sea farming. Green aquaculture techniques such as integrated multi-trophic aquaculture (IMTA) and rice–fish integrated farming are widely adopted. China's aquaculture species are rich in diversity, including fishes, crustaceans, molluscs, seaweeds and sea cucumbers – at least 296 species and 143 varieties based on incomplete statistics.

According to China Fishery Statistical Yearbook 2019, the total output of fishery in 2017 was 64.58 million tonnes, of which the capture fishing output was 14.67 million tonnes (22.7 percent), down 4.73 percent from the previous year. The aquaculture yield was 49.91 million tonnes (77.3 percent), up 1.73 percent from the previous year, of which freshwater aquaculture output was 29.59 million tonnes (59 percent) and marine aquaculture was 20.31 million tonnes (41 percent). In 2018, the aquaculture area was 7 189 thousand hectares, a decrease of 3.48 percent over the previous year, of which the marine aquaculture area was 2 043 thousand hectares (28 percent) and the

freshwater aquaculture area was 5 146 thousand hectares (72 percent). The rapid development of the aquaculture industry has promoted an increase in national per capita consumption of aquatic products, from 41.59 kg in 2011 to 46.28 kg in 2018. The value of aquaculture production in 2018 was CNY 945.6 billion, of which the value of freshwater aquaculture production was CNY 588.4 billion and that of mariculture production was CNY 357.2 billion. All seed/larvae of aquaculture species are artificially bred in hatcheries except for a few species such as eels. In 2018, 1 311 billion freshwater fish fry and 12.8 billion marine fish fry were artificially produced, whereas shrimp larvae production reached 1 341.8 billion (Bureau of Fisheries Administration, National Fisheries Technology Extension Center, and Chinese Fisheries Society, Ministry of Agriculture and Rural Affairs, China, 2019). Parts of the artificially produced seed/larvae were used for release and stock enhancement. A sufficient supply of seed/larvae has laid a sound foundation for the development of aquaculture in China.

1.2 Prospect for further development and major challenges

Aquaculture is regarded as an important strategic emerging industry in China and governments at all levels attach great importance to its healthy and sustainable development and have formulated and promulgated relevant policies and plans to provide policy support for the development of aquaculture. In January 2019, the state policy “Opinions on accelerating the green development of aquaculture” was issued. This is a programmatic document to guide the green development of aquaculture in China.

China’s aquaculture is facing some problems and challenges with respect to its future development. With the changes of national water area use and industrial development policies, the development space for aquaculture is severely compressed by competition from other industry sectors. Water pollution caused by industrial and agricultural development seriously affects the development of aquaculture as well as the quality and safety of aquatic products. National funds invested in fisheries technology and industry is inadequate. The coverage rate of improved varieties in aquaculture is generally not high. Aquaculture diseases are becoming more and more common. There is still a large gap in aquaculture facilities and equipment compared with the developed countries. The use of by-catch or so-called “trash fish” as feeds is still common in some fish farms, and the penetration rate of compound feed has yet to be increased. The improper use of antibiotics directly affects aquatic product quality and safety. Inadequate supervision of the discharge of aquaculture effluent has increased pressure on the ecological environment.

2. Legislative framework for aquaculture governance

2.1 Description of existing legislation for governing aquaculture

Currently, China has established a multi-level, multi-category and multi-form legal system for aquaculture governance with the Fisheries Law of the People’s Republic of China 1986 (amended in 2000 and 2004)³ as the principal law and coordinated with international conventions such as the FAO Code of Conduct for Responsible Fisheries 1986. The Fisheries Law of the People’s Republic of China 1986 is the most comprehensive law in the field of aquaculture in China. Relevant laws, regulations and other normative documents formulated by the fishery management departments at different levels make specific provisions, constraints and guidance for all aspects and relevant fields involved in aquaculture. Parts of the articles from relevant laws are illustrated as follows.

³ FAOLEX Database

2.1.1 Legislation on resources use, registration and licensing in aquaculture

Article 11 of the Fisheries Law of the People's Republic of China 1986: the state conducts unified planning for the use of waters and determines the waters and tidal flats that can be used for aquaculture. Where units and individuals use waters and tidal flats owned by the whole nation as determined by the national plan for aquaculture, users should apply to the fishery administrative department of the local government at or above the county level. The government shall issue a certificate that permits the use of the waters and tidal flats for aquaculture. The specific measures for the issuance of certificates shall be prescribed by the State Council. Collectively owned and nationally owned waters and tidal flats that are used by agricultural collective economic organizations, may be contracted by individuals or collectives engaged in aquaculture production.

Article 8 and 9 of the Aquaculture Quality and Safety Management Regulations (Decree No. 31 of Ministry of Agriculture 2003): the fishery administrative departments of the local people's governments at or above the county level should reasonably determine the water areas and tidal flats used for aquaculture. Units and individuals engaged in aquaculture using waters and tidal flats shall apply for aquaculture certificates in accordance with relevant laws and regulations, and conduct aquaculture production according to approved areas and scales.

Article 15, 16 and 19 of the Law of the People's Republic of China on the Use and Administration of the Sea Areas 2001:⁴ aquaculture, salt industry, transportation, tourism and other industrial planning involving the use of sea areas shall comply with marine functional zoning; units and individuals may apply to the marine administrative department of the people's government at or above the county level for the use of sea areas; after the sea area use application is approved, a sea area use right certificate is issued to the applicant.

2.1.2 Legislation on biodiversity and environment protection in aquaculture

Article 20 and 29 of the Fisheries Law of the People's Republic of China 1986: during aquaculture production, the ecological environment of the waters should be protected, the culture density should be scientifically determined, and reasonable feeding, fertilization, and use of drugs should not cause environmental pollution in the waters; establishment of aquatic genetic resources protection areas in the main growth and breeding areas of aquatic genetic resources with high economic value and genetic breeding value. Without the approval of the fishery administrative department of the State Council, no unit or individual may engage in fishing activities in the aquatic genetic resource protection zone.

Article 4 and 7 of the Aquaculture Quality and Safety Management Regulations (Decree No. 31 of Ministry of Agriculture 2003): promote ecological aquaculture and protect the aquaculture environment; the inlet and drainage systems of the farm or pond should be separated. The discharge of aquaculture waste water shall meet the discharge standards set by the state.

Article 20 of the Marine Environmental Protection Law of the People's Republic of China 1982 (as amended 1999):⁵ the State Council and the people's governments at all levels along the coast should take effective measures to protect the typical and representative marine ecosystems such as important fishery waters, the natural concentrated distribution of rare and endangered marine life, and the living areas of marine life with important economic value.

⁴ FAOLEX Database

⁵ FAOLEX Database

Article 57 of the Law of the People's Republic of China on Prevention and Control of Water Pollution 2008 (amended 2017):⁶ those engaging in aquaculture should protect the ecological environment of the waters, scientifically determine the culture density, rationally feed and use drugs appropriately to prevent pollution of the water environment.

Article 6 of the Implementing Regulations on the Protection of Aquatic Wild Animals of the People's Republic of China 1993 (amended 2013) (Decree No. 645 of State Council): the fishery administrative department shall regularly organize surveys on aquatic wild animal resources, establish resource archives, and provide a basis for formulating plans for the protection and development of aquatic wild animal resources, formulating and adjusting national and local key protected aquatic wild animal directories.

Article 3 and 5 of the Interim Measures for the Administration of Aquatic Genetic Resources Protection Areas 2011 (Decree No. 1 of Ministry of Agriculture): the aquatic genetic resource protection area refers to the waters, tidal flats and adjacent islands, reefs and land areas delineated according to the laws to protect the aquatic genetic resources and their living environment. The fishery administrative department shall formulate the overall plan of the national aquatic genetic resource protection area, and strengthen the construction of aquatic genetic resources protection area.

2.1.3 Legislation on aquaculture seed

Article 16 and 17 of the Fisheries Law of the People's Republic of China 1986: the State encourages and supports the selection, breeding and promotion of excellent aquatic varieties. The new aquatic varieties must be approved by the National Aquatic Variety Certification Committee and promoted by the fishery administrative department of the State Council after being approved. The import and export of aquatic seed is subject to examination and approval by the fishery administrative departments. The production of aquatic seed is examined and approved by the fishery administrative department of the local people's government at or above the county level. The import and export of aquatic seed must be quarantined to prevent any disease from entering the country and going out of the country. The specific quarantine work shall be carried out in accordance with the relevant laws and administrative regulations on animal and plant quarantine. The introduction of genetically modified aquatic seed must be evaluated for safety, and the specific management work shall be carried out in accordance with relevant regulations of the State Council.

Measures for the Management of Aquaculture Seedling 2005 (Decree No. 46 of the Ministry of Agriculture): the measures cover the breeding of aquaculture varieties and the management of production, operation, import and export of aquaculture seedlings. They aim to improve the quality of aquaculture seedlings and maintain aquaculture seedling production by protecting and rationally utilizing aquatic genetic resources, to protect the legitimate rights and interests of producers, operators and users, and finally to promote the sustainable and healthy development of aquaculture.

2.1.4 Legislation on aquaculture feed and drug use

Article 19 of the Fisheries Law of the People's Republic of China 1986: no bait or feed containing poisonous or harmful substances may be used in aquaculture production.

Article 15 of the Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture): the use of compound feed is encouraged; direct feeding of chilled (frozen) bait is restricted to avoid contaminating water quality by residual bait; it is forbidden to use feed and feed additives without product quality standards, without a quality inspection certificate, and without a production license and an approval number. The use of deteriorated and expired feed is prohibited.

⁶ FAOLEX Database

Article 19 and 28 of the Management Regulations on Feed and Feed Additives 1999 (amended 2017) (Decree No. 676 of State Council): where feed additives are added to feed or animal drinking water, they shall comply with the requirements for use instructions and precautions of feed additives, and shall comply with the feed additive safe use regulations formulated by the agricultural administrative department of the State Council. It is forbidden to add to the feed or animal drinking water substances promulgated by the State Council's agricultural administrative department and other substances that have direct or potential harm to the human body, or use them directly to breed animals; it is prohibited to produce, operate or use new feeds, new feed additives that have not obtained a new feed or new feed additive certificate. It is forbidden to operate or use feed and feed additives without a product label, a production license, a product quality standard and an inspection certificate.

Article 16 of the Aquaculture Quality and Safety Management Regulations 2003 (Decrees No. 31 of Ministry of Agriculture): aquaculture products using drugs shall not be used for human food consumption during the withdrawal period. The use of fake and inferior veterinary drugs, other compounds and biological agents prohibited by the Ministry of Agriculture are prohibited. Active pharmaceutical ingredients (APIs) must not be used directly in aquaculture.

Article 38 and 39 of the Management Regulations on Veterinary Drugs 2004 (amended 2017) (Decree No. 404 of State Council): veterinary drugs use shall abide by the regulations for the safe use of veterinary drugs formulated by the veterinary administration under the State Council, and should establish drug records; the use of fake and inferior veterinary drugs and other compounds prohibited by the veterinary administration under the State Council are prohibited. The list of prohibited drugs and other compounds shall be formulated and published by the veterinary administration under the State Council.

2.1.5 Legislation on biosecurity and animal health management in aquaculture

Article 17 of the Fisheries Law of the People's Republic of China 1986: the import and export of aquatic seed must be quarantined to prevent the disease from entering the country and going out of the country. The specific quarantine work shall be carried out in accordance with the relevant laws and administrative regulations on animal and plant quarantine.

Article 22 of the Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of Ministry of Agriculture): refers to adopting technical measures such as putting in disease-free seed, feeding compound feed, and artificially controlling the environmental conditions of the aquaculture, to make the cultured organisms maintain the most suitable growth and development state, and to reduce the occurrence of breeding diseases.

Article 18 of the Measures for the Management of Aquaculture Seedling 2005 (Decree No. 46 of Ministry of Agriculture): the import and export of aquatic seed should be quarantined to prevent the disease from entering the country and going out of the country. The specific quarantine work shall be carried out in accordance with the People's Republic of China Entry and Exit Animal and Plant Quarantine Law⁷ and other laws and regulations.

2.1.6 Legislation on aquatic products quality, traceability, and certification

Article 11, 16, 24, 25 and 32 of the Law of the People's Republic of China on the Quality and Safety of Agricultural Products 2006:⁸ the State should establish a sound standard system of quality and safety for agricultural products. Agricultural product quality and safety standards are mandatory technical specifications. The formulation and release of agricultural product quality and safety standards shall

⁷ FAOLEX Database

⁸ FAOLEX Database

be implemented in accordance with the relevant laws and administrative regulations. The people's government at or above the county level shall take measures to strengthen the construction of agricultural product bases and improve the production conditions of agricultural products. The administrative department of agriculture of the people's government at or above the county level shall take measures to promote the construction of standardized production comprehensive demonstration areas, demonstration farms etc., to guarantee the quality and safety of agricultural products. Producers of agricultural products shall establish agricultural product production records. It is forbidden to use agricultural inputs prohibited by the state in the production of agricultural products. Agricultural products sold must meet agricultural product quality and safety standards, and producers can apply for the use of pollution-free agricultural product marks. If the quality of agricultural products meets the relevant standards for high-quality agricultural products stipulated by the state, producers may apply for the use of corresponding agricultural product quality marks.

Article 3 and 19 of the Measures for the Administration of Geographical Indications of Agricultural Products 2007 (Decree No. 11 of Ministry of Agriculture): the state implements a registration system for geographical indications of agricultural products. The registered geographical indications of agricultural products are protected by law. Producers and operators of agricultural products with geographical indications shall establish a quality control traceability system. The holder of the geographical indication registration certificate of the agricultural product and the user of the certificate shall be responsible for the quality and credibility of the geographical indication agricultural products.

Article 2, 7 and 32 of the Measures for the Management of Pollution-free Agricultural Products 2002 (Decree No. 12 of the Ministry of Agriculture and General Administration of Quality Supervision, Inspection and Quarantine): pollution-free agricultural products refer to unprocessed or primary processed edible agricultural products whose production environment, production process, and product quality meet the requirements of relevant national standards and specifications, and that have obtained certification and are allowed to use the pollution-free agricultural product mark. The state encourages production units and individuals to apply for the certification of pollution-free agricultural products. Units or individuals who have obtained the certification of pollution-free agricultural products may use the pollution-free agricultural product logo on the products, packaging, labels, advertisements, and specification.

Article 4 of the Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture): control aquaculture drugs to ensure the quality and safety of aquaculture products. The state encourages aquaculture units and individuals to apply for pollution-free agricultural product certification in accordance with relevant regulations.

2.1.7 Legislation on working conditions and child labour use in aquaculture

Article 88 of Labour Contract Law of the People's Republic of China 2007:⁹ if the employer has any of the following circumstances, administrative penalties shall be imposed: if it constitutes a crime, criminal liability shall be investigated according to law; if it causes damage to the worker, it shall be liable for compensation – poor working conditions and severe environmental pollution have caused serious damage to the physical and mental health of workers.

Article 15 of Labour Contract Law of the People's Republic of China 2007: employers are prohibited from recruiting minors under the age of sixteen.

⁹ FAOLEX Database

Article 2 of Prohibition of Child labour 2002 (State Council Decree No. 364): no one may recruit minors under the age of 16 (recruitment of minors under 16 years of age, collectively referred to below as child labour). Any unit or individual is prohibited from introducing employment to minors under 16 years of age. Minors under the age of 16 are prohibited from starting their own businesses.

2.2 Existence of legislative instruments to regulate different aspects of aquaculture

Governance area	Coverage by law/act/norm Yes/No	Specific details
Resource use (land, lake, reservoir, river, coastal)	Yes	<ul style="list-style-type: none"> Fisheries Law of the People's Republic of China 1986 Law of the People's Republic of China on the Use and administration of Sea Areas 2001
Registration/ licensing of operation	Yes	<ul style="list-style-type: none"> Fisheries Law of the People's Republic of China 1986 Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture) Law of the People's Republic of China on the Use and Administration of Sea Areas 2001
Environment impact control (EIA, effluent)	Yes	<ul style="list-style-type: none"> Fisheries Law of the People's Republic of China 1986 Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture) Environmental Protection Law of the People's Republic of China 1989 Marine Environmental Protection Law of the People's Republic of China 1982 Law of the People's Republic of China on Prevention and Control of Water Pollution 1984
Biodiversity protection	Yes	<ul style="list-style-type: none"> Fisheries Law of the People's Republic of China 1986 Implementing Regulations on the Protection of Aquatic Wild Animals of the People's Republic of China 1993 (amended 2011, 2013) (Decree No. 645 of State Council) Interim Measures for the Administration of Aquatic Genetic Resources Protection Areas 2011 (Decree No. 1 of Ministry of Agriculture)
Food safety: feed ingredients	Yes	<ul style="list-style-type: none"> Fisheries Law of the People's Republic of China 1986 Management Regulations on Feed and Feed Additives 1999 (amended 2017) (Decree No. 676 of State Council) Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture)
Food safety: drug/ chemical use	Yes	<ul style="list-style-type: none"> Management Regulations on Veterinary Drugs 2004 (amended 2017) (Decree No. 404 of State Council) Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture)

Governance area	Coverage by law/act/norm Yes/No	Specific details
Traceability/ certification	Yes	<ul style="list-style-type: none"> • Law of the People's Republic of China on the Quality and Safety of Agricultural Products 2006 • Measures for the Administration of Geographical Indications of Agricultural Products 2007 (Decree No. 11 of Ministry of Agriculture) • Measures for the Management of Pollution-free Agricultural Products 2002 (Decree No. 12 of the Ministry of Agriculture and General Administration of Quality Supervision, Inspection and Quarantine) • Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture)
Aquaculture seed	Yes	<ul style="list-style-type: none"> • Fisheries Law of the People's Republic of China 1986 • Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture) • Measures for the Management of Aquaculture Seedling 2005 (Decree No. 46 of the Ministry of Agriculture)
Working conditions	Yes	<ul style="list-style-type: none"> • Labour Contract Law of the People's Republic of China 2007
Child labour use	Yes	<ul style="list-style-type: none"> • Labour Contract Law of the People's Republic of China 2007 • Prohibition of Child Labour 2002 (State Council Decree No. 364)
Animal welfare	Yes	<ul style="list-style-type: none"> • Guiding Opinions on Kind Treatment of Experimental Animals 2006 (Decree No. 398 of the Ministry of Science and Technology)

3. Enforcement and effectiveness of governance of aquaculture

3.1 Overall scoring on level of aquaculture governance—effectiveness in enforcement

Governance area	Ranking between 1 and 5 (1 for minimum and 5 for perfect)	Specific details
Resource use (land, lake, reservoir, river, coastal)	5	<ul style="list-style-type: none"> • Fisheries Law of the People's Republic of China 1986 • Law of the People's Republic of China on the Administration of Sea Areas 2001
Registration/ licensing of operation	5	<ul style="list-style-type: none"> • Fisheries Law of the People's Republic of China 1986 • Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture) • Law of the People's Republic of China on the Administration of Sea Areas 2001

Governance area	Ranking between 1 and 5 (1 for minimum and 5 for perfect)	Specific details
Environment impact control (EIA, effluent)	4	<ul style="list-style-type: none"> Fisheries Law of the People's Republic of China 1986 Decree on Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture) Environmental Protection Law of the People's Republic of China 1989 Marine Environmental Protection Law of the People's Republic of China 1982 Law of the People's Republic of China on Prevention and Control of Water Pollution 1984
Biodiversity protection	5	<ul style="list-style-type: none"> Fisheries Law of the People's Republic of China 1986 Implementing Regulations on the Protection of Aquatic Wild Animals of the People's Republic of China 1993 (amended 2013) (Decree No. 645 of State Council) Interim Measures for the Administration of Aquatic Genetic Resources Protection Areas 2011 (Decree No. 1 of Ministry of Agriculture)
Food safety: feed ingredients	5	<ul style="list-style-type: none"> Fisheries Law of the People's Republic of China 1986 Decree on Management Regulations on Feed and Feed Additives 1999 (amended 2017) (Decree No. 676 of State Council) Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture)
Food safety: drug/chemical use	5	<ul style="list-style-type: none"> Management Regulations on Veterinary Drugs 004 (amended 2017) (Decree No. 404 of State Council) Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture)
Traceability/certification	5	<ul style="list-style-type: none"> Law of the People's Republic of China on the Quality and Safety of Agricultural Products 2006 Measures for the Administration of Geographical Indications of Agricultural Products 2007 (Decree No. 11 of Ministry of Agriculture) Decree on Measures for the Management of Pollution-free Agricultural Products 2002 (Decree No. 12 of the Ministry of Agriculture and General Administration of Quality Supervision, Inspection and Quarantine) Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture)
Aquaculture seed	5	<ul style="list-style-type: none"> Fisheries Law of the People's Republic of China 1986 Aquaculture Quality and Safety Management Regulations 2003 (Decree No. 31 of the Ministry of Agriculture) Measures for the Management of Aquaculture Seedling 2005 (Decree No. 46 of the Ministry of Agriculture)
Working conditions	4	<ul style="list-style-type: none"> Labour Contract Law of the People's Republic of China 2007

Governance area	Ranking between 1 and 5 (1 for minimum and 5 for perfect)	Specific details
Child labour use	5	<ul style="list-style-type: none"> Labour Contract Law of the People's Republic of China 2007 Decree No. 364 on Prohibition of Child Labor
Animal welfare	4	<ul style="list-style-type: none"> Guiding Opinions on Kind Treatment of Experimental Animals 2006 (Decree No. 398 of the Ministry of Science and Technology)

3.2 Institutional framework in governing aquaculture at different levels and different areas

The organizations of aquaculture governance in China include central fisheries governance authorities, local fisheries governance agencies, and aquaculture management agencies and organizations authorized by laws or regulations, as well as organizations commissioned by fisheries governance agencies, such as aquaculture technology promotion agencies, fisheries research and education institutions, industry associations and professional and/or technical committees and societies.

3.2.1 Government agencies of aquaculture governance

In China, the governmental aquaculture governance system implements unified national leadership and hierarchical management. The competent national authority is the Bureau of Fisheries affiliated to the Ministry of Agriculture and Rural Affairs and it is responsible for the administration of fisheries throughout the country. Its duties include: drafting fishery development policies and plans; protecting and rationally exploiting and utilizing fishery resources; guiding aquaculture and aquatic product processing and circulation; organizing aquatic animal and plant disease prevention and control; dealing with major foreign-related fishery disputes; safeguarding the national marine and freshwater jurisdictional fisheries rights and interests; organizing the fishery water ecological environment and aquatic wildlife protection; supervising the implementation of international fisheries treaties; supervising and managing offshore fisheries and fishing ports; and guiding the safe production of fisheries.

The fishery administration departments are set up at the provincial, municipal, and county levels, and fishery industries in the administrative areas under their jurisdiction are governed hierarchically based on law. The local fishery administration department is under the jurisdiction of the local government in terms of administrative management and is instructed by the superior fishery administration department in professional matters.

3.2.2 Technology extension systems for aquaculture governance

China has established a comprehensive fisheries (aquaculture) technology promotion system consisting of agencies at five levels, namely national, provincial, city, county, and township. The National Fisheries Technology Extension Center (NFTEC) is a national-level fisheries technology extension institution directly affiliated to the Ministry of Agriculture and Rural Affairs. The main responsibilities of NFTEC include: formulating national fisheries technology extension plans, planning and organizing their implementation; guiding the construction of a fisheries technology extension system nationwide; introducing, testing, integrating and demonstrating key fishery technologies; undertaking the conservation of the aquaculture water environment and fishery resources; preventing and controlling aquaculture pollution; managing fisheries input products; preventing and controlling aquaculture diseases; ensuring the quality and safety of aquatic products; processing and circulating

aquatic products; organizing the training for fishery technology extension personnel and fishermen; developing fisheries technology information, fishery statistics and relevant work such as economic operation analysis; carrying out fishery technology promotion and cooperation; participating in international cooperation and exchanges in fisheries; and organizing research on international trade in aquatic products. Since its establishment, NFTEC has been focusing continuously on the core work of fisheries development to guide the construction of the national fisheries technology extension system which is essential for the healthy and sustainable development of aquaculture in China. In 2017, there were 12 305 technology extension agencies at different levels (as mentioned above) and 34 600 personnel are working for these agencies. More than 1 million person/times were trained by the NFTEC system.

A national aquaculture disease surveillance, prevention and control system was established and is performing its duty on the basis of the national fisheries technology extension system. It is responsible for the monitoring, forecasting and prevention of aquatic animal diseases throughout the country, and for undertaking capacity and team building of the aquatic animal disease prevention and control system. Local aquatic animal epidemic prevention and control agencies at various levels of the fisheries (aquaculture) technology promotion system undertake public welfare duties such as monitoring, testing, diagnosis, epidemiological investigation, epidemic reporting, prevention and control of aquatic animal diseases in their respective jurisdictions.

3.2.3 Science and technology support system for aquaculture governance

In order to promote the progress of aquaculture science and technology, and provide a scientific basis for aquaculture governance, China has set up advanced fishery research and education institutions. Many provinces, municipalities, even some counties have established research and education institutions to support local aquaculture development. The Chinese Academy of Fishery Sciences (CAFS), a national fisheries research institution, is responsible for the basic, applied and high-tech studies on fishery sciences. Affiliated to CAFS, there are nine institutes and four research stations located along the seacoast and river basins in China. Among these are three marine fisheries research institutes, four freshwater fisheries research institutes, one institute for fisheries engineering, and another one for fisheries machinery and equipment. In addition, the Chinese Academy of Sciences (CAS) also has well-known research institutes involving aquaculture, such as the Institute of Hydrobiology, the Institute of Oceanology, South China Sea Institute of Oceanology. There are also many well-known universities involved in aquaculture education and research, such as Ocean University of China (OUC), Shanghai Ocean University (SHOU), Nanjing Agriculture University, Huazhong Agricultural University. These research and/or education institutions provide strong scientific and technological support and are an important guarantee of aquaculture development in China.

In recent years, the Ministry of Agriculture and Rural Affairs has organized the scientific and technological personnel from universities and research institutes nationwide, combined with excellent local institutions, and established the Key Laboratory System and National Agriculture Technology System to provide science and technology support for the sustainable development of agriculture. The duties of the Key Laboratory System are to carry out basic, applied basic and high-tech research related to the development of agriculture, whereas the National Agriculture Technology System is organized to provide technical support for agriculture development. As an important component of agriculture, aquaculture is included in these systems. Currently, six aquaculture categories including shrimp and crab, marine fish, shellfish, algae, important freshwater fish and tilapia are listed in the systems. Production practices in past years have proved that the systems have played an important role in strengthening scientific guidance and technology dissemination, enhancing implementation of laws and regulations on aquaculture, and ensuring the healthy development of aquaculture.

In addition, various professional committees, societies and associations established in China related to aquaculture play an important supporting role in policy formulation and the administrative management of aquaculture. The National Certificate Committee for Aquaculture Original Species and New Varieties is responsible for the validation of the original aquatic species and new varieties, and guiding the construction of original species and new variety farms. The National Aquaculture Standardization Technical Committee is in charge of formulating, organizing, reviewing, and implementing aquaculture standards, conducting standardization research and information consulting services. The China Society of Fisheries is a national academic group composed of aquaculture and aquaculture science-related scientific workers. It conducts activities in the fields of aquaculture to promote the popularization and extension of aquaculture science and technology and promote the talents of those working in aquatic science and technology. China Aquatic Products Processing and Market Alliance is a national non-profit organization composed of enterprises and commercial households engaged in the production, processing, transportation and trade of aquatic products, as well as scientific research and teaching institutions. Its targets include improving aquatic product processing technology and, at management level, standardizing and fostering the aquatic product market.

3.3 Coordination mechanisms among the institutions governing the aquaculture industry at national and local levels

The Fisheries Law of the People's Republic of China 1986 stipulates that the state implement unified leadership and hierarchical management of the supervision and governance of fisheries. The Bureau of Fisheries affiliated to the Ministry of Agriculture and Rural Affairs is responsible for the governance of fishery and fishery administration throughout the country. Fishery administrative departments are set up at provincial, municipal and county levels, and aquaculture in the administrative areas under their jurisdiction is hierarchically governed based on laws. The fishery administrative department of the local people's government at or above the county level is in charge of aquaculture related work within its administrative area. The fishery administrative department of the people's government at or above the county level may set up a fishery supervision and governance agency in important fishery waters and fishing ports. The fishery administrative department of the people's government at or above the county level and its affiliated fishery supervision and governance agency may set up fishery inspection personnel. The fishery inspectors perform the tasks assigned by the fishery administrative department and its affiliated agency. The local fishery administrative department is under the jurisdiction of the local government in terms of administrative governance, and the superior fishery administrative department is responsible for business guidance.

3.4 Human capacity and financial and other support for enforcement of aquaculture governance at different levels

In China, aquaculture technology promotion agencies, aquaculture research and education institutions, industry associations and professional technical committees are authorized or commissioned by national and/or local government authorities to promote and implement government regulations and policies related to aquaculture, and to enhance scientific guidance and technology extension. In addition to the national aquaculture research institutions as well as the national-level industrial alliances mentioned in Section 3.1, there are many local universities and research institutes and

aquaculture alliances that play important roles in local areas. For example, they help to disseminate the laws and regulations, promote technology extension, and ensure the healthy development of aquaculture. They collaborate with government departments to form an organizational system for aquaculture governance in China. Generally, governments provide financial and other necessary supports to the enforcement of aquaculture governance at different levels.

4. Gaps, issues and challenges in aquaculture governance

4.1 Government attention and process for development of laws, regulations and norms for aquaculture governance

China's aquaculture has been developing rapidly, but under the pressure of multiple factors such as resources, environment and population, it is facing complex and changing challenges. Although China currently has a complete system of aquaculture laws and regulations, the process of making and revising laws and regulations cannot fully keep up with the problems emerging in the development of the aquaculture industry. In addition, as aquaculture is affected by multiple factors such as the ecological environment and socio-economics, some issues in the development of the aquaculture industry have not yet been scientifically recognized, and this will also limit the correct implementation of relevant laws and regulations.

4.2 Institutional strengthening and coordination

In order to develop the local economy, local administrative agencies may sometimes weakly enforce laws and regulations related to aquaculture management and different local governments may adopt different management measures for aquaculture resources across administrative jurisdictions. The same rivers or lakes may have different management measures from different local administrative agencies, resulting in a low level of overall aquaculture management.

4.3 Human capacity and financial support for enforcement of laws, regulations and norms

In China, despite the rapid development of aquaculture, its overall influence is far less than that of other agricultural sectors on land because its contribution to national and local economic development is relatively low. Therefore, the governments in some places do not pay enough attention to the aquaculture industry. The human and financial investment in aquaculture is generally inadequate. Thus, the comprehensive capacity of law enforcement personnel needs to be further strengthened and improved.

4.4 Farmers and private sector capability to comply to laws, regulations and standards

The legal and environmental awareness of individual farmers or small-scale aquaculture companies needs to be further strengthened and improved. On some occasions, in order to pursue economic benefits in the production process, the laws and regulations are ignored. In addition, the insufficient scientific and technological knowledge level of individual farmers or small-scale aquaculture companies is an important reason for the low level of aquaculture governance. Therefore, the penetration rate of advanced science and technology among individual farmers or small-scale aquaculture companies still needs to be further strengthened, and the standardized aquaculture system needs to be further improved.

5. Recommendations for strengthening aquaculture governance at national and local levels

5.1 Strengthen the legal framework for regulating different aspects of aquaculture related to sustainability

- i. As population growth and social demand increase, the demand for high-quality aquatic products continues to increase, which requires legal protection of the aquaculture development space. Thus it is significant to attach importance to the sustainable development of the aquaculture industry, and set up a basic guarantee line to provide sufficient resources (such as waters, tidal flats, land) to meet the rigid requirements for aquaculture development by formulating relevant laws or regulations.
- ii. Further improve the aquaculture development planning nationally and locally to tap the development potential of the aquaculture industry. From the legal and policy perspectives, encourage the expansion of the aquaculture industry from shallow waters to deep seas, to increase the development and utilization of inland saline–alkali lands for purposes of aquaculture and to support the development and utilization of new materials and facilities.
- iii. Establish an aquaculture carrying capacity assessment system and develop an aquaculture industry based on ecosystems. Carrying capacity assessment is the basis for scientifically formulating aquaculture development plans, and also a prerequisite and basis for developing environment-friendly aquaculture. It is recommended to formulate corresponding laws and regulations and include the assessment of aquaculture carrying capacity in the duties of aquaculture management departments at all levels.
- iv. Improve the modernization level of aquaculture equipment by legal or regulatory means. Increase central and local financial supports for the modernization of aquaculture facilities and equipment, encourage private capital to play an active role in the modernization of aquaculture, accelerate the progress of upgrading traditional aquaculture ponds and other facilities, and promote the standardization and modernization of aquaculture facilities.
- v. Strengthen the protection of aquaculture waters and establish an ecological compensation mechanism for aquaculture waters. Establish a basic aquaculture waters protection system, strictly restricting the acquisition of aquaculture waters, and legalize and standardize the ecological compensation of aquaculture waters.

5.2 Improve the capacity and supporting environment for better governance of aquaculture

- i. Strengthen the law enforcement teams and invest more funds to increase the level of law enforcement. Law enforcement must be well-equipped and powerful. Law enforcement officers must have a strong physique, professional knowledge, and good professional ethics. All this requires the government to increase financial, material and human support for fishery enforcement.
- ii. Strengthen the promotion and popularization of laws and regulations related to aquaculture governance. Through the national aquaculture technology promotion system, a wide range of publicity and education programmes on aquaculture laws and regulations should be carried out to increase the legal awareness of aquaculture practitioners.
- iii. Strengthen technical training to promote the application of new ideas, new technologies and new models of aquaculture and raise the capability of fish farmers to comply consciously with aquaculture laws and regulations. Giving full play to the scientific and technological advantages of universities and research institutes, organizing technicians to go to the

countryside, and help fish farmers to bring home an understanding and enjoy the benefits of science and technology. By organizing various types of training courses, promoting new concepts, technologies and models of aquaculture to millions of households, science and technology will be transformed into real productivity.

- iv. Strengthen the standardization of aquaculture, and steadily improve the technical level of aquaculture. Attach importance to the promotion and implementation of technical standards and norms in aquaculture, to achieve standardized production for the quality enhancement of aquatic product output.
- v. Speed up the development of aquaculture science and technology. Science and technology are the driving force behind the sustainable development of the aquaculture industry. To further promote the integration of science and technology and the aquaculture industry, science and technology innovations throughout the value chain should be further strengthened for the breakthrough of key technologies which will benefit aquaculture governance.

References

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Annex IV -3 Aquaculture governance in India

Kuldeep K Lal and Pravata Kumar Pradhan

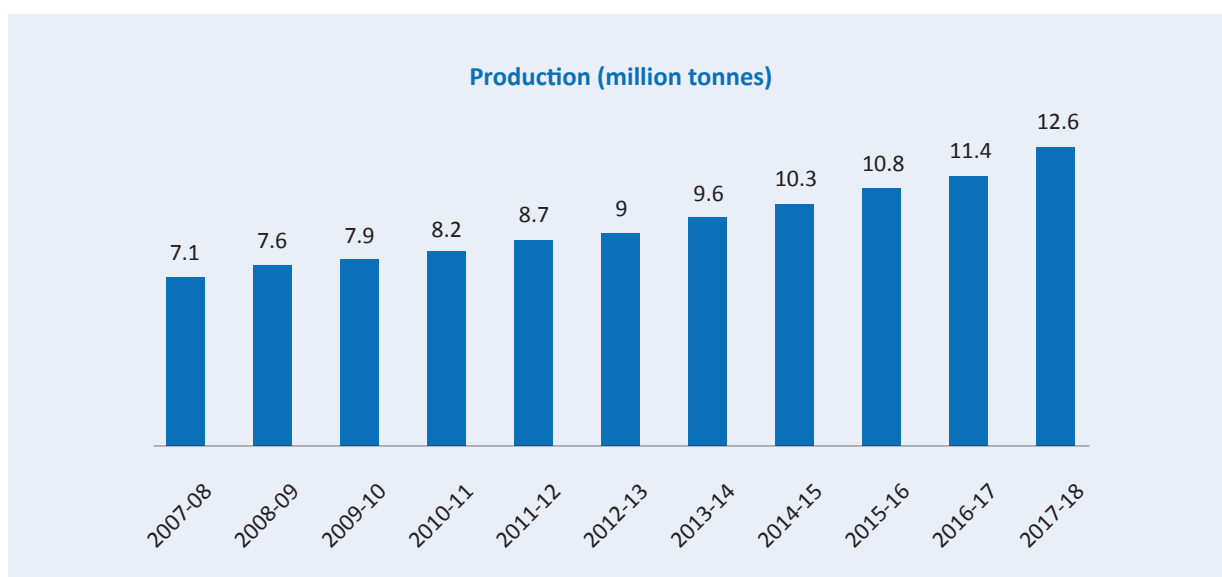
1. Background

Aquaculture in India, mirroring global and regional trends, has emerged as an important industry, and is supported by input and infrastructure supply industries. Considerable research and knowledge has been used in this emergence and growth, especially through the process of domestication. One of the important milestones has been the shift of seed supply from dependence on wild collections, four decades ago, to the captive propagation in hatcheries of several cultivable species. Aquaculture's contribution to the total fishery production is now close to 50 percent. The other factors contributing to this sudden growth of aquaculture are horizontal expansion in area and systems, improved husbandry technologies including feed and additives, the culture environment and disease diagnostics. Further, a ready available consumer demand, both domestic and from abroad, have catalysed aquaculture's growth.

1.1 Status of aquaculture (production and trend, and contribution to food, nutrition and livelihood)

India is the second largest fish producing country in the world with a production of 12.59 million tonnes (MT) in 2017-18, which is more than a sixteen-fold increase compared to the production level of 0.75 MT in 1950-51. The sector has grown more than 7 percent over the last few years (Figure 1). The inland sector contributes about two-thirds (8.9 MT) of the total fish production, whereas, the marine sector contributes about 3.69 MT (DoF, 2019a). The export earnings from the fisheries sector were INR 450 billion in 2017-18 (USD 6.36 billion) and has registered an impressive average annual growth rate of about 19.11 percent. The sector contributes about 1.0 percent of national gross value added (GVA) and over 5.37 percent to the agricultural GVA (2017-18) (DoF, 2019a). The sector continues to be an important source of food, nutrition, income and provides livelihood support to about 16 million people at the primary level and almost twice that number along the value chain.

Figure 1 Total fish production in India during 2007-08–2017-18

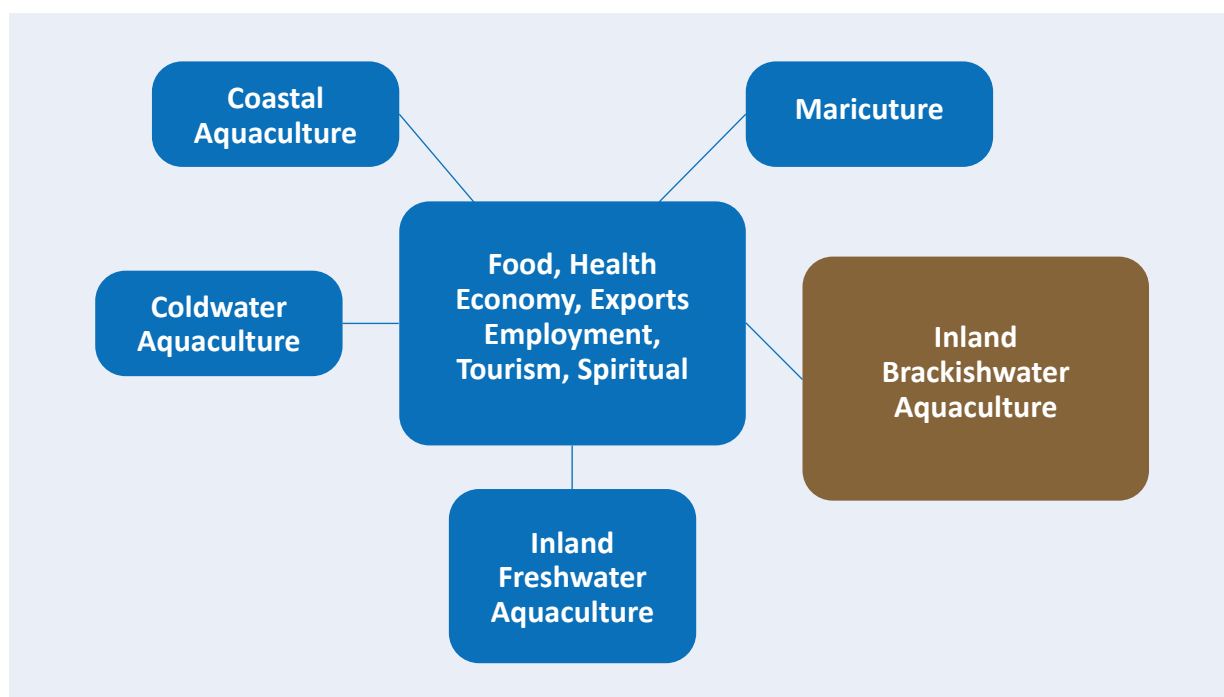


One of the recent milestones in the development of the fisheries sector, including aquaculture, is the establishment of a Ministry of Fisheries, Animal Husbandry and Dairying with a separate Department of Fisheries. Aquaculture governance will be an emerging area, requiring sub-sectoral frameworks, which could be country-specific, addressing different value chains from the production to consumption, to ensure the nutritional security of the society.

1.2 Major farming environments, systems and commodities: aquaculture environment

Aquaculture is an important activity throughout India, widely practised for various purposes including trade, tourism, and spirituality in different environments. The majority of production comes from the inland sector, mostly freshwater aquaculture and is dominated by carps. Cage culture in reservoirs has been expanding recently. India has a unique position of promoting and successfully using inland underground saline water for use in the culture of whiteleg shrimp. Coastal aquaculture is primarily for whitleg shrimp. Seabass and mud crab are also being cultured at a small scale. Mariculture is also being practiced in the form of cage culture in the open sea. Coldwater aquaculture is limited to some of the hill states and trout are the dominant species (Figure 2) .

Figure 2 Different environments used in Indian aquaculture



Over the years, the carp culture system has become more productive and remunerative and several combinations of culture practices have evolved to suit resources, fish species, availability of fertilizers etc. The low-input system relies on the principle of promoting the natural fish food organisms and utilizing the same by the fish feeding at the base of the food chain. Composite fish culture of Indian major carps with silver, grass and common carp is a good example of the same where natural productivity of the pond is fully utilized. Depending only on natural productivity, the average production remains about 500 kg/ha to 1 000 kg/ha. In the medium-input systems, limited supplementation of inputs such as fertilizers increases the annual production to 2 000 kg/ha to 3 000 kg/ha. This system is a common system of practice in most of the freshwater ponds. In the high-input based systems with use of aeration, extruded floating feed, water exchange etc. the annual production increases to 8 000 kg/ha to 10 000kg/ha.

Brackishwater aquaculture in India is synonymous with shrimp farming. From century-old traditional extensive shrimp farming in West Bengal and Kerala, it moved to scientific shrimp farming of tiger shrimp, *Penaeus monodon* in the early 1990s. The outbreak of white spot syndrome seriously affected the tiger shrimp production but through implementation of better management practices, the production levels sustained during 1996 to 2008. With the introduction of Pacific white shrimp *Penaeus vannamei*, there were dramatic changes in the shrimp farming sector.

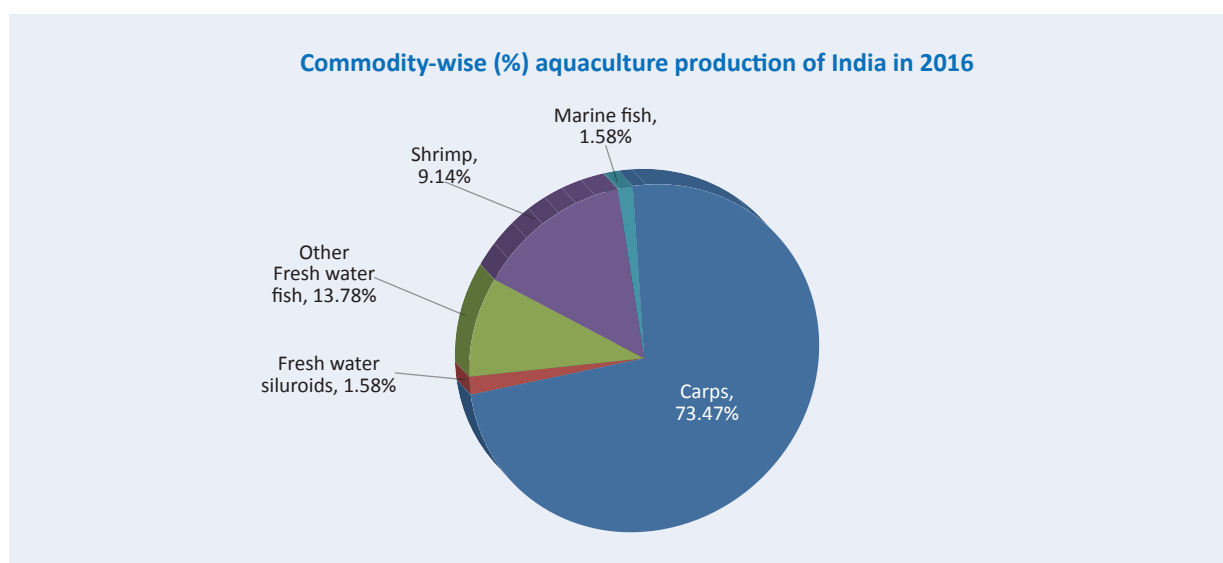
Fish production from the marine sector in India comes mostly from capture fisheries. Sea farming in the country has long been confined to culture of seaweeds, pearl oysters, edible oysters and mussels in a few patches of the southwest coast. However, in recent years, there has been significant development and seed and grow-out production technology of marine finfishes such as cobia, *Rachycentron canadum*, pompano, *Trachynotus blochii*, groupers (*Epinephelus* spp.) and cage culture demonstration has made some progress.

1.3 Brief introduction to production and use of seed, feed and aquaculture drugs

1.3.1 Production status of finfish aquaculture

Freshwater aquaculture has shown a thirteen-fold growth from 0.37 million tonnes (MT) in 1980 to 5.0 MT in 2016. This sector contributes over 89 percent of the total aquaculture production in the country (Figure 3) and comprises Indian major carps, Chinese carps, catfishes (mainly pangasius), tilapia and freshwater prawns. The three Indian major carps, namely catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) contribute the bulk of production (3.79 MT) to the extent of 74 percent of the total freshwater fish production, followed by silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*) (0.4 MT, ~8 percent). Catfishes and tilapia form a second important group contributing to the aquaculture production in India. Among catfishes, cage culture of the exotic *Pangasianodon hypophthalmus* has gained wide acceptance in India. Among the states, Jharkhand has taken the lead in terms of installing about 3 000 cages in various reservoirs during the last three years with production exceeding 50 kg/m² or approximately 500 t/ha. Similarly, the culture of tilapia (*Oreochromis niloticus*) is also gaining importance in freshwater aquaculture and the tilapia production in the country was estimated to be 18 000 tonnes in 2016 (Menaga and Fitzsimmons, 2017).

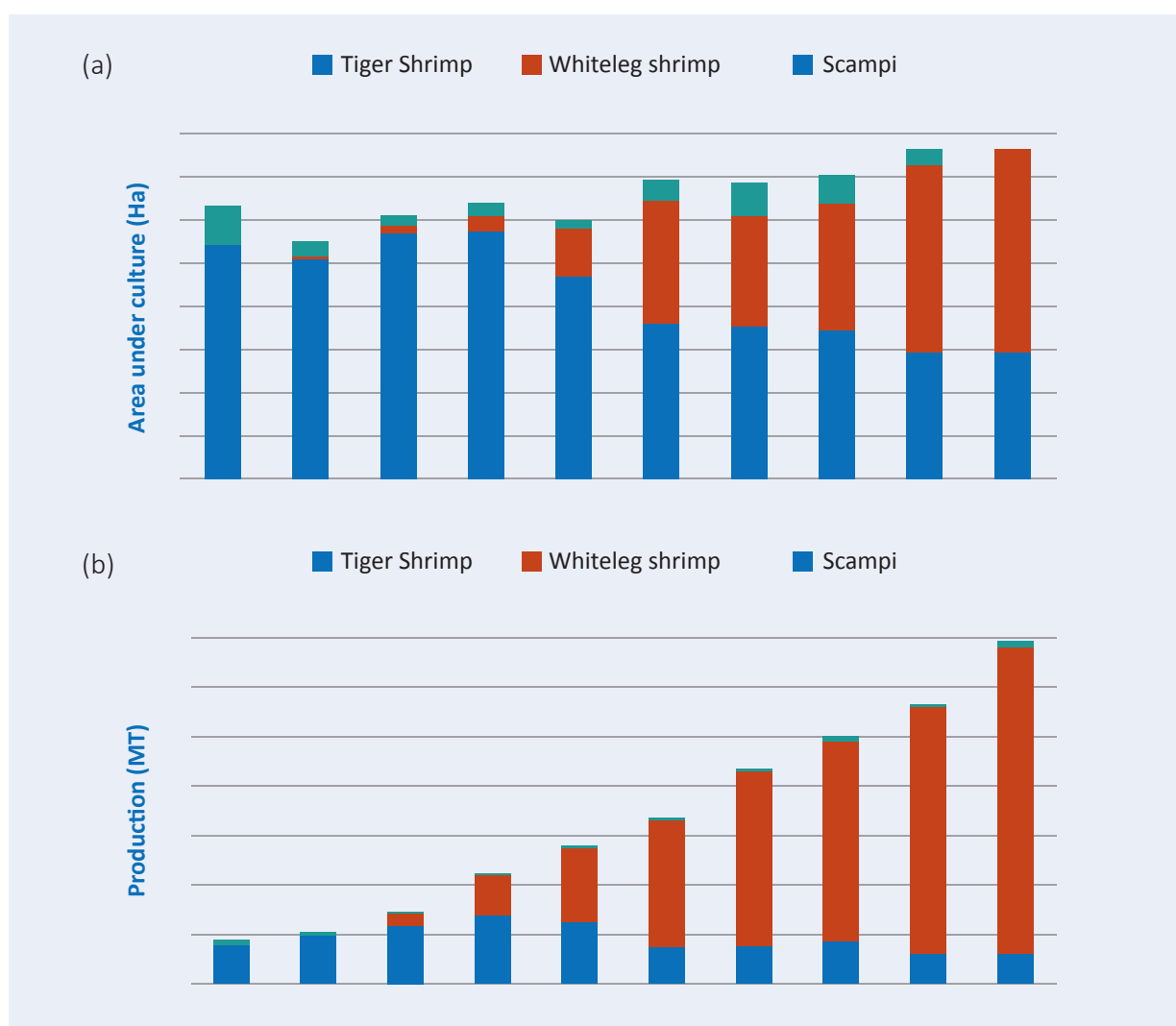
Figure 3 Aquaculture production of India by commodity (%) in 2016. Based on figures from FAO Fisheries Statistic Database (FAO, 2020)



1.3.2 Production status of shrimps and prawn

A comparison of culture area and production of *Penaeus monodon* and *Litopenaeus vannamei* indicate that there has been a decrease both in the area under culture and production of *P. monodon*, whereas, there has been sharp increase in area under the culture and production of *L. vannamei*. In 2017-18, a total of 59 099 ha was under tiger shrimp culture producing 57 691 MT with an annual average production of 0.98 t/ha (Figure 4). Similarly, 93 496 ha area was under *L. vannamei* culture producing 622 327 tonnes in 2017-18. All India annual average productivity of *L. vannamei* was 6.66 MT/ha. The total production of freshwater giant prawn *Macrobrachium rosenbergii* in 2017-18 was 9 983 MT (MPEDA, 2019).

Figure 4 Total area under culture (a) and production of shrimp and freshwater prawn (b) from 2008-9 to 2017-18



With the invention of the hypophysation technique, refinement of hatchery technologies and easy availability of synthetic hormones over the years, there has been significant increase in fish seed production in the country under controlled conditions. Annually, the country produces 21 million carp fry.

Many fish feed industries have been established in several parts of the country but many of the industries are in Andhra Pradesh. Presently, more than 26 feed companies are operational in the country with a production of 1.2 million tonnes of feed.

1.4 Prospect for further development and major challenges

The present annual fish consumption levels in the country of 7 kg/capita and 9 kg/capita for the rural and urban population, respectively, are far below the recommended annual level of 11 kg/capita and far below those of several developing and developed countries in the region. Furthermore, the increase in population growth and increase in the number of fish eaters in the country is poised to greatly increase the fish demand in the coming years and will require the present fish production to double by 2050. It is, therefore, necessary that an appropriate action plan and governance mechanism are in place to cater to the future demand for fish in the country in a sustainable manner. Currently, of the 2.4 million ha available for freshwater aquaculture, about 1.2 million ha is used with an annual national average productivity of 2.9 tonnes/ha. There is need to increase the average productivity and also increase the production area. Similarly, for brackishwater aquaculture, of the 1.2 million ha area only about 0.13 million ha is being utilized. So, there is a need to bring these potential areas including vast inland saline areas under shrimp/high-value fish culture. Bearing in mind that mariculture has already contributed to a substantial seafood production sector in many countries and India has a vast coastline, mariculture in the country presents a great opportunity for increasing seafood production in the face of growing demand for marine protein and limited scope for expanding wild fishery harvests for meeting the demand for fish in the coming years.

2. Current legislative framework for governing the aquaculture sector

Governance is a dynamic process and must be responsive to give solutions to the changing scenarios and needs of the target system, society, sector or value chain etc. This is the process of decision-making, and the process by which such decisions can be expected to be implemented. The governance needs legal frameworks implemented by an authorized agency for the benefit of stakeholders. The legal frameworks guide by setting procedures which are transparent, knowledge-based, and responsive to emerging scenarios, that promote efficiency and are participatory, equitable and inclusive.

The present description is built around the system of aquaculture governance that is fast evolving in India and draws on the policy frameworks already enacted or on some of which are developing under different ministries and are relevant to aquaculture.

2.1 Narrative description of existing legislation for governing aquaculture and its roles

2.1.1 Environment Protection Act 1986 and Coastal Aquaculture Authority Act 2005

The Government of India enacted the Environment Protection Act of 1986¹⁰ under Article 253 of the Constitution. The purpose of the Act is to implement the decisions of the United Nations Conference on the Human Environment. The Act is an “umbrella” legislation containing provisions for all environment-related issues. It also includes the Water (Prevention and Control of Pollution) Act (1974)¹¹ and the Wildlife Protection Act (1972).¹² It authorizes the Central Government to protect and improve environmental quality, control and reduce pollution from all sources and prohibit or

¹⁰ FAOLEX Database

¹¹ FAOLEX Database

¹² FAOLEX Database

restrict the setting and or operation of any industrial facility on environmental grounds. The Water (Prevention and Control of Pollution) Act (1974, as amended) provides for the prevention and control of water pollution, for the maintenance or restoration of the wholesomeness of water, and for the establishment of (central and state) pollution control boards. The Wildlife Protection Act, 1972 is an Act of the Parliament of India enacted for the protection of wildlife, which includes any animal, including crustacean and fish and aquatic or land vegetation which forms part of any habitat. Therefore, environmental impact assessment (EIA) for specified developmental activities, including those on aquatic ecosystems, is mandatory under this act and this has bearing on aquaculture farms in coastal areas, dams on rivers and other similar activities.

Under the provisions of the Environment (Protection) Act 1986, the Coastal Regulation Zone (CRZ) 1991 notification was issued. It outlines a zoning scheme to regulate development in a defined coastal belt. It declares the coastal stretch influenced by tidal action in the landward side up to 500 m from the high tide line (HTL) and the land between the low tide line (LTL) and the HTL as the CRZ. On 11 December 1996, the Indian Supreme Court handed out a historic decision with major implications for the aquaculture sector in a case regarding the setting up of shrimp farms in coastal areas. The Supreme Court – among other things – prohibited the construction/set up of shrimp culture ponds within the CRZ and within 1 000 metres of Chilka Lake and Pulicat Lake, except for traditional and improved traditional types of ponds. The setting up of new industries (except directly relating to the waterfront or directly needing foreshore facilities) are prohibited in the CRZ.

To protect the ecologically fragile coastal areas, seashore, waterfront and other coastal areas and especially to deal with the situation created by the shrimp culture industry in the coastal states/ union territories, an Aquaculture Authority was established to comply with the directions of the Supreme Court, Notification SO 88 (E) (1997), in accordance with the Environment (Protection) Act. The Authority falls under the administrative control of the Ministry of Fisheries, Animal Husbandry and Dairying.

The Coastal Aquaculture Authority Act 2005¹³ was enacted by Parliament of India in the fifty-sixth year of the Republic of India. The powers and functions of the Authority include: (a) to make regulations for the construction and operation of aquaculture farms within the coastal areas; (b) to inspect coastal aquaculture farms with a view to ascertaining the environmental impact caused by coastal aquaculture; (c) to register coastal aquaculture farms; (d) to order the removal or demolition of any coastal aquaculture farms that are causing pollution after hearing the occupier of the farm; and (e) to perform such other functions as may be prescribed.

As per the Act, no coastal aquaculture shall be carried on within two hundred metres from HTL; and no coastal aquaculture shall be carried on in creeks, rivers and backwaters within the CRZ declared for the time being under the Environment (Protection) Act, 1986.

2.1.2 Aquaculture food safety, including certification and traceability

Food control system: The National food control system is an integrated regulatory regime designed to provide safe and wholesome food to all concerned. It provides comprehensive sets of procedures, guidance and an enforcement system on food safety and quality which can be adopted by national governments (FAO, 2006). The national food control system is still evolving in India in line with the changing sanitary and phytosanitary (SPS) based food safety system of the world (Shukla, Singh and Shankar, 2018). In India, there have been various steps to put an overall food control programme in place to ensure safe food for the domestic and international markets. The key essentials of such

¹³ FAOLEX Database

a programme consist of a legal framework, surveillance, monitoring and a certification process for foods throughout the food chain and taking proactive measures if food is deemed unfit for human consumption. The food control system for external markets is being governed by the Export Inspection Council (EIC) whereas, the system for the internal market is being controlled through the Food Safety & Standards Authority of India (FSSAI). The food control system for export is designed to protect the health of consumers and to facilitate trade. The system follows a “farm to fork” (food chain) approach of control from the primary production level to distribution. The inspection and certification are transparent, based on confidentiality and open for scrutiny from various importing countries including exchange of information. The system has well defined roles and responsibilities from food business operators (exporters), the competent authority i.e. EIC, consumers (importers) and scientific institutions. EIC being a regulatory body under the Ministry of Commerce (Government of India) works without any conflict of interest and accordingly maintains consistency and impartiality. Decisions are based on scientific information (sampling, HACCP implementation) and are evidence-based (using audit reports). The food control system is designed in a harmonized manner considering Codex and various international standards to protect the health of consumers and ensure fair practices in the food trade.

The Export (Quality Control and Inspection) Act (1963)¹⁴ empowers the central government to identify commodities which should be subject to quality control or inspection prior to export and to notify competent authorities, to specify the type of quality control or inspection, and to establish, adopt or recognize one or more standard specifications for such notified commodities. The Export of Fresh, Frozen and Processed Fish and Fishery Products (Quality Control and Inspection and Monitoring) Rules (1995) establish the primary responsibility of the industry to ensure that fish and fishery products intended for export are handled, processed at all stages of production, stored and transported under proper hygienic conditions so as to meet the health requirements laid down under these Rules and to conform to the specifications of Order SO 729 (E) (1995).

Order SO 729 (E) (1995) recognizes that fresh, frozen and processed fish and fishery products must be subject to quality control, inspection and monitoring prior to export, taking into consideration the health requirements of importing countries such as the European Union, the United States and Japan. Order SO 729 (E) was recently amended by Order No 722 (E). The latter inserts the maximum residual limits (MRLs) for pesticides, heavy metals and antibiotics and other pharmacologically active substances in fish and fishery products. MRLs fixed by importing countries should be complied with if these MRLs are more stringent than the MRLs prescribed in the Order. As mentioned above, the Order includes a list of antibiotics and other pharmacologically active substances that are prohibited.

At present, food safety regulation in India for the internal system is governed by Food Safety and Standards (Food Recall Procedure) Regulations, 2017, which have widened the scope of recall by covering all food business operators and making each trading partner responsible for food safety. The objective of the regulations is to ensure removal of food under recall from all stages of the food chain, ensure dissemination of information to concerned consumers, and ensure retrieval, destruction or reprocessing of food. These regulations are applicable to food or food products that are determined or *prima facie* considered unsafe and/or as may be specified by FSSAI from time to time.

National traceability practices for fish and fishery products: The produce from the enrolled units, under GPS-enabled registration taken up by the Marine Products Export Development Authority (MPEDA), can be traced back from farm to end-consumer in the case of detection of unwanted or unauthorized substances in the produce. In addition, the pre-harvest test (PHT), to screen the farm produce for banned antibiotics such as chloramphenicol and nitrofurans, is also linked with the ID

¹⁴ FAOLEX Database

issued to the enrolled units. A PHT certificate is compulsory for the exports of aquaculture shrimp to the European Union (EU). Under the Clause 8.3c, pre-processing centres (independent/detached)/ establishments have to maintain PHT certificates and other traceability records pertaining to the aquaculture products processed at least for two years for verification. The details of stock of raw material utilized against each health certificate and balance stock, if any, shall be recorded on the back of the PHT certificate, which shall be countersigned by the verifying official.

All the enrolled farmers of MPEDA must maintain a pond data register in which all input details are available including, source of seed, feeding details, other inputs, sampling details, size of the shrimp during harvest, quantity harvested and to whom the harvested material is supplied. All the stakeholders have been asked to keep the forward and backward linkages to ascertain the traceability. The National Centre for Sustainable Aquaculture (NaCSA), an outreach organization of MPEDA, organizes small farmers to form primary aquaculture societies and provides technical support to build their capacity to produce quality shrimps in a sustainable manner. NaCSA facilitates linkages between aquaculture stakeholders and facilitates formulation of best management practices, strategies and voluntary guidelines which benefit the entire shrimp farming community as a whole aiming at a bottom-up approach.

2.1.3 Management of natural resources for aquaculture, including registration and licensing

At present, the area of registration of aquaculture farms needs further reforms which will help in improving the quality of produce, supply management, environment management and also disease management. Most of the aquaculture and allied businesses are registered as per the registration of the firms as per state laws and to comply with taxation laws. The Coastal Regulation Zone (CRZ) Notification 1991, was the first piece of legislation to raise awareness of the need for registration of farms. The Coastal Aquaculture Authority has been the agency responsible for registration of the farms through the district level administration. However, this proved a time-consuming process. To facilitate the registration of farms, MPEDA has developed a GPS-based database of export-oriented aquaculture farms in the country for their traceability as well as to secure the interests of end-consumers. This is to ensure that shrimp and other exportable varieties of fish are free from any trace of banned and unwanted substances. Under the scheme, MPEDA is enrolling all the farms engaged in production of shrimp, shellfish and other exportable varieties of fish by providing the farmers with cards carrying a unique identification number (farm ID) and quick response (QR) code containing basic information about their farms. The purpose of enrolment is to identify each unit for extending the assistance schemes as well as for their traceability. Although these procedures have been set for the coastal farms, mostly directed to shrimp culture and export-oriented units, the inland sector, including inland saline shrimp culture, is not adequately governed by any such registration at this stage. The upcoming National Inland Fisheries and Aquaculture Policy is expected to address this lacuna. Along with farms, hatcheries also need registration to implement the future accreditation procedures.

2.1.4 Protection for biodiversity

The Biological Diversity Act 2002¹⁵ and Rules 2004 are India's response as a signatory to the Convention on Biological Diversity. The main objective of the act is to protect the biological diversity of the country. The 2002 Act is overarching and covers all the biological resources found in India and the information thereon. It provides a framework for the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and related matters. The Act is implemented by a nodal authority, the National Biodiversity Authority (NBA) (<http://nbaindia.org/>), under the Ministry of Environment and Climate

¹⁵ FAOLEX Database

Change, and is responsible for framing the policies and procedures and their implementation. NBA is supported by State Biodiversity Boards (SBB) and sets up Biodiversity Management Committees (BMC), at district levels. BMCs represent the inclusive participation of the people in the biodiversity management process through preparation of the People's Biodiversity Register (PBR). Till now the NBA has established 29 SBB; 139 831 BMC and 6 449 PBR and notified of 11 biodiversity heritage sites. NBA is responsible for the framework for the access to biological resources and sharing the benefits and intellectual property rights (IPRs) relating to Indian biological resources. NBA functions through executive committees and expert committees to provide appropriate recommendations. Such committees are interface meetings drawing expertise from various relevant ministries, research organizations and civil society persons. NBA can designate repositories for specific purposes in accordance with the provisions of the Biological Diversity Act 2002. Till now, the Act encourages conservation and has a provision to declare a fish stock threatened if it is over exploited.

India might possibly be among very few countries that have comprehensive biodiversity laws and is evolving the procedures for enforcing them. This experience is very important in view of India being biodiversity rich, and a large country that also has many governance levels; indeed many subjects are handled by states as per their own priorities and administrative structures. India has implemented access-benefit sharing (ABS) as per the Nagoya Protocol and there are examples available.

The Government of India enacted the Indian Fisheries Act in 1897. The objective of the Act was to prohibit the use of dynamite and poison in all territorial waters and to make the provisions of the Bengal Private Fisheries Protection Act 1889 of general application. It empowers each state government, with the previous sanction of the central government, to make rules and to apply them to any selected streams or other waters which are the property of the state, or to any other streams or other waters with the consent of the persons owning them or interested therein. This Act also provides suitable penalties for breaches of the proposed law and of the rules made thereunder, and it confers on persons specially empowered by the state government power to arrest without warrant for offences against such law or rules. This Act shall be read as supplemental to any other enactment in force relating to fisheries in the territories to which this Act extends. This is a small piece of legislation containing only seven sections. Section 1 deals with the extent of the Act, Section 2 provides that the Act is a supplement to other fisheries laws, Section 3 defines the expressions "fish", "fixed engines" and "private water", Section 4 provides measures to deal with the destruction of fish by explosives in inland waters and on coasts, Section 5 deals with the destruction of fish by poisoning of waters, Section 6 provides protection of fish in selected waters by rules of state government, and Section 7 is a penal provision providing for arrest without warrant for offences under this Act.

2.1.5 Biosecurity and animal health management

Currently, The Prevention and Control of Infectious and Contagious Diseases in Animals Act 2009 (No. 27 of 2009),¹⁶ amended vide F. No. 35027/10/2013-Fy (H&D) dated 1 April 2014, provides for the prevention of the spread of terrestrial and aquatic animal diseases between states and facilitates the trade in line with international practices. The Aquatic Animal Disease and Health Management Bill 2019 is in the drafting stage and is aimed to deal with aquatic animals specifically. The Bill will provide for: prevention and control of diseases of aquatic animals; prevention of outbreak; transboundary ingress and inter-regional spread of aquatic animal diseases; regulation of quality and usage of inputs in aquaculture; control of residues in aquatic animals and their products for the safety of human health and the environment with a view to ensure sustainable production, minimization of economic losses and to meet the international obligations of the country and facilitate the import and export of aquatic animals and their products; and for matters connected therewith or incidental thereto. (DoF, 2019b)

¹⁶ FAOLEX Database

Some of the important milestones in the biosecurity and health management are the development of guidelines for introducing exotics and quarantine. Subsequently, a quarantine system was established in India. The shrimp broodstock passes through the quarantine system established at Chennai and at the same time, the fish quarantine is done at importers' farms conforming to the established norms, and supervised by a duly constituted committee. The National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) established by the Government of India with funding through the National Fisheries Development Board is being coordinated by the ICAR-National Bureau of Fish Genetic Resources. The programme is being implemented in 20 states of India and has established a network of diagnostic and reporting systems. The programme has enhanced credible reporting of diseases to the Network of Aquaculture Centres in Asia-Pacific (NACA) and the World Organisation for Animal Health (OIE) and has also evolved a mechanism for sending alerts to the industry in the event of new and emerging pathogens. This experience is leading to the establishment of an institutionalized system of disease surveillance in India.

2.1.6 Regulations on feed and drug (including antibiotics) production, marketing and use

An Aquatic Animal Disease and Health Management Bill 2019 has been proposed by the central government to regulate the manufacture, use and traceability of all aquaculture inputs and monitor residues in aquatic animals and aquatic animal products. As per the proposed Bill, the state government/union territories shall ensure that only approved drugs and chemicals are employed in aquaculture, in accordance with guidelines issued by the central government.

Currently, for coastal aquaculture, all the shrimp feed manufacturing units need to be registered with MPEDA and the same needs to be reported to the Coastal Aquaculture Authority (CAA). The CAA has the powers to review the registration of feed mills and to take appropriate decisions in tune with the requirements of the coastal aquaculture sector.

The use of antibiotics in shrimp culture is strictly prohibited as their use may result in the development of antimicrobial resistance to such drugs and the transfer of these resistant pathogens into human beings might result in the development of antimicrobial resistance in humans. The 20 antibiotics/pharmacologically active substances presently banned for use in shrimp culture are listed by the authorities. This ban also applies to other substances as notified by the government from time to time.

Recently, the National Fisheries Development Board (NFDB), Hyderabad began implementing a comprehensive programme to cover food and environmental safety and prevent disease in aquatic animals. For this purpose, NFDB is establishing AquaOne Centres and Aquatic Animal Health Labs. These centres will have field level trained manpower, who can percolate the guidance and information to the ground-level stakeholders. These centres will have appropriate linkages to the referral centres for disease surveillance and food safety.

2.1.7 Laws and regulations on working conditions and safety in aquaculture operations

The labour laws implemented by the Ministry of Labour and Employment, Government of India are applicable to the workforce in the aquaculture sector. India implemented a minimum wages act way back in 1948 and adopted wage fixing criteria. This act has been amended from time to time. The amendment in 2017 referred to payment of wages direct to bank accounts or through digital forms. For a minimum guaranteed income for all workers towards betterment of workers' living standards the Code on Wages Bill has been passed by the Parliament in 2019,¹⁷ which simplifies, amalgamates and rationalizes four Acts. The four Acts¹⁸ being subsumed under The Code on Wages Bill 2019, are The

¹⁷ <http://egazette.nic.in/WriteReadData/2019/210356.pdf>

¹⁸ FAOLEX Database

Payment of Wages Act, 1936, The Minimum Wages Act 1948, The Payment of Bonus Act, 1965 and The Equal Remuneration Act, 1976. It recommends the introduction of a binding national minimum wage. This would imply fixing a single national minimum wage – or different national minimum wages for different states or geographical areas and across the sectors. These are part of labour reforms undertaken by the government for the welfare of unorganized and contract workers. As a part of the reforms The Occupational Safety, Health and Working Conditions Code 2019 and The Code of Social Security 2019 are under the consideration of the Parliament of India. The contract workers in the industry make use of the benefits under the Employee Provident and Employees' State Insurance schemes. Employees' State Insurance is a self-financing social security and health insurance scheme for Indian workers. The fund is managed by the Employees' State Insurance Corporation and provides healthcare to contract worker members and their families, through a chain of specialized hospitals and healthcare centres. As Indian citizens, the labourers are entitled to make use of benefits from recent welfare schemes such as Ayushman Bharat (the Healthcare-Hospitalization and Common Man Insurance Scheme). Further legal frameworks under the law are available for woman and child welfare, which include maternity benefits for working women. Currently, there is no specific policy framework for the aquaculture operations labour and workforce.

2.1.8 Technical standards and guidelines supporting the implementation of laws and regulations

Guidelines for Regulating Coastal Aquaculture: These guidelines are to ensure orderly and sustainable development of shrimp aquaculture in the country and are intended to lead to environmentally-responsible and socially-acceptable coastal aquaculture. The present guidelines cover the entire gamut of shrimp farm management and measures to reduce the environmental impact of the wastewater discharged from shrimp farms, treatment of such wastes and mitigation of the adverse impact of such wastes on the environment as well as the resolution of social conflicts. Furthermore, the guidelines are intended to assist the farmers in adopting good management practices. These Guidelines for Regulating Coastal Aquaculture are for the use of all stakeholders involved, including shrimp farmers, the coastal community, state fisheries departments, pollution control boards and the ministries and departments of the Government of India and the state governments.

Guidelines for regulating hatcheries and farms for introduction of *Litopenaeus vannamei*: Hatcheries engaged in or intending to engage in seed production having the required biosecurity facilities need to be registered with the CAA. Subsequently, they have to seek permission to import specific pathogen free (SPF) broodstock of *L. vannamei* or SPF juveniles of *L. vannamei* (up to 10 g size) for rearing to adult broodstock and to produce and sell postlarvae (PL) of *L. vannamei*. Such hatcheries need to adhere to the guidelines of the CAA with respect to sanitary requirements, water intake, water treatment and discharge of wastewater, disinfection of implements, broodstock in hatchery, seed production and sale, disease reporting and record maintenance, and inspection. All the farmers intending to culture *L. vannamei* need to register their farms and seek permission from the CAA. The farmers must follow guidelines for farming of whiteleg shrimp which include biosecurity measures including fencing, reservoirs, mitigation measures for bird predation, separate implements for each of the ponds, water discharge protocols, norms for culture of *L. vannamei* and record maintenance of farms.

National Strategic Plan on Aquatic Exotics and Quarantine: The National Strategic Plan on Aquatic Exotics and Quarantine provides a framework to regulate the introduction of exotic aquatic species, translocation of species as well as movement of seed within the country and prevent the introduction of exotic aquatic animal pathogens, thereby, helping to minimize the ecological and disease risks associated with the introduction of exotic species.

Aquatic Exotic and Quarantine Guidelines: Aquatic Exotics and Quarantine Guidelines is a complementary document to the National Strategic Plan for Aquatic Exotics and Quarantine. It includes

the criteria/procedures for finalizing potential, approved and prohibited aquatic animal species, evaluation of introduction proposals, management of exotics already present in India, quarantine, surveillance and reporting and networking of diagnostic laboratories. The National Strategic Plan and the Guidelines have been approved by the Ministry of Agriculture and Farmers Welfare.

Guidelines for Green Certification of Freshwater Ornamental Fish: The Green Certification guidelines (Silas *et al.*, 2011) take care of the environmental concerns as well as ensure a value chain system, linking all segments of the ornamental fish sector such as collection from the wild, handling, transport, holding, breeding and culture facilities, conditioning for export, infrastructure and maintenance of records to conform to a value chain system for delivering healthy ornamental fishes to the trade and the hobbyist. The guidelines cover the collection of ornamental fishes and invertebrates from natural waterbodies; primary and secondary holding facilities as well as exporting facilities. Besides, they also cover culture facilities; environmental integrity; best management practices; green seal labelling; documentation and maintenance of data; agencies for accreditation and verification; standards for assessment and geographical indication of species.

Guidelines for Management of Fish Genetic Resources in India: The document Guidelines for Management of Fish Genetic Resources in India is a comprehensive account of all the national regulations and best scientific practices that have been adopted in India for efficient management of fish genetic resources (NBFGR, 2016). This covers the procedures which are implemented in the Indian Council of Agricultural Research (ICAR) and other ministries related to fish genetic resources. The given national and international regulatory environment and the focus on the sustainable management of genetic resources need to be underpinned by systematic science-based efforts, from their exploration in nature and leading to their use and conservation.

2.1.9 National Inland Fisheries and Aquaculture Policy (NIFAP)

The National Inland Fisheries and Aquaculture Policy (NIFAP) has been drafted with the overall objective to create an enabling environment for sustainable development of inland fisheries and aquaculture in the country, to ensure food and nutritional security, gainful employment and livelihoods, economic prosperity and ecological health. The NIFAP adopts an ecosystem approach to fisheries (EAF) management within the overall framework of relevant national and international instruments and policies. The salient features of the policy include: developing action plans for introduction and expansion of shrimp/prawn farming in inland saline/alkaline and freshwater areas with due consideration to sustainability and ecosystem health; preparing an integrated coastal aquaculture development plan for each of the coastal blocks and districts; promoting aquaculture in low-lying areas, lands with saline and alkaline soils, and lands not suitable for crop cultivation; utilizing vast unutilized resources including government-owned land for aquaculture; mandatory registration of aquaculture farms; promoting best management practices (BMPs)/good aquaculture practices (GAPs); putting in place mechanisms to ensure traceability of the aquaculture produce; and establishing a regulatory framework for inland aquaculture by state authorities on the lines of the Coastal Aquaculture Authority. In addition, it is envisaged that aquaculture development efforts should be in alignment with relevant national and global instruments, guidelines and good practices including sustainable development goals (SDGs), Code of Conduct for Responsible Fisheries (CCRF) Guidelines and Voluntary Guidelines on Sustainable Small Scale Fisheries (VG-SSF).

2.1.10 National Policy on Mariculture (NPM) 2018

The NPM has been drafted with the goal to ensure sustainable farmed seafood production for the benefit of food and nutritional security of the nation and to provide additional livelihood options to the coastal communities for a better living. The overall strategy of NPM is to increase seafood production in a sustainable manner, ensure socio-economic development, enhance food, health and nutritional

security and safeguard gender, social equity and the environment. The salient features of the policy include: demarcation of sites for different mariculture activities excluding marine protected areas and ecologically sensitive areas; employing marine spatial planning for data management, analysis, modelling and decision making taking cognizance of CRZ zoning; setting up of offshore technology parks and coastal embankment systems; encouraging an ecosystem approach to aquaculture for the integration of the activity within the wider ecosystem for sustainable development, equity and resilience of interlinked social-ecological systems in conformity with article 9 of the CCRF; assuring availability of stockable size fingerlings for farming; establishing a system of seed certification; ensuring supply of seed of new candidate species through establishment of new hatcheries and farmers co-operatives; developing guidelines for use of feed ingredients; establishing traceability and record-keeping of farming activities and inputs; and ensuring food safety by implementing appropriate national (Food Safety Standards Authority of India) or international standards and regulations including those defined by FAO/WHO Codex Alimentarius. Importantly, exotic and genetically modified species will not be allowed for open sea culture to minimize the risk of escapees from the culture systems.

2.1.11 National Committee on Introduction of Exotic Aquatic Species in Indian Waters

The committee is a decision-making committee headed by the Joint Secretary (Fisheries) with members from different departments and research organizations. The importer submits the proposal for importation of the germplasm in a specified format. The information is assessed by the Committee who accordingly makes a decision regarding permission/rejection of the import proposal.

2.2 Existence of legislative instruments to regulate different aspects of aquaculture

Governance area	Coverage by law/act /norm (Yes/No)	Specific details
Resource use (land, lake, reservoir, river, coastal)	Yes	For coastal aquaculture, there is a Coastal Aquaculture Authority (CAA) for regulating activities connected with coastal aquaculture. For other resources, the respective state fisheries departments are the legislative authority.
Registration/ licensing of operations	Yes	For coastal aquaculture, all the shrimp feed manufacturing units need to be registered with MPEDA and the same need to be reported to the CAA. For other farms, there is no mandatory registration process, however, community waterbodies are allowed to be used for aquaculture under leasing for a specific number of years.
Environment impact controls (EIA, effluent)	Yes	These apply to shrimp farms.
Biodiversity protection	Yes	The Biological Diversity Act 2002 and Rules 2004 are responses of India to its signing of the Convention on Biological Diversity. The main objective of the act is to protect the biological diversity of the country. The Act is implemented by the nodal authority, the National Biodiversity Authority (NBA) (http://nbaindia.org/), under the Ministry of Environment and Climate Change, is responsible for framing the policies and procedures and their implementation.
Food safety: feed ingredients	Yes	The food control system for external market exports is governed by the Export Inspection Council (EIC) whereas, the internal market is controlled through Food Safety & Standards Authority of India (FSSAI).

Governance area	Coverage by law/act /norm (Yes/No)	Specific details
Food safety: drug/chemical use	Yes	An Aquatic Animal Disease and Health Management Bill 2019 has been proposed by the central government to regulate the manufacture, use and traceability of all aquaculture inputs and monitor residues in aquatic animals and aquatic animal products. As per the proposed Bill, the state government/union territories shall ensure that only approved drugs and chemicals are employed in aquaculture, in accordance with guidelines issued by the central government.
Traceability/certification	Yes	The produce from the enrolled units, under GPS-enabled registration taken up by MPEDA, can be traced from farm to end-consumer in case of detection of unwanted or unauthorized substances in the produce.
Aquaculture seed	Yes	As per the CAA guidelines, all the shrimp hatcheries need to be registered by MPEDA and produce healthy disease-free seeds. However, for freshwater fish, there are no such guidelines.
Working conditions	Yes	The labour laws implemented by the Ministry of Labour and Employment, Government of India are applicable to the work force in the aquaculture sector. To mandate a minimum guaranteed income for all workers towards betterment of workers' living standards the Code on Wages Bill was passed by the Parliament in 2019. The contract workers in the industry make use of the benefits under Employee Provident and Employees' State Insurance schemes. As Indian citizens, the labourers are entitled to make use of benefits from recent welfare schemes.
Child labour use	Yes	As per the labour laws, child labour is prohibited.
Animal welfare	No	No specific mechanism available.

3. Enforcement and effectiveness of governance of aquaculture

3.1 Overall scoring on level of aquaculture governance (1 for lowest and 5 for highest)—effectiveness in enforcement

Governance area	Ranking between 1 and 5 (1 for minimum and 5 for perfect)
Resource use (land, lake, reservoir, river, coastal)	3
Registration/licensing of operation	3
Environment impact control (EIA, effluent)	4
Biodiversity protection	5
Food safety: feed ingredients	3
Food safety: drug/chemical use	4
Traceability/certification	3

Governance area	Ranking between 1 and 5 (1 for minimum and 5 for perfect)
Aquaculture seed	4
Working conditions	4
Child labour use	5
Animal welfare	2

3.2 Institutional framework in governing aquaculture at different levels and different areas

The Department of Fisheries (DoF) under the Ministry of Fisheries, Animal Husbandry and Dairying, Government of India is the nodal department dealing with governance of aquaculture and fisheries in the country. Under the department, the Coastal Aquaculture Authority (established under the Coastal Aquaculture Authority Act 2005), regulates coastal aquaculture activities. The National Fisheries Development Board (NFDB) coordinates activities pertaining to both aquaculture and fisheries undertaken by different ministries/departments in the central government and also with the state/union territory governments. In addition, there are four fisheries institutes working under the administrative control of the department (i) the Central Institute of Fisheries Nautical and Engineering Training; (ii) the National Institute of Fisheries Post-Harvest Technology and Training; (iii) the Central Institute of Coastal Engineering for Fishery; and (iv) Fishery Survey of India. In addition to the Central Administrative Authorities, each state has its own Department of Fisheries headed by the Director/Commissioner of Fisheries.

Furthermore, research support is provided by the Indian Council of Agricultural Research (ICAR), which is an autonomous organization under the Department of Agricultural Research and Education, Ministry of Agriculture and Farmers Welfare, Government of India. The Council is the apex body for coordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country.

3.3 Coordination mechanisms among the institutions governing the aquaculture industry at national and local levels

The Secretary, Department of Fisheries (DoF), Ministry of Fisheries, Animal Husbandry and Dairying, Government of India is the administrative head of the Department. She/he is assisted by the Fisheries Development Commissioner and two Joint Secretaries in discharging the responsibilities assigned to this Department. The Department has strong linkages with research organizations under ICAR for technical backstopping on various issues of policy formulation and implementation procedures.

The Coastal Aquaculture Authority regulates activities connected with coastal aquaculture to protect the livelihoods of various stakeholders living in the coastal area and to ensure that aquaculture operations do not cause any harm to the coastal environment. The authority is empowered to make regulations for the construction, operation and registration of aquaculture hatchery and farms in coastal areas, inspection of farms and hatcheries of *Litopenaeus vannamei* to ascertain their environmental impact, removal or demolition of coastal aquaculture farms which cause pollution, fixing standards for all coastal aquaculture inputs, for example seed, feed, growth supplements, chemicals, and the use and management of shrimp aquaculture quarantine facilities. In addition to the registration of farms and hatcheries, registration with the CAA to produce seed and farming of other cultivable species including shrimps, crabs, molluscs, fishes in the country within the notified area with the CAA as per the Act and Rules is mandatory.

In addition to the central administrative authorities, each state has its own Department of Fisheries that is responsible for implementation of departmental and centrally sponsored schemes in the state. In addition to the administrative set-up, the Fisheries Science Division under the ICAR coordinates and monitors the research and academic programmes in fisheries and aquaculture through eight fisheries research institutes.

3.4 Capacity building

Qualified fisheries graduates are available to the administrative departments and private sector. The technically qualified manpower is also trained to carry out specific tasks. The state fisheries departments receive finance from the central government for specific policies on a sharing basis. In addition the National Fisheries Development Board provides financial support to state departments for creating infrastructure for fisheries development.

4. Gaps, issues and challenges in aquaculture governance

4.1 Government attention and process for development of laws, regulations and norms for aquaculture governance.

Aquaculture management is primarily a state subject in India and the policy frameworks formulated by central government are adapted by state administrations as per their needs. However, different states have different priorities, consumption levels of fish, and capabilities to implement policy frameworks. Therefore, to make uniform implementation of aquaculture governance policy frameworks, there will be a need for some states to assist other states in terms of resources and capacity. A large proportion of the population does not consume fish and thus increasing domestic demand is a challenge and needs strategic planning.

4.2 As there are multiple stakeholder institutions to implement various policies and laws, coordination is weak.

The implementation of policy needs multiple ministries to coordinate their actions and this may not happen effectively. The governance of the fisheries sector needs to be sensitized to other sectors such as the environment, biodiversity, science and technology and finance.

4.3 Human and financial resources are available to undertake new challenges for fisheries development. However, appropriate knowledge-based policy frameworks are still either not available or fully implemented.

There is a need for holistic policy to develop the fisheries sector with economically viable and environment-friendly technologies. There is a need for mechanisms to support upscaling of the research programmes into commercial technology and private partnerships need to be encouraged for this.

4.4 Majority of the farmers and private sector actors are small-scale aquaculturists.

Although they are capable and mostly have the intention to comply with laws and standards, the lack of adequate resources, awareness and knowledge is a limiting factor. Cooperatives, if available, can help in increasing acceptance of the regulatory mechanisms and standards.

5. Recommendations for strengthening aquaculture governance at national and local levels

5.1 Strengthen the legal framework for regulating different aspects of aquaculture related to sustainability

- i. The government should intervene to prevent the private sector from prioritizing short-term profits at the expense of the environment. However, all the government interventions should be transparent and the regulations should not only include environmental integrity and food safety, but also enhance profitability and economic benefits.
- ii. Before a licence is given for any aquaculture operation an environmental assessment should be required.
- iii. Mandatory registration of aquaculture farms and the existing processes of registration should be decentralized by empowering the state fisheries departments.
- iv. There should be a national strategy for improved broodstock management and seed production.
- v. A system for seed certification and hatchery accreditation should be prioritized for development.
- vi. An agency for developing and implementing national aquaculture certification standards for the country should be established.
- vii. As the movement of live fish is an important risk factor for the spread of diseases, there should be regulations on fish movements.
- viii. Prior to the introduction of exotic species the benefits should be weighed against costs and there should be a thorough risk assessment.
- ix. A system of traceability in aquaculture from seed production to marketing should be established.
- x. Veterinary drugs and inputs in aquaculture should be better regulated.
- xi. Disease surveillance in the country should be institutionalized.
- xii. Extension machinery for dissemination of technical know-how to the farmers should be strengthened.
- xiii. The gap between the demand and supply of fish for domestic consumption should be reduced.
- xiv. Private industry should make adequate investment in the aquaculture sector.
- xv. Crop insurance in the aquaculture sector should be provided.
- xvi. There are insufficient/unreliable data about aquaculture practices which are essential for making informed decisions. Therefore, it is necessary to have a robust database for aquaculture planning and it should be incorporated into the administrative and legal frameworks with appropriate a budget and trained manpower.

5.2 Improve the capacity and supporting environment for better governance of aquaculture

- i. Promote a resource-based ecosystem approach to aquaculture for enhancement of productivity.

- ii. Improve socio-economic conditions of farmer communities.
- iii. Develop a package of practices for breeding and culture of potential candidate species for sustainable utilization in various aquaculture systems.
- iv. Improve post-harvest technology and marketing in view of current and future needs and anticipated increases in aquaculture production.
- v. Develop better management practices for different culture systems.
- vi. Upgrade aquaculture value chain for higher quality products.
- vii. Establish quarantine facilities at ports of entry for fish.
- viii. Small-scale farms should be encouraged to link to large-scale farms to obtain the technical expertise to meet quality standards and gain market access.
- ix. There should be policies for publicly funded research and such research should be demand driven or determined by industry needs, rather than decided by government officials according to their skills or wishes. Industries should make financial and in-kind contributions for the advancement of research and basic research should be undertaken predominantly by national research institutes/ universities and such basic research should benefit the whole industry and society, which justifies government funding.
- x. The government should promote aquaculture through marketing and ensure fish quality and safety through the hygienic handling and selling of fish and the agents involved in selling of fish should be registered with the Department of Fisheries.
- xi. There should be proper communication strategies so that information on diseases and on any health risk must reach the government and the government should be transparent on issues such as fish health and pollution.

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Annex IV-4 Aquaculture governance in Indonesia

IBM Suastika Jaya

1. Brief introduction to the aquaculture sector

1.1 Overview of the aquaculture sector

Indonesia is an archipelagic country with 1 922 570 km² land and 3 257 483 km² water, comprised of 13 466 islands. The total potential area for aquaculture is about 17.92 million hectares comprised of freshwater, marine, and brackishwater aquaculture of about 2.83 million, 12.12 million, and 2.96 million hectares, respectively (DGA, 2019). Freshwater aquaculture involves freshwater ponds (541 000 hectares), inland waters such as lakes, reservoirs, rivers (158 125 hectares), and integrated rice–fish systems (1.54 million hectares) (Murdaningsih and Muhammad, 2013).

In Indonesia, aquaculture was traditionally practiced sustainably in many areas, especially on Java. Fish farmers have practiced freshwater and brackishwater aquaculture for many centuries. Common carp was a popular commodity in the inland areas of West Java, where they were grown in earthen ponds. Fry production supported the farming. Brackishwater ponds for milkfish grow-out were established on the northern coast of East Java and in Central Java. The use of wild-caught fry supported the farming.

The fast growth of brackishwater aquaculture occurred during the 1980s and 1990s after shrimp culture developed with the availability of shrimp fry from hatcheries and simultaneously with the ban on trawler boats for fishing shrimp in 1980. The shift from traditional milkfish ponds to intensive shrimp ponds ushered in a more industrial aquaculture system. A good example of this is the shrimp industry estate in Lampung in southern Sumatra that occupies 20 000 hectares with many thousands of farmer households involved.

The disease outbreak at the end of the 1990s changed the species culture from *monodon* to *vannamei* shrimp, which promised a better survival rate after specific pathogen free (SPF) broodstock was imported to supply SPF fry. Introducing *vannamei* shrimp during the last decade ushered in a shift from *monodon* to *vannamei* at various levels of intensification, from low density in traditional ponds to super-intensive ponds with a productivity cycle of more than 50 tonnes/ha.

The production of freshwater fishes significantly improved after a government supported intensification programme. Between 2000 and 2005, the Directorate General of Aquaculture (DGA) focused on the development of tilapia. Breeding of a fast growing strain and mono sex culture could increase the productivity of pond and cage culture. Clarias catfish and pangasius also contributed to the production increment for the freshwater aquaculture since the intensive model in small ponds was successfully adopted by the smallholders.

The development of marine aquaculture (mariculture) in the beginning was dominated by seaweed cultivation. The farmers produced raw materials for colloid industries, especially carrageenan and agar. The system was well-adapted in this archipelagic state after the DGA promoted the development of this commodity in 2000. *Gracilaria* spp. also traditionally grew in brackishwater ponds; sometimes it was integrated with milkfish and shrimp. Marine species such as lobster, grouper, barramundi began being farmed in 2002 after artificial hatcheries were able to supply the fry for grow out.

In general, the location of aquaculture in Indonesia depends on the habitat of the species. Thus the country practices freshwater, brackishwater, and marine aquaculture with a variety of cultivated species grown according to their natural habitat and osmotic tolerance. The Government Regulation

28/2017, noted that the cultivation system takes water as media (natural waterbodies) and water as materials (in the artificial captive environment). This categorization has a consequence of dividing aquaculture into open water and closed water systems. Common methods of culture are floating net cages (marine and inland based), pen culture, cage culture, strong flow circulation ponds (marine water ponds), stagnant water ponds, circular and rectangular lined ponds, inland sea water ponds, brackishwater pond estates, fish–rice integrated farms, coastal bamboo poles, intertidal bottom culture, inshore longline culture, longline for pearl oyster and brackishwater ponds for seaweed.

Statistical data released by the government (MMAF, 2019) shows the following aquaculture production categories:

- i. Marine floating net cage culture
- ii. Freshwater floating net cage culture
- iii. Pen culture
- iv. Freshwater cage culture
- v. Strong flow circulation pond culture
- vi. Stagnant water pond culture
- vii. Other marine culture
- viii. Integrated fish–rice culture
- ix. Seaweed culture
- x. Intensive pond culture
- xi. Semi-intensive pond culture
- xii. Traditional/ extensive pond.

1.1.1 Aquaculture production

The statistical data for the marine affairs and fisheries sector (MMAF, 2019) presented the national production of aquaculture in 2017. It was based on provinces, aquaculture systems, and commodities. The compiled data of production are presented in Figure 1 and Figure 2 referring to culture systems and commodities, respectively. The stagnant ponds (freshwater) and extensive ponds (brackishwater) are the top producers. Tilapia and clarias catfish dominated the production when seaweed is excluded with the production of 1.28 million tonnes and 1.13 million tonnes respectively in 2017. Both were grown predominantly in stagnant ponds where 67 percent of tilapia and 94 percent of clarias catfish were produced.

Figure 1 Annual aquaculture production based on culture systems in Indonesia in 2017

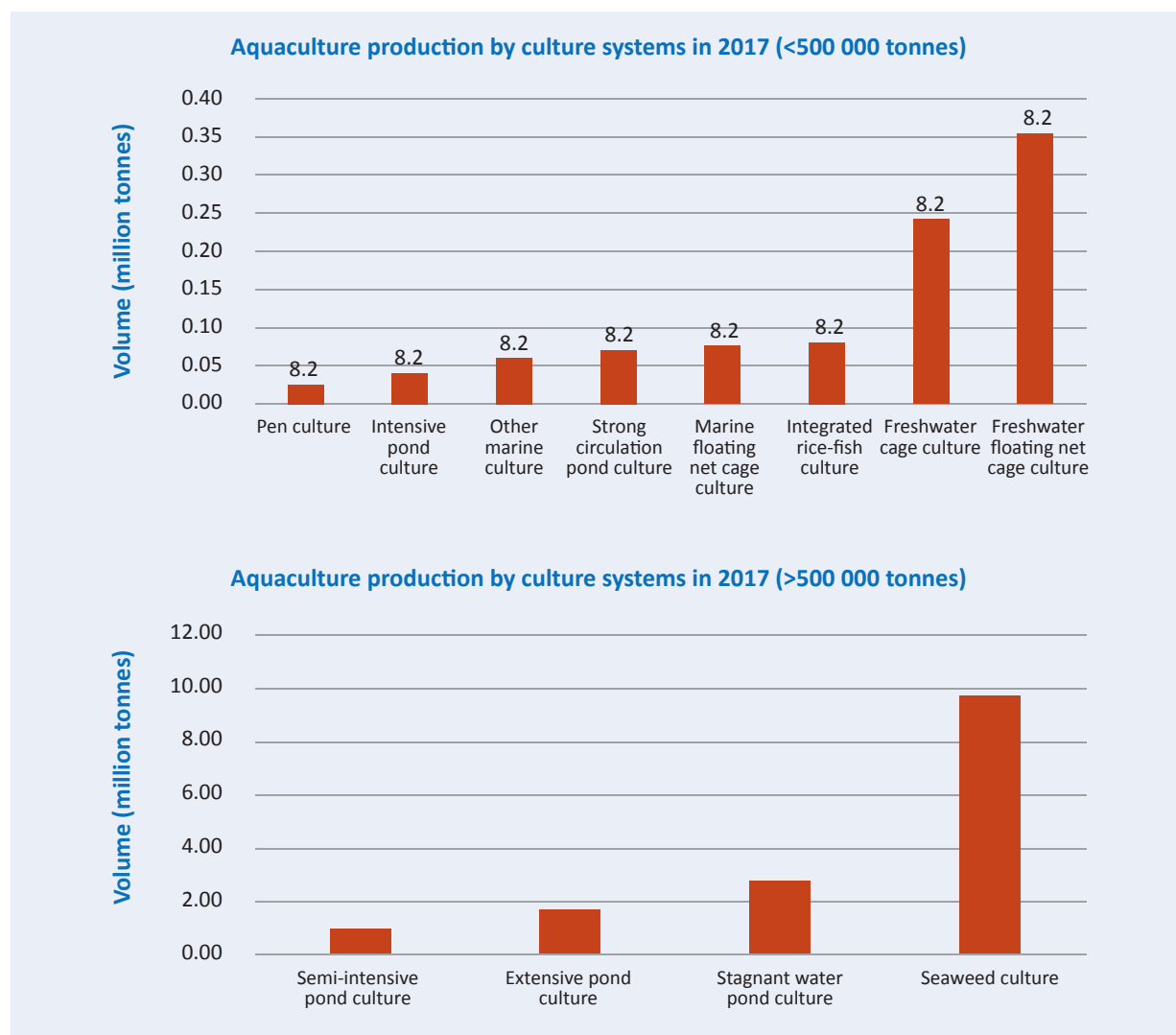
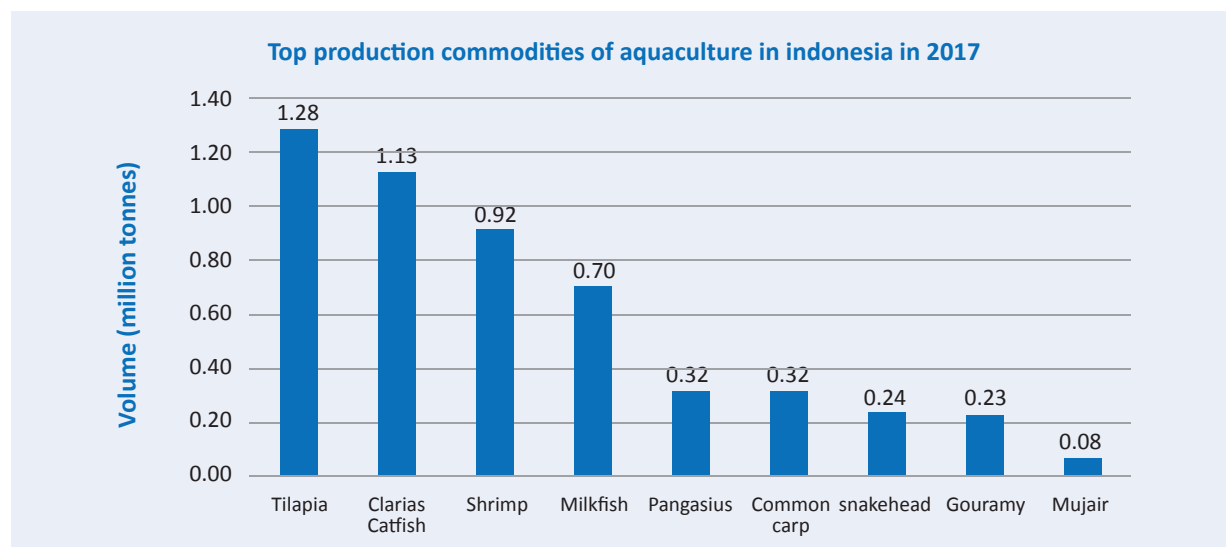
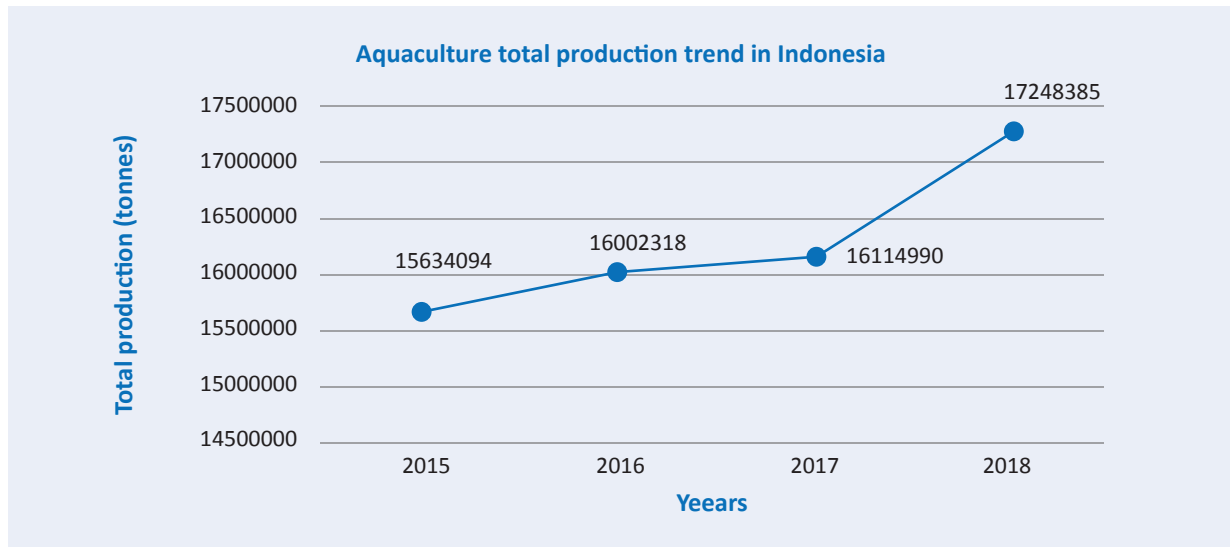


Figure 2 Aquaculture production in 2017 based on commodities



The overall production has been increasing as shown in Figure 3

Figure 3 Aquaculture total production trend over a four-year period



The other prominent aquaculture commodity was ornamental fish, which contributed significantly to trading and income. In 2017 the export value of the product was about USD 27 million, a growth of 12.05 percent over the previous year (Suhana, 2018). However, some of them were caught in the wild. Ninety species have been cultured. The total production of cultured ornamental fishes in Indonesia in 2018 was 1 869 533 pcs, an increase of 13.7 percent per year since 2015. The species were dominated by koi carp (426 345 pcs), followed by betta fish (221 946 pcs), and molly (154 835 pcs).

1.1.2 Seed production

In terms of seed supply for aquaculture, some species are already established using artificial seed production. In freshwater aquaculture, they are:

- i. Clarias catfish (*Clarias* spp.)
- ii. Nile tilapia (*Oreochromis niloticus*)
- iii. Common carp (*Cyprinus carpio*)
- iv. Silver barb (*Puntius* spp.)
- v. Pangasius catfish (*Pangasius* spp.)
- vi. Osphronemus goramy
- vii. Nilem carp (*Osteochilus* spp.)
- viii. Freshwater pomfret (*Collossoma macropomum*)
- ix. Kissing gourami (*Helostoma* spp.)
- x. Giant prawn (*Macrobrachium rosenbergii*).

In brackishwater and marine water they are:

- i. Milkfish (*Chanos chanos*)
- ii. Monodon shrimp (*Penaeus monodon*)

- iii. Vannamei shrimp (*Litopenaeus vannamei*)
- iv. Asian sea bass (*Lates calcarifer*)
- v. Groupers (*Epinephelus* spp.)
- vi. Mouse grouper (*Chromileptes altivelis*)
- vii. Snob nose pompano (*Trachinotus blochii*)
- viii. Pearl oyster (*Pinctada maxima*).

There are also marine/ brackishwater species such as rabbitfish (*Siganus* spp.), lobster (*Panulirus* spp.), giant trevally (*Caranx* spp.), red snapper (*Lutjanus* spp.), Napoleon (*Cheilinus undulates*). Grow out is dependent on wild-caught fry.

1.1.3 Feed

Rising production through intensification involves a consequent increment of inputs, mainly the feed. The feed industries supporting aquaculture businesses in Indonesia have grown rapidly since shrimp farming developed significantly in the 1990s. About 23 feed producers supply the commercial feed to the Indonesian domestic market (Table 1). The Indonesia Feed mill Company Association (GPMT) claimed the feed production for aquaculture in 2018 exceeded 1.65 million tonnes, comprised of 1.3 million tonnes for fish (dominated by feed for freshwater fishes) and 350 000 tonnes for shrimp (Laoli, 2018)

Table 1 Registered aquaculture feed suppliers

No	Supplier/ Company	Feed variant number	Target species
1	PT Cargill Indonesia	18	Milkfish, catfish, goramy, tilapia, common carp
2	CJ Feed Jombang	1	Vannamei shrimp
3	PT Golden Westindo Artajaya	22	Ornamental fish
4	PT Indojaya Agrinusa	5	Catfish, tilapia, gouramy, common carp
5	PT Suri Tani Pemuka	8	Vannamei and monodon shrimp
6	PT Panca Patriot Prima	2	Catfish
7	PT Luxindo Internusa	26	Vannamei shrimp, milkfish, catfish, goramy, tilapia, common carp
8	PT Wonokoyo Jaya Kusuma	4	Tilapia, common carp, catfish,
9	PT Lucky Samudra Pratama	2	Anguilla eel
10	PT Mitra Manggalindo	3	Catfish
11	Grobek Indomakmur	9	Catfish, pangasius, common carp, tilapia, gouramy
12	PT Central Proteina Prima Tbk	20	Tilapia, common carp, pomfret, ornamental fishes, vannamei shrimp
13	PT Indokom Samudra Persada	6	Vannamei shrimp
14	PT Sinta Prima Feedmill	4	Tilapia, common carp

No	Supplier/ Company	Feed variant number	Target species
15	PT Citra Mandiri Kencana	5	Ornamental fishes
16	PT Matahari Sakti	33	Vannamei shrimp, pangasius, catfish, Common carp, gouramy, tilapia
17	CV Rajawali Sakti	12	Vannamei shrimp
18	PT Ace Hardware Indonesia	44	Ornamental fishes
19	CV Mentari Nusantara	2	Catfish
20	PT Citra Ina Feedmill	4	Common carp, pangasius
21	PT Arya Indo Monodon	13	Kuruma and vannamei shrimp
22	PT Gold Coin Indonesia	21	Vannamei shrimp
23	PT Cakrawala Biru Segara	13	Vannamei shrimp

Source: Modified from Supriatna, 2014.

Many drugs/pharmaceutical substances, chemical compounds, preserved microorganisms, and nutritious elements are applied in aquaculture. They have various functions in reducing the risk of mortality, improving production, and increasing profit. There are more than a hundred products other than feed that are registered by MMAF for lawful distribution. Generally, they play a part in:

- i. Disinfection
- ii. Water quality enhancement
- iii. Fertilizer
- iv. Pest eradication
- v. Probiotics
- vi. Organic substances decomposition
- vii. Toxic compounds reduction
- viii. Feed supplement
- ix. Immune stimulation
- x. Growth promotion

2. Legislation (laws and regulations) for aquaculture governance

2.1 Hierarchy of laws and regulations in Indonesia

The hierarchy of laws/ regulations in Indonesia about subsection (1) Article 7 of Law of the Republic of Indonesia No. 12 of 2011 Concerning Making Rules:¹⁹

¹⁹ http://www.flevin.com/id/lgso/translations/JICA%20Mirror/english/4778_UU_12_2011_e.html

- i. Constitution of 1945 (UUD 45)
- ii. People's Consultative Council Decrees
- iii. Laws
- iv. Government Regulations in Lieu of Law
- v. Presidential Regulations/ Decrees
- vi. Regency Regulations
- vii. Province/Municipal Regulations.

Constitutional amendments are only made under the authority of the People's Consultative Council. An act can be created or initiated by the House of Representative (Parliament) or by the government and becomes law by both the agreement of the President and the House of Representatives. The President can declare a Government Regulation in Lieu of Law in a state of emergency, which is then followed by a related Act giving more detail on the subject of the regulation. The Provincial and Municipal Regulations are initiated by both the Provincial House of Representatives and approved by the Governor and the Provincial Parliament (Dewansyah, 2014).

Article 8 subsection (1) of Act 12 of 2011 implicitly explains about the other regulations such as those of government ministers, the Bank of Indonesia, State Audit Board that are binding because of the authority of the institution that initiated the regulations. Democracy in Indonesia provides a bottom-up mechanism in the making and approving of the law. In preparation for the National Legislation Plan, the drafting, discussing, and legalizing of the draft Act, Parliament should conduct public consultations as stated in Act 12 of 2011. Before some regulation becomes law, it is possible for the public to change or modify the regulation. Such judicial review can be requested by submission to the Constitution Court. If there is a regulation against the constitution submission for review is to the Supreme Court.

2.1.2 The aquaculture sector in the Ministry of Marine Affairs and Fisheries

Indonesia ratified the United Nations Convention on the Law of the Sea (UNCLOS) under Act 17, 1985, and all agreements on the implementation of UNCLOS under Act 21, 2009. The Code of Conduct for Responsible Fisheries (CCRF) is one of the established principles and standards applicable to the conservation, management, and development of all fish. The code was adopted in the FAO Conference in 1995, and Indonesia as a UN member is obliged to implement the principles. According to Article 9, regarding aquaculture development, specifically subsection 9.1.1, "States should establish, maintain, and develop an appropriate legal and administrative framework which facilitates the development of responsible aquaculture." In pursuance of this, Indonesia regulates the fisheries sector by the Law of the Republic of Indonesia No. 31 of 2004 Concerning Fishery²⁰ with some revision by the Law of the Republic of Indonesia No. 45 of 2009. Following from this, Government Regulation No. 28/2017 Concerning Aquaculture deals with such things as aquatic animal disease control, fish medicine control and residues and environmental monitoring (Hastuti, 2017).

Since the beginning, fisheries (including aquaculture) governance was under the Ministry of Agriculture. Accordingly, aquaculture governance was not distinct from governance of the agriculture sector or was simply treated as fish farming development, which along with capture fisheries was under the Directorate of Biological Resources. In 1999, the Government of Indonesia (by means of Presidential Decree 355/1999, 26 October) established the Ministry of Marine Exploration, later on its name was changed to the Ministry of Marine Affairs and Fisheries (MMAF). This was the beginning of the fisheries sector being given more attention with aquaculture affairs placed under a specific

²⁰ <http://www.flevin.com/id/lgso/translations/JICA%20Mirror/english/17.31.2004.eng.qc.html>

Directorate-General. In such a situation, discretionary decisions could be more potent than before. The services supporting the development of the aquaculture sector could also be more accessible with a higher priority in terms of budget. It also meant that legislation to support the governance of the aquaculture sector could more easily be established.

The political will of Indonesia in the aquaculture sector has been expressed through institution building at local and national level. Supportive infrastructure and development programmes have benefitted from the participation by various institutions such as the Rural Development Agency, the Finance Agency, the Ministry of Public Works. Almost all of the regencies in all provinces have a fisheries and aquaculture agency. In the National Development Planning Board (Bappenas), the aquaculture sector is treated as part of maritime affairs under the Ministry of Marine Affairs and Fisheries, endorsed by the National Strategic Plan. The development of modern sustainable aquaculture is to be implemented by means of: (i) the development of superior commodities based on competitiveness and comparative advantages; (ii) improving the main production inputs and facilities, such as seed, feed, transportation, irrigation, electricity; and (iii) supporting and disseminating modern and sustainable technologies (Bappenas, 2014).

2.1.3 Environmental protection regulations

Environmental protection and management, in general, have been regulated by Law No. 32/2009 Environment Protection and Management. This environmental law generally promotes the systematic and integrated efforts to protect the environment. The purpose is to preserve the natural environment and its functions and prevent its destruction and pollution using for example planning, control, surveillance, and law enforcement. To protect the environment from the negative impact of human activities, every activity which has an essential impact should be assessed by an environmental impact assessment (EIA). There are 19 guidelines related to EIA. One of them is the Regulation of the State Minister of Environment 11/2006 On Type of Business Plan and/or Activities that Require Analysis of Impact Assessment which presents a list of activities that require an EIA. In the aquaculture sector, according to the regulation, there are two systems that are obliged to do EIA, namely Inland intensive and semi-intensive fish or shrimp ponds without waste/ effluent management and that occupy more than 50 ha, and cage culture (pen culture and floating net cage) in inland waters covering more than 2.5 ha or more than 500 units or in marine water covering more than 5 ha or more than 1 000 units. The EIA is one of the requirements for the issuance of an Environmental License as regulated by Government Regulation 27/2012 On Environmental Licenses (World Services Group, 2012).

Furthermore, Government Regulation 46/2016 mandates procedures for carrying out a strategic environmental assessment to ensure any development programme will be in line with sustainability goals and will take preventive actions to avoid potential destruction, disaster, and all negative impacts. Spatial arrangements in detail or zonation of areas based on such assessment should be implemented by all local governments. With the Presidential Regulation 24/2018 the procedure for obtaining an environmental license became available online and was simplified (Rödl & Partner, 2018).

2.1.4 Regulation of food safety, animal health management, biosecurity

Aquaculture products for human consumption should follow the food quality standard of safety assurance. Animal health management and biosecurity are also related to food safety, so these matters should be integrated. For general food and drug administration, Indonesia has a national Board of Food and Drug Inspection to protect consumers. In the Ministry of Marine Affairs and Fisheries, there is a Director-General who is responsible for product quality enhancement, namely the Director-General of Product Competitiveness Improvement. For controlling the quality and safety of fisheries products, there is a Board of Fish Quarantine and Quality Control. This board is the competent authority for quality assurance certification.

The competitiveness of the fisheries and aquaculture products in terms of value is achieved by means of better handling and processing techniques, the variety of the end products, as well as product promotion and trading. All of these matters are the domain of the Directorate-General of Product Competitiveness Improvement. Product promotion and trading are also closely related to food safety issues (sanitary and phytosanitary issues and residual contamination issues) and environmental issues. The quarantine and quality control agency has a dominant role in the prevention of the spread of disease, the management of epizootic disease, and quality inspection and assurance.

The legal basis of food safety is Law No. 18 of 2012 Concerning Food,²¹ Government Regulation 57/2015 Concerning the System of Quality Assurance and Safety of Fishery Products, and the Enhancement of Added Value of Fishery Products, and MMAF Regulation 74/2016 Concerning Official Control of Quality and Safety of Fisheries Products that Enter the Republic of Indonesia. In Act 18/2012, Article 68 mentions that the government should determine the norms, standards, procedures, and criteria of food safety. The stakeholders (farmers, fishers, aquaculturists, and food companies) are obliged to follow the norms, standards, procedures, and criteria. Article 69 explains that the arrangement of food safety is conducted through sanitary rules, food additive rules, genetic manipulation rules, irradiation rules, packaging rules, food safety assurance, quality assurance, and halal assurance for certain products.

The Government Regulation 57/2015 explains that the quality assessment and safety of fisheries products comprises the development and application of: i) raw materials; ii) hygiene, handling, processing; iii) requirement and quality standard of product; iv) facilities and equipment; v) testing method; vi) quality control; vii) quality assurance; and viii) certification. The MMAF Regulation 74/2016 regulates:

- i. requirements and procedures for the import of fishery products;
- ii. products inspection;
- iii. entry point of fishery products;
- iv. importing products by hand luggage;
- v. re-import of fishery products.

In animal health management, there are two aspects separately regulated, i.e. the spread of disease as a result of transportation and health management in the farming system. The first is mostly regulated by Law 16/1992 Concerning Animal, Fish and Plant Quarantine and MMAF Regulation 9/2019 Concerning Fish Quarantine Installation, which contains guidance on good fish quarantine practice. The second aspect is regulated by Government Regulation 28/2017 On Fish Farming, including use of fish drugs in Article 35, management of fish health in Articles 55–71; MMAF Decree 02/2007 on Methods of Good Aquaculture Practices; Director-General of Aquaculture Circular 4575/2019 Prohibition on Using Shrimp Broodstock from Grow-Out Production Ponds.

Biosecurity also relates to health management other than environmental protection. This matter is already addressed by the regulations of some institutions to minimize the epizootic risk at the farm level, such as:

- i. fish quarantine;
- ii. environmental protection; and
- iii. good aquaculture practice.

²¹ FAOLEX Database

Tight control of inter-area transportation of fish using quarantine as per the regulations could prevent the wide spread of disease from the infected area. The list of quarantine-related diseases in each region is according to the epidemic status of the region. On-farm level biosecurity is part of Good Hatchery Practices and Good Aquaculture Practices. The Guidance of Good Hatchery Practices has been standardized as Indonesia National Standard SNI:8035: 2014 (MMAF, 2014) and Good Aquaculture Practices as SNI: 8228:2015 (BSN, 2015).

2.1.5 Regulation on management of natural resources for aquaculture

The norm of natural resources management is stated in Article 33 of the Indonesian constitution. Land, water, and all natural resources are under the authority of the state and utilized for people's benefit.

Natural resources for aquaculture include: inland aquatic ecosystems, marine ecosystems, coastal ecosystems, aquatic organisms, genetic resources, ground and surface water. The government regulates the aquaculture activities related to the utilization of land, water, and other natural resources to ensure both the natural resources and aquaculture are well protected. Fisheries Law No. 31/2004 "stipulates provisions on utilization of fish resources, either for fish catching or fish breeding, in the Indonesian EEZ [Exclusive Economic Zone] and the open seas according to the international conditions, to ensure their preservation and the protection of the environment. The Ministry [of Marine Affairs and Fisheries] shall determine provisions for the regulation of: fishing gear, allowable catch, fish breeding, prevention of pollution, protected fish, etc." (ILO, no date).

In Government Regulation No. 28/2017 On Fish Farming, Article 6 mentions that the local government (governor, regent) has the authority to establish planning of water and land utilization for aquaculture. In Article 8, water resources are categorized according to the aquaculture system applied, i.e. as media for aquaculture in a reservoir, lake, river, swamp, and other inland waters and as a material for aquaculture in pond, tank, and other containers. According to Article 12, the minister, governor, regent who has authority should protect the land area for aquaculture by means of establishing aquaculture zones.

The other regulation related to natural resources management and aquaculture is Law 27/2007 On the Management of Coastal Areas and Small Islands. Article 4 mentions that the management of the coastal area and small islands has the purposes to protect, conserve, rehabilitate, utilize, and enhance such resources with their ecological system sustainably. Article 16 mentions the right to utilize the coastal water (including water surface, water column, and water bottom) for a period of 20 years. Article 23 states that the utilization of small islands and adjacent aquatic resources is prioritized in terms of one or more interests: conservation, education, training, research and development, marine aquaculture.

2.1.6 Regulations to protect biodiversity

For biodiversity protection, Indonesia has ratified the Convention on International Trade in Endangered Wild Flora and Fauna (CITES) by Presidential Decree 43/1978. Indonesia has also shown a commitment and political will to support biodiversity protection mandated by other international instruments such as the United Nation Convention on Biodiversity 1992.

Some national regulations related to biodiversity protection are:

- i. Law No. 5/1990 On Conservation of Living Resources and their Ecosystems²²
- ii. Law No. 32/2009 On Environmental Protection and Management²³
- iii. Law No. 31/2004 On Fisheries²⁴
- iv. Government Regulation No. 7/1999 Concerning Conservation of Flora and Fauna
- v. Government Regulation No 8/1999 On Utilization of Wild Flora and Fauna
- vi. Government Regulation No. 13/1994 On Game Hunting Affairs
- vii. Government Regulation No. 68/1998 On Areas of Natural Conservation
- viii. Government Regulation No. 8/1999 On Utilization of Wildlife
- ix. Government Regulation No. 15/1984 On Fishery Resource Management in the Indonesian Exclusive Economic Zone (EEZ)
- x. MMAF Regulation No. 30/2010 On Management and Zoning Plan of Aquatic Conservation Areas

Generally, the regulations above offer species-based or area-based protection of endangered biodiversity and promotes its conservation.

2.1.7 Regulations on feed and drugs

Good quality feed and drugs are required for aquaculture. They are regulated by Government Regulation 28/2017 On Aquaculture. Chapter IV Paragraph 2 Articles 30–34 regulate feed and drugs with respect to:

- i. production standards
- ii. production/ preparation/ supply
- iii. distribution
- iv. certification/ licensing
- v. quality surveillance.

Following Government Regulation 28/2017, the Ministerial Regulation 55/2018 On Fish Feed and Ministerial Regulation 01/2019 On Drugs for Fish were introduced. The scope of the Ministerial Regulation 55/2018 includes:

- i. supply of feed
- ii. certification service
- iii. reporting
- iv. surveillance.

The scope of Ministry Regulation 01/2019 includes:

- i. supply and distribution
- ii. service on certificate and reference letter
- iii. reporting
- iv. surveillance.

²² FAOLEX Database

²³ FAOLEX Database

²⁴ FAOLEX Database

The 01/2019 Fish Drug Regulation in Indonesia elaborated the previous regulations such as:

- i. Ministerial Regulation 04/2012 On Fish Drugs and renewed by Ministerial Regulation 14/2013);
- ii. Ministerial Regulation 24/2014) On Good Fish Drug Manufacturing Practices
- iii. Ministerial Regulation 52/2014 On Fish Drug Classification.

The domestic drug supply should follow the guidance of Good Fish Drug Manufacturing Practices. The compliance with the guidance is proved by the granting of a certificate, which is one of the important requirements for the distribution of licenses. In this regulation, complete guidance on good fish drug manufacturing practices was attached.

2.1.8 Regulation of working conditions and safety in aquaculture operations

There is no specific regulation on working conditions and safety pertaining to aquaculture operations in Indonesia. The working safety conditions for all sectors are regulated by Act 1/1970 On Work Safety and Act 13/2003 On Manpower followed by Government Regulation 50/2012 On the Implementation of Occupational Health and Safety Management System. This government regulation is designed to guarantee that a work safety and health management system is adopted in the working area and involves the management team, the labour association, and labour in order to prevent and minimize accidents and the outbreak of diseases at work and create a comfortable, efficient, and productive working place. It comprises a management system for working, assessment of the system, and surveillance of compliance. Aquaculture activities are not exempted. See Table 2 for a summary of regulations concerning the environment and working conditions of aquaculture operations.

Table 2 Regulations concerning environment and working conditions of aquaculture operations

Subject	Legal basis	Scope/ purposes of the rules
1. Environmental protection	Act 32/2009	Environment protection and management
	Ministry of Environment Regulation 11/2006	The list of activities that require an EIA to be conducted
	Government Regulation 46/2016	Procedure related to strategic resources/ environment assessment
	Government Regulation 27/2012	Environment license
	Ministry of Environment and Forestry Regulation 24/2018	Exception of licensing of activities in regencies with legalized zoning
2. Food safety, biosecurity and animal health management	Act 18/2012	Food
	Government Regulation 57/2015	Quality assurance system and safety of fishery products and their added value.
	Ministry of Marine Affairs and Fisheries Regulation 74/2016	Quality control on safety of fishery products entering Indonesia jurisdiction

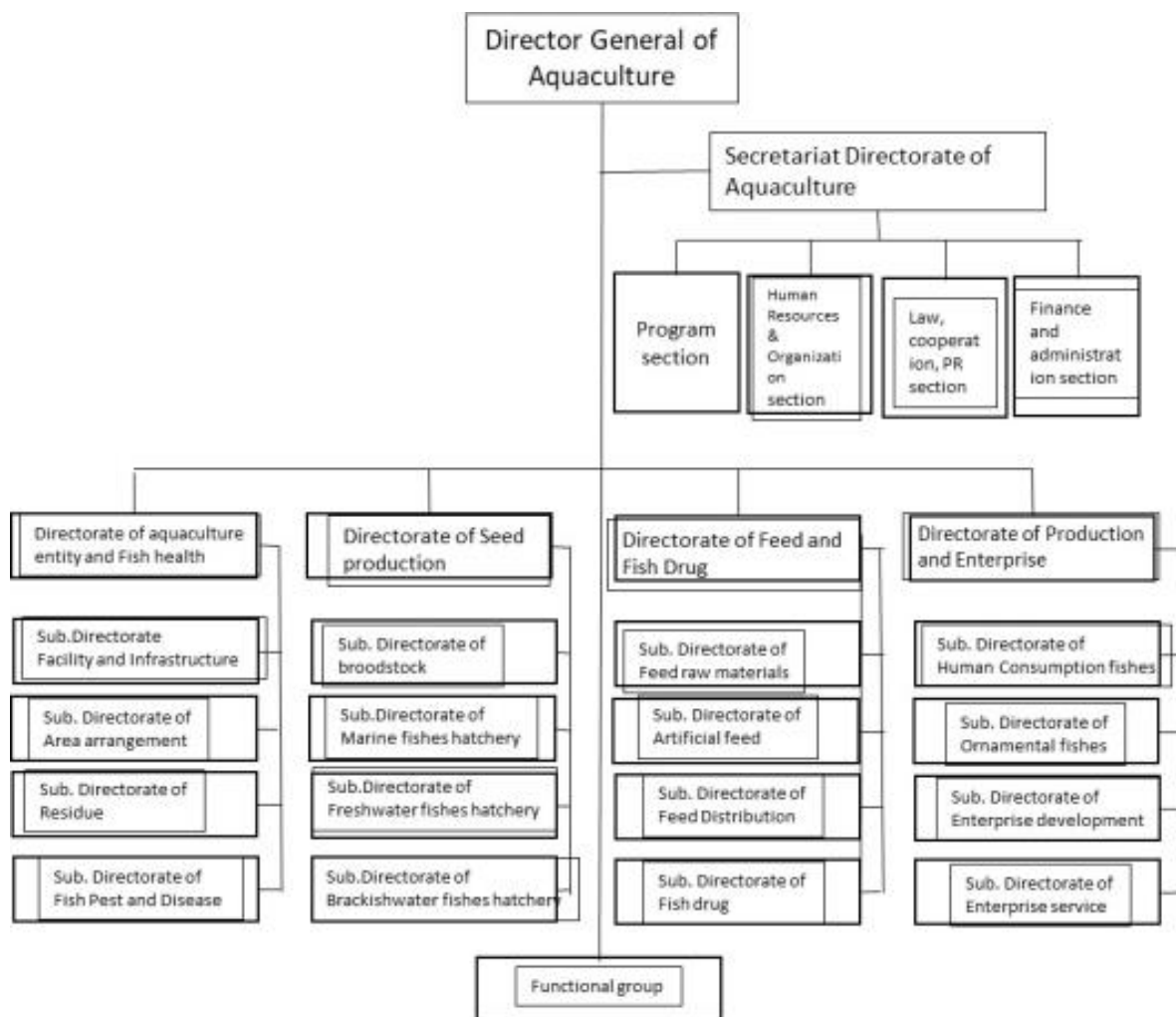
Subject	Legal basis	Scope/ purposes of the rules
3. Management of natural resources for aquaculture	Constitution UUD45, Article 33	Natural resources utilization
	Act 31/2004	Fisheries
	Government Regulation 28/2017	Fish farming
	Act 27/2007	Management of coastal area and small islands
4. Protection of biodiversity	Presidential Decree 43/1978	CITES ratification
	Act 5/1994	Legalization of UN Convention on Biodiversity
	Government Regulation 7/1999	Conservation of flora and fauna
	Government Regulation 8/1999	The utilization of wild flora and fauna
	Government Regulation 13/1994	Game hunting
	Government Regulation 68/ 1998	Sanctuaries and protected areas
	Government Regulation 8/1999	The utilization of wildlife
	Government Regulation 15/1984	Natural resources management in EEZ Indonesia
	MMAF rule 30/2010	Management plan and zonation of aquatic conservation area
5. Feed and drugs	Govt. Reg. 28/2017	Standards; production/ preparation/ supply; distribution; certification/ licensing; quality surveillance
	Ministry Regulation 55/2018	Supply of feed; certification; service; reporting; surveillance
	Ministry Regulation 01/2019	Supply and distribution; service on certificate and reference letter; reporting; surveillance
6. Working conditions and safety in aquaculture operations	Act 1/1970	Regulate working safety in all working places and conditions (land, ground, water surface, underwater, air) inside Indonesian jurisdiction Requirements for work safety
	Act 13/2003	The right of employee/labour to be protected by work safety and health measures The obligation of employers to apply a work safety and health management system
	Government Regulation 50/ 2012	Management system for work safety and health, assessment, and surveillance of compliance.

3. Institutional framework and mechanisms governing the aquaculture industry at national and local levels

Aquaculture development in Indonesia is dealt with as part of the marine and fisheries sectors, which achieved greater priority after the MMAF was established in 2000. Governance of aquaculture is divided into four directorates under the Director-General of Aquaculture and each is working to support consumer services and development. As seen in Figure 4, these comprise:

- i. Directorate of Aquaculture Entity and Fish Health
- ii. Directorate of Seed Production
- iii. Directorate of Feed and Fish Drug
- iv. Directorate of Production and Enterprise.

Figure 4 Organization structure of Directorate-General of Aquaculture



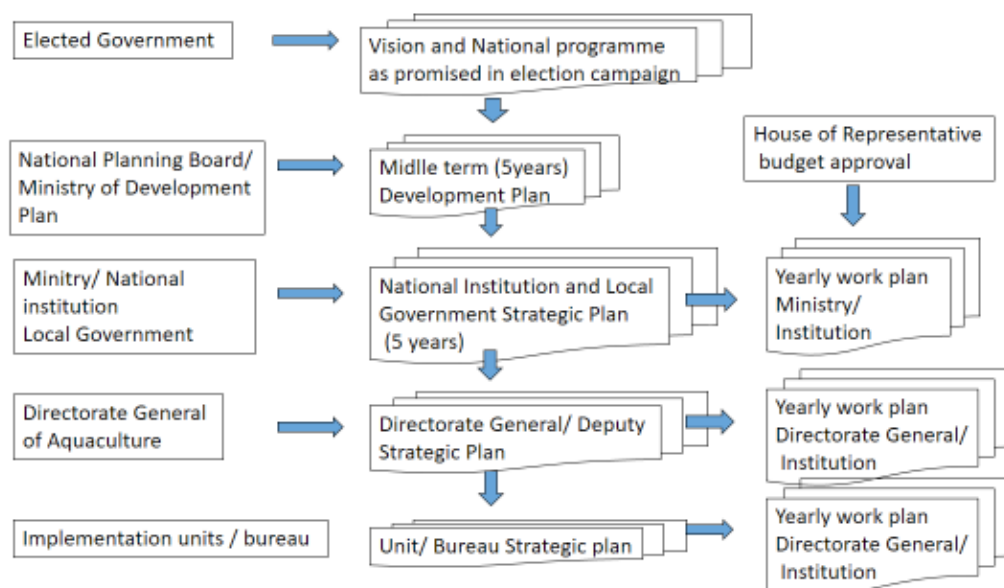
Source: DJPB, 2017

The mission of the Directorate of Aquaculture Entity and Fish Health is to ensure the sustainability of aquaculture through proper utilization of natural resources and effective disease control. The integrated use of resources and integrated prevention of disease outbreaks is much more efficient in a spatial entity. The Directorate of Seed Production and the Directorate of Feed and Fish Drug support the sustainability of aquaculture through supporting the supply of seed and the feed as required in terms of quantity, quality, and price/cost. Seed and the feed are the dominant factors controlling the success of production. The supply, quality, distribution, trading, and the availability of raw materials are under government control and surveillance. The Directorate of Production and Enterprise ensures the production of fish fit for human consumption. Ornamental fish is dealt with as part of aquaculture industry development services.

Fisheries and aquaculture activities at province and district level follow the guidelines established by MAFF. Each local government receives a budget to develop aquaculture in its province or districts. The Minister delegates authority to the governor and regent to coordinate the concurrent activities in their area. The institutions involved in aquaculture development are farmer groups/ associations, extension offices, financial institutions (banks), fisheries and marine offices, technical implementation units (TIUs), quality control laboratories, sub-district government.

Indonesia State Governance is conducted under the planning system as regulated by the National Development Planning System Law (Law 25/2004). The Mid-term Development Plan (five-year plan) is prepared by the elected president as part of the campaign promises made during the general election. The National Planning Board adopts the vision and mission of the elected government to formulate the Government Work Plan and Mid-term Development Plan. These should be followed by the relevant ministries/ institutions and local governments when formulating their strategic five-year plans. The Directorate General of Aquaculture (DGA) under the Ministry of Marine Affairs and Fisheries (MMAF) follows up with the ministry's Strategic Plan for more detailed planning. The institutional framework of planning mechanisms is shown in Figure 5.

Figure 5 Institutional framework of national planning mechanism in Indonesia



The breakdown of the five-year work plan by the annual work programme is discussed and finalized in the previous year. The institutional framework of the annual budget allocation for the aquaculture development programme is shown in Table 3.

Table 3 Institutional framework for annual budget allocation for aquaculture development in Indonesia

Institution	Activities/ role	Goal
Ministry of Finance	Propose state budget and expenditure plan of the year	Quantify state budget and expenditure plan of the year
House of Representatives	Approve state budget and expenditure plan of the year	Approve state budget and expenditure plan of the year
National Planning Board	Coordinate and prioritize ministerial and institutional budget of the year	Strategic goal of the ministry is to support the national development programme
DGA	Propose detailed activities as delegated by MMAF and coordinate the programme among the TIU and local agencies	Identify detailed activities and budget plan of the year to support the ministerial goal and coordinate activities among local agencies
Provinces fisheries agencies	Propose budget and synchronize the work plan	Detail activities and budget plan of the year as decentralized programme
District fisheries agencies	Propose budget and synchronize the work plan	Detail activities and budget plan of the year as co-administration task programme
Technical implementation units	Arrange the allocated budget and synchronize the work plan	Detail activities and budget plan of the year as allocated by DGA

Aquaculture development is a part of economic development and aims to: (i) increase the incomes and prosperity of fish farmers, create more jobs and business opportunities; (ii) enhance the protection and rehabilitation of aquacultural resources; (iii) improve the aquaculture production and its productivity; (iv) fulfil the consumers' demands and meet the need for industrial raw materials; (v) increase exports (Deputy Maritime and Natural Resources, 2019). The strategic plans of MMAF 2015–2019 and DGA 2015–2019 explain the objectives of aquaculture development. They are: (i) raising the prosperity of fish farmers; and (ii) establishing the sustainability of aquaculture resources. The instrument used to support, control and evaluate development programmes is a balanced scorecard system. By this system, the day-to-day work can be harmonized with strategy and progress towards strategic targets can be measured and monitored using various key performance indicators (KPI). The strategic target from the stakeholder perspective is the raising of the prosperity of the farmers, which is indicated by income per capita, gross domestic product, and the exchange value. The institutions involved in this programme would be responsible for all forward and backward linkages of the sector, such as infrastructure, facilities, production input supply, finance, enforcement, market, trading, processing.

Table 4 The institutional framework for increasing production

Institution	Activities/ role	Goal
DGA	Coordinating the programme	Increase production
Provincial agency	De-concentration programme implementation	Establish and integrate the production programme
District agency	Co-administration task implementation	Build capacity of supporting agency
Technical Implementation Unit	Supervising, delivery of seed, broodstock, feed, disease surveillance	Properly apply technology, have sufficient superior broodstock and high health seed
Extension centre	Supervising the production unit	Properly apply technology
Finance	Capital lending	Cover all the needs of production
Feed and drug supply	Marketing / supply	Fulfil the needs of production and quality
Aquaculture equipment supply	Marketing / supply	Fulfil the needs of production
Law enforcement	Inspection, prevention	Ensure convenient and secure conditions
Quarantine	Fish inspection	Avoid disease outbreaks

An important aspect of aquaculture for increasing profits, reducing risk, and ensuring sustainability is the application of improved technology. Using more efficient and cost-effective techniques, a business can make more profit at the same production rate. The risk of product failure because of disease or improper technology should be minimized by improving technology, and hopefully the probability of success also increases following such improvements. The government promotes technology improvement through applied research and selection. The institutional framework for selection of the improved aquaculture technologies for dissemination is shown in Table 5.

Table 5 Selection and dissemination of the improved aquaculture technologies

Institution	Activities/ role	Goal
Research centre	Organizes the selection process Drafts some innovations	Identify the nominees for selection
Technical Implementation Unit	Drafts innovation or some improved aquaculture technology	Submit nominees for selection
Expert groups (external)	Editors/ correctors	Justify the proposed technology
Universities	Resource persons	Have available scientific judgment
Farmer associations	Early adopter	Share experiences
Technology assessment and application board (BPPT)	Resource persons	Have available expert judgment
Extension specialists	Users/ disseminators	Ensure effective application and dissemination
Aquaculture inspectors	Users/ disseminators	Ensure effective application and compliance with legal aspects

4. Technical standards and guidelines supporting the implementation of laws and regulations

Technical guidelines supporting the implementation of regulations are usually part of ministerial rules or the Director-General's guidance or the Director-General's instructions. In Government Regulation 28/2017 On Fish Farming, all aspects of aquaculture are regulated as norms. The following guidelines are incorporated into ministerial rules and Indonesian national standards.

- i. Article 7 section (2) mentions that guidelines for drafting the utilization of land and water plans should be regulated by ministerial rules.
- ii. Article 10 section (4) mentions that technical standards for water and land should be regulated by ministerial rules.
- iii. Article 12 section (5) states that the determination of procedures, requirements, and decrees of aquaculture zones should be governed by ministerial rules.
- iv. Article 15 section (4) mentions that Indonesian national standards should determine superior broodstock and high quality of seed.

The rules of the Director-General of Aquaculture can be part of the guidelines also. They are referred to as ministerial rules. The DGA rules announced on the official website include:

- i. Director-General of Aquaculture rule number 9/2019 Technical Guidelines for Delivery of Supporting Facilities For On-farm Feed Production.
- ii. Director-General of Aquaculture rule number 86/2018 Technical Guidelines for Management of Participation-based Pond Irrigation.
- iii. Director-General of Aquaculture rule 4575/2019 The Prohibition of Utilizing Shrimp from Grow-out Ponds for Broodstock in Seed Production.
- iv. Director-General of Aquaculture rule 65/2015 Implementation of Certification.

The Indonesia National Standard (in Bahasa: SNI) is also one of the legal aspects of production or procedures in the aquaculture sector. Assurance for quality agreed by stakeholders' consensus would be useful for trading, agreement, or customer protection. The SNI is declared by the National Standardization Board (BSN), after particular procedures followed by the initiator.

The Director-General of Aquaculture announced that almost 250 standards related to aquaculture have been legalized by BSN supporting the stakeholders (Saputro, 2016). BSN started to release the standards concerning aquaculture in 1999, and up to 2014 there were 62 standards stipulated for aquaculture commodities species and their production procedures (Suptriatna, 2014). The standards for various commodities established up to 2014 are shown in Table 6.

Table 6 SNI standards based on commodities

No	Commodities	Standard	Title
1	Milkfish	01- 6148 – 1999 01- 6149– 1999 01- 6150– 1999	Milkfish broodstock Milkfish fry Milkfish fry production
2	Cottonii seaweed	7672:2011 7673.1:2011 7673.2:2011 7673.3:2011	Initial stock of <i>Eucheuma cottonii</i> Production of <i>Eucheuma cottonii</i> initial stock – off-bottom method Production of <i>Eucheuma cottonii</i> initial stock – longline method Production of <i>Eucheuma cottonii</i> initial stock – Bamboo raft method
3	Gourami fish	01- 6485.1 – 2000 01- 6485.2 – 2000 01- 6485.3 – 2000	Gourami parent stock Gourami fry Gourami fry production
4	Asian seabass	01- 6145 – 1999 01- 6146 – 1999 01- 6147 – 1999	Seabass parent stock Seabass fry Seabass fry production
5	Humpback grouper	6487.1.2011 6487.2.2011 6487.3.2011	Humpback grouper broodstock Humpback grouper fry Humpback grouper fry production
6	Tiger grouper	6488.1:2011 6488.2:2011 6488.3:2011	Tiger grouper broodstock Tiger grouper fry Tiger grouper fry production
7	Bull frog	02- 6730.1 – 200 02- 6730.2 – 200 02- 6730.3 – 200 02- 6730.4 – 200	Bull frog fry Bull frog parent stock Bull frog fry production Bull frog broodstock production
8	African catfish	01- 6484.1– 2000 01- 6484.2– 2000 01- 6484.3 – 2000 01- 6484.4 – 2000	African catfish parent stock African catfish fry African catfish parent stock production African catfish fry production
9	Common carp – majalaya strain	01- 6130 – 1999 01- 6131 – 1999 01- 6132 – 1999 01- 6133 – 1999	Common carp – majalaya strain parent stock Common carp – majalaya strain parent stock production Common carp – majalaya strain fry Common carp – majalaya strain fry production
10	Common carp – sinyonya strain	01- 6134 – 1999 01- 6134 – 1999 01- 6134 – 1999 01- 6134- 1999	Common carp – sinyonya strain parent stock Common carp – sinyonya strain parent stock production Common carp – sinyonya strain fry Common carp – sinyonya strain fry production
11	Black Nile tilapia	6138:2009 6138:2009 6138:2009 6138:2009	Black Nile tilapia parent stock Black Nile tilapia parent stock production Black Nile tilapia fry Black Nile tilapia fry production
12	<i>Pangasius djambal</i>	01-7256-2006 01-7256-2006 01-7256-2006 01-7256-2006	<i>Pangasius djambal</i> parent stock <i>Pangasius djambal</i> fry <i>Pangasius djambal</i> parent stock production <i>Pangasius djambal</i> fry production

No	Commodities	Standard	Title
13	Siam pangasius	01- 6483.1 – 2000 01- 6483.2 – 2000 01- 6483.3 – 2000	Siam pangasius parent stock Siam pangasius fry Siam pangasius parent stock production
14	Freshwater prawn	01- 6486.1 – 2000 01- 6486.2 – 2000 01- 6486.3 – 2000 01- 6486.4 – 2000	Freshwater prawn parent stock Freshwater prawn fry Freshwater prawn fry production Freshwater prawn parent stockproduction
15	Blue shrimp	01-7257-2006	Blue shrimp parent stock
16	Vannamei shrimp	01-7252-2006 01-7253-2006 01-7254-2006	Vannamei shrimp fry Vannamei shrimp parent stock Vannamei shrimp fry production
17	Monodon shrimp	01-6142-2006 01-6143-2006 01-6144-2006 01-6145-2006	Monodon shrimp broodstock Monodon shrimp fry Monodon shrimp fry production Monodon shrimp handling in storage tank

Source: Supriatna, 2014

5. Gaps, issues, and challenges in aquaculture governance

5.1 Laws and regulations

After reviewing the regulations related to aquaculture, it could be seen that there are a number of gaps such as:

Government Regulation 28/2017 On Fish Farming needs derivative regulations to follow its various articles such as:

- i. on guidance for planning the utilization of land and water;
- ii. on rules for technical standards of water and land;
- iii. on determination of procedures, requirements, and aquaculture area allocation;
- iv. on determination of requirements and procedures of license issuance for a breeding programme for genetic improvement;
- v. on requirements and license issuance for releasing new strains for aquaculture; and
- vi. on inland and marine area zoning to protect aquaculture by minister, governor, regent under their authority.

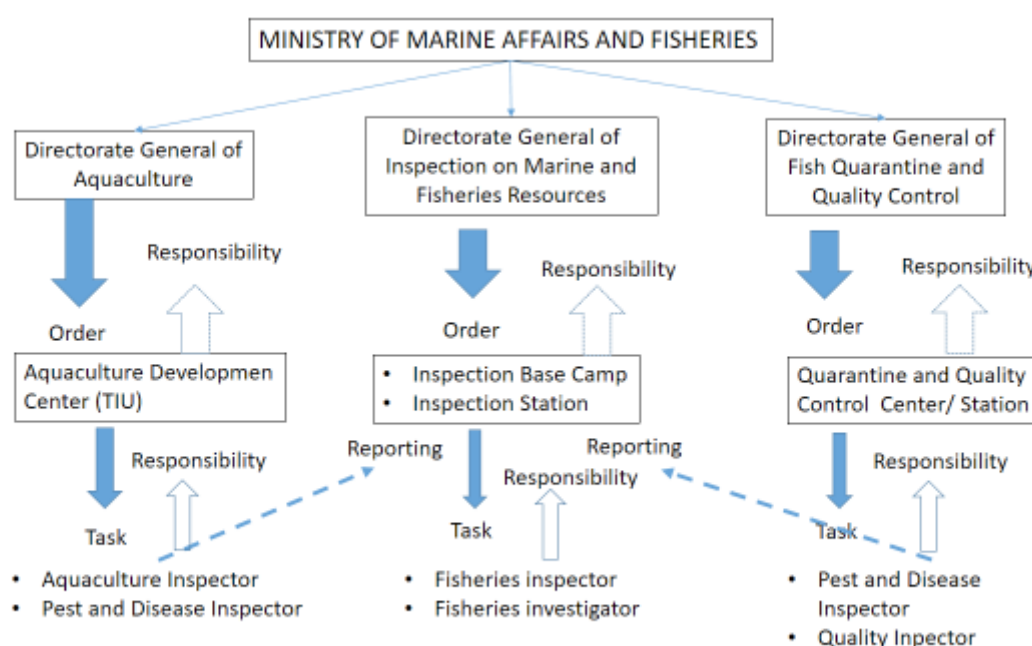
5.2 Institutional arrangements

In Indonesia, small-scale fishers or smallholders dominate the sector and are strongly assisted by the regulations under Act 7/2016 On Protection and Empowerment of Small-scale Fishers, Fish Farmers, and Salt Producers. One of the derivative rules is Ministerial Regulation 18/2016 On Protection Insurance on Risk of Fishers, Fish Farmers, and Salt Producers. Small-scale aquaculture however is not specifically covered by the protection insurance in terms of risks.

The inspection regime is under Ministerial Regulation 17/2014 and is the responsibility of the Directorate-General of Inspection on Marine and Fisheries Resources. Meanwhile, the personnel

available for aquaculture inspection are in the Technical Implementation Unit (TIU) under the Directorate-General of Aquaculture or in Fish Quarantine under the Directorate-General of Fish Quarantine and Quality Control. There are 15 TIUs all over Indonesia that are tasked with supporting aquaculture development in its respective region. There are more than 47 quarantine quality control units all over Indonesia, especially in the entrance and exit ports. The reporting of surveillance/inspection by the inspector, as stated in Article 18, is referred to the head of the surveillance base camp/station/ centre. After compilation, the station head's report is sent to the Director-General of Inspection on Marine and Fisheries Resources. This reporting mechanism is appropriate for the inspection stations under the DG of Inspection. There are six base camps and eight stations throughout the country. Surveillance working mechanisms are shown in Figure 6.

Figure 6 Surveillance working mechanism in MMAF as stated in Article 18



The service and empowerment of small-scale aquaculture must consider the skill level, independence level, and the need for capital. It requires an institution with authority under the Directorate-General of Aquaculture to accelerate its development. The Act 7/2016 On Protection and Empowerment of Small-scale Fishers, Fish Farmers, and Salt Producers is a strong support with respect to this.

5.3 Enforcement

The law related to the aquaculture sector should ensure sustainability if the enforcement capacity is sufficient to ensure compliance. The law is however ambiguous in terms of enforcement and it can therefore be difficult to determine a violation. A special investigator for the sector (with an aquaculture science background) could be of considerable help in determining violations of the law and improving law enforcement. As yet there is no such special investigator.

6. Recommendations

- i. Strengthen the legal guidance following acts and government regulations to ensure development and enforcement of clear norms, standards, procedures regarding all aspects of aquaculture governance.
- ii. Zoning policies and regulations should be developed to facilitate aquaculture development and government at central or local level should issue spatial information related to permissible locations for aquaculture operations, protected areas, etc.
Concerning the dominance of small-scale aquaculture farms in the sector, the ministry should create an institution for governing these. An additional organizational structure is needed at deputy or directorate level that focuses on empowerment and providing services to small-scale farmers.

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Annex IV-5 Aquaculture governance in Malaysia

Ms Hasnisa binti Haji Abdul Hamid

1. Introduction

Since independence in 1957, Malaysia has undergone rapid economic and infrastructural development, making Malaysia one of the most progressive countries in the region. Nevertheless, rural agriculture is facing challenges as the majority of farmers are ageing and struggling with lack of access to finance and new technology.

The potential for aquaculture development in Malaysia exists in all three types of aquatic environment, namely marine water, brackishwater and freshwater. For coastal aquaculture, Malaysia has very extensive mudflats and low-lying coastal sites including mangrove swamps and adjacent areas, and the west coast of Peninsular Malaysia is relatively sheltered from the monsoons. For freshwater aquaculture, there are several large man-made lakes, disused mining pools and low-lying inland areas that can be developed. Aquaculture was started in Malaysia in the 1920s through part-time activity to supply fresh or live fish for special functions or festivals. Then the sector expanded through freshwater fish cultured in paddy irrigation, disused mining ponds and later the earthen pond system was introduced. Marine aquaculture was started with cockle culture in soft mud in the coastal areas and marine finfish cage culture in river estuarine areas.

In general, it can be said that Malaysia is endowed with very suitable climatic and geographic conditions for aquaculture. Warm temperatures throughout the year favour very rapid biological growth, and culture operations are not threatened by extreme adverse weather conditions such as typhoons and hurricanes which often plague some neighbouring countries. However, it is still essential to carry out proper site selection and feasibility studies to determine the suitability of any particular area for any type of aquaculture and to ensure that the site conditions are within the optimum environmental range required for the species to be cultured. At the same time, the development has to follow prescribed regulatory measures so as to prevent or minimize any possible adverse effects on the environment or aquatic resources. Malaysia, with a hot tropical climate and a wealth of waterbodies/resources, has vast opportunities and potential to develop aquaculture commercially. Since there is a decline in the catch of fishery products from the sea (capture fisheries) and an increase in the per capita consumption of the population, aquaculture has a vital role to play in the nation's food production and food security. Strategically located in the middle of Southeast Asia, Malaysia is an important producer, market and trading nation for fish and fishery products in the region.

Being in the tropics, Malaysia is also blessed with a great variety of species amenable to culture and the very rapid reproductive cycle of the culturable species, many of which breed throughout the year under culture conditions, e.g. *Macrobrachium rosenbergii*, *Oreochromis* spp., *Clarias* spp. and *Puntius gonionotus*. Exotic species such as the grass carp, bighead carp and silver carp also take a considerably shorter time to attain sexual maturity under tropical conditions in Malaysia than in temperate conditions, and many local species, e.g. *Macrobrachium rosenbergii* and *Panaeus monodon* start to reproduce well within a year.

Aquaculture production in Malaysia for the year 2017 was 427 022.66 tonnes (t) valued at MYR 3.041 billion. About 18 378 aquaculturists are involved in various culture systems. The production is dominated by seaweed culture (46 percent) with a total of 202 965.58 t, followed by marine aquaculture (31 percent) with 121 460.24 t and then freshwater aquaculture (23 percent) amounting to 102 596.84 t. Aquaculture production in Malaysia also includes ornamental fish farming and aquatic plants. In 2017, 281 million tail of ornamental fish were produced valued at MYR 283 million. For aquatic plants, 112 million bunches were cultivated valued at MYR 12.9 million.

The farming of the aquatic species mainly takes place in earthen ponds, tanks (concrete), floating cages, pens, longline and sea bottom (cockles). More than 40 aquatic species are cultured and cockles accounts for the major production by weight. The most popular cultured species for freshwater are tilapia, catfish, carps, giant prawn, river catfish, channel catfish. As for the marine and brackishwater farming, the main species cultured are shrimp, seabass, grouper, snapper, cockles, mussels, oysters and seaweeds.

Demand for fish is expected to increase from 1.3 million tonnes in 2010 to 1.9 million tonnes by 2020 with a growth of 3.8 percent per annum. The Penggunaan ikan per kapita dijangka meningkat daripada 46 kilogram kepada 55 kilogram dengan pertumbuhan sebanyak 1.9% setahun bagi tempoh yang sama. Peningkatan ini disebabkan oleh kesedaran pengguna terhadap sumber protein yang lebih sihat dan berkhasiat. Government of Malaysia has strongly emphasized aquaculture to support the increased demand for fish. For Malaysia, the per capita consumption will increase from 53.1 kg in 2013 to 61.1 kg in 2020. The increase is because of consumer awareness of fish being a healthier source of protein and nutrients than land fauna. Under the National Agro-Food Policy the aquaculture sector will need to produce 716 000 tonnes by 2020. The Department of Fisheries Malaysia has set some development strategies to achieve the production target namely: (i) Increasing productivity; (ii) implementing the Economic Transformation Programme (ETP); and (iii) restructuring the development of new areas.

The production of marine aquaculture has contributed significantly to the export earnings of the country. The production of tiger prawns from earthen ponds is now an important source of raw material for the exports of the fisheries product processing industry. Marine fish products such as shrimp and finfish are now exported to the China, Hong Kong SAR and China markets. The production of seaweed has been identified as one of the new areas that is expected to increase the export contribution of the fisheries subsector to the national economy. Currently, seaweed production is undertaken by small fishermen in the state of Sabah. The targeted production is 300 000 tonnes of seaweed from aquaculture by 2020.

The export value of aquaculture, including fish products, particularly fillet is expected to increase from MYR 1.4 billion in 2010 to MYR 3.2 billion in 2020. Under the National Agro-Food Policy, the development in the fisheries subsector will be focused on accelerating the growth of the aquaculture industry, increasing the production of fries and expanding inland aquaculture and marine fish cage farming, as well as to increase the incomes of coastal fishermen including aquaculturists.

2. Institutional framework governing the aquaculture industry

2.1 Ministerial level

The Ministry of Agriculture and Agro-based Industry has formulated the agro-food policy and charted its future direction. The policy sets out strategies and identifies programmes as well as projects to be implemented to ensure the development of the agro-food sector. The Ministry has also built a pro-business environment to ensure private sector driven growth in the agro-food sector. But the realization of the agro-food policy and its strategy as well as the successful outcome of the programmes and projects will also depend on extraneous factors that are beyond the Ministry's control. The extraneous factors include the active participation of agro-entrepreneurs, the role of state governments, fiscal and non-fiscal incentives packages and the changing of mindset among investors to accept the agro-food sector as an emerging vibrant industry with the potential to generate wealth.

The Ministry of Agriculture and Agro-based Industry emphasizes that “agriculture is business”. It is a phrase designed to change the mindset of traditional farmers and encourage them to adopt a commercial approach in their cultivation rather than simply engage in subsistence farming. Agriculture, including aquaculture, must now be operated in a business environment that seeks to minimize costs and maximize profits in order to remain viable and competitive. It is also designed to attract graduates to become modern farmers. Agriculture has always been associated with poverty and viewed as a backward sector. The Ministry wants to remove this stigma by highlighting that agriculture is a business venture like any other market-driven business such as manufacturing or construction. The aim is to attract fresh graduates as second echelon farmers. The Ministry also hopes to attract local entrepreneurs and investors to invest and develop the agro-food and downstream processing industries commercially.

Under the Ministry’s organizational structure, there is a Division of Crop, Livestock and Fisheries Industry that was established to coordinate the issues of the agriculture industry including fisheries. Among the areas of work in this section involving fisheries are:

- i. fisheries production development planning through aquaculture projects as well as fishery jetty / harbour;
- ii. planning for fishermen’s community development through the Special Fishermen’s Housing Project, granting of subsidies, incentives and fisheries funds as well as compensation to aquaculture and fishermen;
- iii. formulating, reviewing and evaluating freshwater fish supply policy;
- iv. ensuring compliance with the requirements of export of fish to European Union (EU) countries;
- v. regulating the development budget for the Department of Fisheries (Peninsular), Department of Fisheries Sabah, Department of Marine Fisheries Sarawak, and Fisheries Development Authority of Malaysia (LKIM);
- vi. managing foreign crew applications in the capture fishery industry;
- vii. acting as Secretariat for: the Technical Working Group on Improving the Status of Threatened Species; Steering Committee, Diesel and Petroleum Subsidy Implementation Scheme; National Seaweed Development Committee; National Parks and Reserves Advisory Council Committee; and
- viii. coordinating issues related to the Indian Ocean Tuna Commission (IOTC) and the Coral Triangle Initiative (CTI).

2.2 Departmental level

Below Ministerial level, the aquaculture sector in Malaysia is governed by the Department of Fisheries (DOF) Malaysia. In this Department, the Aquaculture Development Division formulates aquaculture policy and does comprehensive planning, monitoring and evaluation of functions performed at the regional and local levels. The DOF also acts as an information centre where information on all the latest aquaculture-related technologies is available and where information from researchers and specialist institutes are compiled, processed, evaluated, recorded and disseminated at regional and local levels. The dissemination of information is intended to raise awareness among fishermen and aquaculturists about fisheries technology and public affairs regarding fisheries.

The DOF is intensifying its research, development and extension services under the present Malaysia Fisheries Plan with the following objectives:

- i. increase fish supplies to meet the growing demand;
- ii. increase the incomes of fish farmers;
- iii. utilize unused and coastal land for the socio-economic improvement of the rural areas; and
- iv. upgrade aquaculture operations from subsistence level to become an organized and fully-fledged industry.

In view of the great many species available for culture in Malaysia, particularly in the freshwater environment, and the need to prevent the dissipation of limited resources on too many species, research and extension efforts will be directed at certain priority species which are selected on the basis of the positive biological attributes of the species, their culture technology and their potential in achieving the objectives of aquaculture development. In view of the lower consumer demand for freshwater fish than for marine fish, a product promotion campaign is in progress to encourage Malaysians to eat more freshwater fish.

Among the most significant of the government inputs to achieve the stated targets is the provision of supporting institutional services. In this regard, a comprehensive series of programmes have also been formulated by the DOF, such as (i) research, (ii) extension, (iii) training, (iv) resource management, (v) marketing services and (vi) fiscal incentives.

- i. Research efforts are directed at almost all aspects of aquaculture, particularly those that currently constrain the industry. Resource inventory studies are being undertaken to establish the extent to which the country's aquaculture resources may be exploited. The DOF has five fisheries research institutes conducting aquaculture business as part of their research activity. Research into commercial seed production and culture technologies of a number of fish species that are currently cultured or have potential for culture is also being undertaken. Research into the nutrition of organisms and the formulation of commercial feeds is also being pursued. Fish diseases, both indigenous as well as exotic, are being studied to lessen their impact on aquaculture production. In relation to this, a network of disease control and quarantine centres was set up throughout the country to monitor the impact of any disease, be it imported or local, on the industry. These centres will also provide diagnostic and advisory services to operatives facing disease problems. Research into various aspects of post-harvest handling of aquaculture products, aquaculture economics and engineering is also being conducted.
- ii. The DOF's Aquaculture Extension Network was upgraded to improve the transfer of state-of-the-art technology to the industry, particularly through the aquaculture extension centres, in the fields of seed production, nursery management, nutrition, culture systems, handling and processing. Information and technology delivery systems are, in particular, being enhanced by the reorganization of the present extension service along the lines of the Training and Visit (T&V) system whereby knowledge and skill gained by field extension personnel during a training programme is transferred to contact farmers through field visits.
- iii. The DOF is also undertaking carefully designed courses in various aspects of aquaculture. Currently, there are seven training modules open for industry participation in the Aquaculture Extension Center. These are in the fields of freshwater fish and prawn culture, brackishwater fish and prawn culture, cage culture, fish breeding, freshwater prawn hatchery management, marine prawn hatchery management and ornamental fish culture including aquatic plants. All these courses are conducted free for the benefit of the industry.
- iv. Another important support service concerns resource management and conservation. A programme of rational management will ensure the perpetuity of a given resource and enhance the benefits that accrue from its exploitation. For example, the opening up of

brackishwater pond farms in mangrove areas will need to be regulated as from the ecological standpoint it is prudent to develop only 20 percent of total mangrove forests for aquaculture. Further, the maintenance of a 100 m mangrove/green belt along the coast line will help to avoid negative physical and biological repercussions. Similar management measures will be employed to ensure the rational and sustained growth and development of other culture systems.

- v. Another supporting service of significant importance is marketing. The government is looking closely into broadening the existing market base for aquaculture products so as to make the industry less susceptible to price and supply fluctuations. Foremost among the government's efforts is an active market promotion programme to widen consumer awareness and acceptance of aquaculture products. These involve the use of the mass media (radio, television and newspapers) to popularize their consumption. Other forms of promotion, such as cooking demonstrations and competitions and discount sales of aquaculture commodities will also be undertaken. The processing of raw aquaculture products into forms more acceptable to the consumer, such as canned fish, fish balls, crackers (*keropok*) and snack foods, is also being looked into. The government is also exploring export markets for aquaculture products.
- vi. In addition to the provision of institutional services, the government also offers incentives to intending investors. For example, sensitive to the credit needs of the industry, the government actively encourages banks and other financial institutions to lend to the agricultural (which includes aquaculture) sector. Incentives in the form of tax reliefs are also provided for those wishing to venture into the industry.

2.3 Region level (State Fisheries Office)

At the state level, the State Aquaculture Development Section was established to provide technical and general development services to external development activities through the following functions:

- i. Trials and demonstrations.
Trials and demonstrations are carried out to validate a local-level technology. Local-level trials need to be made to ensure that new technologies are technologically and economically appropriate to the local conditions. If the results of this experiment are found to be beneficial then the technology is passed on to the aquaculturists.
- ii. Demonstrations.
Demonstrations are a way to show fish farmers how to make use of new technologies and fish or electronic equipment such as auto-feeders, solar panels and underwater aerators. Aquaculturists can also point to the benefits of a modern technology that has been verified locally.
- iii. Training
State-based officers are responsible for providing and organizing meetings and training on matters relevant and appropriate for external development staff, as well as aquaculturists. Basically this information and communication activity involves dissemination through media too such as fisheries newsletters, fisheries brochures, posters, pamphlets, guidebooks, and other printed materials. The latest information is also shared via electronic media, mainstream media, and through social media for the purpose of reaching aquaculturists in a timely manner.

2.4 Local level (District Fisheries Office)

The District Fisheries Office (DFO) headed by the Head of the Fisheries District is the frontline of the entire aquaculture management system. DFO personnel are the closest people to the target group, especially aquaculturists. Aquaculture Fisheries Assistants are deployed to carry out the development tasks using the training and visit (T&V) system of extension. This system allows the Fisheries Department to establish a two-way direct relationship. All the problems and feedback can be addressed by the Aquaculture Fisheries Assistants who are always in close contact with the fishers, and work to address the problems faced by the fishers. The T&V system is also used to provide all development services.

The District Fisheries Office is also responsible for registering all aquaculturists in the area for the purpose of coordinating domestic data, in addition to carrying out aquaculture extension work from time to time. The District Fisheries Office is also the first to go to the field in the event of any natural disaster involving the aquaculture industry. All fishery landing data including aquaculture production will be collected at the District level before being forwarded to the State Fisheries Office which integrates it into the electronic short message peer to peer system for aquaculturists, known locally as the “e-SMPP akua” system.

2.5 Aquaculture extension centres

The Department of Fisheries organizes training programmes that are mainly directed at the operatives of the industry although in recent years its role is being expanded to provide in-servicing training to the lower category staff such as the extension workers, enforcement personnel and fisheries assistants at the field level. In the case of aquaculture, training is fairly well-developed in the aquaculture extension centres. Training on the basic techniques of fish culture and its practical know-how are carried out for fish culturists and extension workers. Such courses are being conducted at the major fish breeding stations throughout the country where facilities are available for practical work. Moreover, a range of modular courses geared towards the needs of the sector is being developed.

Specifically they are directed at two major client groups namely the operatives and extension workers. The courses for the operatives deal with the basic techniques of stocking, rearing, harvesting, handling, marketing and maintenance of the culture systems in use. Formal scientific training will be kept to a minimum and teaching will be heavily oriented towards the practical. Training courses for the extension workers are more in depth. Apart from learning the “how” they will be taught the “why” of aquaculture practices also. At the end of the course they are expected to be able to promote aquaculture development by assisting in identification of suitable sites, project planning and implementation and supervising the progress of the project.

Included in the training programme is a component on extension philosophy and methodology to facilitate the extension workers in discharging their technical duties. In line with the needs of the industry, six modular courses have been developed. They are freshwater fish and prawn culture in ponds, brackishwater fish and shrimp culture in ponds, cage culture of fish, freshwater fish breeding, freshwater prawn breeding and the breeding of marine shrimps. The modular approach is taken as it not only addresses the individual needs of the clients but also allows flexibility.

The aquaculture extension centres have been established since the 1970s under the organizational structure of the Department of Fisheries Malaysia for the purpose of passing on information from Department and Ministry levels to aquaculturists. These centres: (i) conduct courses and training on target groups; (ii) carry out expansion activities; (iii) enable fisheries work; and (iv) carry out research.

For the purpose of conducting courses and training, the aquaculture extension centres have a module:

- i. scheduled (formal) courses for participation of staff, breeders and industry players on a yearly basis; and
- ii. unscheduled courses divided into industry training for interns and attachment courses for hatchery operators from time to time on demand.

Almost all aquaculture extension centres regularly carry out extension services that include:

- i. field visits consisting of information sessions, meetings, *in situ* training, mentoring and monitoring programmes;
- ii. technology transfer involves breeding and grow-out technology through guided hatchery and incubator programmes; and
- iii. technical services provided to the target group include project site selection and disease diagnosis.

Aquaculture development centres also play a role in providing fish fry production activities such as:

- i. Egg and fry are produced for the purpose of supplying for free or for sale and for release to public waters. Free fry supply is provided for aquaculturists who are new to aquaculture and are limited to specific species only. The release of fish fry programmes to the public waters will greatly benefit the local community especially inland fishermen. All of these programmes that are interconnected with each other will create economic activity that will provide income to everyone involved and improve the standard of living in line with the rapid development.
- ii. Broodstock are provided to new hatchery operators who want to obtain a good breed for breeding purposes in their own hatchery.
- iii. The broodstock provided will also ensure its sustainability for use by operators or exchange with other centres and interested hatchery operators.

The aquaculture extension centres are also not left behind in conducting studies comprising:

- i. reproduction, including breeding, nursing and refining technology;
- ii. grow-out, covering aspects of growth and productivity; and
- iii. foods, including feed and nutrition studies and alternative feed studies.

3. Legislation

Legitimacy, in this context, is defined as the extent to which principles, rules or standards are consistent with existing values and norms. If such standards or rules are seen as legitimate, then it is more likely that people will comply with them. In a study on user participation in fisheries (Jentoft and McCay, 1995), it was concluded that legitimacy among all affected interests was a key to the success of fisheries management regimes and was contingent upon content as well as process (the way decisions are reached). Aquaculture is no different. Aquaculture policy making, planning and management will be more stable and enduring if it is legitimate and because it is considered legitimate by all directly or indirectly affected by developments compliance will be greater (Thomas, Walker and Zelditch, 1986).

The laws and regulations that deal with access to aquaculture in Malaysia are:

- i. Fisheries Act 317 of 1985.²⁵
- ii. Fisheries (Marine Culture System) regulations 1990.²⁶
- iii. Fisheries (Cockle Conservation and Culture) regulations 2002.²⁷
- iv. Fisheries (Inland Fisheries Aquaculture) (Federal Territory of Kuala Lumpur and Federal Territory of Labuan) Rules 2017.²⁸
- v. Environmental Quality Act 127 of 1974.²⁹
- vi. National Land Code 56 of 1965.³⁰
- vii. Animal Feed Act 698 of 2009.³¹
- viii. Animal Welfare Act 772 of 2015.³²

It is important to note here that the Fisheries Act 1985 operates a distinction between aquaculture in riverine waters and in marine waters and that this distinction is based on the location of the culture system and not on the type of the water (fresh, sea or marine) used. It provides for a license system for marine culture systems but not for aquaculture in riverine waters (it gives the state authority the power to promote and regulate the development of this activity). The legislation concerning freshwater management, as far as riverine aquaculture is concerned, is left to the state and the situation and complexity of the regulations may differ from state to state.

With the introduction of the Fisheries Act 1985 and the subsequent Fisheries (Marine Culture System) Regulations 1990, various procedures for establishing culture systems in the maritime waters of Malaysia came into force. Under this act, aquaculture is defined as “the propagation of fish seed or the raising of fish through husbandry during the whole or part of its life cycle” and culture system is defined as “any establishment, structure or facility employed in aquaculture and includes bottom culture, raceway culture, raft culture, rope culture and hatchery”. All fish culture in Malaysian maritime waters must obtain a permit and license for establishing a marine culture system from the District Fisheries Office at the location of the project before the project starts. Aquaculturists will also need to obtain a temporary occupational license (TOL) while the issuing of a marine culture system license is in process at the District Fisheries Office level.

The Fisheries (Cockle Conservation and Culture) Regulations 2002 are regulations specifically for the conservation and breeding of cockles of the species *Anadara granosa*, *Anadara ovalis* and *Barbati* spp. For the purpose of harvesting cockles in public waters or more precisely cockles from a natural site, the fisher must be licensed by the District Fisheries Office. Whereas for the purpose of breeding cockles at the site of cultivation, it can be implemented by breeders and fishers provided with a marine culture system license. Both of these conditions are intended to control the production of adult seeds and shellfish from Malaysian waters to avoid being smuggled abroad as well as to systematically record shellfish landings.

²⁵ FAOLEX Database

²⁶ FAOLEX Database

²⁷ FAOLEX Database

²⁸ [https://www.dof.gov.my/dof2/resources/user_1/UploadFile/AKTA_PERATURAN/P.U.\(A\)65.pdf](https://www.dof.gov.my/dof2/resources/user_1/UploadFile/AKTA_PERATURAN/P.U.(A)65.pdf)

²⁹ FAOLEX Database

³⁰ FAOLEX Database

³¹ FAOLEX Database

³² <https://www.ecolex.org/details/legislation/animal-welfare-act-2015-act-772-lex-faoc176896/>

Fisheries (Inland Fisheries Aquaculture) (Federal Territory of Kuala Lumpur and Federal Territory of Labuan) Rules 2017 were finally gazetted and came into operation on 1 March 2017. As inland fisheries/aquaculture falls under states' jurisdiction in Malaysia, the new rules shall apply to any person who carries out aquaculture activity in relation to inland fisheries in aquaculture premises for commercial purposes in the Federal Territory of Kuala Lumpur and the Federal Territory of Labuan. The application of these new regulations in states other than the federal territory comes after adaptation and adoption by the state government.

In the promotion of environmentally sound and sustainable development, the Government of Malaysia has established the necessary legal and institutional arrangements such that environmental factors are considered at the early stages of project planning. The legislation that is related to the prevention, abatement, control of pollution and enhancement of the environment in Malaysia is the Environmental Quality Act 1974. The Act restricts the discharge of wastes into the environment in contravention of the acceptable conditions. To date, 38 sets of Regulations and Orders as per Appendix A of the Act have been introduced and enforced. The Director-General of Environmental Quality has been appointed by the Minister to administer this Act and any regulations and orders made thereunder. Environmental assessment is an important technique for ensuring that the likely impacts on the environment of a proposed development are fully understood and taken into account before such development is allowed to go ahead. In Malaysia, environmental impact assessment (EIA) is required for activities prescribed under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987. Those industrial activities that are not subject to the mandatory EIA requirements are nevertheless subject to various regulations under the Environmental Quality Act 1974 (EQA).

The National Land Code (NLC) is the law regarding land administration in Peninsular Malaysia. It does not apply in the states of Sabah and Sarawak. Nothing in this Act can affect the previous implementation or anything that was made under any previous land law insofar as it relates to land, or the provisions of any other law enacted before the commencement of this Act. The Code is related to land and land tenure, the registration of title to land and of dealings therewith and the collection of revenue therefrom within the states in Peninsular Malaysia. For the purposes of the aquaculture industry, aquaculturists must adhere to the National Land Code by obtaining valid land ownership before commencing culture operations. Ownership of land whether permanent title, temporary title or temporary occupational license is required before the project takes off.

The Animal Feed Act 2009 was enacted and came into force on 1 January 2010, with the aim of establishing the Animal Feed Board. The Board is responsible for administering and enforcing the Act for all livestock industries including ruminants, non-ruminants, poultry and aquaculture. Among the functions of the Board is to regulate the quality of animal feed through the control of the import, manufacture, sale and use of animal feed and animal feed additives. This is to ensure that animal feed meets the needs of the animal's nutrition, is harmless and non-harmful so that animal and animal products are safe for human use. Under this Act, monitoring programmes to monitor the use of antibiotics / chemicals in feed and animal feed additives in animal feeders and livestock farms are also emphasized. Regulations relating to the use of antibiotics / chemicals have been developed and enforcement actions against non-compliance with existing regulations have also been tightened. Pet food and breeders awareness campaigns on animal feed safety and antimicrobial resistance were also held. Regular monitoring of feed and nutrition practices through the audit of aquaculture farms and feed mills based on the Fish Quality Certification (FQC), Malaysia Good Aquaculture Practice (MyGAP) and Feed Store and Feed Mill Monitoring Program is also ongoing.

The Animal Welfare Act 2015 (Act 772) seeks to keep pet owners accountable for their pets. Pets here includes aquatic animals such as ornamental fishes. Under this Act the owner is responsible for

ensuring that the animals are kept in the proper environment, have an appropriate diet, are able to display their natural behaviour patterns, animals are housed together or separate (as appropriate) and protected from pain, suffering, injury or illness. The Animal Welfare Board has also been formed with 11 representatives from various relevant agencies including higher education institutions to manage matters related to animal welfare.

Other than the aforementioned Acts there are some regulations related to the import and export of fish in Malaysia namely:

- i. Fisheries Regulations (Fish Disease Control Compliance for Exports and Imports) 2012
- ii. Fisheries Regulations (Fish Quality Control for Export to the European Union) 2009
- iii. Fisheries Regulations (Prohibited Imports, etc., for fish) Act 1990 and Fisheries Regulations (Prohibition of Import, etc, for fish) Amendment 2011
- iv. Act on International Trade in Endangered Species (Act 686)

4. Standards and guidelines

The Department of Fisheries (DOF) has developed several standard operating procedures (SOP) especially related to fish health and has conducted official control activities at farms and exporter premises for export purposes. The objective of the DOF is to manage the fisheries and aquaculture as an economic, profitable and sustainable industry in the long run and at the same time to protect and rehabilitate the habitats in the marine ecosystem. Although the Department has high production targets for the aquaculture industry, it also aims to ensure that the industry is environmentally sound and observes high animal health and welfare standards, and regulations are used to ensure good aquaculture practices by farmers/ aquaculturists.

4.1 Compliance with biosecurity requirements

The DOF is the competent authority for aquatic animal health management in Malaysia and is responsible for the implementation of official control along the supply chain from farm to the exporter premises. The Fisheries Biosecurity Division plays a key role in implementing official controls, official analysis and official guarantee for fish and fisheries products for export. Official controls have been carried out throughout the supply chain from the source up to the final stage (exporter premises/processing plant) and also responsible for the issuance of health certificates for live fish for export purposes and work related to international standards for food safety and quality such as Codex, sanitary and phytosanitary (SPS) standards and European Union requirements and aquatic animal health standards such as those of the World Organisation for Animal Health (OIE) and the Network of Aquaculture Centres in Asia-Pacific (NACA). For the official control at the entry and exit points, the Department of Malaysian Quarantine and Inspection Services (MAQIS) under the Ministry of Agriculture and Agro-Based Industry is responsible for enforcing control at the entry points, quarantine stations and quarantine premises to ensure that plants, animals, carcasses, fish, agricultural produce, soils, microorganisms and food which are imported into and exported out of Malaysia comply with the health aspect of humans, animals, plants and fish and food safety.

There is a mechanism to prevent and control the occurrence and spread of aquatic animal diseases namely implementing an Aquatic Animal Health Action Plan to solve problems of transboundary pathogens or diseases transfer as required by the SPS Agreement. The Malaysian strategic plans for aquatic animal health will keep on strengthening the implementation of law and legislation, tightening import/ export procedures, introducing disease surveillance, monitoring and control systems, enhancing research and development on aquatic animal disease, establishing diagnosis units,

improving capacity building, encouraging efficient technology and knowledge transfer, promoting public awareness, developing contingency plans to control disease outbreaks and providing funding support.

4.2 Malaysian Good Aquaculture Practice

The Malaysian Aquaculture Farm Certification Scheme (SPLAM) was introduced in 2005 and applies to pond aquaculture rearing systems, cages, tanks, hatcheries and seaweed production. The objective of the scheme is to produce safe and high quality aquaculture products for consumption, produced in a manner that will not cause any hazardous effect to the environment, animal welfare and complies with the workers' safety and health requirement. The SPLAM is a voluntary scheme which applies good aquaculture practice, is responsible and environment-friendly at the farm level.

The Malaysian Good Agriculture Practice (MyGAP) is a rebranding initiative that replaces the Malaysian Aquaculture Farm Certification Scheme (SPLAM) for the aquaculture sector. Its objective is to raise confidence among the consumers about hygienic and safe aquaculture products and produce without affecting the quality of the environment. It is also a way to get government assurance for safe aquaculture products and is accomplished through sampling activity. MyGAP certification is also way to get farm commitments to produce safe aquaculture products for human consumption and to raise consumers' confidence about Malaysian aquaculture produce. The ultimate goal is always to widen the marketing channel for Malaysian aquaculture produce.

The MyGAP certification evaluation is based on two Malaysian standards (MS):

- i. MS 1998: 2007- Good Aquaculture Practice (GAQP) – Aquaculture Farm General Guidelines.
- ii. MS 2467: 2012 – Code of Practice for Seaweed Cultivation.

The five main evaluation and compliance criteria for the standards can be simplified as covering the following aspects:

- i. food security
- ii. fish health requirement
- iii. occupational safety and health
- iv. environmental sustainability
- v. animal welfare.

All the five auditing aspects have been broken down into 18 items that aquaculture operators have to comply with to obtain the certificate as follows:

- i. site selection
- ii. waste water control
- iii. farm construction
- iv. the nature and cleanliness of touched surfaces
- v. design of ponds/cages
- vi. occupational health
- vii. water management
- viii. farm sanitary practice

- ix. pond fertilizing
- x. social and welfare of workers
- xi. pest and predators control
- xii. farm produce harvesting and handling
- xiii. raw material supply (additives, fish fries)
- xiv. labelling, storage and usage of hazardous compounds
- xv. health management of livestock
- xvi. farm record keeping
- xvii. farm biosecurity control
- xviii. halal (i.e. conforming to certain food preparation and ingredient rules defined by the religion of Islam).

Other than rules and regulation, standards, the Department of Fisheries Malaysia has also developed notifications / standing orders / circulars relating to imports and exports including:

- i. Notice requirements for import conditions for live fish
- ii. Biosecurity Circular No. 1 of 2010 About conditions of import / export / transport of live fish
- iii. Supporting documents for the purpose of shrimp exports to the United States
- iv. WTO Notification 20 (Import conditions for import of live fish into Malaysia)
- v. WTO Notification 26 Add. 3 (Health certificate requirements for import of live ornamental fish into Malaysia)
- vi. Standing Orders of the Director General of Fishing (Enforcement of the Fisheries Act 1985)

5. Institutional mechanisms for governance at national and local level

5.1 Role of state governments

Under the Constitution of Malaysia, the development of agriculture is undertaken jointly by the federal government and state governments as it is in the Concurrent List whereas land is solely under the purview of state governments. The planned production growth of 6.8 percent which the government hopes to achieve during the Eleventh Malaysia Plan requires additional agriculture land. The aquaculture subsector will need 38 400 ha to reach the production target of 716 000 tonnes by 2020. The federal government therefore is working very closely with state governments to ensure that additional land required for production of agricultural products is given due consideration.

5.2 Local level organization

For years, some form of cooperation and sharing of responsibilities or economic-based activities among the fisheries communities has prevailed in some localities in Malaysia. The aquaculturists in the same area (villages and districts) are sharing the same needs and issues in their localities regardless of whether they are small-scale or large-scale aquaculture producers. Therefore, the DOF encourages them to group together in order to identify their needs and problems as well as solve their problems through their various economic activities.

The DOF realizes that fisheries resources including an expanding aquaculture industry cannot be managed, monitored and supervised by government officers only, it has therefore encouraged the communities' active participation through the appointment of good local leaders and by strengthening the well-organized organizations. The bottom-up approach is emphasized where proposals for projects/activities originate from the fishers themselves. This approach has shown a high rate of compliance with the regulations and success in projects/activities implementation. The DOF established myKP or Malaysian Fisheries Community to be responsible for implementing fisheries community-based activities. With more emphasis currently being given to resources management and agro-based industries, DOF upgraded the Fisheries Resources Management Community (Komuniti Pengurusan Sumber Perikanan) or KPSP to myKP. The main function of myKP is to develop and strengthen the livelihoods of fisher communities in the country through cooperation, entrepreneurship, education and responsible fisheries resource management. Hence, the myKP has become more competitive, dynamic and has a greater impact on the community.

5.3 Collaboration between DOF (Fisheries Research Institute) and hatcheries operators

The warm climate throughout the year provides an excellent breeding ground for the production of fries for high-value fish rearing such as the hybrid grouper and tiger grouper. The supply of quality fish and shrimp fries are encouraged through joint collaboration between the Fisheries Research Institute and private hatchery operators. The aim is to increase the production of fish fries and shrimps from 16.0 billion in 2013 to 30.6 billion fries in 2020 by incentivizing private hatchery operators through matching grants, apart from the loans they get through financial institutions. In addition, research on new fish varieties that are resistant to climate change and disease is being intensified with cooperation between local and foreign universities and hatchery operators.

Broodstock development is important for the production of more productive cultures. General development features include disease resistance, maturity, rapid growth, weather resistance and so on. Such activities will largely be based on genetic biotechnology and culture science. In addition to the knowledge and expertise of such programmes, it involves high management costs and requires a long-term timescale. Most hatchery operators will not be able to afford or be able to implement such activities on their own because of the cost and time constraints. However, they are aware that such programmes are essential to ensure the aquaculture industry is sustainable. Following the government's policy of making the food sector (agriculture and fisheries) the third most important economic sector under the National Agricultural Policy plan, the government's involvement with the private sector, especially hatcheries operators is crucial to producing disease-resistant fish. The department through a series of workshops established the department's Nucleus Breeding Center (NBC) where the government is responsible for conducting a collection of founder stock studies, followed by the establishment of the base population and subsequent family production. This will be followed by the Broodstock Multiplication Center (BMC), whereby selected private hatcheries will receive fry and prospective broodstock to breed and subsequently produce quality seeds before they are turned over to their respective hatcheries and breeders for culture.

5.4 Collaboration between DOF and fisher associations

The government has developed a plan for coastal fishers to diversify their source of income by aquaculture activities. The fishers are provided with proper training and assistance to start aquaculture activities; transforming their economic activities from capture in the wild to rearing. Interaction among the fishers is carried out through fisher associations that also serve as a channel for feedback regarding resource issues, the environment and other matters of concern. This platform is to encourage the fishing community to participate in aquaculture as an alternative to fishing and therefore indirectly reduce the fishing pressure on the coastal resources which are being overexploited.

5.5 Roles of institutes of higher learning in Malaysia

Fisheries training in Malaysia is done mainly at the university level. The higher level of training is done by the University of Agriculture, which offers a three-year diploma course in Fisheries Science (Aquaculture and Marine Science) whereas the University of Science offers a four-year course leading to a Bachelor of Science (Marine Biology). Postgraduate courses are also available in the various field of fisheries in these universities. All these graduates are usually absorbed by government fisheries agencies as researchers, administrators, enforcement officers, and extension officers where they play the role of managing, developing and administering the fisheries industries in accordance with sound fisheries principles.

5.6 International collaboration in training

It is clear from the Malaysia example and many others too that regardless of the categories and types of trained manpower required both to administer, manage and man the fisheries industry, it is important to recognize that there is a trend towards increased specialization and different levels of training. Further it can be construed that the training requirements of most developing countries are largely similar, especially on a regional level where the fisheries are basically the same. Given the above situation, it will be beneficial to strengthen collaborative programmes on training so as to reduce duplication of efforts at national level. Educational and training institutions are generally costly to establish and more so to operate and maintain. As such, collaborative effort in training can work towards redressing the problem of not only scarce finance but also shortage of expertise in the area. Perhaps as a general guideline, training of people in the simpler skills should be done at home not only because it involves a greater number of people but also because they are not likely to obtain full benefit from training abroad when there are language and other social impediments. However, training of the highly specialized personnel is best done on an international level because first the facilities available for such training are limited and second the numbers involved are relatively small. It is in this area where the impact of collaborative training programmes backed by international financing will be most felt by developing countries. Examples of these are the Southeast Asian Fisheries Development Centre's training programme on developing core personnel for the aquaculture industry. Another area where collaboration in training can be effective is in the exchange of information on training curricula, trainers' manuals, and teaching aids. In this way countries can learn from each other to upgrade training at national level.

6. Gaps, issues and challenges in aquaculture governance

6.1 Lack of effective delivery system

Good governance has become a very popular concept, but the challenges of implementing it have been huge, especially in least-developed and even moderately-developed countries. Effective delivery systems play an important role in good governance. Information from headquarters should reach the local level right after the information is delivered but sometime there is a breakdown in the delivery system because of a lack of understanding of the issue at the local level. The problems faced by the frontline groups at the local level do not always reach the headquarters because frontline aquaculturists hide their problems and try to overcome them by themselves. Research information is also sometimes stored in manuscripts and research journals that aquaculturists don't have easy access to.

6.2 Cooperation between agencies

The governance of Malaysian maritime waters is not just about national maritime borders and security issues. Good maritime governance and maritime policies are essential to prevent losses and damaging effects to the country. Malaysian maritime governance involves over 51 Acts and regulations through the involvement of 31 maritime-related agencies from over 10 different ministries. Of course this all requires the unified coordination of all parties. The lack of control over illegal fishing activities on the east coast of Peninsular Malaysia, for example, has resulted in a loss of revenue of MYR 6 billion in 2018 alone. The International Chamber of Commerce and Industry of Malaysia (MICCI) reports the loss of tax revenue because of smuggling in the country's maritime zone causes a loss of MYR 8 billion annually. This does not account for the losses resulting from water pollution and the destruction of the country's coral reefs which greatly affects the fisheries, shipping and tourism sectors. Inland aquaculture subsectors such as freshwater aquaculture are very much affected by the overlap of the state and federal government powers. After all, for Malaysia, land matters are state matters.

6.3 Competition over land use

Although the resources for the development of aquaculture are plentiful, like any other agriculture sector, it too has several constraints, namely the availability of good land/waterbodies reserved for the industry. Here, the sector has to compete with other industries for the available land required to develop aquaculture. Although Malaysia is blessed with natural resources there is lack of land and waterbodies available which are exclusively reserved for aquaculture. The legislation concerning freshwater management, as far as riverine aquaculture is concerned, is left to the state government and the situation and complexity of the regulations may differ from state to state. The DOF has to work hard to get gazetted areas for the purpose of aquaculture so that the industry can thrive.

6.4 Enforcement in aquaculture

Fisheries (Inland Fisheries Aquaculture) (Federal Territory of Kuala Lumpur and Federal Territory of Labuan) Rules 2017 are still in the stage of adaptation and adoption by various states. Thus enforcement of rules pertaining to aquaculture at the state level is not possible at the present time. Moreover, myGAP certification is on a voluntary basis and thus aquaculturists cannot be forced to comply with its strict terms and conditions. The willingness of the aquaculturists to fully accept myGAP as the best aquaculture practice is best obtained by financial incentives.

7. Recommendations for strengthening aquaculture governance at national and local levels

7.1 The Adoption of Fisheries (Inland Fisheries Aquaculture) Rules

The Federal Territory of Malaysia (Kuala Lumpur and Labuan) gazetted the Fisheries (Inland Fisheries Aquaculture) Rules in March 2017 and it is imperative that all state officers bring these rules to the attention of state governments. The process of adaptation and adoption might take a long time at the state level as it requires the involvement of all parties at the headquarters and state level to understand other relevant agencies in the state. The results will certainly have a positive impact on the aquaculture industry in terms of safety and sustainable aquaculture production.

7.2 Review of Fisheries (Marine Culture System) Regulations

Under the Fisheries Act 1985, there are specific regulations called Fisheries (Marine Culture System) Regulations that have been in force since 1990 for all types of marine water culture system including cage culture, pole culture, pen culture, raft culture, rack culture, mollusc culture and hatchery operations. After 30 years in force, these regulations require a slight change in line with current technology and industry involving marine water. The DOF is also in the process of setting up standard operating procedures for management of the marine culture system that have never been provided before to state officers and local level officials. It is also intended to compile all insights and practices passed down through the generations in written documentation for future reference and review.

7.3 Cooperation between federal government and state government

As the aquaculture industry is more closely bound to the regulations relating to the National Land Code, it is hoped that the state officers will understand the importance of cooperation between the federal government and the state government and play a greater role in communicating with the state government to ensure that targeted aquaculture production is achieved. Face to face sessions between the federal government officials and the state government officials also need to be held regularly to exchange views and achieve a win-win situation in land use matters.

7.4 Importance of the myGAP certification scheme

The DOF is in the process of introducing myGAP certification as a mandatory certification scheme for all aquaculturists. This is to ensure that the aquaculture production is safe for human consumption and the aquaculture industry itself is sustainable. The Fisheries Biosecurity Division together with Headquarters and State Aquaculture Development Division staff should regularly carry out roadshows, campaigns and information sessions on myGAP and its importance to all aquaculturists on a regular basis. Continuous awareness programmes are needed to ensure that the importance of this certification is understood by all aquaculturists and workers in aquaculture farms. The department will also consider the third party certification method, as practiced in other developed countries, as an alternative to the existing certification in the country.

7.5 Development of standard operating procedures (SOPs)

The development of SOPs is essential to ensure that all staff are following the same procedures. It is also to ensure that each and every reference is from the same legislative source whether it be an act, rules or regulations. It is a concern that differences in the way the work is done and the procedures adopted result from there being no SOPs. Thus, different delivery systems will be used for executing tasks and ultimately lead to contradictions and disharmony. Basically all the work methods performed at the various district and state levels can be assembled and harmonized into one set of uniform SOPs for everyone's reference. The SOPs also need to be periodically reviewed to ensure that the procedures adopted are in line with the changes in time and technology. The delivery and understanding of the SOPs also needs to ensure that they reach the staff through regular workshops and training.

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Annex IV-6 Governance of aquaculture in Thailand

Chumnarn Pongsri

1. Introduction

Freshwater aquaculture has been developed in Thailand for a long time, but brackishwater aquaculture is much more recent. In 2017, aquaculture production was about 1.081 million tonnes and valued at THB 90 303 million (USD 1 = THB 30.60) contributing about 45.36 percent of the total fisheries production (DOF, 2019). Aquaculture activities in Thailand can be divided into two categories: freshwater aquaculture and coastal aquaculture.

Freshwater aquaculture, mainly pond and rice field culture, has been practiced in Thailand for almost a century. The development of freshwater aquaculture started in 1922 after the import of Chinese carp for culture near Bangkok. In 1951 the Department of Fisheries set up an aquaculture promotion programme. At present, more than 50 freshwater aquatic species have been cultured. The five most important species, in terms of annual production, are Nile tilapia, hybrid catfish, snakeskin gourami, giant river prawn, and snakehead (DOF, 2019).

Brackishwater along the coast was traditionally used for subsistence fisheries, using bamboo traps, castnets, and gillnets. Shellfish were also collected by hand from their natural beds. Three decades ago, coastal aquaculture started with the introduction of intensive culture technologies and has today become the most successful in terms of income. It is also encouraged by the depletion of coastal resources caused by overfishing and the deterioration of environmental conditions. The most important species cultivated are fish such as barramundi and grouper, shrimps, shellfish, and crustaceans such as mud crab. This includes both the systematic rearing of the species from the fry stage onwards and fattening of wild juveniles in captivity as in the case of mud crab. Shellfish and shrimp culture give the most important yields.

Thailand is among the top producers of aquaculture products of the world. During 2008 to 2017, the mean aquaculture production was 1 081 154 tonnes (THB 90 303 million) of which 418 586 tonnes (THB 24 117 million) was from freshwater aquaculture, and 662 568 tonnes (THB 66 186 million) from coastal aquaculture. In 2017, the production from coastal aquaculture was 480 609 tonnes, consisting of marine shrimp (74.88 percent), marine bivalves (20.44 percent) and marine finfishes (4.67 percent). Production from freshwater aquaculture was 416 100 tons, consisting of Nile tilapia (53.29 percent), walking catfish (27.17 percent) and freshwater giant prawn (5.19 percent) (DOF, 2019).

1.1 Freshwater aquaculture in Thailand

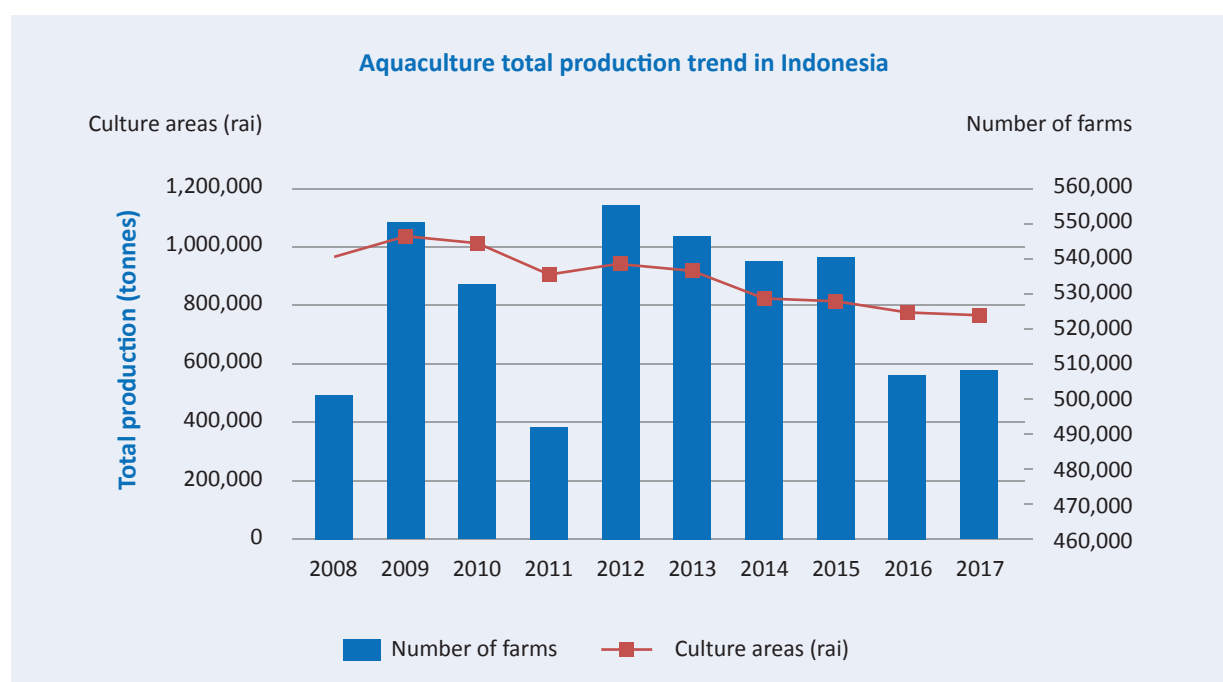
Freshwater aquaculture includes culture in ponds, paddy fields, cages and ditches. There are several types of freshwater aquaculture in Thailand. These include culture of single species or monoculture, culture of mixed species or polyculture, and culture of aquatic animals with other agricultural activities, for example with terrestrial animals, crops, plants or integrated farming.

Farmers started to conduct aquaculture in Thailand in 1966, and it became more popular after the Department of Fisheries' (DOF) success in artificial propagation of many freshwater fishes. Even though freshwater aquaculture in Thailand is generally at subsistence level, products from freshwater aquaculture are not only for home consumption, but also for sales mainly in the domestic market and a few products are exported to foreign markets. It serves as a major source of high-quality protein, particularly for rural people. With diverse cultured species in Thailand, many species are of reasonable price which all the population can afford. Apart from food fishes, ornamental fishes are

currently becoming common in freshwater aquaculture as they can provide good economic benefits to farmers despite rather small culture areas.

The average number of freshwater aquaculture farms operated during the years 2008 to 2017 was 527 205 farms. Culture areas during the period fluctuated according to climatic condition, for example a heavy flood in 2011 drastically decreased the number of culture areas (Figure 1). More of the cultured species are herbivores rather than carnivores. Major culture areas are in the Central and Northeastern regions.

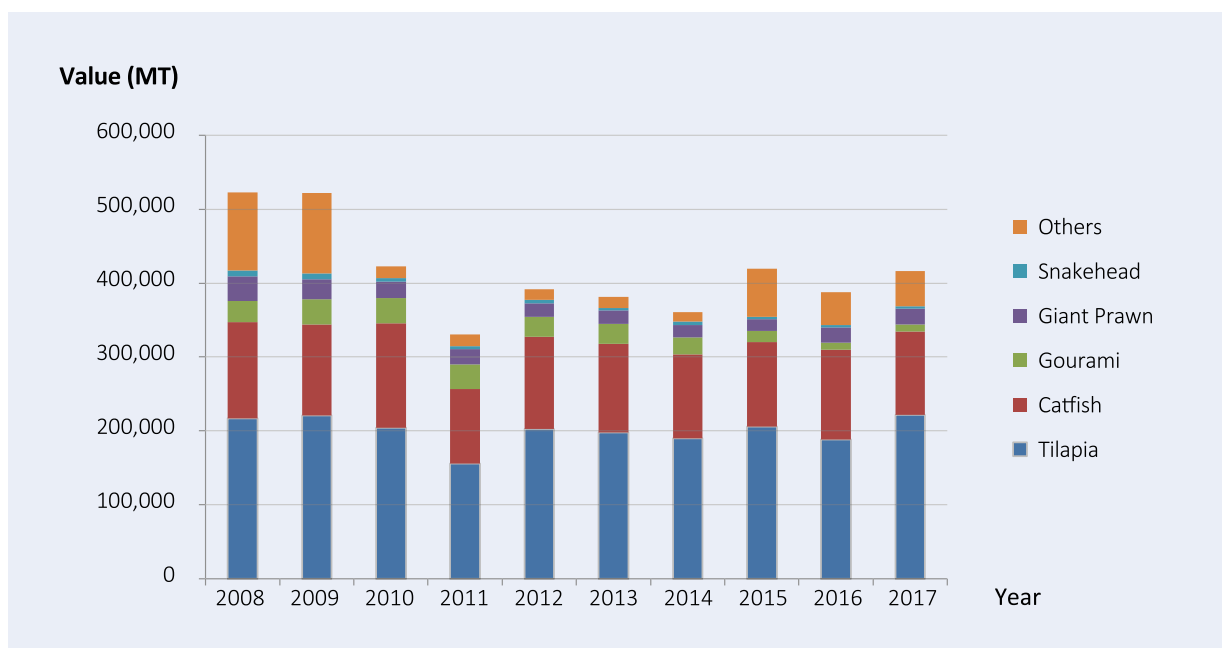
Figure 1 Number of freshwater aquaculture farms and culture areas



Source: Statistics Analysis Group, Fisheries Development Policy and Strategies Division, Department of Fisheries, Thailand

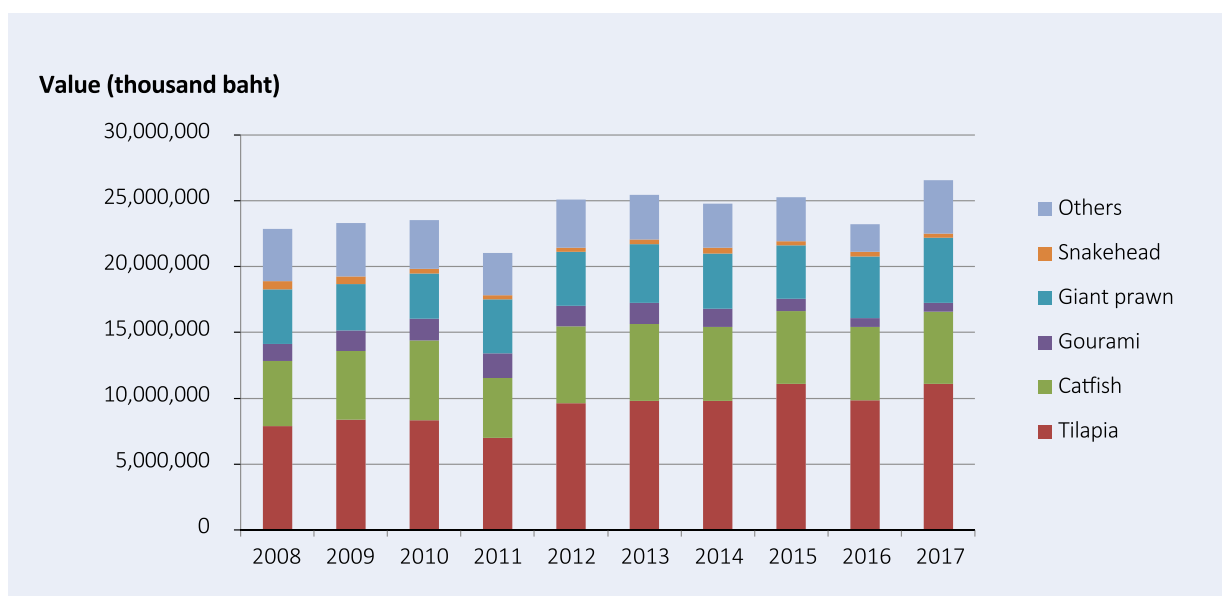
During the years 2008 to 2017, the average production from freshwater aquaculture was 415 586 million tonnes (MT) with the mean value of THB 24 117 million. In 2017, key cultured species in Thailand freshwater aquaculture were: Nile tilapia (*Oreochromis niloticus*) 221 726 MT, hybrid catfish (*Clarias macrocephalus* x *C. gariepinus*) 113 057 MT, snakeskin gourami (*Trichogaster pectoralis*) 9 201 MT, freshwater giant prawn (*Macrobrachium rosenbergii*) 21 600 MT, snakehead (*Channa striata*) 3 221 MT, and others 47 295 MT (Figures 2 and 3).

Figure 2 Volume of key freshwater aquaculture products in Thailand (2008 to 2017)



Source: Statistics Analysis Group, Fisheries Development Policy and Strategies Division, Department of Fisheries, Thailand

Figure 3 Value of key freshwater aquaculture products in Thailand (2008 to 2017)



Source: Statistics Analysis Group, Development Policy and Strategies Division, Department of Fisheries, Thailand

A major factor limiting the growth of freshwater aquaculture practices in Thailand is the poor economic return on investment when compared to brackishwater species. Advanced aquaculture techniques, including intensive pond and cage farming, have been developed and are available, but the profit margin remains small.

1.2 Coastal aquaculture in Thailand

Brackishwaters along the coast were traditionally used for subsistence fisheries using bamboo traps, castnets and gillnets. Crustaceans were also collected by hand from their natural beds. Coastal aquaculture started to gain people's interest in the 1970s with the introduction of intensive culture technologies in both hatchery and grow-out operations, and is today the most successful in terms of income. It is also encouraged by the depletion of coastal resources caused by overfishing.

The most important species cultured today is white shrimp that was introduced from the Americas just over 20 years ago as a solution to the disease problems that at the time were playing havoc in the rapidly expanding pond production of black tiger shrimp. With close to 350 000 tons, white shrimp today represents 75 percent of total brackishwater aquaculture in Thailand. Other species of significant importance are seabass (barramundi), black tiger shrimp, grouper, green mussel, blood cockle and oyster.

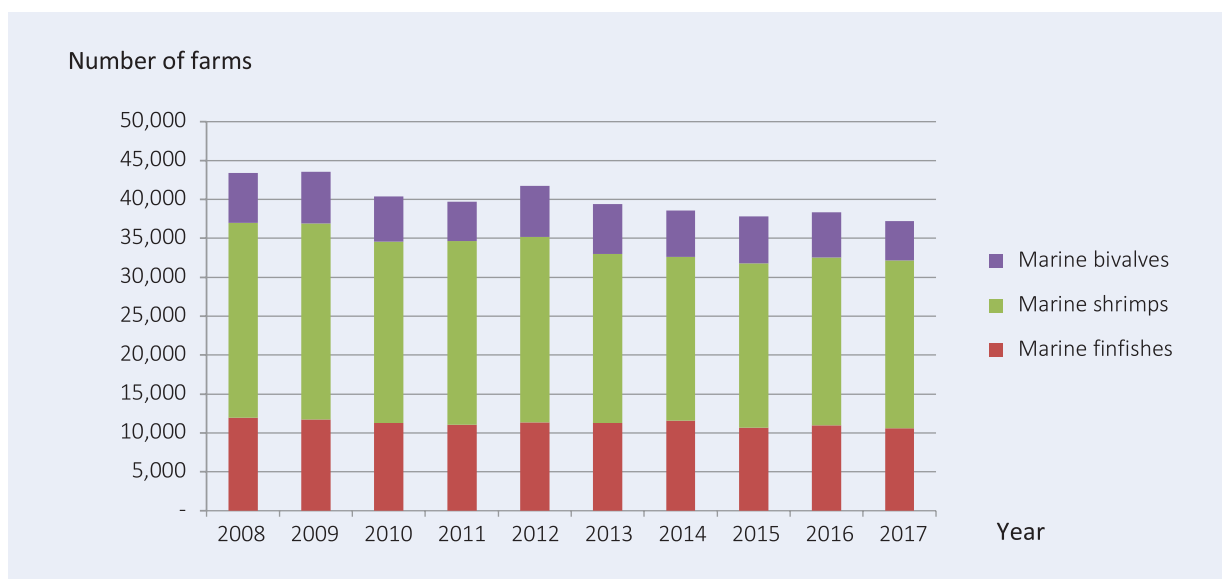
Other major species that are being looked at for more intensive development in the near future are mud crab (for soft-shell crab farming) and milkfish. Advanced aquaculture techniques are available but haven't been applied because of a lack of market confirmation and supply chain development.

Mean annual production of coastal aquaculture in Thailand during the years 2008 to 2017 was 662 568 MT. However, annual production fell to 480 609 MT in 2017. This was caused by a sharp drop of marine shrimp production because of the widespread outbreak of "Early Mortality Syndrome (EMS)" or "Acute Hepatopancreatic Necrosis Syndrome (AHPNS)" in the marine shrimp farming industry. As the proportion of marine shrimp production is normally 60 percent of total production from coastal aquaculture, the outbreak of EMS or AHPNS in Thai shrimp production affected overall coastal aquaculture production.

Major cultured species in Thai coastal aquaculture are: (i) marine shrimps (white shrimp, black tiger shrimp); (ii) marine finfishes (seabass, groupers); and (iii) marine bivalves (oysters, blood cockles, green mussels).

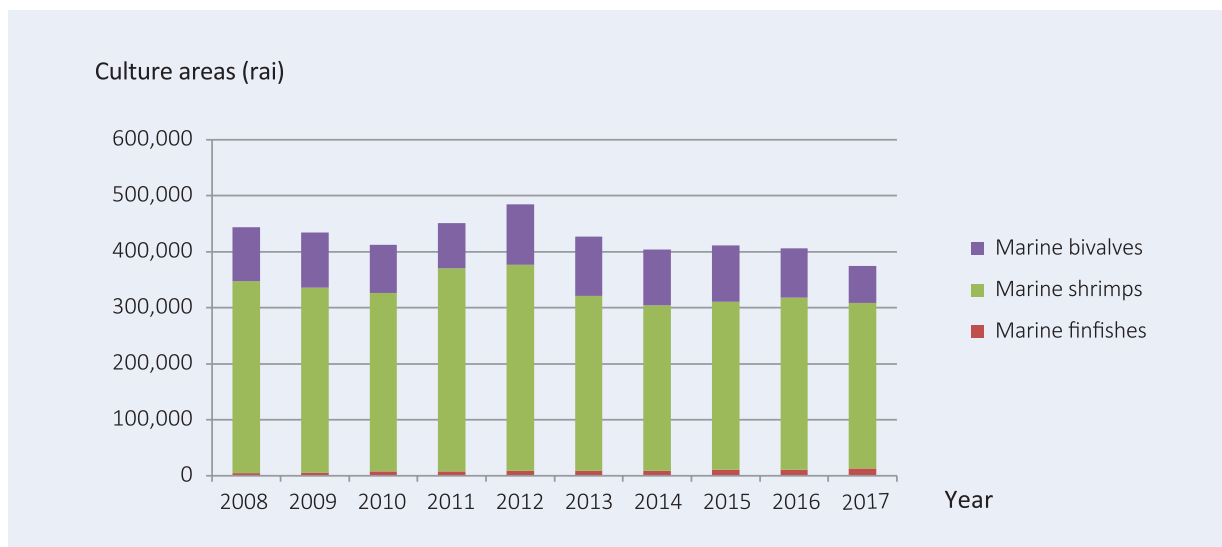
During the years 2008 to 2017, the number of coastal aquaculture farms was slightly reduced at the mean rate of 3.02 percent annually, i.e. from 43 399 farms in 2008 to 38 939 farms in 2017 (Figure 4). Similarly, culture areas for coastal aquaculture during the period also slightly reduced at the mean rate of 1.64 percent annually. This was because of the decrease of marine shrimp and marine bivalves culture areas at the mean rate of 1.37 percent and 2.92 percent annually, respectively. However, culture areas of marine finfishes increased at the mean rate of 12.58 percent annually. In 2017, culture areas of marine shrimp, marine bivalves and marine finfishes were 294 683 rai 66 614 rai and 13 529 rai, respectively (Figure 5).

Figure 4 Number of coastal aquaculture farms in Thailand (2008 to 2017)



Source: Statistics Analysis Group, Fisheries Development Policy and Strategies Division, Department of Fisheries, Thailand

Figure 5 Culture areas of coastal aquaculture in Thailand (2008 to 2017)



Source: Statistics Analysis Group, Fisheries Development Policy and Strategies Division, Department of Fisheries, Thailand

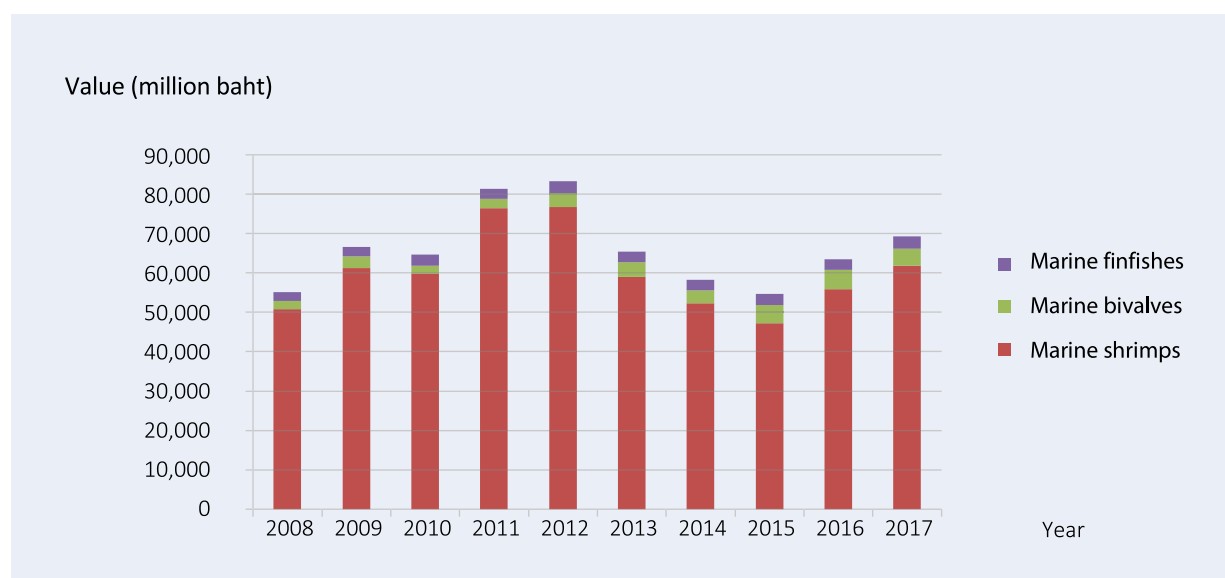
During the years 2008 to 2017, the total volume of coastal aquaculture in Thailand decreased at the rate of 4.69 percent, but value increased by 3.63 percent annually. Whereas the marine finfishes production increased both by volume and value, the production volume of marine shrimps and marine bivalves decreased but their values increased. In 2017, total volume and value from coastal aquaculture was 480 609 MT and THB 62 230 million, respectively. Total volume was 3.8 percent lower than in 2016, but total value was 9.08 percent higher. This was because of the higher price of marine shrimps (Figures 6 and 7).

Figure 6 Production volume of coastal aquaculture in Thailand by animal groups (2008 to 2017)



Source: Statistics Analysis Group, Fisheries Development Policy and Strategies Division, Department of Fisheries, Thailand

Figure 7 Value of coastal aquaculture production in Thailand by animal groups (2008 to 2017)



Source: Statistics Analysis Group, Fisheries Development Policy and Strategies Division, Department of Fisheries, Thailand.

1.3 Aquatic animal feeds industry in Thailand

Aquatic animal feed manufacturing in Thailand is well established with advanced production technology. In 2019, there were 49 large commercial aquatic animal feed establishments registered to DOF or the Department of Land Development (DLD), accredited with national/international standards and operations. Ten out of forty-nine establishments are accredited voluntarily with good manufacture practices (GMP) and Hazard Analysis Critical Control Point (HACCP). The commercial feeds produced are mainly pellets specifically formulated according to the nutritional requirements

of cultured species at different grow-out stages. Prior to producing any aquatic animal feeds commercially, the manufacturers have to submit the feed formulas to the DOF for consideration and approval.

Aquaculture feeds for marine shrimps, freshwater giant prawns, marine fishes and freshwater fishes, either herbivorous, carnivorous, or omnivorous species are adequately available to meet the domestic demand in Thailand. Lots of aquaculture feeds, both shrimp and fish feeds, are exported to foreign markets including ASEAN, Australia and Neareast countries. However, Thailand is importing special feeds such as artificial feeds for high-valued larvae, broodstock feeds, and, recently, feeds for grow-out sea bass.

Apart from 49 commercial feed establishments, there are some 30 supplementary feed establishments in Thailand. These establishments provide various types of supplementary feeds/ingredients, such as feed premix, vitamins, minerals. All kinds of feedstuffs/ingredients used in aquatic animal feeds has to be approved and controlled by the DOF as well.

In terms of quantity, the estimated amount of aquaculture feeds required for key cultured species in Thailand for the year 2019 is 1 119 931 tons. These include 448 154 tons of marine shrimp feeds (feed conversion ratio (FCR) = 1.2); 33 778 tons of freshwater prawn feeds (FCR = 1.5); 33 763 tons of marine fish feeds (FCR = 1.5); and 604 235 tons of freshwater fish feeds (FCR = 1.6).

Estimated feed ingredients required for the aforementioned quantity are: 255 886 tons of soybean meal; 117 058 to 161 874 tons of fishmeal; 224 991 tons of corn; 192 086 tons of wheat flour; 134 355 tons of cassava; and 130 978 tons of distiller's dried grains with solubles (DDGS).

2. Legislation

Even though aquaculture operations in Thailand started long before the establishment of the Fisheries Act B.E. 2490 (A.D. 1947), there was no legal definition of "aquaculture" until the establishment of the Fisheries Act B.E. 2558 (A.D. 2015) in which "aquaculture" is legally defined. After the Fisheries Act B.E. 2558 (A.D. 2015) was repealed by the Royal Ordinance on Fisheries B.E. 2558 (A.D. 2015),³³ the legal definition of "aquaculture" appears therein as follows:

"Aquaculture means the culture of aquatic animals or aquatic animal species breeding by means of natural methods, artificial insemination methods or by any other method on an aquaculture ground in any stage of the life cycle of any such aquatic animal."

"Aquaculture ground means a pond, enclosure, cage or an area used for agriculture of any other description notwithstanding that it is located on a tract of land owned privately or in public domain of State or in any fishing ground that the digger, the builder, the creator, the owner or the possessor thereof aims to use directly for aquaculture purposes."

The Royal Ordinance on Fisheries B.E. 2558 (A.D. 2015) and its amendment B.E. 2560 (A.D. 2017) is the principal legislative instrument dealing with fisheries and the cultivation of aquatic animals in Thailand. The Royal Ordinance is administered by the Ministry of Agriculture and Cooperatives (MOAC). Its Department of Fisheries (DOF) is the principal government agency responsible for managing and developing fisheries and aquaculture. Its mandate and structure are set out in the Ministerial Regulation on the Formation of the Department of Fisheries B.E. 2559 (A.D. 2016), which provides DOF, *inter alia*, with the authority and responsibility to:

³³ FAOLEX Database

- i. apply, implement and enforce the Royal Ordinance on Fisheries and other relevant laws related to fishery matters;
- ii. study, research and develop aquaculture, genetic improvement, breeding of aquatic animals, ornamental fishes, aquatic plants, aquatic animal feeds, aquatic animal health, and other related subjects;
- iii. study, research and explore fisheries resources, fishing grounds, fishing gears, ecosystems both within and outside Thai waters, and maintain/enhance fisheries resources to be used at a sustainable level;
- iv. study, research and develop preservation techniques, fish processing, fish and fishery products storage, packaging, biological technology and innovations in post-harvest technology;
- v. study, research and develop aquatic products quality control and safety systems, including ensure the compliance with national/international standards of Thai aquatic products;
- vi. promote participation of all relevant stakeholders in fisheries management, conservation, set up fishing and fisheries resources utilization measures in accordance with the laws, and prevent, deter and eliminate illegal fishing within and outside Thai waters;
- vii. develop monitoring, control and surveillance system for fishing operations, and efficient traceability system for tracing source of origin of fish and fishery products throughout production lines to consumers;
- viii. study, research, develop and promote fisheries technology transfer and business development on aquaculture, fishing operations, processing, and other related business;
- ix. implement international obligations and cooperation on fisheries resources management and conservation, either on technical matters, trade, investment, or other fisheries-related activities;
- x. study, develop and implement information technology system, geological information and networks, information technology and communication management, data storage and dissemination, and provide information services; and
- xi. perform other functions as prescribed by laws to be its powers and duties or entrusted by the Ministry and the Cabinet.

The Royal Ordinance is further implemented at the provincial and district level. The Ministerial Regulation on the Formation of the Department of Fisheries B.E. 2559 (A.D. 2016) sets out the authority of both the Provincial Fishery Officer (each province has a Provincial Fishery Officer) and the District Fishery Officers. The District Office and the officers therein report to the Provincial Officer. The Royal Ordinance empowers the Provincial Fisheries Committee to formulate provincial plans, coordinate and cooperate with relevant agencies, both public and private, at province level, to manage and conserve fisheries resources and the environment in their territories.

Provisions in the Royal Ordinance fully support the sustainable management and governance of aquaculture operations in the country under the umbrella of fisheries management policies by way of promoting the participation of all stakeholders in the management and conservation of aquatic animal resources, as well as to establish a system of good governance in order to ensure sustainable use as determined by the examination of best scientific evidence and balanced by economic, social and environmental considerations, in line with the ecosystem approach and the precautionary approach.

The Tambol Council and Tambol Administrative Organization Act 199³⁴ empowers local communities, at subdistrict level, to manage and conserve natural resources and the environment in their localities. These powers enable local communities to regulate any activities in their areas including aquaculture activities.

The National Fisheries Committee

In order to strengthen the participatory approach in fisheries management and development, the national fisheries management policies are to be adopted by the National Fisheries Committee which was established under Section 13 of the Royal Ordinance on Fisheries B.E. 2558 (A.D. 2015).³⁵

The National Fisheries Committee comprises the Prime Minister as its chairperson, Minister of Agriculture and Cooperatives as its vice-chairperson, Permanent Secretary of the Ministry of Foreign Affairs, Permanent Secretary of the Ministry of Agriculture and Cooperatives, Permanent Secretary of the Ministry of Transport, Permanent Secretary of the Ministry of Natural Resources and the Environment, Permanent Secretary of the Ministry of Labour, Commander-in-Chief of the Royal Thai Navy, Commissioner General of the Royal Thai Police, Director-General of the Department of Provincial Administration, President of the National Farmers' Council, President of the Thai Chamber of Commerce, President of the Federation of Thai Industries as committee members, and not more than ten experts appointed by the Minister as committee members. The Director-General of the Department of Fisheries serve as a committee member and secretary.

To ensure full participation of relevant stakeholders, expert committee members pursuant to section 13 are appointed from the following persons:

- i. one association representative in each of the following fields: coastal fisheries, offshore fisheries, fisheries outside Thai waters, inland fisheries, aquaculture and aquatic animal processing;
- ii. not more than two persons having knowledge or operational experience in the field of natural resources and the environment;
- iii. not more than two fisheries academics.

The National Fisheries Committee has the power and duty to determine fisheries policies and supervise fisheries management, including determining the country's aquaculture development policies and determining control measures in order to achieve such policies.

The National Fisheries Committee provides the policy directives to the DOF through the adopted Fisheries Management Plan and the Master Plan on Aquaculture Development (2017–2021). The overall strategy for the country's fisheries management is stipulated in the Master Plan on Aquaculture Development (2017–2021). Among others, it aims at increasing technical capacity and institutionalization of extension workers and fish farmers. Strategies include the promotion of good aquaculture practices (GAqP) by strengthening of aquaculture techniques and management, promoting cost-effective and environment-friendly aquaculture, upgrading production quality and hygiene, and expanding markets for aquaculture products.

³⁴ http://thailaws.com/law/t_laws/tlaw0462.pdf

³⁵ <https://www.fisheries.go.th/law/web2/images/PR2558/6-royalfisheries.pdf>

The Provincial Fisheries Committee

In the decentralization process, there will be a provincial fisheries committee in each of the provinces prescribed by the Minister of Agriculture and Cooperatives. Any such provincial fisheries committee shall comprise the Provincial Governor as chairperson, a representative of the Ministry of Natural Resources and the Environment, a representative of the Marine Department, the Provincial Chief Prosecutor in the capacity of the Head of the Provincial Chief Attorney's Office, the Provincial Commerce Officer, the District Chief of each district where fisheries operations are undertaken, the Chief Executive of the Provincial Administrative Organization, the President of the Provincial Farmers' Council as *ex officio* committee members, and not more than thirteen experts appointed by the Provincial Governor as committee members. The Provincial Fisheries Officer serves as a committee member and secretary. In any province having areas contiguous with marine waters or the Mekong River, a representative of the Royal Thai Navy is added as an *ex officio* member.

Expert committee members in provincial fisheries committee are appointed from among the following persons: (1) representatives of local fishing community organizations in the fields of coastal fisheries, offshore fisheries, freshwater fisheries, aquaculture or aquatic animal processing who have been registered as local fishing community organizations as deemed appropriate after due consideration of the fair and comprehensive distribution of the stakeholders; and (2) not more than three persons having knowledge or operational experience in the field of fisheries or in the fields of natural resources and the environment.

The Provincial Fisheries Committee has several powers and duties, including to: (i) compile recommendations and propose approaches to the promotion of the fishing profession, the management, maintenance, conservation, restoration and sustainable utilization of aquatic animal resources by local fishing community organizations in its jurisdiction and submitting them to the Committee for deliberation in the preparation of policies; (ii) deliberate upon and make suggestions regarding approaches to the development or the resolution of problems related to fisheries, or the management, maintenance, conservation, restoration and sustainable utilization in fishing grounds in its jurisdiction to the Minister of Agriculture and Cooperatives, the National Fisheries Committee, or the Director-General of the Department of Fisheries; (iii) issue notifications pursuant to section 56, section 71, and section 77 which are published in the Government Gazette; and (iv) take any other action as assigned by the Minister of Agriculture and Cooperatives or the National Fisheries Committee.

There is direct involvement of the Provincial Fisheries Committee in aquaculture as per Section 79 of the Royal Ordinance which stipulates that no one will undertake an aquaculture enterprise outside the areas prescribed as aquaculture zones by the Provincial Fisheries Committee.

In addition, the provisions of Chapter 6 of the Royal Ordinance on Fisheries B.E. 2558 (A.D. 2015) aim to promote aquaculture as an alternative source of aquatic animal products in accordance with the overall objective of achieving long-term economic, social and environmental sustainability and ecosystem balance, while also ensuring the proper quality and hygienic standards for consumption.

In order to ensure quality and safe consumption for the benefit of consumers of aquatic animals, a fish farmer must properly comply with the agricultural commodity standards prescribed by the Agricultural and Food Commodity Standards Committee in accordance with the law on agricultural and food commodity standards.

To facilitate compliance with the provision on food safety and standards in aquaculture, the Department of Fisheries has a duty to promote, develop and provide guidance with respect to aquaculture in order to achieve standards without compromising the state of the ecological environment and the

abundance of aquatic animal resources. The Department issues a certificate certifying compliance to such standards on the part of a fish farmer when requested.

In case of any person wishing to request the certifying of aquaculture standard attainment, or request that the Department of Fisheries inspect and certify kinds, features, quality or origin of any aquatic animal, or analyse specimens of soil, water, aquatic animals or factors of production in any specific individual's case, they must lodge a request and pay expenses for the issuance of any such certificate or for a verification in accordance with the Regulations prescribed by the Director-General of the Department of Fisheries.

For the purposes of supervising the quality of aquaculture and to prevent environmental consequences or hazards to consumers or others' enterprises, a Ministerial Regulation may be issued to determine the kinds of aquatic animals or aquatic animals' features or types, forms or sizes or the objectives of aquaculture enterprises to be classified as those under aquaculture control.

To secure proper operations of fish farmers, the Director-General of the Department of Fisheries has the power (Section 78) to determine that a fish farmer undertaking an aquaculture enterprise in aquaculture zones notifies the aquaculture undertaking to the competent official as per the procedure prescribed. The Director-General can also: (i) determine the origins of aquatic animals prohibited for use in aquaculture; (ii) determine the types, features, and quality of aquatic animals' feed prohibited in aquaculture; (iii) determine the kinds and quantities of any drug, chemical or hazardous matter prohibited in aquaculture; (iv) determine criteria and operational methods in the management of effluent water or solid waste from aquaculture farms; (v) determine rules and procedures for preventing leaks of water used in aquaculture from aquaculture grounds; (vi) determine any further matter necessary for the prevention of impacts to the environment, or danger to consumers or to others' enterprises.

No person shall undertake a form of aquaculture in a fishing ground that is a public domain of the State unless a license is granted by the competent official.

With the above-mentioned provisions under the Royal Ordinance on Fisheries B.E. 2558 (A.D. 2015) and its amendment B.E. 2560 (A.D. 2017), and relevant laws, rules and regulations, there are adequate fundamental tools required to promote and regulate aquaculture operations in Thailand (Table 1), which include the following elements:

- i. environment protection;
- ii. aquaculture food safety, including certification and traceability;
- iii. management of natural resources for aquaculture, including registration and licensing
- iv. protection of biodiversity;
- v. biosecurity and animal health management;
- vi. regulation on feed and drug (including antibiotics) production, marketing and use; and
- vii. laws and regulations on working conditions and safety in aquaculture operations.

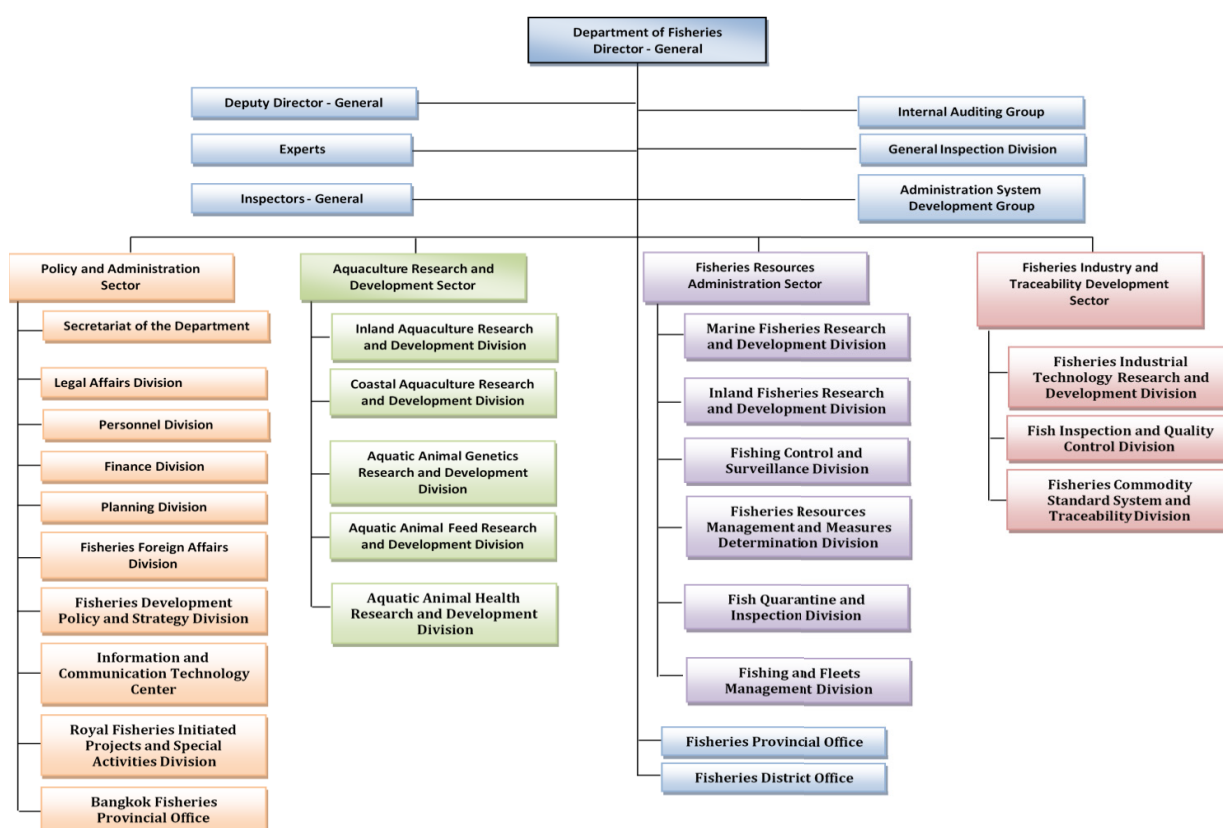
Table 1 Availability of legislative instruments (law/act/norm/to regulate different aspects of aquaculture

Governance area	Coverage by law/ act/norm Yes/No	Specific details
Resource use (land, lake, reservoir, river, coastal)	Yes	Royal Ordinance on Fisheries B.E. 2558 (2015) The Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992)
Registration/licensing of operation	Yes	Royal Ordinance on Fisheries B.E. 2558 (2015)
Environment impact control (EIA, effluent)	Yes	Royal Ordinance on Fisheries B.E. 2558 (2015) The Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992)
Biodiversity protection	Yes	Royal Ordinance on Fisheries B.E. 2558 (2015) The Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992)
Food safety: feed ingredients	Yes	Royal Ordinance on Fisheries B.E. 2558 (2015) Animal Feed Control Act, B.E. 2558 (2015)
Food safety: drug/chemical use	Yes	Royal Ordinance on Fisheries B.E. 2558 (2015) Animal Epidemics Act, B.E. 2558 (2015) Animal Feed Control Act, B.E. 2558 (2015) Food Act B.E. 2522 (1979) Medicine Act B.E. 2510 (1967)
Traceability/certification	Yes	Royal Ordinance on Fisheries B.E. 2558 (2015) Agricultural Commodity Standards Act, B.E. 2551 (2008)
Aquaculture seed	Yes	Royal Ordinance on Fisheries B.E. 2558 (2015) Agricultural Commodity Standards Act, B.E. 2551 (2008)
Working conditions	Yes	Good Labor Practices Guidelines for Workplace
Child labour use	Yes	Good Labor Practices Guidelines for Workplace
Animal welfare	Yes	Cruelty Prevention and Welfare of Animal Act B.E. 2557 (2014)

3. Institutional framework governing the aquaculture industry

The Department of Fisheries (DOF), under the Ministry of Agriculture and Cooperatives, plays an important role in aquaculture development planning and implementation. This includes aquaculture extension services and the transfer of fish culture technologies. The DOF is divided into two levels of administration: central administration and regional administration. Central administration includes four sectors with twenty-four divisions. Regional administration includes 76 provincial fisheries offices. The organizations within the DOF that share responsibility for aquaculture management and development are: Aquaculture Research and Development Sector, which includes five divisions (Inland Aquaculture Research and Development Division, Coastal Aquaculture Research and Development Division, Aquatic Animal Genetics Research and Development Division, Aquatic Animal Feed Research and Development Division, and Aquatic Animal Health Research and Development Division); 42 Inland Aquaculture Research and Development Centers; 16 Coastal Aquaculture Research and Development Centers; 6 Aquatic Animal Genetics Research and Development Centers; 1 Aquatic Animal Feed Technology Research and Development Center; 1 Aquatic Animal Health Research Center; 76 provincial fisheries offices; and 527 fisheries district offices (Figure 8).

Figure 8 Organization chart for Department of Fisheries



In addition, there are two divisions under the Fisheries Industry and Traceability Development Sector, i.e. Fish Inspection and Quality Control Division, and Fisheries Commodity Standard System and Traceability Division, that provide support to the management and development of aquaculture in Thailand.

The DOF has articulated a vision for the sector: “Managing changes towards sustainable fisheries development” and its missions and strategies are a sort of roadmap for achieving that vision.

Missions:

- i. promoting and encouraging the efficient increase of aquaculture production at all stages;
- ii. promoting and developing quality of aquaculture production and fishery products throughout the whole supply chain in complying with Thai and international standards;
- iii. regulating and controlling fisheries resources for sustainable utilization and maintenance of diversity including creating participation of fisheries communities and people engaged in fisheries resources management in the community;
- iv. promoting and encouraging study and research on all areas of fisheries, developing and transferring new fisheries technologies, and building on research on value-added innovation;
- v. promoting capacity building to enhance knowledge and expertise in line of responsibility including reorganizing the structure of organizations to make them appropriate for the new mission.

Strategies:

- i. enhancement of aquaculture production;
- ii. quality development of aquaculture production and fishery products;
- iii. fisheries resources management for sustainability and diversity;
- iv. research and technical development including fisheries technologies;
- v. human resources and organization development.

It is clear from the DOF’s missions and strategies that aquaculture is a significant sector in its mandate. The key Divisions of DOF that are directly responsible for and/or support aquaculture management and development in Thailand and that which include the promotion of governance of aquaculture operations are:

- 1) Inland Aquaculture Research and Development Division (IARDD), which has statutory responsibilities to:
 - i. conduct studies, research, and development on aquaculture technology of freshwater aquatic animals/plants, as well as freshwater farm management;
 - ii. conduct studies and research on production and breeding of freshwater aquatic animals/plants;
 - iii. conduct studies, research and promote business of aquatic animal/plant aquaculture;
 - iv. conduct studies, research and experiments on aquatic animal/plant farming, with emphasis on farmers’ participation;
 - v. produce quality seed of aquatic animal/plant species suitable for aquaculture;

- vi. monitor, control, conduct surveillance on freshwater aquaculture production processes to ensure compliance with relevant regulations and standards;
 - vii. provide technical services on freshwater aquaculture subjects by means of technology transfer, consultation, supervision, etc.;
 - viii. provide laboratory services on soil, water quality analyses, including set up water quality standards for freshwater aquaculture operations; and
 - ix. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.
- 2) Coastal Aquaculture Research and Development Division (CARDD) which has statutory responsibilities to:
- i. conduct studies, research, and development on aquaculture technology of coastal aquatic animals, marine animals, seaweeds, as well as coastal farm management;
 - ii. conduct studies, research and rehabilitation of coastal ecosystem and environment within aquaculture ground;
 - iii. conduct studies and research on production and breeding of coastal aquatic animals, marine animals, and seaweeds;
 - iv. conduct studies, research on biodiversity of coastal aquatic animals, marine animals, and seaweeds;
 - v. conduct studies, research and promote aquaculture business of coastal aquatic animals, marine animals and seaweeds;
 - vi. conduct studies, research and experiments on coastal aquatic animals, marine animals, seaweeds farming, with emphasis on farmers' participation;
 - vii. produce quality seed of coastal aquatic animals, marine animals, seaweeds suitable for aquaculture;
 - viii. monitor, control, conduct surveillance on coastal aquaculture production processes to ensure compliance with relevant regulations and standards;
 - ix. provide technical services on coastal aquaculture subjects by means of technology transfer, consultation, supervision, etc.;
 - x. provide laboratory services on soil, water quality analyses, including setup water quality standards for coastal aquaculture operations;
 - xi. monitor, control, surveillance on the operations of seawater irrigation system for coastal aquaculture; and
 - xii. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.
- 3) Aquatic Animal Genetics Research and Development Division (AAGRDD), which has statutory responsibilities to:
- i. conduct studies, research and development on genetic-related technology in aquatic animals/plant;
 - ii. conduct studies and research and development on genetic improvement in aquatic animals/plants, both genotypically and phenotypically;

- iii. conduct studies, research and development on domestication of wild animals/plants for aquaculture and genetically-improved purposes;
 - iv. conduct studies, research and development on cryopreservation technology of wild, genetically-improved strains and new strains;
 - v. conduct research on-station, and on-farm tests on genetically-improved strains of aquatic animals/plants, with emphasis on farmers' participation;
 - vi. produce and breed genetically-improved strains of aquatic animals/plants;
 - vii. monitor, control and conduct surveillance of aquatic animal/plant production processes to ensure full compliance with relevant regulations and international standards;
 - viii. provide technical services on genetic-related matters in aquatic animals/plants;
 - ix. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.
- 4) Aquatic Animal Health Research and Development Division (AAHRDD), which has statutory responsibilities to:
- i. conduct studies and research on aquatic animal health and diseases, including immunology and biotechnology;
 - ii. conduct studies, research on aquatic animal disease diagnosis, as well as on disease prevention, therapeutics and epidemiology techniques;
 - iii. control, oversee, regulate, and develop aquatic animal disease surveillance system, report on aquatic animal disease outbreaks, negotiate and coordinate with domestic and international aquatic animal health organizations/institutions;
 - iv. control, oversee, regulate, and enhance aquatic animal health, good sanitation at farms and post-harvest facilities, as well as issue health certification for export products in accordance with the regulations and requirement;
 - v. provide technical services, transfer technology and suggestions on aquatic animal health and diseases;
 - vi. provide reference laboratory services for aquatic animal diseases diagnosis to both government and private sectors; and
 - vii. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.
- 5) Aquatic Animal Feed Research and Development Division (AAFRDD), which has statutory responsibilities to:
- i. conduct studies, research and development on aquatic animal feed and feed-related technology;
 - ii. set up the standards and conduct feed quality control in accordance with the Animal Feeds Quality Control Act and relevant laws;
 - iii. supervise, inspect, control and oversee the sanitation and standards of aquatic animal feed factories;
 - iv. monitor, control and conduct surveillance on the uses of pharmaceutical and chemical products, raw materials and ingredients, including microorganisms used in aquatic animal feeds to ensure the compliance with the laws, prescribed standards, or international standards;

- v. provide services on aquatic animal feed licenses issuance, registration, certification for quality assurance of aquatic animal feeds, or other certifications relevant to aquatic animal feeds in accordance with the Animal Feed Quality Control Act and related laws;
 - vi. provide technical services, transfer technology and suggestions on aquatic animal feeds; and
 - vii. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.
- 6) Fish Quarantine and Inspection Division (FQID), which has statutory responsibilities to:
- i. conduct studies, analyses and research on trade in aquatic animals and fisheries production factors;
 - ii. conduct studies, analyses, research and issuance of licenses or certificates for importation, exportation, transition of fish and fishery products, and fisheries production factors in accordance with fisheries law and other relevant laws;
 - iii. monitor, control and conduct surveillance on trade in aquatic animals and fisheries production factors to ensure the compliance with fisheries law and other relevant laws;
 - iv. manage and control the entry into ports of foreign fishing vessels in accordance with relevant legislations;
 - v. conduct operations in accordance to international trading protocols, and other related protocols/agreements;
 - vi. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.
- 7) Fisheries Commodity Standard System and Traceability Division (FCSTD), which has statutory responsibilities to:
- i. conduct studies, research, development and setting up the quality standard system for fish and fishery-product production along the supply chain, (from cultivation ponds, fishing grounds, processing plants) to ensure the compliance with national/international standards as well as importing countries' standards and obligations;
 - ii. conduct studies, research, development and setting the sanitation standard system for aquatic animals fishing, handling, processing, storing fish and fishery products to ensure the compliance with national/international standards as well as importing countries' standards and obligations;
 - iii. conduct studies, research and development on commodity standard system in accordance with national/international standards and obligations of importing countries;
 - iv. conduct studies, research and development on laboratory quality system, and supervise the DOF's laboratories;
 - v. conduct studies, research and setting up processes for efficient traceability system;
 - vi. issue certification, regulate and maintain quality control system of certified establishments along their whole production line;
 - vii. negotiate and coordinate with trading partners on production system certification and quality standard of fishery products, agreement establishment and finding solutions relevant to fishery products sanitation standards;

- viii. provide consultation services and recommendation, coordinate and attend the meetings with domestic and foreign institutions relevant to quality control system, fisheries commodity standard certification and traceability along the supply chain in fish and fishery products production;
- ix. provide technical services, transfer technology and suggestions on fisheries quality control and standards; and
- x. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.

8) Fish Inspection and Quality Control Division (FIQCD), which has statutory responsibilities to:

- i. conduct studies and research on food safety and sanitation development in production and manufacturing processes, and develop quality control analysis programmes to accommodate international standards;
- ii. supervise, inspect and regulate the sanitation and safety in food processing establishments, set tools for information retrieval in compliance with the fisheries laws, international standards and obligations of importing countries;
- iii. regulate, inspect and oversee the quality and safety of fisheries products by physical, chemical and microbiology processes in compliance with the laws and related standards;
- iv. regulate, inspect and oversee the quality of aquaculture grounds, fishing grounds, as well as quality of their harvests/catches;
- v. provide reference laboratory services for quality control analyses of fisheries products for the laboratories of DOF, entrepreneurs and oversee entrepreneurs;
- vi. establish quality control system in accordance with international standards;
- vii. provide technical services, transfer technology and suggestions on inspection, quality control and safety of fisheries products; and
- viii. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.

9) Provincial Fisheries Office has statutory responsibilities to:

- i. conduct studies, analyses, research, and assessment of fisheries technologies to support proper business and career establishment in fisheries, supervise fisheries-related firms and activities to ensure compliance with the laws/regulations/ agreements and other related standards;
- ii. provide supervision services, control fishing activities and aquaculture farming in accordance with the Fisheries Act and other related laws;
- iii. establish fisheries strategic plan, fisheries development plan and fisheries database, including promote and disseminate fisheries information to the public;
- iv. perform secretarial services of the provincial fisheries committee and the regional committee for administrative sanctions on fisheries offences;
- v. promote the registration and establishment of local fisher/farmer groups/organizations;
- vi. provide advice, suggestions and support to local administrative organizations for the development of the fisheries sector;

- vii. provide technical services, transfer technology and suggestions on fisheries-related technology, including promotion of good practices to ensure sanitation quality and standards;
- viii. issue licenses, permission documents, certifications, and provide registration services to ports, transshipment vessels, and storage facilities as required bylaws;
- ix. collect fishing gear revenues and fishing-related charges;
- x. supervise, oversee, support the function of district fisheries office; and
- xi. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.

10) District Fisheries Office has statutory responsibilities to:

- i. promote and support proper business and career establishment in fisheries, supervise fisheries-related firms and activities to ensure compliance with the laws/regulations/agreements and other related standards;
- ii. provide supervision services, control fishing activities and aquaculture farming in accordance with the Fisheries Act and other related laws;
- iii. establish fisheries development plan and fisheries database, including promote and disseminate fisheries information to the public;
- iv. provide advice, suggestions and support to local administrative organizations for the development of the fisheries sector;
- v. provide technical services, transfer technology and suggestions on fisheries-related technology, including promotion of good practices to ensure sanitation quality and standards;
- vi. issue licenses, permission documents, certifications, and provide registration services to ports, transshipment vessels, and storage facilities as required by laws;
- vii. collect fishing gear revenues and fishing-related charges;
- viii. supervise, oversee, support the function of district fisheries office; and
- ix. collaborate and support work of other relevant divisions/agencies, or as assigned by DOF management.

Apart from DOF, there are several laws and regulations under responsibilities of other government agencies that are relevant and supportive to the promotion of aquaculture governance. See for example Section 4.5.

4. Technical standards and guidelines

The DOF, since 2003, has set up 18 technical standards pertaining to fish and fishery products processing to be used as guidelines for implementation by fisheries-related establishments in Thailand. These include technical standards in fishing operations, aquaculture, post-harvest handling and processing.

Since DOF's restructuring in 2016, the Fisheries Commodity Standard System and Traceability Division (FCSTD) has had statutory responsibilities in relation to: (a) aquaculture certification to assure that the aquaculture production conforms with national standards for aquaculture;³⁶ and (b) monitoring of aquaculture operations to ensure the compliance with the standards to which the farms are certified. The ultimate goal is to build the confidence of consumers at both domestic and global levels that aquaculture products from Thailand are of good quality, safe for human consumption and concerned with environmental and social responsibility including animal welfare. This is in line with the primary objectives of the Department of Fisheries on sustainable management of fishery resources taking into account environmental, social and economic aspects, maintaining the ecological balance while building public confidence in food safety and the quality of aquaculture products.

4.1 Aquaculture standard certification

The FCSTD provide the aquaculture certification for the standards shown in Table 2.

Table 2 Aquaculture standards in Thailand

No.	Aquaculture standard	Standard Code	Standard type
1	Good Aquaculture Practices (GAP) for Hatchery of Disease-free Pacific White Shrimp	TAS 7432	Mandatory
2	GAP for Marine Shrimp Farm	TAS 7401	Voluntary
3	GAP for Marine Shrimp Hatchery and Nursery*	TAS 7422	Voluntary
4	GAP for Marine Finfish Farm	TAS 7429	Voluntary
5	Organic Agriculture, Part 1: The Production, Processing, Labelling and Marketing of Produce and Products from Organic Agriculture	TAS 9000	Voluntary
6	GAP of the Department of Fisheries (for shrimp and tilapia)	None	Voluntary
7	Code of Conduct of the Department of Fisheries (for shrimp)	None	Voluntary

* Expected to be accredited ISO/IEC 17065 by 2020.

Although the FCSTD is authorized by law to inspect and certify aquaculture farms, it also acts as a certification body (CB) with respect to the third-party certification scheme referred to in ISO in which the certification process for particular products, processes and services has been accredited ISO/IEC 17065 by the National Bureau of Agricultural Commodity and Food Standards (ACFS), an internationally recognized accreditation body.

Farmers applying for aquaculture certification with the DOF through FCSTD can be assured that the certificates will be issued within 85 working days upon the receipt of application. The farmers can either apply for aquaculture certification in person at the Fisheries Provincial Offices located in every province across the country or apply online directly on the FCSTD website (<https://www.fisheries.go.th/thacert/>).

³⁶ National aquaculture standards refer to the Thai Agricultural Standards (TAS) developed by the National Bureau of Agricultural Commodity and Food Standards (ACFS) and notified by the Ministry of Agriculture and Cooperatives, Thailand.

4.2 Farm inspection

The FCSTD carries out farm auditing and laboratory testing processes in close collaboration with professionally qualified and well-trained auditors and official laboratories under various divisions of the DOF based across the country in order to ensure that DOF can deliver the inspection and certification services within the defined time frame.

4.3 Farm surveillance

All certified farms are subjected to surveillance audits at least once a year throughout a three-year period of farm certification to assure that the operations of certified farms comply with aquaculture standards for which they were certified. The monitoring is particularly stringent on the use of veterinary drugs and chemicals in aquaculture.

4.4 Short-term goals

- i. Expansion of the scope of ISO/IEC 17065 accreditation

A short-term target of DOF is to strengthen the certification process accredited to ISO/IEC 17065 to cover all shrimp farming enterprises. This will be accomplished by expanding the scope of accreditation to include “GAP for Hatchery of Disease-free Pacific White Shrimp (TAS 7432)”. This target is particularly challenging since it is the only mandatory aquaculture standard implemented at present and also involves shrimp disease diagnostic laboratories in the certification process.

- ii. Strengthening competency and capacity of laboratories and auditors

In order to support the expansion of the scope of ISO/IEC 17065 accreditation to TAS 7432, the Department of Fisheries’ diagnostic laboratories with competence in the analysis of shrimp diseases are required to be accredited for ISO/IEC 17025. The auditors also need to be trained to gain specific qualifications for auditing TAS 7432.

- iii. Promoting group certification

While maintaining the existing certified farmers at the commercial scale, DOF will continue to support and promote group certification for small-scale farmers to reduce their burden on certification costs.

- iv. Establishing a traceability system

A traceability system for aquaculture farm certification is being developed by applying information technology. This will enable the Fisheries Commodity Standard System and Traceability Division (FCSTD) to trace back and forth in order to mitigate risks associated with food safety. It will also enable FCSTD to link with relevant database systems of other divisions of the Department of Fisheries in order to reduce the redundancy and to automatically verify the information.

4.5 Good labour practices guidelines for the workplace

The Ministry of Labour (MOL) has authority in labour administration and protection, skill development, the promotion of employment of people and any other governmental functions as prescribed by the law.

The Department of Labour Protection and Welfare is responsible for labour standard setting, labour protection, occupational safety, health, and the working environment, labour relations, state enterprise labour relations and labour welfare. It develops and promotes standards, models, mechanisms and measures, and solves problems with a view to enhancing the competitiveness in trade and developing workers' quality of life.

The Department of Labour Protection and Welfare has the following powers and duties: i) to establish and develop labour standards, as well as encourage, supervise and recognize the establishments managed in compliance with international labour standards; ii) to ensure workers' rights and benefits in the formal and informal sectors are protected in accordance with the laws, and possess a good quality of life; iii) to carry out its functions under the law on labour protection, the law on labour relations, and other related laws; iv) to promote and develop a system on occupational safety, health and the working environment; v) to promote, develop and disseminate knowledge and understanding of labour standards, labour protection, occupational safety, labour relations, state enterprise labour relations, and labour welfare; vi) to promote and arrange for the provision of labour welfare; vii) to prevent and resolve conflicts, labour disputes and industrial unrest, to develop an information system on labour protection and welfare, and to formulate and coordinate the Department's action plans to be in line with the Ministry's policy and strategy; and viii) to perform other functions as prescribed by law or as instructed by the Ministry and the Cabinet.

With the aforementioned powers and duties, the Department of Labour Protection and Welfare established generic guidelines entitled the Good Labour Practices Guidelines for Workplaces for all types and sizes of workplaces as voluntary guidelines covering all aspects required in the development of employment and working conditions in compliance with national and international standards, including the prevention on the uses of forced, child, and female labour in any workplaces. The Guidelines have been developed in accordance with the legislation framework on labours, labour protection and welfare, labour relations, occupational safety, health, and the working environment, employment and social assurance, the International Labour Organization and the United Nations' Protocols.

5. Institutional mechanisms for governance of aquaculture

In order to strengthen the governance of aquaculture in Thailand, the government and relevant agencies, especially the DOF, have established several mechanisms.

As participation is a key element of governance, Thailand allows full participation of relevant stakeholders in policy establishment at all levels.

At national level, the National Fisheries Committee, chaired by the Prime Minister together with members from various public and private agencies, has adopted national policies on fisheries targeting sustainable utilization of fisheries resources and aquaculture covering social, economic and environmental dimensions. These policies are key basic instruments/concepts for government agencies and relevant stakeholders to develop programmes/projects for implementation at operational levels.

The same principle applies to all committees established by laws, i.e. at provincial level, the Provincial Fisheries Committee, chaired by the provincial governor together with members from various public and private agencies in the province, adopted the provincial framework on fisheries targeting sustainable utilization of fisheries resources and aquaculture in the responsible areas.

The participation of all relevant stakeholders in the Committee reflects the transparency in the policy setting and programmes/projects formulation processes. However, in case there is inadequate information for the Committee to proceed on policy/programme/project formulation in any subject, a sub-committee on that particular subject can be set up to study, investigate and submit in-depth information to the Committee for further action.

Within the DOF, after restructuring in 2016, there are many divisions taking part in several subject areas which will eventually support the development of governance of aquaculture in Thailand. Specific divisions/committees/working groups have been established according to specific subjects. These include:

i. The DOF Committee on Biological Diversity and Biosafety

On 8 January 2018, the Director-General of DOF signed a DOF Order No. 18/2018 on the establishment of the DOF Committee on Biological Diversity and Biosafety. Chaired by the Director-General, the Committee consists of 26 experts/members from relevant divisions of the DOF and has been tasked to propose to the DOF policies as well as implementation and operation plans that conform with the Convention on Biological Diversity (CBD), particularly with the Cartagena Protocol on Biosafety and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The Committee also has a duty to consider and provide suggestions to DOF for permission on importation, exportation, transition, breeding, rearing, possessing of live aquatic animals and plants as defined by the Royal Ordinance on Fisheries B.E. 2558 (A.D. 2015) and its amendment B.E. 2560 (A.D. 2017), including genetically-modified aquatic animals and plants.

The Committee plays a coordination role with the National Committee on Biological Diversity Conservation and Utilization and relevant agencies in order to support, accelerate, monitor, assess and solve problems that may occur in the implementation of directives, policies, measures and plans in biological diversity conservation and utilization.

The Committee has the role to oversee and control work plans/projects/activities related to biosafety in biological technology, and genetic engineering research of the DOF on living modified organisms (LMO). In addition, the Committee could provide suggestions on the implementation of biosafety measures and monitor whether the implementation is in line with the guidelines on biosafety specified under the National Framework on Biosafety.

Moreover, the Committee could coordinate with agencies and officers responsible for import control of live organisms into the country, and provide recommendations or suggestions on safe handling procedures in case the imported aquatic animals or plants are harmful or suspected to be harmful.

Moreover, the Committee has a duty to provide recommendations on fair and equal benefit sharing from genetic resources utilization under prior agreed conditions. Likewise, the Committee can establish and task sub-committee(s) or working group(s) for specific assignment(s), as appropriate.

ii. The DOF Committee on Aquatic Animal Feed

Thailand established the Animal Feed Quality Control Act B.E. 2558 (A.D. 2015)³⁷ to set the national quality control framework on both terrestrial and aquatic animal feeds/feedstuffs to ensure safety of feed in livestock and aquaculture industries. The Department of Livestock Development (DLD) under the Ministry of Agriculture and Cooperatives has full responsibility for implementation and enforcement of the law.

³⁷ <https://www.ecolex.org/details/legislation/animal-feed-quality-control-act-be-2558-2015-lex-faoc159736/>

The DLD has delegated authority for aquatic animal feed quality control to the DOF. The Aquatic Animal Feed Research and Development Division under the DOF is the main implementing agency on behalf of the DOF. The Committee on Aquatic Animal Feed has been established to supervise good practices at every step of the production process of the aquatic animal feed industry, from sources and quality of raw materials/ingredients, feed formulation, production standards, traceability, etc.

The Aquatic Animal Feed Research and Development Division is also responsible for registration and inspection of aquatic animal feed factories and approval of aquatic animal feed formulas for commercial purposes.

Overall scoring on level of aquaculture governance (1 for lowest and 5 for highest)—effectiveness in enforcement

Governance area	Ranking between 1 and 5 (1 for minimum and 5 for perfect)	Specific details
Resource use (land, lake, reservoir, river, coastal)	4	The Provincial Fisheries Committees are responsible for the allocation of aquaculture sites within their provinces
Registration/licensing of operation	5	All aquaculturists have to register with DOF
Environment impact control (EIA, effluent)	4	There are provisions prescribed by the laws, but enforcement is incomplete
Biodiversity protection	4	There are provisions prescribed by the laws, but enforcement is incomplete
Food safety: Feed ingredients	5	There are provisions prescribed by the laws. Fully enforced in commercial feed industries
Food safety: Drug/chemical use	5	There are provisions prescribed by the laws. Fully enforced in commercial feed industries and commercial aquaculture
Traceability/certification	5	There are provisions prescribed by the laws. Fully enforced in commercial aquaculture
Aquaculture seed	4	There are national standards for commercial hatcheries available. Fully enforced in advance hatcheries
Working conditions	5	There are provisions prescribed by the laws. Fully enforced in commercial aquaculture
Child labour use	5	There are provisions prescribed by the laws. Fully enforced in commercial aquaculture
Animal welfare	3	Awareness has been raised on animal welfare recently

In order to improve the efficiency of aquaculture governance in Thailand, the DOF in fiscal year 2019 is implementing the Project for Upgrading Agriculture Commodities Quality Standards covering the whole country. The goals of the Project in 2019 are:

i.	Farm standard and sanitation inspection	31 479 farms
ii.	Factory inspection	917 factories
iii.	Control and check production factors at farms and factories	87 091 samples
iv.	Raw materials and products analysis	58 951 samples
v.	Monitoring and surveillance on import and export smuggling	54 700 cases
vi.	Monitoring and surveillance on aquatic diseases for products for exports	155 126 samples
vii.	Certification of live shrimps exported to People's Republic of China	25 200 samples
viii.	Monitoring of environment quality of open waters	17 055 samples
ix.	Monitoring and control on import, export and transfer of fisheries products	10 711 cases
x.	Monitoring and quality control on bivalves	6 350 samples

The aforementioned activities were implemented by 11 divisions of DOF, namely: 1) Inland Aquaculture Research and Development Division; 2) Coastal Aquaculture Research and Development Division; 3) Aquatic Animal Genetics Research and Development Division; 4) Aquatic Animal Feed Research and Development Division; 5) Aquatic Animal Health Research and Development Division; 6) Marine Fisheries Research and Development Division; 7) Inland Fisheries Research and Development Division; 8) Fish Quarantine and Inspection Division; 9) Fisheries Industrial Technology Research and Development Division; 10) Fish Inspection and Quality Control Division; and 11) Fisheries Commodity Standard System and Traceability Division.

Total budget for this Project in fiscal year 2019 was THB 339 431 500.

6. Gaps, issues and challenges in aquaculture governance

In recent years the Thai Government has reformed the Thai fisheries sector with the aim of achieving the sustainable management of fisheries resources and good aquaculture practices. The reforms have included the establishment of a new legal framework and the strengthening of the sector's institutions. After the establishment of the Royal Ordinance on Fisheries B.E. 2558 (A.D. 2015) and its amendment B.E. 2560 (A.D. 2017), more than 200 subsidiary rules and regulations have been issued to supplement the implementation in accordance with the laws.

Although there are adequate tools in place in the government sector for the proper promotion of aquaculture governance in Thailand, there are still some gaps, issues and challenges. These include:

- i. lack of political will and degree of support from central and local governments;
- ii. lack of capacity of concerned agencies in regulating and enforcing compliance with the laws/rules/regulations/measures;
- iii. limited understanding of both public and private sectors, including most government officers, on aquaculture governance;

- iv. limited participation of stakeholders in planning and implementation processes of aquaculture governance promotion;
- v. insufficient interaction among government agencies concerned;
- vi. Thai aquaculture comprises mainly small-scale farmers with limited investment capacity – it has been very difficult to upgrade farming practices of numerous farms in accordance with the common rule/regulation/standard requirements;
- vii. conflict of interests and competition in multiple use of the resources among stakeholders; and
- viii. inadequate human and financial resources investment from government in enhancing governance of aquaculture operations.

The fisheries reforms in Thailand, after the establishment of new legal framework in 2015, allow the government to direct the aquaculture sector to align it with all requirements and standards. The DOF together with concerned agencies are in the process of setting up the necessary tools to enable the aquaculture sector to comply with the relevant laws and to support and enhance good aquaculture practices and, eventually, the governance of aquaculture in the country. However, during this transition period, there will be several gaps, issues and challenges, as mentioned above, that will need to be addressed. It can be anticipated that sustainable and responsible aquaculture will be greatly enhanced in Thailand with due consideration of environmental, social and economic aspects, maintaining the ecological balance while building public confidence in food safety and the quality of aquaculture products in the years to come.

7. Recommendations for strengthening aquaculture governance

Thailand has for decades proved itself to be a country of high potential in aquaculture and has achieved considerable success in developing the sector. The increasing importance of aquaculture, both coastal and freshwater, reflects its contribution to the country's economic development. Further development of aquaculture is therefore in the national interest.

An expanded research and technology development programme for aquaculture will offer significant benefits to both producers and consumers of aquatic products by enhancing the production efficiency and quality of aquatic organisms cultivated for both food and non-food purposes. It will also help assure environmental compatibility of aquaculture systems, enhance understanding of biological systems and processes, lead to the development of new or improved aquatic products and processes, and contribute to conservation, enhancement, or utilization of important genetic resources.

Although there are opportunities to improve production efficiency of aquaculture substantially through research in the various subject areas (e.g. genetics, aquatic animal health, reproduction and early development, and growth, development and nutrition), there are also significant opportunities for research and technology development to improve the sustainability and environmental compatibility of aquaculture systems. Of primary concern is the protection and conservation of water resources. Benefits could include improved water utilization, reduced waste output from aquaculture systems, improved waste management, development of economically viable uses of waste by-products, and reduced costs of waste treatment. The innovative water re-use systems and waste management technologies should also be developed and promoted.

The development of improved means to assure the safety and quality of aquaculture products through innovative processing technologies and new product development are opportunities for aquaculture. Research can lead to new techniques to improve the freshness, colour, flavour, texture,

taste, nutritional characteristics and shelf life of cultured products. Practical technologies can be developed to detect, test and reduce toxins, contaminants, and residues in aquaculture products. Development and adoption of uniform quality standards throughout the aquaculture industry and assurance of product safety and high quality will improve consumer confidence in domestically cultured fauna.

It is important to build ownership and where possible, transfer implementation activities to the private sector. Both the public (government) and private sectors have particular roles and responsibilities to play in developing sustainable aquaculture. The increasing importance of aquaculture argues in favour of the government giving priority to developing clear, well-formulated, and realistic policies for aquaculture development, based on financial, social and environmental sustainability. As the private sector is the key to successful and sustainable aquaculture development, the views of industry should be taken into account in policy formulation, research and development.

Aquaculture technology in Thailand will continue to play an increasingly vital role in maintaining low-input aquaculture as a supplier of protein for domestic consumption. The aquaculture sector will also develop into a highly competitive, sustainable aquaculture industry to meet consumer demand for cultivated aquatic foods and products that are of high quality, safe, competitively priced, and nutritious and are produced in an environmentally responsible manner with maximum opportunity for making a profit in all sectors of the export industry.

In order to accomplish the target of sustainable aquaculture, Thailand should continue to establish, maintain and develop an appropriate legal and administrative framework which facilitates the development of responsible aquaculture, as deemed necessary. Thailand should also promote responsible development and management of aquaculture, including an advanced evaluation of the effects of aquaculture development on genetic diversity and ecosystem integrity, based on the best available scientific information. Importantly, Thailand should produce and regularly update aquaculture development strategies and plans, as required, to ensure that aquaculture development is ecologically sustainable and to allow the rational use of resources shared by aquaculture and other activities.

The close coordination, collaboration and commitment among relevant stakeholders, both public and private sectors, in enhancing aquaculture governance is to be strengthened in order to sustain responsible aquaculture operations in Thailand.

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Annex IV-7 Aquaculture governance in Viet Nam

Trinh Quang Tu and Tran Dinh Luan

1. Introduction

Aquaculture is an important economic sector of Viet Nam. For nearly two decades, aquaculture development has contributed to creating livelihoods for millions of people in rural and coastal areas, ensuring the domestic food supply, promoting a strong shift in the agricultural and rural economic structure, hunger eradication and poverty alleviation, and significantly increasing exports and economic growth, especially in coastal areas.

Over the period of 1990 to 2018, the annual average growth rate of fishery production reached 7.51 percent, from 1 020 tons in 1990 to 7.74 million tons in 2018. Much of the growth in production can be attributed to continued expansion in aquaculture, which increased from a 27.45 percent share of the sector in 1990 to an approximately 54 percent share in 2018 with an average annual growth rate of 12.7 percent, compared to 5.9 percent for capture fisheries. Although there is a growing domestic market as income improves and local demand increases, a strong export market is the driving force behind the growth in aquaculture. In addition, favourable government policies such as aquaculture development programmes for the period 2000 to 2010 and land conversion of inefficient agricultural and salt production lands to aquaculture areas have also boosted the sector. In 2018, the total value of Viet Nam's seafood exports reached USD 9.0 billion, accounting for about 23 percent share of the total export value of agriculture, forestry and fisheries (MARD, 2019). Viet Nam currently ranks third among the largest seafood exporters in the world with export markets now in more than 160 countries and territories (FAO, 2016).

However, the rapid development of aquaculture has also raised several issues for the sector, including issues of environmental pollution and disease outbreaks, ecosystem degradation, food safety and market issues. These have posed important questions about the sustainability of the sector such as will aquaculture continue to maintain stable development growth rates in the future, will policies, strategies and development plans in the fisheries sector be sufficient and significantly support the sector in meeting social, economic and environment concerns, and will there be any gaps and needs in the management system that require to be solved to make the sector develop sustainably?

In recent years, the government and the Ministry of Agriculture and Rural Development have issued many important legal documents to orient and promote fisheries development in the direction of increasing added value and sustainability. This chapter aims to review the governance issues of aquaculture development in Viet Nam, especially in the context of the new Fisheries Law 2017 that came into force on 1 January 2019 in response to the challenges encountered by the sector in recent years.

2. Brief overview of aquaculture sector

2.1 Potential of water surfaces

Viet Nam is geographically endowed with ideal conditions for a thriving fishery sector, namely two large deltas (Red River and Mekong River Deltas), numerous river systems and reservoirs,³⁸ a coastline 3 260 km long, plus over 1.0 million km² of the exclusive economic zone (EEZ) with more than 3 000 islands and islets scattered offshore,. According to the Directorate of Fisheries (2018), the total of potential water surface for aquaculture is about 1.7 million hectares, which comprise:

³⁸ There are 2 860 rivers with 112 estuaries and 2 470 reservoirs across the country.

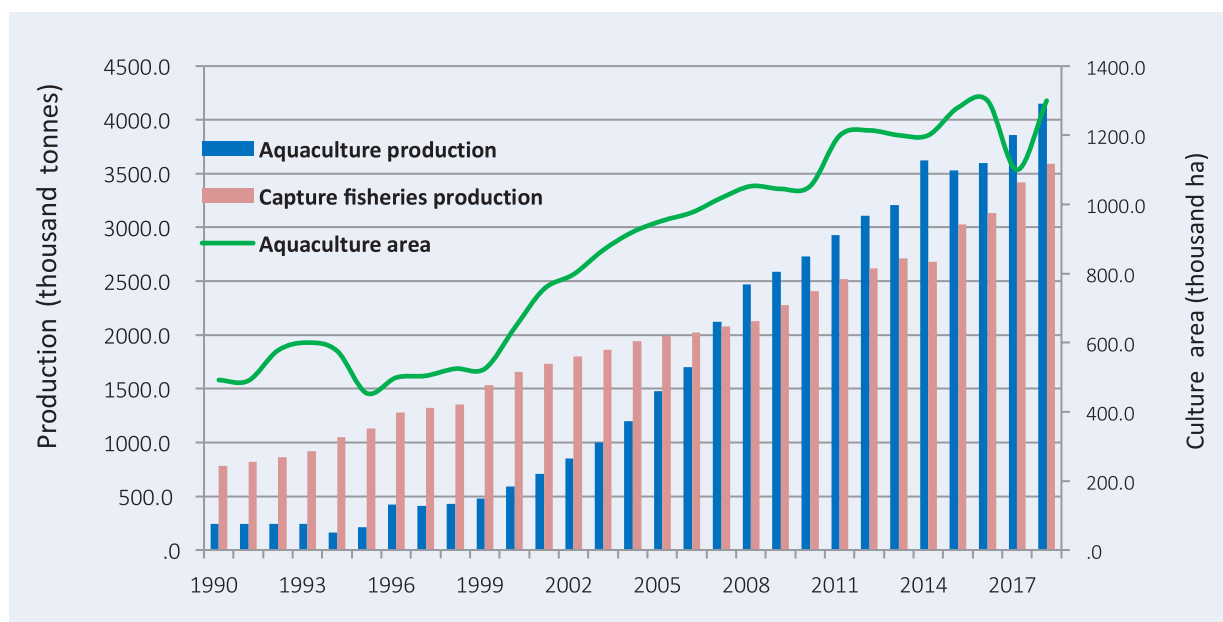
- i. 120 000 ha of small ponds, lakes and canals;
- ii. 340 000 ha of large water surface reservoirs, including both irrigation and hydro electric reservoirs;
- iii. 580 000 ha are paddy fields which can be used for aquaculture;
- iv. 500 000 ha of brackish and marine waterbodies, of which about 153 300 ha comprise intertidal coastal areas; 79 900 ha comprise straits, bays and lagoons; 100 000 ha are offshore sea.

2.2 Aquaculture sector performances

The booming of Viet Nam's aquaculture sector in the last two decades has been driven by the strong growth of export markets and the incentive policies of the government, especially after the government Resolution 09³⁹ that allows the use of unused coastal areas and the conversion of inefficient rice and salt production land into aquaculture, and the Decision 224⁴⁰ that approved an aquaculture development programme for the period 2000 to 2010.

Aquaculture production growth has resulted from the development of mass-scale seed production and other efficiency improvements which have boosted productivity. During the period 1990 to 2018, the average annual growth of aquaculture area and production were 3.41 percent and 10.33 percent respectively. Since 2007, aquaculture production has surpassed capture fisheries, making an important contribution to the growth of the fisheries sector (Figure 1). In 2018, the total aquaculture area reached 1.3 million ha, in which marine water area accounted for over 65 percent. Aquaculture production was about 4.15 million tons and the majority of the output originates from the Mekong River Delta, which accounts for about 70 percent of Viet Nam's total farmed fish production and 80 percent of total farmed shrimp production.

Figure 1 Aquaculture production volume in Viet Nam (1990 to 2018)



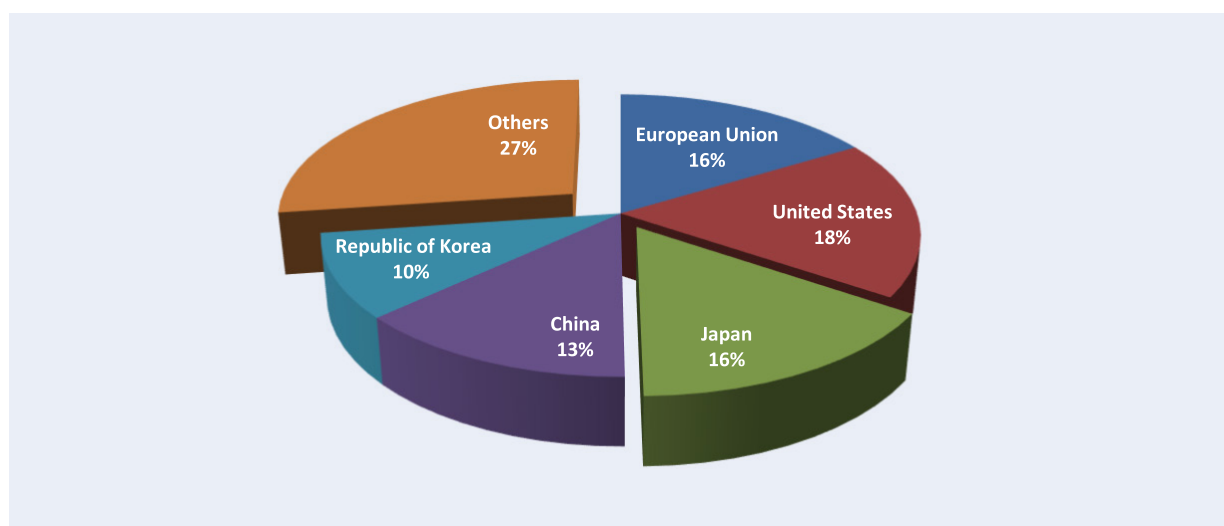
Source: Directorate of Fisheries

³⁹ The Resolution No. 09/2000 /NQ-CP dated 15 June 2000 on "A number of orientations and policies on economic restructuring and consumption of agricultural products".

⁴⁰ The Decision No. 224/1999/QĐ-TTg dated 8 December 1999 by Prime Minister on "Aquaculture development program for the period 2000–2010".

Driven by growing global demand, Vietnamese seafood exports have increased significantly. The value of exported seafood increased from USD 1.8 billion in 2000 to USD 9 billion in 2018, in which aquaculture accounted for about 65 percent of the total seafood export value. This has made Viet Nam the third largest exporter of seafood globally. The main export markets are the United States, the European Union, Japan, China and the Republic of Korea (Figure 2). Shrimp and catfish products are still two key export products, accounting for about 45 percent and 20 percent respectively of total export value, followed by molluscs and tuna, which respectively representing about 8 percent and 6 percent.

Figure 2 Viet Nam's seafood export market 2018



According to the Master Plan on Aquaculture Production Development to 2020, Vision to 2030,⁴¹ aquaculture will be developed in a sustainable manner, prioritizing industrial farming of major culture species for export (catfish, shrimp, whiteleg shrimp, tilapia and marine fish) and being suitable to each region's potential and strengths, and market demand. Aquaculture production is planned to reach 4.5 million tons (65 percent of total fisheries output) by 2020 and 6.3 million tons by 2030 (70 percent of total fisheries output).

Following the principles set out in the Strategy and Master plan, MARD recently approved the Scheme and Action plan⁴² to restructure the fisheries and aquaculture sector to ensure it will be a leading commodity producer by focusing on high value-added growth and sustainable development.

2.3 Cultured species, farming systems and production

Viet Nam's aquaculture has a diversity of species and production systems according to geographic and climatic conditions.

2.3.1 Freshwater aquaculture

There are five very popular cultured fish species in the North and North Central regions that belong to the *Cyprinidae* family such as common carp (*Ciprinus carpio*), silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), big head carp (*Aristichthys nobilis*) and major Indian carps including catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigal*). Mono-

⁴¹ The Decision No. 1445/QĐ-TTg dated 16 August 2013 by Prime Minister on approving "the Master Plan on Fisheries Development to 2020, Vision to 2030".

⁴² Decision No. 2760/QĐ-BNN-TCTS dated 22/11/2013 and Decision No. 1167/QĐ-BNN-TCTS dated 28/05/2014.

sex tilapia (*Oreochromis niloticus*) and red tilapia (*Oreochromis spp.*) have recently been introduced and are potential culture species for export. The above species are farmed in diverse systems such as monoculture and polyculture in ponds and cages,⁴³ integrated farming or VAC (garden–pond–livestock), integrated rice–fish, and with different levels of intensification, ranging from improved extensive, semi-intensive to intensive. The area under production of tilapia has increased between 2014 and 2018 and the production has increased very significantly over the same period (Table 1).

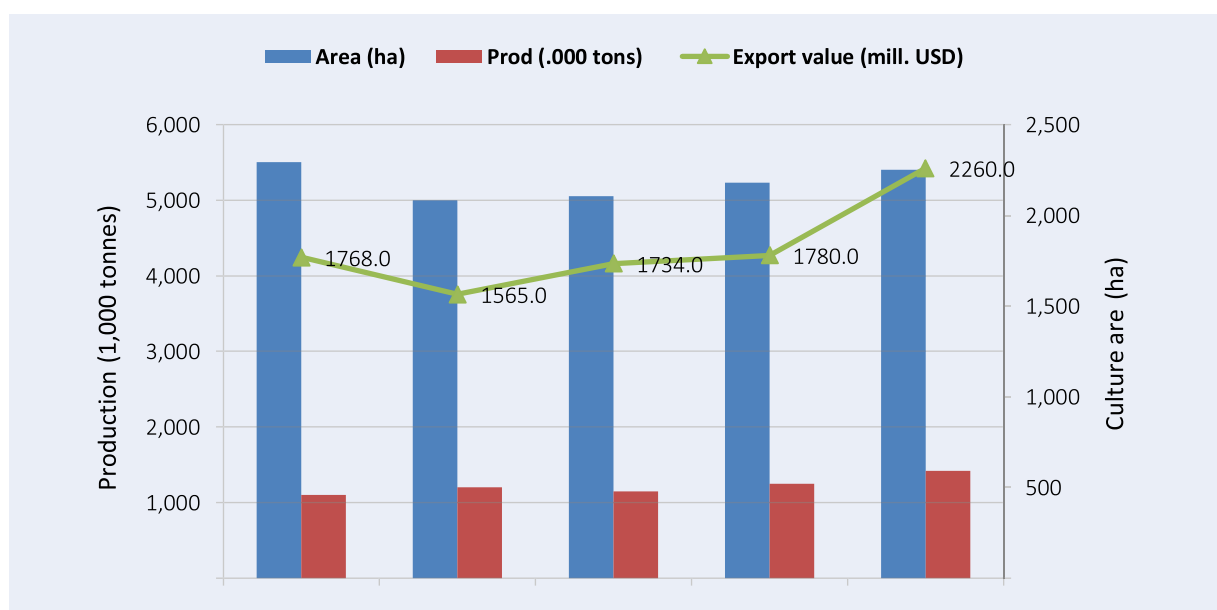
Table 1 Cultured area and production of tilapia in Viet Nam (2014–2018)

	2014	2015	2016	2017	2018
Area (1 000 ha)	25.88	25.75	25.00	21.00	30.00
Production (1 000 tonnes)	189.68	187.80	200.00	150.00	255.00

Source: Directorate of Fisheries

Catfishes (*Pangasius hypophthalmus* and *P. bocourti*), which are the representative and major export species of the Mekong Delta have the greatest production (about 70 percent of the total freshwater fish production). These species are often raised intensively in ponds and cages. Pond culture of *P. hypophthalmus* has been dominant since 2005 with a very high intensification level. On average, the culture productivity reached about 230 tons/ha. In 2018, the total production reached 1.42 million tons with an export value of USD 2.26 billion, accounting for 25 percent of the total seafood export value (Figure 3).

Figure 3 Catfish production in Viet Nam (2014–2018)



Source: Directorate of Fisheries

Giant freshwater prawn (*Macrobrachium rosenbergii*), climbing perch (*Anabas testudineus*) and snakehead fish (*Chana micropeltes*) are also common species cultured in ponds and/or intercropping in paddy fields in the southern provinces.

⁴³ Cage fish farming is practiced in rivers and reservoirs.

2.3.2 Brackishwater and marine aquaculture

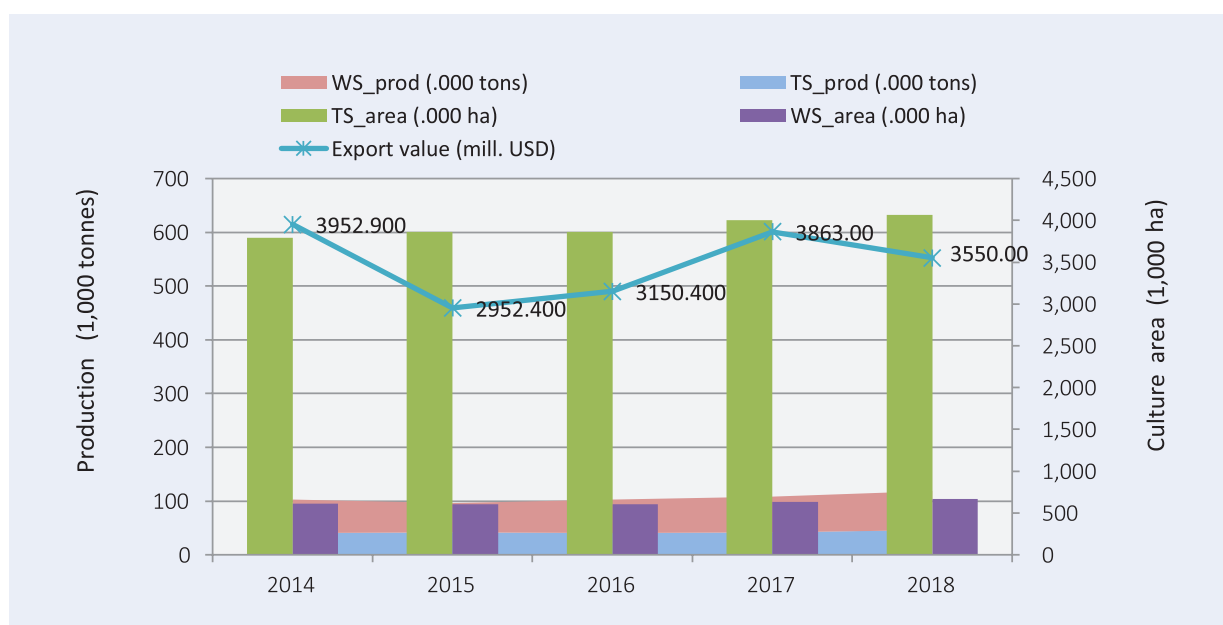
Various species have been raised falling into four major groups, namely crustacean, marine fish, molluscs and seaweed. Depending on the species, the farming systems vary across regions with different degrees of intensification.

- i. **Crustaceans:** brackishwater shrimp (*Penaeus monodon*, *P. vannamei*); lobster (*Panulirus ornatus*, *P. hormarus*, *P. timpsoni* and *P. longipes*) and mud crab (*Scylla* spp).

Brackishwater shrimps, including black tiger shrimp (*Penaeus monodon*) and whiteleg shrimp (*Penaeus vannamei*) are key export species farmed in all coastal provinces of Viet Nam, but mostly concentrated in the Mekong Delta (accounting for 90 percent by areas and 80 percent by production). In 2018, the total shrimp production was 0.76 million tons with an export value of USD 3.55 billion (Figure 4).

Black tiger shrimp is a native species and commonly cultured in different improved extensive farming systems such as integrated pond culture of shrimp, marine fish, mud crab and seaweed; rotational shrimp–rice system (Soc Trang, Kien Giang); and integrated shrimp–mangrove (Ca Mau, Bac Lieu). Whiteleg shrimp has been cultured since 2000 and has become the major culture species because of its short culture period and high production. This species is mainly cultured as monoculture in ponds with a high degree of intensification, ranging from semi-intensive, intensive to super-intensive. On average for the period 2014 to 2018, whiteleg shrimp accounted for 60 percent of the total shrimp production although the culture area of whiteleg shrimp only accounted for 14 percent of the total area.

Figure 4 Brackishwater shrimp production in Viet Nam (2014–2018)



Note: TS- Black tiger shrimp; WS- Whiteleg shrimp

Source: Directorate of Fisheries

Lobsters are typical culture species in the South Central region of Viet Nam, mainly distributed in Khanh Hoa and Phu Yen provinces (over 90 percent of the total production). The farming system is mainly cage culture on bays and around islands near the shore, and dominated by ornate spiny lobster (*P. ornatus*). In 2017, the total number of cages was 85 790 (2.65 million m³) with a production of 1 546 tons.

- ii. **Marine fish:** groupers (*Epinephelus coioides*, *E. malabaricus*, *E. tauvina*), cobia (*Rachycentron canadum*), seabass (*Lates calcarifer*), red drum (*Sciaenops ocellatus*), yellowfin pompano (*Trachinotus blochii*)

Marine fish are cultured as either monoculture or polyculture in cages and ponds. Cage culture is popular in some provinces such as Quang Ninh, Hai Phong (North), Khanh Hoa, Phu Yen (Central) and Kien Giang, Ba Ria-Vung Tau (South).

- iii. **Molluscs:** Hard clam (*Meretrix lyrata*, *Anadara granosa*), geoduck clam (*Lutraria philippinarum*), oysters (*Crassostrea ariakensis*, *C. gigas*), green mussel (*Perna canaliculus*).

Molluscs are farmed in two major systems, including intertidal culture (hard clam, sweet snail, blood cockle) and cages/hanging ropes on river mouths and bays (geoduck clam, green mussel, oyster).

- iv. **Seaweed:** *Gracilaria verrucosa*, *Kappaphycus alvarezii*, *Porphyra dentata*.

Seaweed is often grown in improved extensive shrimp ponds in North Central and South Central provinces. Figures for mariculture production for 2010–2017 (excluding 2011, 2013 and 2016) are presented in Table 2.

Table 2 Mariculture production in Viet Nam (2010–2017)

Categories	2010	2012	2014	2015	2017
Area (ha)	38 880	39 110	39 320	40 102	250 379
Production (tons)	156 681	200 175	282 188	308 587	478 640
- Marine fish	15 751	34 413	34 026	30 550	29 770
- Molluscs	133 534	158 277	239 473	269 161	287 075
- Crustacean	7 396	7 485	8 689	8 876	60 195
- Seaweed	-	-	-	-	101 600

Source: Directorate of Fisheries 2010–2017

2.4 Seed production

Viet Nam has been successful in artificial breeding technology research and seed production of most aquatic species for grow-out aquaculture. Only a few species still depend on natural and/or imported seed sources (e.g. lobster). In general, current seed production for key aquaculture species has met the grow-out culture demands:

- i. **Brackishwater shrimp:** A total of 2 457 hatcheries of brackishwater shrimp, including 1 885 hatcheries of tiger shrimp and 602 of whiteleg shrimp are in operation and distributed mainly in the South Central provinces. Whereas broodstock of black tiger are mainly dependent on natural sources, whiteleg broodstock are mainly imported, accounting for 90 percent (180 000 to 260 000 individuals) of the total demand for broodstock. In 2018, the total seed production was 120 billions of postlarvae (PL), in which 69 percent was whiteleg shrimp (82.5 billion PL).

- ii. Catfish: There are 230 hatcheries and 4 000 fingerling nursery households in the Mekong Delta. Recently, the broodstock quality has significantly been improved with about 30 000 broodstocks selected. In 2018, about 25 billion catfish fries (2.5 billion fingerlings) were produced for grow-out culture.
- iii. Tilapia: There are 250 hatcheries producing and supplying tilapia seeds, in which 50 hatcheries have broodstock with over one million individuals. Annually, about 1.2 billion fries and 0.5 billion fingerlings have been produced, meeting about 75 percent of tilapia seeds for grow-out culture.
- iv. Other species: Except lobsters which depend entirely on natural and imported seeds, most aquaculture species such as freshwater fish, freshwater giant prawn, molluscs (hard clam, sweet snail, blood cockle), marine fish (e.g. groupers, cobia, seabass, yellowfin pompano) have been able to produce seeds, supplying enough for grow-out culture demands.

2.5 Feed supply

In Viet Nam, the feed used for aquaculture includes by-catch or so-called “trash fish”/shellfish, homemade feed and industrial feed. Homemade feed and trash fish are still used in some farming systems such as: improved extensive system of shrimp, mud crab and marine fish; cage culture of lobsters and marine fish; and sweet snail. However, using low quality formulated feeds and by-catch may cause polluted waters and spread disease.

Industrial feeds have been commonly applied for semi-intensive, intensive farming systems of all key aquaculture species (shrimp, catfish, and tilapia). According to the Directorate of Fisheries (D-Fish) (2018), there are currently about 130 aquatic feed companies in Viet Nam with an annual production of 3.77 million tons, meeting 85.6 percent of the domestic demand. By 2020, the demand for aquaculture feed is projected to increase to 5 or 6 million tons.

However, almost all of the market share of aquatic feed is in the hands of foreign businesses. In particular, the shrimp feed market is almost 100 percent owned by foreign direct investment (FDI) groups such as Uni-President (30 percent to 35 percent market share), CP Group, and Tomboy. Besides, Viet Nam also imports 140 000 to 150 000 tons of aquatic feeds annually from Thailand, Taiwan Province of China, and China, Hong Kong SAR.

2.6 Drug, chemicals and probiotics

Along with the rapid development of aquaculture, both in terms of area and degree of intensification, the use of drugs, chemicals and probiotics has also increased, especially in the farming of some key aquaculture species such as brackishwater shrimps, pangasius catfish and tilapia. The current use of drugs and chemicals in aquaculture has a number of purposes such as managing water quality and pond sediment, increasing natural food biomass, managing disease and aquatic animal’s health, feed production, managing and improving seed production efficiency, and promoting the growth of culture species.

According to the Directorate of Fisheries (D-FISH), there are more than 400 enterprises producing and importing products of environmental treatment and improvement used in aquaculture. About 3 000 products are currently on the market, of which 83 percent are produced domestically. Probiotics account for about 40 percent and the rest are chemicals and some minerals.

The most common products used in shrimp farming were lime (e.g. CaCO_3 , CaO); substances to kill bacteria, parasites and algae bloom (e.g. iodine, benzalkonium chloride (BKC), chlorin, formalin, formol); minerals (e.g. azomite, diametene), vitamin C; micronutrients and enzymes to increase the shrimp's immune system, probiotics and antibiotics (e.g. flofenicol, oxytetraciline).

Similarly, various kinds of drugs and chemicals used in catfish and tilapia farming in the Mekong Delta include chemicals used to disinfect and improve the pond water environment (BKC, zeolite, chlorine, formol); vitamins and probiotics; and antibiotics (e.g. enrofloxacin, sulfadimethoxine, trimethoprim).

3. Certifications

Currently, Viet Nam's aquaculture industry is facing dozens of different technical standards and certification schemes from the Vietnamese government and private certification bodies. The most common standards applied include GlobalG.A.P. BAP/GAA, and ASC. These standards focus on: (i) ensuring the quality of food hygiene and safety; (ii) disease safety; (iii) environmental safety; (iv) social security; and (v) traceability of products. Up until 2019, Viet Nam had a total of 192 BAP certified farms and feed mills; 349 ASC certified farms; and 76 GlobalG.A.P. certified farms.

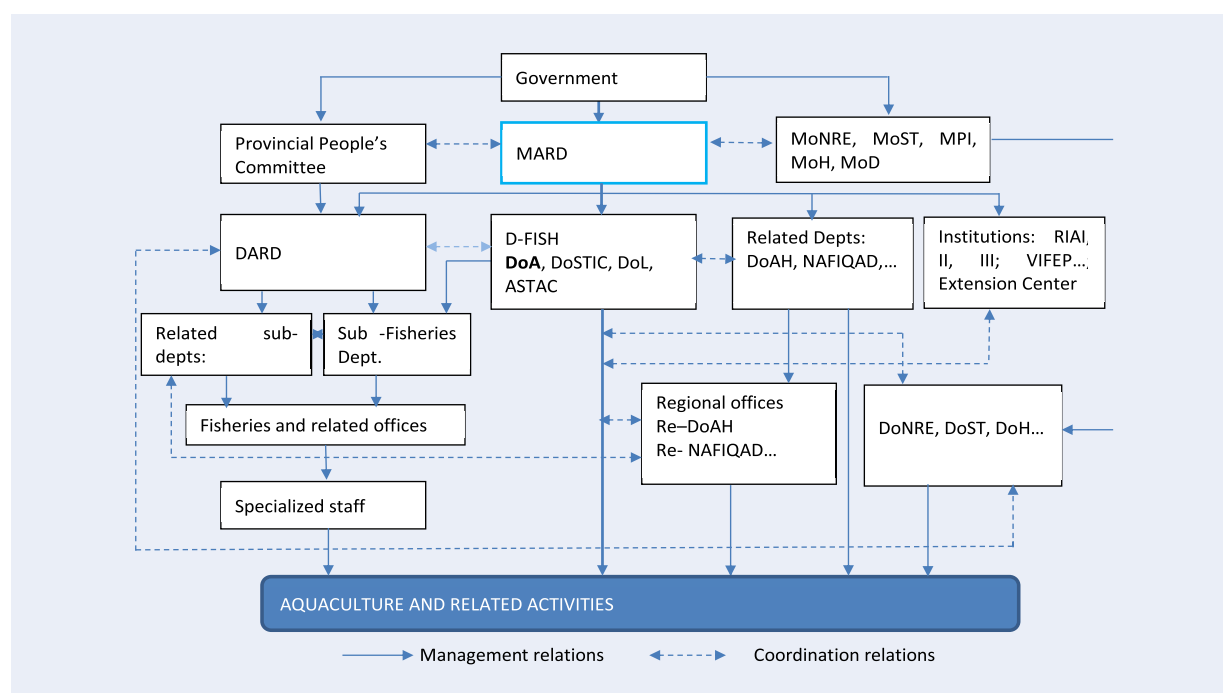
Viet Nam is also promoting good practices for aquaculture (referred to as VietGAP) that was first issued together with the Decision No.1503/QĐ-BNN-TCTS on 5 July 2011 by MARD, and later replaced by Decision No.3824/QĐ-BNN-TCTS on 6 September 2014. The certification aims at ensuring product quality and food safety by complying with current standards and regulations of the government and provisions of the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO). The certification scheme requires environmental impact evaluation as well as evaluation of the socio-economic implications of projects. The certification scheme also requires the aquaculture farms to strictly abide with the provisions the agreement of the International Labour Organization (ILO) on labour rights.

The VietGAP certification is currently granted by 9 authorized agencies. To apply VietGAP, MARD also issued Decision 1617/QĐ-BNN-TCTS on 18 July 2011 that gives detailed guidelines for key aquaculture species including catfish (*P. hypophthalmus*), giant tiger prawn (*P. monodon*) and white shrimp (*P. vannamei*). The certification programme is also likely to be extended to other aquatic species in Viet Nam. It is estimated that currently there are 701 VietGAP certificates issued to over 1 000 aquaculture farms with an area of 6 960 ha.

4. Institutional framework governing the aquaculture industry

The institutional framework for governing the fisheries sector (including aquaculture) in Viet Nam is outlined in Figure 5. There is a plethora of agencies involved and coordination can be a major challenge.

Figure 5 Management framework for aquaculture development in Viet Nam



The Central Government is the highest executive organ. It is responsible for issues related to politics, economy, culture, society, national defence, and foreign policy. For the national fisheries and aquaculture development, the government administers all affairs mainly via the Ministry of Agriculture and Rural Development (MARD).⁴⁴ The MARD controls all institutions in its sector in order to fulfil annual, five-year, and long-term development plans and strategies, which are handled by the national assembly or the central government. It has the right to issue legal documents in order to implement decisions made by the national assembly and the central government (Article 2, Session 10, Decree No. 15/2017/ND-CP). Other institutions such as the Ministry of Planning and Investment (MPI), the Ministry of Science and Technology, Ministry of Environment and Natural Resources (MoNRE), Ministry of Health (MoH) play roles as consultant units for the government or collaborating partners of the MARD.

Under MARD, the Directorate of Fisheries (D-Fish) is a focal body that directly oversees the management of fisheries and aquaculture⁴⁵ nationwide. Its responsibilities lie in strategic planning for the development of fisheries and aquaculture in the country and enforcement of law and regulations related to seafood production and conservation of aquatic resources. D-Fish is also responsible for collecting and compiling data on fisheries and aquaculture production throughout the country. In addition, other related departments under MARD, such as Department of Animal Health (DoAH),⁴⁶ Department of Agro-Forestry-Fisheries Quality Assurance (NAFIQAD),⁴⁷ Department of Science, Technology and Environment (DoSTE); Directorate of Water Resources (DoWR) are also involved in governing the fisheries sector, either directly or indirectly through cooperating with D-Fish.

⁴⁴ MARD was established in 1995 by combining the Ministry of Agriculture and Food Industry, the Ministry of Forestry and the Ministry of Irrigation. In 2007, the Ministry of Fisheries was also merged into MARD. Its latest functions, tasks and organization are defined in Decree No. 15/2017/ND-CP, dated 17 February 2017.

⁴⁵ D-Fish was established in 2010 under Decision No. 05/2010/QĐ-TTg. Its latest functions, tasks and organization structure are defined in Decree No. 27/2017/QĐ-TTg, dated 3 July 2017.

⁴⁶ DoAH was established in 2011 under Decision No. 1453/QĐ-BNN-TCCB and is responsible for minimizing the impact of diseases on Viet Nam's animal health. Its latest functions, tasks and organization structure are defined in Decree No. 1399/QĐ-BNN-TCCB, dated 13 April 2017.

⁴⁷ NAFIQAD's functions, tasks and organization structure are defined in Decision No. 1120/QĐ-BNN-TCCB dated 31 March /2017. NAFIQAD is responsible for ensuring the quality and safety of agricultural, forestry, fishery products.

Within D-Fish, there are professional departments in charge of various fields, in which the Department of Aquaculture (DoA) is a specialized unit assigned to help D-Fish perform the state management of aquaculture.⁴⁸ D-Fish also has two centres, namely the Center for Aquaculture Surveying, Testing and Accreditation (ASTAC)⁴⁹ and the Center for Fisheries Information (CFI). These centres serve D-Fish's management of aquaculture and also provide public services in this field according to its functions and duties and the provisions of the law.

Similar to the Ministry's structure, D-Fish also has a number of related professional departments serving the its management of fisheries and aquaculture, such as the Department of Science, Technology and International Cooperation (DoSTIC); the Department of Legislation (DoL); the Department of Conservation and Aquatic Resource Development (DCARD).

At local level, the Department of Agriculture and Rural Development (DARD)⁵⁰ is a professional agency of the Provincial People's Committee (PPC) that performs the functions of advising and assisting the PPC in the management of agriculture and rural development, including aquaculture. DARD is also under the direction, inspection, professional guidance of MARD.

Based on MARD's direction, DARD is responsible for the management and development of fisheries and aquaculture in each province. The management system at the provincial and district levels is similar to that at the national level. Under the new Fisheries Law, their role could increase according to recent legislative changes.

In addition to the state management bodies, there are also relevant agencies and organizations such as research institutes and commodity associations indirectly playing a supporting role for fisheries sector management and development such as Research Institute for Aquaculture I, II, III, Vietnam Institution of Fisheries Economics and Planning (VIFEP); universities and colleges (Nha Trang University, Hanoi Agriculture University); Viet Nam Fisheries Association (VINAFAIS); Association of Seafood Exporters and Producers (VASEP); National Agriculture Extension Center (NAEC).

5. Legislation

In Viet Nam, current legal documents of the state management system on aquaculture comprise: (i) the laws promulgated by the National Assembly (the Fisheries Law, Veterinary Law, Environmental Protection Law etc.); (ii) decisions, decrees and directives of the Prime Minister; and (iii) circulars, decisions and directives issued by the government ministers to guide and enforce the implementation of the laws. These documents focus on the following principles: (i) aquaculture must develop on the principle of sustainability and ecological safety; (ii) it does not cause social conflicts in the use of different resources, as well as use of the same resources for different economic purposes on the principle of integrated use and management; and (iii) the state supports and facilitates the development process of aquaculture towards industrialization and modernization.

In general, most of the laws are currently not detailed, but they are in the form of framework laws (also called "pipe" laws). To enforce the laws, the government needs to issue decrees and decisions, and accordingly sectoral ministries also promulgate circulars, joint circulars, decisions (issued development plans and strategies) and technical regulations that provide details and guide the implementation.

⁴⁸ DoA's functions, tasks and organization structure are defined in Decision No. 907/20 17/QĐ-TCTS-VP, dated 1 September 2017.

⁴⁹ ASTAC's functions, tasks and organization structure are defined in Decision No. 912/20 17/QĐ-TCTS-VP, dated 1 September 2017.

⁵⁰ For DARD's functions, tasks and organization structure in the provinces see <https://sonnptnt.soctrang.gov.vn/>

The basic legislation for governing the fisheries and aquaculture sector in Viet Nam is the Law on Fisheries, its guiding documents and technical regulations. Before 2019, the fisheries sector in Viet Nam was managed according to the Law on Fisheries No. 17/2003/QH11 (hereafter referred to as the Fisheries Law 2003), which was adopted in 2003, came into force on 1 July 2004, and remained applicable until 31 December 2018.

In response to the challenges encountered by the seafood sector in recent years, especially in the context of increased climate change and global integration, substantial policy and legislative changes have been undertaken. A new Law on Fisheries No.18/2017/QH14 (hereafter referred to as the Fisheries Law 2017) was adopted on 21 November 2017 and took effect on 1 January 2019, replacing the 2003 Law on Fisheries.⁵¹ The Fisheries Law 2017 includes 9 chapters and 105 articles that regulate: (i) all activities related to fisheries and aquaculture; (ii) the rights and obligations of organizations and individuals engaged in fisheries and aquaculture activities or related activities; and (iii) state management on fisheries and aquaculture. The new fisheries law adds more regulations (and also more details) that meet integration requirements, especially in the context of Viet Nam's seafood exports, which face many technical barriers.

For aquaculture, the state management regulations are detailed in Chapter 3 with 4 sections and 25 articles (from Article 23 to article 47) that cover the management of seeds, feeds and water environmental treatment products, and aquaculture related activities:

- i. Seed management is specified in the Section 1 with 8 articles (Article 23 to 30). Accordingly, aquatic seeds selling on the market have to meet requirements such as in the list of aquatic species allowed to produce and trade in Viet Nam; conforming with applied standards and the regulations; ensuring seed quality according to official standards and quarantine regulations. The section also sets out conditions for seed production and nursing businesses; provisions on seed importing and exporting, testing and accreditation of seed.
- ii. Feeds and water treatment products are detailed in the Section 2 with 7 articles (Article 31 to 37). Similarly, feeds and water treatment products sold on the market have to meet requirements such as conforming to applied standards and official regulations; ensuring quality according to official standards; having ingredients of chemicals, probiotics, microorganisms and raw materials on the list of permitted use constituents in aquatic feed production.
- iii. Aquaculture has been regulated in Section 3 with 5 articles (Article 38 to 42). The Fisheries Law 2017 regulates conditions for aquaculture farms, culture species, production types and purposes of aquaculture, in which cage aquaculture and key culture species must be registered with the provincial authorities. A new point in the Fisheries Law 2017 stipulates that marine aquaculture must be licensed by competent authorities.⁵² In addition, the new law also provides detailed regulations on allocating, leasing, and acquisitioning land and marine areas used for aquaculture (Section 4, Articles 43 to 47), and the authority of state agencies. The allocation and/or lease of the marine area must be based on the national marine spatial planning, provincial planning and legal provisions of the sea, ensuring national security and defence.

⁵¹ FAOLEX Database

⁵² Responsibility for license granting lies with the Provincial People's Committees for aquaculture activities taking place up to six nautical miles from the shore; after which, the responsibility falls on MARD (D-FISH). The government (MARD) regulates the licensing of aquaculture at sea to foreign investors and foreign-investment economic organizations.

Compared with the Fisheries Law 2003, the new law allows longer allocating and leasing times for marine areas for aquaculture – up to 30 years, plus the period can be extended up to an additional 20 years.

The Fisheries Law 2017 also provides additional regulations on (i) the national fisheries database that has been built consistently from the central to the local level and standardized to for ease of updating, extracting and managing by information technology (Chapter 1, Article 9); (ii) co-management in aquatic resources management, whereby the community is recognized and assigned management rights in a certain area (Chapter 2, Section 1); (iii) the allowed aquaculture activities in marine protected areas.

For state management of aquaculture, besides the regulations on the content of state management of fisheries; the responsibilities of the government, ministries, ministerial-level agencies and people's committees at all levels, the Fisheries Law 2017 also stipulates the responsibilities of the Vietnam Fatherland Front and its member agencies, social-professional and social organizations.

To implement the Fisheries Law 2017, the government and MARD have also issued a number of the circulars, decrees and decisions to guide and detail the Fisheries Law's regulations which are provided in Table 3. Along with the promulgation of a decree to guide the Law (Decree No.26/2019/ND-CP), the Government has also issued a decree on penalties for administrative violations in the fisheries sector (Decree No.42/2019/ND-CP), in which the maximum fine in the field of protecting aquatic resources is up to VND 1.0 billion.

Table 3 A list of guiding documents for implementing the Fisheries Law 2017

	Document reference	Date	Regulatory topic
1	Decree No.26/2019/ND-CP	8 March 2019	Detailing a number of articles and measures to enforce the Fisheries Law 2017
2	Decree No.42/2019/ND-CP	16 May 2019	Penalties for administrative violations in the field of fisheries
3	Decision No.50/2018/QĐ-TTg	13 December 2018	Regulations on key aquaculture species
4	Circular 07/2019/TT-BNNPTNT	7 August 2019	Promulgating national technical regulations on aquatic feeds
5	Circular 08/2019/TT-BNNPTNT	9 August 2019	Promulgating national technical regulations on environmental treatment products for aquaculture
6	Circular 25/2018/TT-BNNPTNT	15 November 2018	Processes and procedures for risk assessment and licensing of imported live aquatic products
7	Circular 26/2018/TT-BNNPTNT	15 November 2018	Management of seed, feed and water treatment
8	Circular 24/2018/TT-BNNPTNT	15 November 2018	Updating, extracting and managing the national database on fisheries
9	Circular 19/2018/TT-BNNPTNT	15 November 2018	Guiding the protection and development of aquatic resources
10	Decision No.7453/BNN-TCTS	8 October 2019	Implementing fisheries database development at provincial and local levels

In parallel with the Fisheries Law, the Veterinary Law 2015⁵³ is also an important legal basis in governing the aquaculture industry. Based on the Veterinary Law, government's decrees⁵⁴ and decisions,⁵⁵ MARD has also issued a number of circulars regulating: (i) disease prevention and control; (ii) quarantine of aquatic animals; (iii) management of veterinary drugs; (iv) organizing the veterinary system, from central to district level and veterinary staff at commune level. With the reorganization of the veterinary system, the goal of MARD is to be proactive in preventing and controlling aquatic animal diseases.

The aquaculture industry, in addition, is also governed by other related laws and regulations, including: the Land Law 2013,⁵⁶ the Planning Law 2017,⁵⁷ Environmental Protection Law 2014,⁵⁸ the Food Safety Law 2010,⁵⁹ the Law on Standards and Technical Regulations,⁶⁰ the Water Resources Law,⁶¹ the Science and Technology Law 2013,⁶² the Investment Law 2014,⁶³ the Goods and Product Quality Law 2018,⁶⁴ the Labor Law 2012,⁶⁵ and the Biodiversity Law 2012.⁶⁶ These laws with regulations on aquaculture management are referenced in the Fisheries Law.

In the Fisheries Law 2017, regulations on conditions for aquaculture farms, whereby all farms must comply with legal regulations on: (i) the use of land and coastal area; (ii) environmental protection; (iii) veterinary hygiene; (iv) labour safety; and (v) food safety. These regulations are already promulgated in the relevant laws mentioned above. For example, in the Environmental Protection Law 2014, environmental protection in aquaculture is stipulated in Article 71.

In addition, on the basis of the relevant laws, MARD has also promulgated legal documents on state management of aquaculture such as regulations on prevention and control of aquatic animal diseases (Circular No.44/2016/TT-BNNPTNT).

⁵³ The Veterinary Law 2015 (No.79/2015/QH13) approved by the Thirteenth National Assembly at its Ninth Session dated 19 June 2015.

⁵⁴ The Decree (No.35/2016/NĐ-CP) gives details and guides the implementation of a number of articles of the Veterinary Law 2015.

⁵⁵ The Decision (No.16/2016/QĐ-TTg) of Prime Minister stipulating the establishment, organization and operation of the steering committee for animal disease prevention and control at all levels.

⁵⁶ The Land Law 2013 (No.45/2013/QH13) approved by the Thirteenth National Assembly at its Sixth Session dated 29 November 2013.

⁵⁷ The Planning Law 2017 (No. 21/2017/QH14) approved by the Fourteenth National Assembly at its Fourth Session dated 24 November 2017.

⁵⁸ The Environmental Protection Law 2014 (No.55/2014/QH13) approved by the Thirteenth National Assembly at its Seventh Session dated 23 June 2014.

⁵⁹ The Food Safety Law 2010 (No.55/2010/QH12) approved by the Twelfth National Assembly at its Seventh Session dated 17 June 2010.

⁶⁰ The Law on Standards and Technical Regulations (No. 68/2006/QH11) approved by the Eleventh National Assembly on Ninth Session dated 29 June 2006.

⁶¹ The Water Resources Law (No. 17/2012/QH13) approved by the Thirteenth National Assembly at its Third Session dated 21 June 2012.

⁶² The Science and Technology Law 2013 (No. 29/2013/QH13) approved by the Thirteenth National Assembly at its Fifth Session dated 21 June 2012.

⁶³ The Investment Law 2014 (No.67/2014/QH13) approved by the Thirteenth National Assembly at its Eighth Session dated 26 November 2014.

⁶⁴ The Goods and Product Quality Law 2007 (No.05/2007/QH12) approved by the Twelfth National Assembly at its Second Session dated 21 November 2007 and the Unified Document of the Law (No.30/VBHN-VPQH) approved by the National Assembly dated 10 December 2018.

⁶⁵ The Labor Law 2012 (No.10/2012/QH13) approved by the Thirteenth National Assembly at its Third Session dated 18 June 2012.

⁶⁶ The Biodiversity 2008 (No. 20/2008/QH12) approved by the Thirteenth National Assembly at its Third Session dated 23 November 2008.

6. Technical standards and regulations

In supporting state management in aquaculture, a number of national standards and technical regulations have also been developed and issued by MARD and related Ministries (e.g. Ministry of Science and Technology (MoST), Ministry of Natural Resources and Environment (MoNRE).

6.1 National standards

The national standards (TCVN) are regulations on technical specifications and management requirements used as standards to classify and evaluate products, goods, services, processes etc. in order to improve their quality and effectiveness. In aquaculture, the national standards are often developed by D-FISH (MARD) and appraised by the Directorate of Standardization, Metrology and Quality, then issued by MARD or MoST. These standards include technical requirements on aquaculture grow-out farms and hatcheries; broodstock and seeds (fry, fingerling); feeds used in aquaculture; diagnostic procedures for aquatic animal disease; codes of practice for fisheries and fishery products. It should be noted that the code of practice (TCVN 7265:2015) is entirely equivalent to CAC/RCP 52-2003, Rev. 4-2008 developed by the Codex Committee. Table 4 presents a list of national technical standards in aquaculture.⁶⁷

Table 4 A list of national standards in aquaculture

	National standards	Technical requirements
I	Seed production and trade	
1	TCVN 8398:2012	Seed (PL15) of black tiger shrimp (<i>P. monodon</i>)
2	TCVN 8399:2012	Broodstock of black tiger shrimp (<i>P. monodon</i>)
3	TCVN 9586:2014	Fry, fingerlings and broodstock of 17 freshwater fish species
4	TCVN 9963:2014	Fry, fingerlings and broodstock of catfish (<i>P. hypophthalmus</i>)
5	TCVN 10462:2014	Fry, fingerlings and broodstock of spotted grouper (<i>Epinephelus coioides</i>) and cobia <i>R. canadum</i> – marine fish.
6	TCVN 9388:2014	Fingerlings of denti carp (<i>Spinibarbus denticulatus</i>)
7	TCVN 9389:2014	Fingerlings and broodstock of giant freshwater prawn (<i>Macrobrachium rosenbergii</i>)
8	TCVN 10463:2014	Fry, fingerlings and broodstock of red bellied pacu (<i>Colossoma brachypomum</i>)
9	TCVN 10464:2014	Fingerlings of pompano (<i>Trachinotus blochii</i> ; <i>Trachinotus ovatus</i>)
10	TCVN 9388:2014	Fingerlings of denti carp (<i>Spinibarbus denticulatus</i>)
11	TCVN 10465:2014	Fingerlings and broodstock of freshwater turtle (<i>Trionyx sinensis</i> , <i>Trionyx steinachderi</i>)
12	TCVN 10257:2014	Seed (PL12) of whiteleg shrimp (<i>Litopenaeus vannamei</i>)
II	Feed production and trade	
1	TCVN 10300:2014	Compound feeds for catfish (<i>P. hypophthalmus</i>) and tilapia (<i>Oreochromis</i> spp.)
2	TCVN 9964:2014	Compound feed for black tiger shrimp (<i>P. monodon</i>)

⁶⁷ For details see <https://tongcucthuysan.gov.vn/vi-vn/th%C3%B4ng-tin-h%E1%BB%AFu-%C3%ADch/ti%C3%AAu-chu%E1%BA%A9n-quy-chu%E1%BA%A9n>

	National standards	Technical requirements
3	TCVN 10325:2014	Compound feed for whiteleg shrimp (<i>Litopenaeus vannamei</i>)
4	TCVN 10301:2014	Compound feed for cobia (<i>Rachycentron canadum</i>) and seabass (<i>Lates calcarifer</i>)
5	TCVN 11754:2016	Technical requirements and test methods for <i>Artemia</i> spp. (used in aquaculture feeds)
6	Code of practice for fisheries and fishery products	
III	TCVN 7265:2015	Aquaculture and fisheries; preliminary processing, deep processing, preserving; transporting and retailing aquatic products including shellfish, invertebrates and aquatic products for use as food

6.2 National technical regulations

Technical regulations are regulations establishing technical specifications and management requirements that products, goods, services, processes, etc. must comply with to: (i) ensure hygiene, safety and human health; (ii) protect animals, plants and environment; and (iii) protect national interests and security, consumer rights and other essential requirements. Technical regulations are promulgated by competent authorities for compulsory application.

Currently, national technical regulations applied in aquaculture have been developed for grow-out farms, hatcheries, aquatic feeds and environment treatment products. These regulations technically specify conditions on veterinary hygiene, food safety, biosecurity and environment protection for aquaculture grow-out farms and hatcheries, particularly for some key species such as brackishwater shrimps, catfish and tilapia; safety criteria and permissible limits for aquatic feeds (compound, complementary, and live feeds) and environment treatment products (chemicals and biological products) used in aquaculture (Table 5).

Organizations and individuals who produce and trade aquatic feeds and environmental treatment products need to declare their conformity according to different measures, depending on products produced domestically or imported. D-Fish and DARDs are responsible for checking and inspecting the implementation of those regulations as assigned and decentralized by MARD.

Table 5 A list of national technical regulations in aquaculture

	National technical regulations	Technical requirements
	QCVN 02-15: 2009/ BNNPTNT ¹	Conditions for food hygiene and safety in fisheries production
1	QCVN 02-15: 2009/ BNNPTNT	Conditions for food safety, biosecurity and environment for hatcheries
2	QCVN 01- 80: 2011/ BNNPTNT ²	Veterinary hygiene conditions in grow-out aquaculture farms
3	QCVN 01- 81: 2011/ BNNPTNT	Veterinary hygiene conditions in hatcheries
4	QCVN 01- 83: 2011/ BNNPTNT	Animal diseases: sample collection, storage and shipment

	National technical regulations	Technical requirements
5	QCVN 02- 19: 2014/ BNNPTNT ³	Ensure veterinary hygiene, environmental protection and food safety of grow-out farm of brackishwater shrimps (<i>P. monodon</i> , <i>Litopenaeus vannamei</i>)
6	QCVN 02-20:2014/ BNNPTNT	Ensure veterinary hygiene, environmental protection and food safety of catfish grow-out farms
7	QCVN 02- 25 : 2017/ BNNPTNT ⁴	Ensure veterinary hygiene, environmental protection and food safety (hatchery of tilapia)
8	QCVN 02- 26 : 2017/ BNNPTNT	Ensure veterinary hygiene, environmental protection and food safety (grow-out farm of tilapia)
9	QCVN 02-31-1 : 2019/ BNNPTNT ⁵	Safety criteria and permissible limits for compound feeds used in aquaculture
10	QCVN 02-31-2 : 2019/ BNNPTNT	Safety criteria and permissible limits for supplemental feeds used in aquaculture
11	QCVN 02-31-3 : 2019/ BNNPTNT	Safety criteria and permissible limits for fresh and live feeds used in aquaculture
12	QCVN 02-32-1:2019/ BNNPTNT ⁶	Environment treatment products in aquaculture (chemicals and biological products)

7. Gaps, issues and challenges in aquaculture governance

Being considered an important food production industry as well as a key economic sector of Viet Nam, aquaculture development has been pushed to achieve fast growth, but without losing concern for protection of the environment and aquatic resources, effectiveness and sustainability. In recent years, Viet Nam has also made much effort in improving the governance of the aquaculture sector towards increasing added value and sustainable development, and meeting integration requirements, as reflected in the improvement of the legal framework with the new Fisheries Law 2017. Several management regulations have been revised and supplemented compared to the Fisheries Law 2013, and projected to create positive changes. However, currently state management of the aquaculture sector is still facing a number of shortcomings and challenges which require to be addressed, namely:

- i. Aquaculture production in Viet Nam is dominated by small-scale, mainly household production. Farmers' awareness and compliance with management regulations and planning in aquaculture are still limited. This has led to difficulties in managing environmental pollution and aquatic animal diseases. Small-scale production and lack of linkages⁶⁸ have also resulted in low production efficiency, uneven product quality and limited market access.
- ii. Poor infrastructure, including irrigation systems and wastewater treatment systems are also a major constraint for aquaculture development and management. Most of the existing irrigation systems for aquaculture, especially in coastal areas, were previously designed for agricultural development (mainly for rice development). When converted to aquaculture they were no longer suitable. In some areas, there exists conflicts over water sources between aquaculture and agriculture.

⁶⁸ Both vertical and horizontal linkages in the aquaculture supply chain.

- iii. In addition, most of the grow-out culture and seed production areas currently do not have a separate water supply and drainage system. Wastewater treatment systems are almost unavailable. As a result, the risks of environmental pollution and the occurrence of diseases and their spread increase as the intensification of aquaculture increases.
- iv. The stability of aquaculture planning in provinces is still limited because of the lower priority for aquaculture development compared to some other economic sectors such as tourism and industry. In many areas where there has been an advantage for aquaculture development, aquaculture farms and/or hatcheries are in competition with tourism and/or resort areas.
- v. Viet Nam's aquaculture, with diversified farming types and small-scale production, is strongly influenced by changes in natural conditions and environmental factors, especially recent climate change. Global warming could increase the virulence of pathogens and animal diseases, and reduce ecosystem productivity and biodiversity. Sea-level rise and extreme weather events would damage infrastructure, aquaculture farm facilities and cause saltwater intrusion.
- vi. Globalization and deeper international integration creates opportunities to expand markets for Viet Nam's seafood products, but are also huge challenges for the sector. Globalization of the seafood chain requires increased traceability, ecological sustainability, and health and safety certifications. Actually, Viet Nam's seafood sector is facing various kinds of sustainable certifications (for example, GlobalG.A.P., ASC, BAP) and increased technical barriers from importing countries. In such a context, legal and regulatory compliance is becoming very difficult for Viet Nam and the government must have an effective legal framework, health and safety procedures, and good aquaculture management practices in order to meet the increased requirements.

8. Recommendations

- i. Review existing national standards and technical regulations on aquaculture early on the basis of the new Fisheries Law and international standards in order to supplement and improve the regulations and standards effectively and give support for aquaculture management.
- ii. Promote the implementation guidance of the law for local officials, while raising awareness about the provisions of the law for all actors in the aquaculture supply chain, especially for small aquaculture producers. It is possible to print leaflets and/or disseminate information about the new Fishery Law in the mass media or through related workshops/conferences.
- iii. Promote development of aquaculture cooperatives and value chain linkages. Developing value chain linkages in aquaculture is an indispensable trend and also an urgent need for small-scale production in the context of international integration and globalization, and participation in global value chain of seafood products. Cooperatives are the best means of production to perform the role of linkages between actors. Recently, Viet Nam issued a number of policies to promote value chain linkages and production cooperatives in the field of agriculture and fisheries such as the Decision No. 62/2013/QĐ-TTg of Prime Minister on policy to encourage the development of co-operation, collaboration to link agricultural production with consumption. The government also issued the Decree 55/2015/ND-CP dated 9 June 2015 on credit to serve agriculture and rural development.

- iv. Promote public–private partnership (PPP) models at national and provincial scale to mobilize capital for the sustainable development of aquaculture. In the context of limited government and provincial budgets, and international development assistance capital plummeted as Viet Nam became a middle-income country and PPPs in the development of aquaculture infrastructure are considered to be the most appropriate. For this, recently the government issued the Decree 15/2015/ND-CP dated 14 February 2015 on investments in the form of PPP with Article 4, Section 1.e on “Infrastructure for agriculture and rural development and development services linking production with processing and consumption of agricultural products”. Accordingly, MARD also issued the Circular 14/2017/TT-BNNPTNT dated 5 July 2017 providing detailed guidance on PPP investment in agriculture and rural areas.
- v. Promote research activities on policies for sustainable aquaculture development under increased climate change and international integration, especially policies supporting international certification/standards; production organization types in aquaculture, including cooperatives, value chain linkages, inclusive business models; and seed production and grow-out culture technologies towards biosafety, food safety, climate change adaptation as well as meeting increased requirements of import markets.

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