Report of the

FAO REGIONAL TRAINING WORKSHOP
ON INNOVATIVE INTEGRATED AGRO-AQUACULTURE
FOR BLUE GROWTH IN ASIA-PACIFIC

Kunming, China, 12–17 June 2017
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FAO REGIONAL TRAINING WORKSHOP ON INNOVATIVE INTEGRATED AGRO-AQUACULTURE
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This report describes the activities and outputs of the FAO technical workshop entitled “FAO Regional Training Workshop on Innovative Integrated Agro-Aquaculture for Blue Growth in Asia-Pacific”, an activity supported by the Strategic Programme on Sustainable Agriculture of FAO. The workshop was held in Kunming, China, from 12 to 17 June 2017.

This report was prepared jointly by the FAO’s Fisheries and Aquaculture Department (Austin Stankus, Consultant; Oluwafemi Ajayi, Consultant; Jiansan Jia, Deputy Director, retired) and the FAO Regional Office for Asia and the Pacific (RAP) (Weimin Miao, Aquaculture Officer) together with the Freshwater Fisheries Research Centre (FFRC) of the Chinese Academy of Fisheries Sciences (Xinhua Yuan, Deputy Director-General) under the coordination of FAO’s cross-cutting Strategic Programme on Sustainable Agriculture (Matthias Halwart, Senior Programme Officer).

The contributed papers are reproduced as submitted.
ABSTRACT

The FAO Fisheries and Aquaculture Department and FAO’s Regional Office for Asia and the Pacific jointly sponsored and implemented a regional training workshop to support scaling up of innovative integrated agro-aquaculture (IAA) for Blue Growth in selected countries in the Asia-Pacific region at Fubao Culture Town & Spa Hotel in Kunming, Yunnan province, China, from 12 to 17 June 2017. As an FAO Reference Centre for Aquaculture and Inland Fisheries Research and Training, and as the technical backstopping agency for the successful introduction of integrated rice-fish culture practices in Hani terraced rice fields, the Freshwater Fisheries Research Centre (FFRC) of the Chinese Academy of Fishery Sciences (CAFS) partnered with FAO in the organization of the training workshop.

The training workshop was organized to share IAA models, experiences and lessons in IIA development, for the purpose of extension and improvement of rice-fish systems and similar IAA models, with low input and high output. The training workshop focused on the objectives to:

- Share the principles and technical context of IAA systems, their socioeconomic and ecological benefits and successful cases;
- Exchange information on the development of IAA systems in the participating countries;
- Document the success and lessons of IAA system development;
- Development of country specific draft plan of action (including policy and strategy pitch) for promoting IAA systems and practices;
- Enhance the understanding of workshop participants to farmer and community experiences and operations related to IAA through visits to selected sites and exchange with the farmers and cooperatives.

Twenty three (23) participants from six (6) Asian countries, namely Bangladesh, Indonesia, the Lao People’s Democratic Republic, Myanmar, the Philippines and Viet Nam, attended the training workshop. FAO supported the participation of four (4) participants from each country, of which two (2) were selected from the agriculture sector and two (2) from the aquaculture sector. There were also two agricultural officers from Yunnan province of China supported by another FAO project.
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ACKNOWLEDGEMENTS

Numerous individuals contributed to the successful organization and implementation of this technical workshop, which resulted in the present publication. All of them are gratefully acknowledged for their efforts and contributions during the preparatory phase and the workshop itself.

The workshop was supported by resource persons from FAO’s Plant Production and Protection Division, the Fisheries and Aquaculture Department, the Social Policies and Rural Institutions Division, the Regional Office for Asia and the Pacific, and the FAO China country office – demonstrating the cross-sectoral nature of this workshop.

Special thanks go to Freshwater Fisheries Research Centre for the technical and logistical support provided to the organization of the workshop.

The support of the Strategic Programme 2 Major Area of Work on Efficient Resource Use under the revised Strategic Framework of FAO is kindly acknowledged.
### ABBREVIATIONS AND ACRONYMS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>AGP</td>
<td>Plant Production and Protection Division (FAO)</td>
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<td>ASEAN</td>
<td>Association of Southeast Asian Nations</td>
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<td>BWDB</td>
<td>Bangladesh Water Development Board</td>
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<td>CAFS</td>
<td>Chinese Academy of Fishery Sciences</td>
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<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<td>FFS</td>
<td>Farmer Field Schools</td>
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<td>FFRC</td>
<td>Freshwater Fisheries Research Centre (China)</td>
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<td>GIAHS</td>
<td>Globally Important Agricultural Heritage Systems</td>
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<td>IAA</td>
<td>Integrated Agro-Aquaculture</td>
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<td>IPM</td>
<td>Integrated Pest Management</td>
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<td>MOALI</td>
<td>Ministry of Agriculture, Livestock and Irrigation</td>
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<td>PPP</td>
<td>Public Private Partnership</td>
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<td>RIBG</td>
<td>Regional Initiative for Blue Growth in Asia</td>
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<td>RRI</td>
<td>Regional Rice Initiative</td>
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<td>S&amp;G</td>
<td>Save and Grow</td>
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<td>SEAFDEC</td>
<td>Southeast Asian Fisheries Development Centre</td>
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<td>SIRP</td>
<td>Sustainable Intensification of Rice Production</td>
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<td>SRI</td>
<td>System of Rice Intensification</td>
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<td>SDG</td>
<td>Sustainable Development Goals</td>
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<td>SSC</td>
<td>South-South Cooperation</td>
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<td>TRM</td>
<td>Tidal River Management (Bangladesh)</td>
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BACKGROUND

1. Aquaculture has been one of the fastest growing food production sectors in the past decades globally. It has grown from 56 million tonnes in 2009 to 74 million tonnes in 2014. In addition, 27 million tonnes of aquatic plants were cultured in 2014. Importantly, in terms of food security and the environment, about half of the world’s aquaculture production of animals and plants came from non-fed species. As the major contributor to the world aquaculture production, the Asia region achieved average annual growth of 8.4 percent in aquaculture production in the past three decades. Asian aquaculture production reached 92.8 million tonnes in 2014, which accounted for 91.7 percent of the world’s total. Currently, Asian aquaculture supplies some 60 percent of food fish for the people while contributing to the livelihood in the region significantly (FAO, 2016).

2. With the foreseen population growth and expected economy recovery and growth, it is anticipated that the demand for food fish will increase significantly in the coming decades. It is projected that world apparent fish consumption will increase by 31 million tonnes in the next decade to reach 178 million tonnes in 2025. Therefore, it is important to maintain the sustainable growth of aquaculture to meet the global demand for food fish in the future, considering the contribution of the region to the world fish production. The continued growth of aquaculture will also contribute to blue economic growth in the region.

3. FAO is currently implementing a Regional Initiative for Blue Growth (RIBG) in Asia-Pacific, which seeks to achieve sustainable growth of Asian aquaculture and contribute to food security and nutrition. One of the outcomes of the RIBG is “Improved efficiency and sustainability in aquaculture and capture fisheries production through innovative management systems and production practices for more efficient and sustainable use of resources (fisheries, water, land, forests, etc.) and restoration of ecosystem services and functions”.

WORKSHOP ORGANIZATION

4. In order to contribute to the RIBG, FAO Fisheries Department and Regional Office for Asia and the Pacific jointly sponsored and implemented a regional training workshop to support scaling up of innovative integrated agro-aquaculture (IAA) for blue growth in selected countries in Asia Pacific region. The workshop was held at Fubao Culture Town & Spa Hotel in Kunming, Yunnan province, China, from 12 to 17 June 2017. It was designed to provide a platform for information exchange on IAA models, experience and lessons in development process, through the technology and experience sharing, and a site visit to Hani terraced field in Honghe County, Yunnan province.

5. As an FAO Reference Centre for Aquaculture and Inland Fisheries Research and Training, and the technical backstopping agency for the successful introduction of integrated rice-fish culture practices in Hani terraced field, Freshwater Fisheries Research Centre (FFRC) of Chinese Academy of Fishery Sciences (CAFS) worked with FAO towards the organization of this training workshop.

6. Twenty-three (23) participants from six (6) Asian countries, namely Bangladesh, Indonesia, The Lao People’s Democratic Republic, Myanmar, the Philippines and Viet Nam, attended the training workshop. FAO supported the participation of four (4) participants from each country, of which two (2) were selected from the agriculture sector and two (2) from aquaculture sector. There were also two agricultural officers from Yunnan province of China with the support of another FAO project. A group photograph is provided in Appendix 8. Selected photos are included in Appendix 7.

7. Many resource persons from FAO, FFRC, Huazhong Agricultural University, and Shanghai Ocean University contributed to the workshop as key lecturers in the training session.

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1. The FAO GCP/RAS/229/SWE project promotes IPM and integrated farming systems (including agro-aquaculture) capacity building work involving farmers in Yunnan and elsewhere in the Greater Mekong Subregion.
8. The training workshop methodology consisted of lectures, case studies, group work, country reports and a field trip to the Hani terraced fields in Honghe County. The adopted agenda, facilitators, and the list of participants are provided in Appendix 1 and 2 respectively.

OBJECTIVES

9. The training workshop was organized to share IAA models, experiences and lessons in IIA development, for the purpose of extension and improvement of rice-fish systems and similar IAA models, with low input and high output. The training workshop focused on the objectives to:

- Share the principles and technical context of IAA systems and their socioeconomic and ecological benefits and successful cases;
- Exchange information on the development of IAA systems in the participating countries;
- Document the success and lessons of IAA system development;
- Development of country specific draft plan of action (including policy and strategy pitch) for promoting IAA system and practices;
- Enhance the understanding of workshop participants to farmer and community experiences and operations related to IAA through visits to selected sites and exchange with the farmers and cooperatives.

OPENING SESSION

10. The participants were welcomed by Fishery Officers from the Bureau of Fisheries/Ministry of Agriculture of China, the Chinese Academy of Fishery Sciences (CAFS), Yunnan Provincial Bureau of Fisheries, Provincial Department of Agriculture and Honghe County government. Mr Xu Pao, Director General of FFRC opened the meeting and facilitated the session.

11. Mr Chen Jia, Director of Aquaculture Department of the Bureau of Fisheries, China, discussed the aquaculture industry and its important role in meeting the supply of aquatic products in the market, ensuring national food security, generating employment and increasing farmers' income in the last decades. As one of the typical models for IAA, integrated rice-fish farming has a long cultural history and rich practical experience. Additional advantages are reduced competition for grains for human consumption, and reduced land usage. In these systems, water serves a dual-purpose, a single field can provide double income, and the same area promotes three positive impacts. It can not only effectively promote food production, greatly promote the agro- and aqua- farmers’ income, but also support ecological benefits. The integration of three industries is an effective approach for poverty alleviation through rural development. This can be considered a starting point for promoting the transformation of farming modes and structural adjustment of the aquaculture industry, supporting the transition to green aquaculture.

12. Mr Cui Lifeng, President of CAFS, delivered a welcome speech. He informed participants of the research of CAFS in the development of IAA systems such as: fish-mulberry, fish-sugar cane, fish-fruits, fish-flowers, fish-grass, fish-vegetable, fish-rice, fish-livestock and poultry, fish-mangroves and others. The research includes ecological and biological principles, policy and socio-environment components, consideration of traditional culture and other aspects of IAA systems. The results include improvement of resource use efficiency of aquatic resources and agriculture wastes, increased comprehensive benefits of farming practices, and sustainable development of the aquaculture industry, as well as the harmonization of agriculture, aquaculture and environment protection. CAFS renewed its willingness to actively participate and support FAO's initiatives and programmes, notably through exchange visits and cooperation programmes with participating countries through South-South Cooperation.

13. Mr Zhang Mu, Director General of Yunnan Provincial Bureau of Fisheries, provided a brief overview of the basic information regarding the development status of integrated agriculture and aquaculture in Yunnan. He provided policy aspects of the aquaculture industry, and discussed cooperation projects between Yunnan province and countries of the Association of Southeast Asian
Nations (ASEAN) community in the agriculture sector. Using the example of loach-rice culture in Yunnan as a success story, participants were invited for a site visit during this training workshop. To achieve the goals of mutual benefits and sustainable development of the fishery economy, Yunnan province will continue to develop IAA systems as an innovative approach to boost poverty alleviation with scientific support.

14. Mr Zhang Zhijun, Governor of Honghe County, elaborated on the case of rice-fish culture programmes in Honghe County using large-scale, yet precise, practices towards poverty alleviation through extension and support to the enabling environment.

15. Mr Hans Martin Dreyer, Director of FAO’s Plant Production and Protection Division, discussed the background and significance of FAO’s work on IAA, highlighting the fact that food security and nutrition are still not achieved for many people in rural areas around the world. Rice-fish farming systems, and innovative integrated agriculture methods in general, exhibit great potential as part of the solution to feed a growing world population. Such farming systems can offer an efficient way to use sustainably natural resources, which are increasingly scarce, especially freshwater, and land, but also provide a means for farmers to earn additional income. It is the interest of national policy makers to consider such systems, because they allow for increased production in a socially, environmentally and economically sustainable manner. Sustainable intensification of rice production (SIRP) is an important work stream for FAO’s Plant Production and Protection Division. FAO calls for upscaling of rice-fish farming systems through institutional support, collaboration among key institutions, awareness raising, training and extension, and financing mechanisms to support farmers. All are needed to make these promising farming systems become successful in Asia Pacific region. South-South Cooperation and Triangular Cooperation can enable the further spread of these techniques by facilitating exchanges of expertise, technicians and capacity development. Strong stakeholder engagement and a supportive enabling environment are also key requirements.

16. Mr Matthias Halwart, Senior Programme Officer and Outreach Delivery Manager of FAO’s Sustainable Agriculture Programme, introduced the background of this training workshop. He detailed the benefits and limitations of IAA systems and explained the five principles of FAO’s Common Vision to Sustainable Food and Agriculture and its relation to Agenda 2030. He also made the link from local action to global targets. He highlighted that IAA could help deliver against the Sustainable Development Goals (SDG) indicators, and that the people-centred approach could promote sustainable agriculture and food systems. He concluded that:

i) IAA shows multiple benefits and advantages over mono-cropping systems;
ii) Better ecological knowledge by the farmer leads to more resilient, productive and sustainable systems that produce a wide range of food and nutrition;
iii) Participatory approaches, including Farmer Field Schools,² have higher success rates and impacts when compared to “classroom-type” approaches for technology transfer;
iv) Widespread adoption of these integrated systems is in line with FAO’s Common Vision of Sustainable Food and Agriculture and will help countries deliver and report against SDG indicators;
v) China, with its excellent results in the piloting, adaptation and widespread extension of IAA systems, can play a leading role in accelerated adoption;
vi) FAO renewed its willingness and availability to work with Countries through facilitation of South-South Cooperation and other mechanisms.

TECHNICAL PRESENTATIONS

17. Mr Yuan Xinhua, Deputy Director General of FFRC moderated the whole-day activities including the introduction of resource persons, exchanges and comments, discussions and reviews.

² More information on Farmer Field Schools can be found on FAO’s Global FFS Platform, available here: http://www.fao.org/farmer-field-schools/en/
Innovative Integrated Agro-Aquaculture - a new approach to food security, nutrition and rural livelihood

18. Mr Miao Weimin, Aquaculture Officer/FAO Regional Office for Asia and the Pacific, Bangkok, Thailand, provided further clarifications on IAA farming systems, including addressing the “what, why and how”.

19. He reviewed the concepts of IAA and introduced the differences from traditional integrated fish farming in the aspects of development targets, farming technology, management practices, and development approach. He also listed the issues and challenges of IAA, which include:

i) The transformation of farmers’ concepts and farming practices, which is a long process requiring continuing support;
ii) Significant investment is needed during the initial stages, including for earthworks and seed/input supply;
iii) Risks need to be well-managed, including extreme weather events, severe flood and/or drought, extreme temperature and pollution;
iv) Potential disease problems can occur as a result of intensification and out-sourced seed;
v) Urbanization and the subsequent loss of quality labour in rural areas can limit the available human resources;
v) Farmers can become over-focused on fish/aquatic animals due to their high economic value, and overlook or even abandon the rice plantation.

20. These challenges notwithstanding, there are many reasons to support the adoption of IAA systems, specifically for their contribution to sustainable food systems with the potential to support higher food security and nutrition, alleviate poverty and provide livelihood opportunities in the context of socio-demographic changes. To support scaling-up of innovative agro-aquaculture, stakeholder support is needed to provide enabling policy with appropriate strategy, capacity building at local levels, and support to value chain development.

Success story: Innovative practices on rice-fish culture in Honghe County, Yunnan province - a case study

21. Mr Xu Pao, Director General of FFRC, shared the Centre’s experiences of research, extension and demonstration of rice-loach culture, specifically in the Hani terraced fields in Yunnan province. One key initiative of this project is the conservation of the terraced fields as a Globally Important Agricultural Heritage System (GIAHS). The combined culture of rice and fish has been a traditional source of livelihood for the local farmers, and the project goals include building upon the traditional experience to upscale this IAA practice to reduce poverty and support rural development. The innovative model includes several key stakeholders, comprised of Local and Provincial Government, Private Enterprise of fish hatcheries and seed suppliers, the FFRC research institution, extension agents and most importantly the farmers themselves. These stakeholders have worked together on the achievements of scaling up the IAA development in terraced fields.

Introduction to Integrated Agro-Aquaculture (IAA): Theory and practices

22. Mr Li Dapeng, Vice Dean of College of Fisheries, Huazhong Agricultural University, provided an overview of IAA and shared case studies from China. He introduced the history and development, the significance, the different modalities, and the construction of IAA in China including technical details. He mentioned that there are great advantages for developing IAA systems, which include:

i) Providing a method to reduce feeding costs;
ii) Improving the efficient utilization of material, energy and resources;
iii) Improving rice growing conditions and promoting increases in paddy yields;
iv) Reducing rice production costs, while greatly increasing the output value and benefit; 
v) Improving rural environmental sanitation; and 
vii) Achieving sustainable development of aquaculture and the environment.

23. He also listed typical modes of IAA systems in China including farming fish in paddy fields, integrated planting and farming fish, mulberry fishpond, animals-gas-fish-vegetables, and the ecological recirculating aquaculture system, and provided details on the concepts and technical measures of above-mentioned modes. Finally, he shared two case studies and success stories of construction of IAA systems, which were: i) Hongxianxi's re-circulating pond method using planted grass on pond bunds to feed grass carp and and ii) the ecological floating rafts culture method from Chonghu, Gong’an county. Both of these cases demonstrated how the concepts of IAA have been adapted to local conditions.

**General rice-fish culture including technical, financial, social and environmental aspects**

24. Mr Yuan Xinhua, Deputy Director of FFRC, provided a presentation on the technical, financial, social and environmental aspects of rice-fish culture. He expanded beyond the technology innovation of IAA, and included important associated management considerations, including:

i) selection of the correct IAA model, species and branding; 
ii) cooperative structures, such as public-private partnerships (PPP); 
iii) quality development and improvement on both the rice and the fish; 
iv) value-chain strengthening on both supply-side and sales and distribution; and 
v) integration with the tourism sector, including ecotourism, with the example of GIAHS sites.

25. He provided an analysis of the social aspects of IAA, including harmonization with other aspects of rural development toward local development goals. IAA has opportunities to attract/retain farmers, especially youth, to work on the land and address the issue of “greying of agriculture”. Furthermore, IAA increases the income of the farming family through additional revenue streams and value-added products. It can support the provision of job opportunities for all groups, including rural people, ethnic minorities, youth, elderly, men and women.

26. He emphasized the role of IAA in protecting ecosystem services of the environment, the reduction of harmful chemical inputs through ecological control of pests, which also leads to improved food safety and food quality. He also pointed out the constraints for IAA adoption, as well as some measures and recommendations to overcome these constraints.

**Innovative Integrated Agro-Aquaculture Systems in China**

27. Mr Liu Qigen, from Shanghai Ocean University, presented a lecture on innovative IAA systems in China. He introduced the history of IAA in China, innovations of integrated fish farming and integrated rice-fish farming in both theory and practice. He specially shared the key techniques (including species of fish/ other animals and strain of rice to choose, field engineering, rice planting, field management) and main modes (including the distribution, fish size, stocking density, harvest, marketing, etc.) of IAA in China.

**COUNTRY REPORTS**

28. Each country delegation (Bangladesh, Indonesia, the Lao People’s Democratic Republic, Myanmar, the Philippines, and Viet Nam) presented a country report, each lasting 30 minutes including discussions. The session was facilitated by Messrs Yuan Xinhua and Austin Stankus.

29. The country reports are presented in Appendix 3 as received by the workshop organizers with minor linguistic editing.
BUSINESS PLANS AND POLICY BRIEFS

30. Participants, working in country groups, prepared both a business pitch and a policy pitch regarding IAA practices. The objective of the business pitch was to engage participants in a dialogue of the triple bottom line of sustainability of IAA practices, specifically focusing on improved livelihoods for farmers. The objective of the policy pitch was to facilitate discussion on the enabling environment necessary to support the upscaling of IAA practices at national level.

31. Through an interactive process, country groups prepared a business pitch, with the following guidance:

“Imagine that you are an agriculture extension agent and you want to convince a farmer to adopt IAA practices. Your task is to convince the farmer that adopting this practice is a good idea, and that it will increase their profitability and livelihood. This should include a description of the current challenges (e.g. farmers are not earning enough money), a description of the opportunities (e.g. adopt Rice-Fish culture), how much it will cost and how much the farmer will earn, and what are the concrete steps to be taken. Above all, you should demonstrate: What is the bottom line – how will the adoption of this practice improve their livelihood?”

32. Country groups also prepared a policy brief, with the following guidance:

“A policy brief is a short document that presents the vision, goals and strategic objectives to a non-specialized audience. It is a medium for exploring an issue and distilling the lessons learned. It is a vehicle for providing policy advice – and can be used to advocate for changes in policy to create a more enabling environment.”

33. Messrs Matthias Halwart and Austin Stankus facilitated these sessions. Guidelines for the policy pitch and business pitch, including guiding questions to support an enabling environment for IAA (Appendixes 4 and 5) were distributed and explained. The FAO experts and lecturers were available to provide guidance for the pitch preparations. Finally, the business pitches and policy briefs were presented by each country to the plenary, and feedback and comments were provided by the FAO experts and other countries’ participants.

34. These were designed to be useful tools, feasible and specific according to the situations of their respective countries. Participants of each country summarized the concrete actions that they will take upon their return to support the adoption of the IAA practices. For example, the participants from the Philippines focused on promoting the development of aquaponics in Northern Luzon; Indonesia promoted the expansion of organic rice fish farming; Myanmar promoted the rice-fish culture for small scale farmers in Delta (Ayeyarwaddy) and irrigated areas (upper Myanmar); and Viet Nam promoted shrimp-rice farming in the Mekong Delta.

35. An FAO IAA portfolio (Appendix 6) was also provided to the participants. The videos of *Indonesia Rice-Fish Farming* and *Aquatic Biodiversity and Nutrition - The Contribution of Rice-based Ecosystem in Laos* were jointly viewed by the participants.

FIELD TRIP ACTIVITIES

36. Participants engaged in field trip activities in several places over the course of two days to experience an example of successful rice-fish culture in the Hani terraced fields. Participants also visited the exhibition hall of Yunnan Zhonghai Fishery Co., Ltd. in Kunming to better understand the role of seed supply, technical guidance, and marketing for the farmers.

37. Participants were provided a tour of the Loach Breeding Center in Menglong Village, Yisha Town, Honghe County. They visited the indoor and outdoor seed production facilities, and exchanged with the technicians on key points of induced breeding technologies, pond nursery and enhancement, and
transportation and distribution to the farmers. They also attended the unveiling ceremony of Hani Terrace Rice-Fish Integration Technology Demonstration Base of FAO Reference Center for Aquaculture and Inland Fisheries Research and Training. Messrs Matthias Halwart (FAO), Xu Pao (DG of FFRC), Xiao Yan (President of Yunnan Zhonghai Fishery Co., Ltd.) and He Tao (Governor of Honghe County) delivered speeches. The experience of Honghe Nongyou Loach Professional Cooperatives was also shared to the participants, especially the model of ‘scientific research institution + leading enterprise + cooperative + demonstrators + cooperative members’ to promote the rice-fish farming practices to achieve the goals of improving the terraced field productivities, increasing farmers’ income to reduce poverty, and protection of terraced fields and the associated cultural value.

38. Participants toured Bijun and Shamaba terraced fields in Baohua Town. The governor of Baohua Town, Mr Chen Yonggui, introduced the rice-loach farming model and the achievements through the application of this model, especially for the poverty alleviation of farmers. They also introduced the work of tourism exploitation for the rice-fish culture in terraced fields. Farmers in the town were also interviewed by FAO experts and participants.

CLOSING SESSION

39. At the closing session FAO experts debriefed and reviewed the activities and outcomes of the workshop. The participants were highly satisfied with the administrative and logistical organization of the training workshop. The participants also appreciated the organization of FAO and spoke highly of topics, suggestions and visits by resource persons, FAO experts and FFRC, which are relevant to their work. The participants were inspired through lectures, country reports, success story sharing and the field visit. They all reached the consensus to promote this innovative IAA development in their respective countries, noting the contribution to poverty alleviation and support towards the Sustainable Development Goals (SDGs).

CONCLUSIONS

40. At the end of the training workshop, the general and specific objectives were achieved and the overall outcomes were the following:

- Participants were able to enhance their knowledge about the principles and technical context as well as the socioeconomic and ecological benefits of IAA systems.
- Information about systems, success stories and experiences of IAA in participating countries were shared through lectures, discussions and country reports.
- Business plans and policy pitches were formulated by each participating country through joint efforts in order to take national action to support the further development of IAA systems upon return of the participants to their home country.
- Understanding of participants of farmer and community experiences and practices relevant to IAA systems, especially on the innovative rice-fish culture model, was enhanced through the field visit to terraced fields in Honghe County. The experience of rice-loach culture in terraced fields with the model of ‘scientific research institution + leading enterprise + cooperative + demonstrators + cooperative members’ to benefit the communities and local farmers deeply impressed the participants.
- Follow-up visits and on-site guidance by FAO and FFRC to the participating countries were proposed and specific technical support requests can be expected.
- Regular communication, sharing of information and success stories, and further capacity building for the accelerated adoption and promotion of innovative IAA systems to achieve the goals of blue growth in the Asia Pacific region was recommended by the participants.

Reference
**APPENDIX 1: WORKSHOP AGENDA**

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<td>DAY-5: Friday 16 June</td>
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<td>08.00</td>
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<tr>
<td>DAY-6: Saturday 17 June</td>
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<td>09.00</td>
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<td>12.00</td>
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<tr>
<td>17.00</td>
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<tr>
<td>17.00</td>
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<tr>
<td>17.30</td>
</tr>
</tbody>
</table>
APPENDIX 2: LIST OF PARTICIPANTS AND FACILITATORS

Md. Mahmudur RAHMAN  
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APPENDIX 3: COUNTRY REPORTS

COUNTRY REPORT BANGLADESH

Introduction
Agriculture and Aquaculture are two major components of biological production with equal importance in providing livelihood, food security, economy, employment and export earnings in Bangladesh. For centuries, the two sectors have run side by side, very often with same physical and biological resources. With increased demand and resource constraints, it is time to maximize profit through rational utilization of common resources like land, water, labour, capital and organization with resource recycling, environmental compatibility and product quality.

Bangladesh has thirty agro-ecological zones (BBS, 2014). Agro-aquaculture found its momentum in Bangladesh as early as the 1980s. In consideration of people’s perception and practical utility, new and more innovative ideas come into play all the time in these two promising sectors, which help boost primary production in many ways.

Innovative agro-aquaculture in Bangladesh is divided into at least ten major ways:
- integrated (concurrent) rice-fish aquaculture;
- alternate rice-fish culture;
- sorjan - homestead fruit garden ditch-fish culture;
- pond dyke vegetable-fish culture;
- aquaponic vegetable-fish culture;
- water recycled agro-aquaculture;
- pen aquaculture;
- floating net cage aquaculture in floodplains;
- floating bed agro-aquaculture;
- beel;
- nursery with spawn, fry and fingerling stocking;
- Daudkandi Model agro-aquaculture;
- Vabadaha Model agro-aquaculture.

Past and current status of Integrated Agro-Aquaculture in Bangladesh
IAA in Bangladesh dates back to the last century through the introduction of fish culture in paddy fields, which is popularly known as paddy-cum-fish culture in Meghna-Dhanagoda Irrigation Project, Chandpur (Central Bangladesh) by Bangladesh Water Development Board (BWDB, the then WAPDA, Government of Bangladesh). This practice was used as an additional income generating activity, with rice as the major crop and fish as a subsidiary crop. The fish species were mainly catfishes, *Heteropneustes fossilis* and *Clarias batrachus*. The same practice expanded in Northern Bangladesh as an induction effect.

BWDB built some polders (protected areas for agriculture encircled with heavy earthen embankments made in the vulnerable coastal regions to control flood, tide and tidal surges with sluice gate facilities) in Southern Bangladesh in order to protect agricultural lands from flood and salinity intrusion from the sea with no notion of fisheries potential. Unfortunately, within a short time, people found polders to be under-functioning and their land became waterlogged (inundated). However, these areas supported large fishery catches of estuarine fish and shrimp without any cost. Having found no other alternatives to agriculture, communities gradually moved from agriculture to aquaculture at varying degrees. They changed their cropping pattern from exclusive agriculture to agro-aquaculture. They find it most suitable and more profitable for aquaculture than agriculture with this saline water where they found excellent production of shrimps (*Macrobrachium rosenbergii* and *Penaeus monodon*) and later on other salinity species.

---

3 A beel is a pond (wetland) with static water.
tolerant fishes (e.g. *Rhinomugil corsula*, *Mugil cephalus*, *Sicamugil cascsasia*, *Mugil parsa*, *Mystus gulio*, *Cyprinus carpio*). The salinity level of the polders varied between 5 and 20 parts per thousand. The method was to allow tidal water to come into the polder and then the outlet was closed, thus entrapping fry and fingerlings of natural fish fauna. Fish were allowed to grow in natural conditions with neither artificial stocking of fry nor supplementary feeding. This type of practice has continued since middle of the 1980s, and it was gradually converted from extensive to improved-extensive with some selective fry stocking and supplementary feeding. Now in Southern Bangladesh, aquaculture has become the major practice, with agriculture considered a secondary option in consideration of level of adoption and economic return. Even so, agriculture continued in the rest of the country as the dominant practice. Aquaculture remains an activity low land paddy fields and floodplains in the Central, Northern and Eastern Bangladesh with suitable freshwater species of Indian and Chinese major carps and other finfishes especially: *Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, *Anabas testudineus*, *Heteropneustes fossilis*, *Clarias batrachus*, *Mylopharyngodon piceus*, *Barbodes gonionotus*, *Aristichthys nobilis*, *Hypophthalmichthys molitrix*, *Cyprinus carpio* and *Oreochromis* spp.

**Agro-aquaculture succession and adaptation to climate change**

Bangladesh is an agrarian country with prime production of rice, cereals and pulses. The country has experienced a major breakthrough in rice production; rice production has tripled since the independence of the country in 1971, reaching 35 million tonnes in 2016 up from 10 million tonnes in 1971. The most recent agriculture statistics are as follows and in Table 1:

- Total farm holdings: 15.18 million ha;
- Cultivable land: 8.56 million ha;
- Irrigated land: 7.41 million ha;
- Cropping intensity: 192 percent;
- Triple cropped area: 1.72 million ha;
- Double cropped area: 3.85 million ha;
- Single cropped area: 2.35 million ha.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Total area of cultivation (million hectares)</th>
<th>Total production (million tonnes)</th>
<th>Average yield (tonnes/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>1.13</td>
<td>35</td>
<td>3.10</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.49</td>
<td>1.36</td>
<td>2.78</td>
</tr>
<tr>
<td>Maize</td>
<td>0.4</td>
<td>2.76</td>
<td>6.98</td>
</tr>
<tr>
<td>Potato</td>
<td>0.5</td>
<td>0.10</td>
<td>20.77</td>
</tr>
</tbody>
</table>

Although Bangladesh has achieved self-sufficiency in food grains, it also faces uncertainty due to adverse climatic conditions. With adverse impacts of increased climate change and natural disasters, people are moving from exclusive agriculture to inclusive agro-aquaculture for their mere existence and better return. Aquaculture is more resilient to climate change than agriculture, supportive to farmers and fetches higher prices both locally and globally. On the other hand, shrimp aquaculture has become the major thrust for export earnings from polders in southern Bangladesh; polders and sluice gates no longer protect agricultural land, which faces salinity intrusion, destruction of embankments, siltation and blockade of water exchange, which are compounded with permanent water logging and frequent tidal surges. The same situation happens with vast areas of South Central Bangladesh named Vabadaha water logged zone covering an area of 12 000 ha in two Upazilas of Khulna (Fultala, Dumuria) and three Upazilas of Jessore district (Keshobpurs, Monirampur and Avoynagar).

**Present status of agro-aquaculture in Bangladesh**

Bangladesh, one of the world's leading fish producing countries with a total production of 3.9 million tonnes, aquaculture contributes 56.8 percent to total production (FRRS, 2017). Since independence in 1971, fish production has increased 5.5 fold overall, and for aquaculture as much as 20 fold. The
diversified fisheries resources of the country are divided into three groups, which are inland capture fisheries, inland aquaculture and marine capture fisheries. Inland culture includes mainly pond/ditch, baor, shrimp/prawn farming, and seasonal cultured water-body. Together, these areas cover an area of about 0.80 million ha. In view of agro-aquaculture, annual fish production of Bangladesh is given in Table 2, which shows that open water agro-aquaculture and closed water agro-aquaculture contribute 21.75 percent and 11.54 percent, respectively, to the total fish production of Bangladesh. Agro-aquaculture contributes around 40 percent of total inland fish production (Table 2).

Table 2: Annual fish production and yield by production ecosystem (FRSS, 2017)

<table>
<thead>
<tr>
<th>Production ecosystem</th>
<th>Area (thousand ha)</th>
<th>Production (thousand tonnes)</th>
<th>Contribution (%)</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusive open water fisheries</td>
<td>1 100</td>
<td>205</td>
<td>5</td>
<td>186</td>
</tr>
<tr>
<td>Open water agro-aquaculture</td>
<td>2 818</td>
<td>843</td>
<td>22</td>
<td>299</td>
</tr>
<tr>
<td>Total open water</td>
<td>3 919</td>
<td>1 048</td>
<td>27</td>
<td>267</td>
</tr>
<tr>
<td>Exclusive closed water fisheries</td>
<td>405</td>
<td>1 756</td>
<td>45</td>
<td>4 437</td>
</tr>
<tr>
<td>Closed water agro-aquaculture</td>
<td>410</td>
<td>447</td>
<td>12</td>
<td>1 090</td>
</tr>
<tr>
<td>Total closed water</td>
<td>4 714</td>
<td>3 252</td>
<td>57</td>
<td>690</td>
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<tr>
<td>Exclusive marine fisheries</td>
<td></td>
<td>627</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Grand total</td>
<td></td>
<td>3 878</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Exclusive open water fisheries: rivers, estuaries, Sundarbans, Kaptai lake; open water agro-aquaculture: beels, floodplains; exclusive closed water fisheries: ponds, oxbow lakes, pens, cages; closed water agro-aquaculture: paddy fields fish culture, prawn ghers; exclusive marine fisheries: the Bay of Bengal.

The practice and prospect of innovative IAA lies mainly in introducing aquaculture in low-lying paddy fields and shrimp ghers, polders and water-logged area in Vabadaha, and plain lands of Daudkandi region using the Daudkandi agro-aquaculture model. People practice paddy-cum-fish culture traditionally using the basic concept of maximizing profit through minimum, planned and recycled investment. People found polders beneficial in early days for agriculture when the national policy prioritized agriculture for Green Revolution in the 1960s. Soon after, people found polders a hazard and detrimental to even their agriculture and livelihood. To remove detrimental effects of polders, people returned to culture their indigenous knowledge of Austamasi - a locally evolved coastal tidal water management plan, which is popularly known as Tidal River Management.

Tidal River Management and Vabadaha agro-aquaculture Model

A practice starting hundreds of years ago, Tidal River Management (TRM) is used by coastal farmers in Southwest Bangladesh. Farmers build embankments around their land in a specific time of the year (austamasi- referencing an eight-month cycle) to protect their land from tidal saline water. With this, they cultivate their land for a period and then cut the embankment after harvesting the crop and allow the tide to flow into the farmland. The embankment is built in November-December (late winter) and cut off in July-August when the rains come. It thus helps people to cultivate their land and also make their land fertile. However, BWDB made embankments across the river basins with sluice gates through the polder project. Primarily this project yielded good results but soon it ceased to continue with the inception of Farakka Barrage in 1975 and the withdrawal of upstream fresh water. Saline water intrusion and tidal effects continued to reach high above the sluice gate of Vabadaha, and huge clay deposits accumulated in the riverbed and blocked sluice gate mouths. In the 1980s, the upstream connecting rivers (e.g. Kubadak, Betna, Chitra, Nabaganga, Begboti, Mukteswari, Horihor, Vadra, Sri) started to die. Riverbeds in some cases raised higher than the beels. Thus, the entire system became collapsed and resulted in heavy and acute human devastation compounded with water logging of rainwater in the rainy season.

Bhabadaha is the central place of this water logging problem in coastal Southern Bangladesh where a sluice gate was erected in 1961 in the upstream of the River Sri. It had 21 regulators to drain the water
flow so it is locally called the ‘21 Fhukon gate’. It contributed profoundly in 1960s and 1970s to drain the upland water flow of Avoynagar, Monirampur, Keshabpur and Jessoresadar Upazila under Jessore district through the Mukteswari-Teka-Sri River, but it started to cease in 1980s and causing immense sufferings in their livelihood and food security due to water logging. BWDB tried in many ways to keep up flow of the rivers, but in vain. BWDB took Khulna Jessore Drainage and Rehabilitation (9 KJDR) project in 1993 to resolve this water logging, but was ultimately unsuccessful. Communities requested to remove all the structures and return to the Austamasi (TRM) method. The government paid attention to people’s call, and now BWDB is implementing the TRM officially. TRM allows a certain coastal beel to receive tidal flows, discharge the clay and sediment, and allow the clay-free water to pass to the river. After three to four years, another beel is selected for the same, and so on. Thus, 50 beels would support the system for 200 years. The benefit of this system is that planned land reclamation through tidal upcoming sand deposition and lifting of the beel basin on one hand, and flow of clay-free tidal water to downward ebb tide through the river basin without unwanted sand deposition and blocking of river mouth. The community or authority compensates the farmers of the beel for the period during which crop farming is impossible.

TRM in southern Bangladesh paved the way for a unique innovative IAA there. A case study made with 13 randomly selected cooperative projects in Vabadaha area shows a surprising result. People changed their cropping pattern with diverse sectoral investment and more profitable gains. Table 3 shows that out of 314 ha, no farmers are exclusively agriculture. Only three cooperatives are exclusively aquaculture, and all the cooperatives use integrated agro-aquaculture. Table 4 shows sectoral cropping diversity and income where in 13 firms paddy caters for Tk\(^4\) 287.08 million and other agro products Tk 1.95 million totaling Tk 289.03 million whereas aquaculture Tk 666.36 million and other fishery Tk 52.35 million totaling Tk 718.70 million. The grand total income is Tk 1468.80 million.

**Table 3:** Farming systems of cooperatives in the Vabadahaby area, by culture area (ha) in 2016

<table>
<thead>
<tr>
<th>Upazila</th>
<th>Name project</th>
<th>Exclusive agriculture</th>
<th>Exclusive aquaculture</th>
<th>Agri-aquaculture</th>
<th>Others</th>
<th>Total (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keshabpur</td>
<td>Gonogher</td>
<td>-</td>
<td>-</td>
<td>22.0</td>
<td>12.0</td>
<td>34.3</td>
</tr>
<tr>
<td></td>
<td>Nutongher</td>
<td>-</td>
<td>-</td>
<td>19.0</td>
<td>09.0</td>
<td>28.0</td>
</tr>
<tr>
<td></td>
<td>Gumgher</td>
<td>-</td>
<td>-</td>
<td>17.0</td>
<td>14.2</td>
<td>31.2</td>
</tr>
<tr>
<td></td>
<td>Auriakhaligher</td>
<td>-</td>
<td>-</td>
<td>15.0</td>
<td>03.5</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td>Busto tulagher</td>
<td>-</td>
<td>-</td>
<td>8.0</td>
<td>10.5</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td>Khalargher</td>
<td>-</td>
<td>-</td>
<td>3.0</td>
<td>0.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Monirampur</td>
<td>Purbasha fisheries &amp; IRRI culture Society</td>
<td>0</td>
<td>0</td>
<td>34.3</td>
<td>0</td>
<td>34.3</td>
</tr>
<tr>
<td></td>
<td>Nehalpur-Lakhaidanga Agriculture &amp; Fisheries Society</td>
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<td>0</td>
<td>51.0</td>
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<tr>
<td></td>
<td>Lakhaidanga Agriculture &amp; Fisheries Society</td>
<td>0</td>
<td>0</td>
<td>85.0</td>
<td>0</td>
<td>85.0</td>
</tr>
<tr>
<td></td>
<td>Paddabon Rice &amp; Fisheries</td>
<td>0</td>
<td>0</td>
<td>7.6</td>
<td>0</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td>Bilkedaria-I</td>
<td>0</td>
<td>30.0</td>
<td>0</td>
<td>0</td>
<td>30.0</td>
</tr>
<tr>
<td></td>
<td>Pattargher</td>
<td>0</td>
<td>34.0</td>
<td>0</td>
<td>0</td>
<td>34.0</td>
</tr>
<tr>
<td></td>
<td>Beel Kedaria -II</td>
<td>0</td>
<td>12.8</td>
<td>0</td>
<td>0</td>
<td>12.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0</td>
<td>76.8</td>
<td>262.0</td>
<td>49.8</td>
<td>313.9</td>
</tr>
</tbody>
</table>

\(^4\) Bangladeshi taka (BDT): USD 1.0 = BDT84.8
Table 4: Production of cooperatives in the Vabadaha area, by cropping system and income (million Taka), in 2016

<table>
<thead>
<tr>
<th>Upazila</th>
<th>Name of Project</th>
<th>Area (ha)</th>
<th>Value (million Taka)</th>
<th>Agriculture</th>
<th>Aquaculture</th>
<th>Fishery</th>
<th>Total</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Paddy</td>
<td>Aquaculture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Others</td>
<td></td>
<td></td>
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<td></td>
</tr>
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Enabling Environment: Government Interventions, Policies and Sector priorities
The Government of Bangladesh supports agro-aquaculture through its two leading Ministries, the Ministry of Agriculture and the Ministry of Fisheries and Livestock. Although there are no specific laws or regulations for the promotion of IAA in Bangladesh, there are some supportive policies in relation to agriculture, fisheries, water resources and land use, as follows:

- National Land Use Policy defines the character of agricultural land and restricts use of agricultural lands for non-agricultural purposes. It also prohibits filling up water bodies as well as encourages people for integrated use of agricultural lands.
- Bangladesh Water Act (2013) limits the use of water resources beyond the critical limit for ensuring the availability of water for agriculture and aquaculture.
- Coastal Zone Policy (2005) promotes integrated development of crop, fisheries and livestock sub-sectors for equitable use of scarce water resources in coastal zone of Bangladesh.
- The Law on Protection of playground, open space, park and water body (2000) also enunciates the restriction of filling up of these establishments that also promotes ecosystem conservation and integrated cultivation of crops and fish in low-lying areas.
- National water policy of Bangladesh prioritizes use of water in agriculture and fisheries sector. It empowers National Water Resources Council to co-ordinate all water resources management activities in the country (MWR, 1999). Likewise, the ministry also formulated Coastal Zone Policy 2005 in order to harmonize and coordinate all development activities in the coastal zone.
- As a signatory country, Bangladesh follows Code of Conduct for Responsible Fisheries for Fisheries Resources Management, aquaculture development and integration of fisheries into Coastal Area Management (FAO, 1995).
- National Fisheries Policy (1998) which focuses on policies on conservation, management and harvest of open water fisheries, aquaculture and management of inland closed water fisheries, coastal water shrimp aquaculture, fish conservation and management of marine fisheries,
fisheries training, extension and research with due emphasis on employment, quality control and foreign exchange earnings.

- National Shrimp Policy (2014) protects and promotes environment-friendly and socially acceptable shrimp aquaculture with zone and land allocation (GoB, 2014).

**Stakeholder involvement**

The major government stakeholders and driving forces of IAA are the Ministry of Agriculture, the Ministry of Fisheries and Livestock, and their extension and research wings. Nevertheless, the Bangladesh Water Development Board under the Ministry of Water Resources, the Ministry of Land, and the Ministry of Local Government also contribute to the promotion of IAA.

**Ministry of Agriculture**

The Ministry of Agriculture has a mandate involving production of crops including rice and other cereals. The Ministry works include:

- Develop agricultural policies, plans, regulations, acts, etc. for sustainable agricultural development and for food sufficiency;
- Provide support in developing new agricultural technologies to boost agricultural production and coordinate with local and international trade agencies for marketing;
- Monitor implementation of agricultural policies, plans, projects, programmes and regulations;
- Monitor distribution of agricultural inputs and subsidies and marketing of the agricultural products in local and international markets;
- Develop capacity of the professionals and other actors with the recent developments in agricultural sector elsewhere in the world;
- Provide administrative and policy support to the Ministry agencies for planning and implementation of the development programs /projects and coordinate with donors and development partners for funding and technical assistance.

**Department of Agricultural Extension**

The Department of Agricultural Extension is the largest agency of the Ministry of Agriculture that supports the farmers through application, demonstration and dissemination of modern technologies developed by research organizations. It contributes to IAA through advanced training of farmers and demonstration services. The Department has implemented a project that promoted demonstration and training relating to vegetable production in floating beds. It is one of the examples of IAA where vegetable cultivation was integrated with aquaculture.

**Bangladesh Rice Research Institute**

The Bangladesh Rice Research Institute is a major component of the National Agricultural Research System of Bangladesh, dealing with research and development in relation to rice production. It also contributes to IAA to produce vegetables and fish side by side in coastal region homestead gardens, also known as Sorjan. The Institute has also developed technologies for the utilization of fallow land in the Aman season in the Gopalganj area through changing the cropping pattern of water-logged areas with one crop of rice and another crop of fish.

**Ministry of Fisheries and Livestock**

The Ministry of Fisheries and Livestock aims to promote fisheries and livestock sector through policy formulation, legislation, implementation of rules and regulations and policy advocacy for its underlying departments, which are: Department of Fisheries, Department of Livestock, Bangladesh Fisheries Research Institute, Bangladesh Livestock Research Institute, Bangladesh Fisheries Development Corporation.

**Department of Fisheries**

The Department of Fisheries is the front line public sector organization for the promotion of aquaculture and fisheries development. It disseminates modern aquaculture technologies through training, demonstration and extension; renders advisory services; and supports fisheries stakeholders. It also
works for the protection, conservation and promotion of inland closed and open water fisheries and marine harvest; maintains fish sanctuaries, regulates seasonal closures; and bans specific fishing gears and practices. It also works to facilitate arrangements for institutional credit for fish and shrimp farmers, fishers, fish traders, and fisheries entrepreneurs. It also facilitates livelihood support through alternative income generating activities towards poverty alleviation, employment generation, promotion of export, and food security, safe and quality fish production and market chain development. It supports agro-aquaculture through beel nurseries, promoting floating net cage aquaculture and pen aquaculture in open water floodplains and different models of best practices including agro-aquaculture, namely: the Daudkandi Model, Vabadaha TRM-based cooperative agro-aquaculture and similar.

**Bangladesh Fisheries Research Institute**

Bangladesh Fisheries Research Institute is an autonomous government research institution for fisheries and related research. This institution is responsible for carrying out basic and adaptive research for development and management of all living aquatic resources in Bangladesh. It also works on technology development and technology transfer training and extension of stakeholders. It has a mandate to promote IAA.

**Bangladesh Fisheries Development Corporation**

This is an autonomous body under Ministry of Fisheries and Livestock to promote fish marketing in the country.

**Ministry of Water Resources**

Ministry of Water Resources formulates and regulates water use policies in the country. It provides technical assistance in the field of irrigation, flood control, anti-water-logging and drainage of waterways. It maintains flood control structures, dams, and embankments.

**Bangladesh Water Development Board**

Bangladesh Water Development Board (BWDB) is an autonomous functional unit of the Ministry of Water Resources to implement projects and programs of water control in the country. This agency also promotes small-scale water management projects and promotes agro-aquaculture through providing training and technical support.

**Individual adoption**

There are two types of rice-fish farming systems in Bangladesh: capture and culture. In the capture system, wild fish enter the rice fields from adjacent floodplains during the monsoon, however, in the culture system, rice fields are deliberately stocked with fish. Fish culture in rice fields is broadly classified as alternate (rotational) and integrated (concurrent) and it has been identified in a study that regardless of the farming system employed, the majority of rice-fish farmers produce fish in rice fields for income generation, while 34 percent and 12 percent did so for household consumption and suitable biophysical conditions, respectively. According to this study, 54 percent of rice-fish farmers were involved in integrated rice-fish farming while 46 percent practiced alternate farming. Integrated farming was found under both rain-fed and irrigated conditions. However, because of poor irrigation facilities, only a few farmers (12%) were involved in irrigated rice-fish farming.

Integrated rice-fish farming faces a number of challenges including the lack of technical knowledge of farmers, high production costs, flood, drought, water pollution and land tenure arrangements. Despite the income derived from fish production in integrated farming, many farmers perceived rice as the main crop and fish as a by-product. Fish production in rice fields was considered as a bonus to be achieved with additional inputs, but high input costs are a major hindrance. At present, rice farmers are not taking risks by investing in rice-fish farming – they are ‘staying poor to stay secure’. High fish mortality occurs because of poor water quality because of water pollution, turbidity, low water levels and high water temperature.
Cost-benefit analysis of IAA
According to the survey conducted by Ahmed et al. (2011), the highest average annual variable costs usually incurred from alternate farming are costs associated with fish fingerlings and feed, while the lowest were from rice monoculture. Labour costs generally constituted the highest single operational cost, accounting for 29%, 43% and 51% of total variable costs in alternate, integrated and rice monoculture, respectively. However, annual fertilizer cost becomes the highest in rice monoculture and similar for alternate and integrated rice-fish farming. It was noted that the costs for fish feed were only about twice as high for alternate farming than for integrated farming although the input was much higher.

Fixed costs included depreciation (i.e. ploughing and pesticide spray equipment, fish net and rice threshing machine), interest on operating capital and land-use cost or lease money. The largest single fixed cost for rice and rice-fish farmers was cost of land. Fixed costs accounted for 28%, 30% and 34% of total costs in alternate, integrated and rice monoculture, respectively.

The average annual net return is higher in integrated farming, compared to rice monoculture and alternate farming. Integrated farmers obtain the highest net return because of a combination of two rice crops and fish production. Although there is higher fish production in alternate farming, the average annual net return is lowest for alternate farmers because, for a single crop, they had the highest production costs and the lowest rice production.

Revenue and Food Security Impact of IAA
While IAA enhances on-farm resource-use efficiency and productivity via the integration of resource flows between terrestrial and aquatic subsystems, it moves to a whole-farm perspective, utilizing ponds and paddy fields by optimizing management of on-farm resources. It has been concluded by some studies based on the experimental design of before-and-after and with-and-without basis that if farmers adopt IAA they would be better off in terms of outcomes such as productivity, income, and food security.

The production of a fish crop between the two rice crops provides the farmer with an off-season job. This can increase the income without increasing expenses. The combined culture leads to a reduction of labour in weeding and an increase in the yield of paddy by 5–15 percent. The increased rice production in the rice-fish integration is attributed to various factors, such as reduction in the number of harmful insects, reduction in rat population due to increase in the water level, increase in organic fertilization by fish excreta and remains of artificial feed, and better tilling of the rice seedlings due to the activity of the fish. The introduction of IAA reduces poverty for IAA adopters, as the poverty rates fall an average of 16 percent. Investment in IAA improves incomes beyond simply income from fish. Adoption also results in significantly increased fish consumption.

Conclusions
IAA is a smart solution as resources of primary production are becoming scarcer and there is increased demand of outputs against decreased input supply compounded with climate change. Selection of hydro-ecological zone-specific best practices, climate-resilient adaptive species with value chain development are the three most important requirements in this regard. It is time to explore all good practices already developed elsewhere in the word for the betterment of the world humanity for safe, sufficient and quality-ensured food security with due respect to water quality, soil health, natural conservation and biodiversity protection. Bangladesh is ready to extend her all-round support and cooperation for any future endeavour for promotion of IAA locally and globally.

References


COUNTRY REPORT THE LAO PEOPLE’S DEMOCRATIC REPUBLIC

Introduction
Rice is a staple food for Lao People, and essential for food security, and the National Policy of the Lao Government promotes intensification of rice production. Rice is one of the most important crops, and countrywide production targets are set by the Lao Government. Lao farmers produce sufficient rice, with a surplus, to ensure national food security. However, rice production is still not optimized in terms of productivity and quality. In 2015, there were 984,932 ha of rice cultivated, of which 957,836 ha was harvested. Total production was 4,102,000 tonnes, and the average yield was about 3.90 tonnes/ha (DOA 2015).

Lao farmers increasingly make use of improved, high-yielding rice varieties and other production inputs, such as chemical fertilizers and pesticides. Recent surveys show that Lao farmers use production inputs inefficiently, and that they can and should make better-informed decisions regarding the rational use of inputs. Hence, there is a need, as identified by Ministry of Agriculture and Forestry, to support Farmer Field Schools (FFS) to provide education opportunities for farmers to acquire knowledge and skills for sustainable intensification of rice production.

In this regard, there have been several projects, of which was an important one with an objective to implement Farmers Field School on Save and Grow-Sustainable Intensification of Rice Production. The purpose was to educate Lao rice farmers through field-testing of sustainable rice intensification practices, making optimal use of the multiple good and services of paddy-based farming systems aiming at resource-use efficiency, growing healthy crops, getting higher yield and doing so in a sustainable manner. Important partners included Department of Agriculture and the National IPM Programme, Ministry of Agriculture and Forestry, Department of Livestock and Fisheries as well as Agriculture and Extension staff and smallholder farmers.

The FFS development approach using the Save and Grow (S&G) paradigm has been used to promote sustainable intensification of rice production in the Lao People’s Democratic Republic. Whereas all FFS interventions promoted the use of Integrated Pest Management (IPM), other targets, (e.g. curriculum, content and learning modules) varied from province to province depending on their geographic, social and economic conditions for rice cultivation and other types of agriculture productions. Targets in Xieng Khouang and Savannakhet provinces were to increase yields while using fewer seed inputs, more organic fertilizer and less chemical fertilizer, and reduce the labour cost. In Champasack province, the focus was on the promotion of environmental-friendly production practices and the increase of productivity by balancing the use of organic and chemical fertilizers. In Xayaboury, extravagant use of seeds and the increase of labour costs are major issues. Thus, this province targeted reducing the amount of seed used and the labour costs through shifting from transplanted to direct-seeded crops.

Assessment of results of Farmers Field Schools for Save and Grow (S&G) -based Sustainable Intensification of Rice Production (SIRP) in the Lao People’s Democratic Republic.
A summary of activities, which were implemented starting in April 2015, began with an Inception cum Curriculum Development and Refresher Training Workshop for FFS on Save and Grow Sustainable Intensification Rice Production, which was jointly organized by FAO and Department of Agriculture in Vientiane from 1-7 April 2015. FFS trainers received training on practical implementation of the Save and Grow concepts and good practices for sustainable intensification of rice production. Based on prior implemented baseline surveys on current location-specific rice production practices, a curriculum was then developed for pilot testing in the Save and Grow-SIRP Farmers Field Schools. With these curricula, thirty one (31) season-long FFSs were implemented between 2015-2016 during the wet seasons (April-November) by both experienced and new FFS trainers, spread throughout 12 districts of four provinces (Savannakhet, Champasak, Xieng Khouang and Sayabouly).

FFS field results show that rice yields have increased compared to the baseline. In Xieng Khouang province, rice yields increased by 15 percent compared to 5.2 tonnes/ha harvest in the control plot while Save and Grow practices integrated with rice-fish practices increased rice yield by 26 percent compared...
to the control. The yields in Xayaboury declined by 5 percent from 4.9 tonnes/ha rice yield in the control plot. The rice yields in Savannakhet were 41 percent higher compared to the 4.1 tonnes/ha yield in the control plot while Save and Grow plot using rice-fish had increased 38 percent from the control. In Champasak province, FFS S&G-SIRP fields produced a 36 percent higher yield compared to the 3.5 tonnes/ha control plot.

The FFS S&G-SIRP experimental plots demonstrated that FFS farmers can “produce more with less”, the key concept behind S&G. The FFS S&G-SIRP showed lower input costs compared to the traditional control plots, especially the reduced amount of seed and labour in Xieng Khouang and Xayaboury provinces. However, with this success, some schools have increased the cost for chemical fertilizers and manure compared to the control. The economic performance assessment showed that these higher inputs, in fact, made good economic sense in terms of higher net returns achieved. In conclusion, the FFS approach for S&G has demonstrated good success in 2015, and all indications suggest that results from FFS interventions in 2016 will show similar results. The results obtained from the FFS field experiments provide clear evidence of the success, and imply that knowledge and skills of farmers have improved dramatically after the introduction of FFS.

Another lesson learned was that farmers were mainly interested in special topics that related to their location specific problems on pests and rice growing techniques rather than general topics identified for them as part of a standard FFS curriculum. This means that it is important for trainers to understand local field situations and farmer needs prior to designing a locally and situation specific FFS curriculum and that weekly adaptations of the curriculum and associated learning modules is necessary for ensuring relevant training and good farmers interest and participation in the FFS sessions.

**Other projects**

A project titled “The System of Rice Intensification (SRI) in the Lower Mekong River Basin” is an Asian Institute of Technology-led, FAO and Oxfam partnered, and European Union-financed project that aims to contribute towards enhancing the resilience of rainfed rice farmers confronting climate change in the Lower Mekong River Basin region. The action is being implemented in four countries in the lower Mekong delta: Cambodia, Lao People’s Democratic Republic, Viet Nam and Thailand from 2013-2017.

Another project, entitled “Sustaining and enhancing the Momentum for Innovation and Learning around the System of Rice Intensification (SRI) in the Lower Mekong River Basin”, has been implemented in the Lao People’s Democratic Republic with international partners. SRI action research and farmer training activities are implemented in three selected provinces: Vientiane, Khammouane and Savannakhet. Each province selected three districts with rainfed rice based farming systems, as follows: Vientiane province (Meun, Vang Vieng and Feuang); Khammouane province (Nakay, Yommalath and Mahaxay); and Savannakhet (Champphone, Songkhone and Xayaboury). In 2015, Farmer Participatory Action Research was conducted in all three provinces to train the trainers with a total 90 participants (40 percent women). In 2016, Farmer Participatory Action Research was conducted in the nine districts within three provinces involving 1 150 farmers (40 percent women).

**Fish System**

The Lao People’s Democratic Republic enjoys rich aquatic biodiversity and the rice fields are a sanctuary for a diverse set of aquatic organisms. The aquatic resources from rice-based ecosystems have become vital to the Lao people, especially those living in rural rice production areas. An earlier study examined the role and nutritional value of aquatic resources in the diet and livelihoods of rural people. It revealed that the aquatic organisms are a substantial part of the food supply of Lao rural people and provide animal protein and micronutrient resources for consumption in rural households. The traditional rice-fish production in the Lao People's Democratic Republic upland was estimated 16–120 kg/ha (DLF 1997), where in lowland with stocking have recorded 250 kg/kg (Horcle 2007) and The Provincial

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Additional information on this project may be found here: [http://www.sri-lmb.ait.asia](http://www.sri-lmb.ait.asia)
Aquaculture Development Project (LAO/97/007) is estimated average production at 153 kg/ha (FAO, 2013).

In Phase II of Regional Rice Initiative (RRI), the Department of Livestock and Fisheries worked closely with staff from the District and Provincial Agriculture and Forestry Offices in two provinces (Savannakhet and Xieng Khouang). The aim was to explore the importance and economic valuation of aquatic animals and plants in rice-field environments and support implementation of the dry season promotion trials in two provinces. The experience and lessons learned from these trails provide the DLF with practical, poverty-focused recommendations on extensive aquaculture and aquatic animal enhancement/conservation, which will strengthen MAF/DLF’s contributions towards the development of multi-sectorial strategies to improve food and nutrition.

The consumption of aquatic animals and plants during the dry season from two provinces was collated and summarized by DLF. Ten families from two villages of Savannakhet province and 10 families from one village in Xieng Khouang province collected these data with support and assistance provided by district and provincial extension staff. In Xieng Khouang, 10 farming families recorded consuming 10 species of fish, 6 species of other aquatic animals, including frogs, eels, snails, crabs and insects, 7 aquatic plants and 6 types of aquatic forest products (in areas of natural forest next to the rice fields). The average total consumption of these resources per person was about 280 g/day (recorded over a 10-day period) with an economic value of about USD 1/day. This is a significant contribution to rural food security and represents approximately double the monetary value of average daily rice consumption (about 550 g/day/person). The survey highlights the importance of these resources during the six-month dry season and the essential contribution they make to dietary intakes of protein and fat. However, the consumption of these resources during the dry season is less than half the weight (and value) recorded by a similar survey conducted (with the same farmers), during the rainy season in 2015.

Working in partnership with rural communities, FAO and the Department of Livestock and Fisheries, in October 2016, implemented Farmer Promotion Trials with 30 farming families in some of the poorest areas of the country. These Promotion Trials test recommendations aimed at improving the food and nutrition security of farmers dependent on rice-based livelihoods through micro-scale rice-fish culture. Farmers have dug their ponds on the margins of rice fields, which are mostly integrated into the family’s vegetable production system. Before being released into the rice fields, waste vegetables are fed to the fish and small amounts of manure from free-range chickens are used to fertilize the water. Pond construction exploits the availability of cheap plastic sheets, which in the last few years have been increasingly used in commercial agriculture. The Promotion Trials have been highly successful, this is demonstrated by other development projects, and neighbouring farmers have already showed considerable interest in replicating the strategy. By promoting it more widely, there is the potential to not only significantly increase rice-fish production in the wet season, but also provide a “safety-net” of a highly nutritious food during the dry season. Among the lessons learned, it was noted the importance of building upon earlier RRI work in the Lao People’s Democratic Republic, which highlighted the economic and cultural importance of rice-fish systems, and the value of indigenous knowledge in developing rice-field fisheries. The value of aquatic animals in rice-field environments is generally underestimated, and for many small-scale farmers it exceeds the economic value and nutritional importance of their rice.

Incorporating the importance of these resources into government policy can only be achieved with local understanding and participation. Intensification of aquatic animal production in traditional rice-fish systems is difficult to achieve. The risks and costs of paddy field modification are too high for many small-scale farmers. Small ponds dug by hand are not big enough to grow substantial quantities of fish, but can effectively augment and intensify traditional rice-fish systems. General awareness of semi or intensive rice-fish is raised by the presence of extension activities within a village however; farmers often adopt a precautionary approach to starting activities on their own. Many farmers expressed the need to observe successful, reliable rice-fish in their village before risking investment of labour or money in rice-fish.
References:
COUNTRY REPORT MYANMAR

Introduction
Myanmar has an ethnically diverse population of about 51.7 million, and a land area of 676,578 km². The country is divided into 15 states and regions, with 135 different officially recognized ethnic groups. Approximately 72 percent of the population lives in rural areas where 85 percent of poverty is concentrated; 24 percent of rural households are considered vulnerable. According to the Integrated Household Living Conditions Survey, the poverty rate in Myanmar in 2011 was approximately 25.6 percent. In Myanmar, 61 percent of employment is generated by the agriculture sector, and 54.2 percent of those engaged in agriculture, hunting and forestry fell below the general poverty line. With a per capita income of USD 1,205, Myanmar is ranked 165th out of 180 countries in the world, and according to the World Bank, approximately 66.9 percent of total employed in the country are working poor earning USD 2/day or less.

The exported amount of fish and fishery product was 0.438 million metric tonnes and the value of which was USD 605.8 million in 2016-2017. These products were exported to 39 different countries.

In Myanmar, there is a gender-based division of labour in crop-cultivation, although it may differ according to cropping patterns and between states and regions. Women perform most tasks related to crop cultivation. This normally includes planting, caring, weeding, transplanting, harvesting, threshing, postharvest operation, and marketing. Women in Myanmar have a high burden of work, which includes both productive and reproductive work.

Food security is a problem in remote upland areas (ADB, 2012a) but some sources have also reported this as an issue in the more prosperous areas of the Delta since Cyclone Nargis (Steinberg, 2010; Dapice et al., 2010). Pressure on living standards has increased levels of indebtedness and helped to fuel large-scale emigration to neighbouring countries in search of employment (Dapice et al., 2010).

With 80 percent of farm holders having less than 10 acres, Myanmar agriculture is dominated by smallholder farmers; and female smallholders perform most tasks in crop agriculture. The Agriculture Development Strategy (ADS) cannot ignore male and female smallholders. In fact, regional experience indicates that emphasis on male and female smallholders might have not only benefits in terms of poverty reduction and reducing inequality, but in terms of economic efficiency and growth. Wherever smallholder production is efficient and competitive, and thus financially and economically viable, the urgent need to tackle rural poverty and raise rural incomes makes the promotion of smallholder agriculture a high priority.

Myanmar’s rural infrastructure overall is still poor. The investment needs are huge, but in addition to government investment, support is likely to come from both multilateral and bilateral development partners. Department of Rural Development (MOALI) is actively involved in several renewable energy activities, including solar energy, micro hydro. In addition, rural infrastructure including roads and bridges. Farmers will need support through long-term credit lending schemes, with low interest rates, to support the adoption of IAA. In addition, the costs of digging canals in the rice field are insurmountable for some farmers, who will need financial support. Indeed, the lack of access to long-term credit and high digging costs are blocking issues for the adoption of IAA for many farmers.

Against this background, the Table 5 provides a simplified strengths, weaknesses, opportunities, and threats (SWOT) analysis of the Myanmar Agriculture and Natural Resources sector.
### Table 5: SWOT [Strengths, Weaknesses, Opportunities, Threats] Analysis of Myanmar’s Agriculture and Natural Resources Sector

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<tbody>
<tr>
<td>Rich endowment of natural resources (water, soil, forest, coastline)</td>
<td>Research, Extension, and Education are underfunded, and weakly coordinated</td>
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<tr>
<td>A variety of agroecological areas suitable to agriculture, livestock, fisheries, and forestry</td>
<td>Departments of MOALI still need to be fully integrated</td>
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<tr>
<td>Large irrigated areas</td>
<td>Limited access of farmers to timely and quality inputs</td>
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<tr>
<td>Relatively high land/labour ratio</td>
<td>such as seeds, fertilizers and pesticides, and animal health services</td>
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<tr>
<td>Basic structure of agricultural research, extension, and education institutions</td>
<td>Extension systems not responsive to female and male farmers needs and demands</td>
</tr>
<tr>
<td>Surplus in a few commodities (rice, pulses, fruit, maize, shrimp, cattle, etc.)</td>
<td>Limited diversification away from rice</td>
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<tr>
<td>A growing domestic market</td>
<td>Limited access of female and male smallholder farmers to secure land right</td>
</tr>
<tr>
<td>Improved regional integration and connectivity particularly with GMS and ASEAN</td>
<td>Land registration, classification and titling in need of reorganization</td>
</tr>
<tr>
<td>Strategic location for exports to China, India, and ASEAN</td>
<td>Limited quality and safety of agricultural products</td>
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<td></td>
<td>Weak transport and communication infrastructure</td>
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<td></td>
<td>Gender inequality and women’s rights in agriculture</td>
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<td></td>
<td>Low capacity of institutions to carry out key governance functions such as planning, policy formulation and analysis, monitoring and evaluation, safeguards</td>
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<td></td>
<td>Unbalanced expenditures within MOALI with limited funds available for research, extension, education, seed development, land administration and management.</td>
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<td></td>
<td>Inefficient use of water resources and irrigation systems</td>
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<td>Weak statistical systems</td>
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<td>Weak capacity in policy formulation and analysis</td>
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<td>Limited access of smallholder farmers to financial services</td>
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<td></td>
<td>Low productivity levels and productivity growth</td>
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<td></td>
<td>Low value added produced by agroindustry</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
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<tbody>
<tr>
<td>Growing demand for safe, convenient, and processed food in urban Myanmar</td>
<td>Land grabbing continues and results in social and economic unrest</td>
</tr>
<tr>
<td>Growing export demand for several products where Myanmar has comparative advantage</td>
<td>Unsustainable use of natural resources might result in environmental damage and land degradation</td>
</tr>
<tr>
<td>Growing interest of domestic and international investors given the increasing regional integration with GMS and ASEAN and increasing connectivity in ICT and economic corridors</td>
<td>Natural disasters</td>
</tr>
<tr>
<td>High potential for competitive exports in several value chains (rice, pulses, fruit, vegetables, shrimp, cattle, maize, cassava, rubber)</td>
<td>Pace of HRD too slow to sustain rapid economic reforms (i.e. absorptive capacity remaining too low)</td>
</tr>
<tr>
<td></td>
<td>Slowing down of reform process and increasing social economic unrest</td>
</tr>
<tr>
<td></td>
<td>Little preparedness to face competition from more competitive ASEAN neighbours in the presence of AEC</td>
</tr>
</tbody>
</table>
Past and current status of integrated agri-aquaculture

Rice-fish culture is being implemented by several States and Divisions since 2015-2016, with a total cultured area of about 5 826 ha. Nearly 7.3 million fish seeds have already stocked. The rate of stocking density is 1 250 fish/ha (500 fish/acre), and all fingerling are between 7.5–10 cm (3–4 inches) and are distributed by Department of Fisheries (Ministry of Agriculture, Livestock and Irrigation). Production of fish from rice-fish farming is used for household consumption or domestic use. The average production of rice-fish farming is 46.87 kg/ha (30 viss/acre). The Department of Fisheries provides each rice-fish farmer 500 seed/acre, which is free for charge. The species used are: tilapia, rohu, common carp and silver barb. The price at harvesting time is 1 300 Kyat/Kg/Species (2 000 Kyat/viss/species) due to their size. The fish-livestock integrated farming practices are being used. In Myanmar, there is no fish and vegetable hydroponic farming.

At the beginning of 2016, three Ministries, which were the Ministry of Agriculture and Irrigation, the Ministry of Livestock, Fisheries and Rural Development, and the Ministry of Cooperative were integrated as Ministry of Agriculture, Livestock and Irrigation (MOALI). One of the purposes was to harmonize the different Ministries to reduce friction over mandates and competition for resources.

MOALI is forming Agriculture Development Strategy in 2016, which aims to be an integrated and shared strategic documented based on the considerable efforts made by the government, private sector, civil society, and development partners in proposing various approaches to agricultural development. This strategy is the result of a process led by the Government with the participation of several stakeholders. The strategy aims at indicating clear priorities in the short, medium and long-term.

This Strategy also includes improvements in the productivity of land and labour. Agricultural productivity requires the adoption of appropriate technologies and knowledge to increase efficiency and sustainability of agricultural production consistently with market demand. The measure to raise agricultural productivity include those related to i) effective agricultural research and extension; ii) efficient use of agricultural inputs; iii) efficient and sustainable practices and use of natural resources (land, water, soils, and forests); iv) increased resilience to climate change and disasters.

Stakeholder Involvement

Before 2002, the rice-fish culture was implemented by the Department of Fisheries, Ministry of Livestock and Fishery, and at that time a traditional (lower intensity) method was used which focused primarily on a stock enhancement programme. Things changed in 2002 when the new practice was introduced to Myanmar. Twelve participants engaged in a rice-fish culture training in 2002, at FFRC in Wuxi, China. This training was attended by participants from Myanmar, the Lao People’s Democratic Republic and Cambodia. After 2002, new rice-fish farming or Chinese style was changed to traditional method. The new design was to raise the paddy dykes and to dig small canals around and edge of the rice plot.

The rice-fish culture is being conducted in Myanmar with Japan International Cooperation Agency, Australian Centre for International Agricultural Research, and FFRC (China). They are development partners of Myanmar’s rice-fish culture. Department of Fisheries has established one demonstration farm in Yangon for extension purposes for rice-fish farmers. The Department of Fisheries has trained for their staffs using a training for trainers methodology for rice-fish extension purposes. The Department of Fishery is expanding small-scale aquaculture extension services, which include integrated farming and rice-fish farming. The Farmer Field School approach is use only for paddy and other crops through the extension services of the Agriculture Department.

Enabling Environment

In March 2012, two new land laws were passed by parliament, namely the Farm Land Law and the Vacant, Fallow or Virgin Land Management Law. The Farm Land Law builds on the constitutional

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6 Myanmar kyat (MMK): USD1 = MMK1 300
principle of the Right to Ownership and provides a tool for farmers to register their land, for which a Land Use Certificate can be issued. The Certified Farmland can be mortgaged, sold and transferred.

Most of the current irrigation systems are designed for paddy and the intuitional and infrastructure needed for a more diversified agriculture are not in place. Irrigation systems are not maintained and the benefit cost ratio of investment is low. Moreover, in spite of 84 percent of the agriculture land not being irrigated rainfed agriculture system.

Although a number of activities for social protection are being conducted by government and non-government agencies, implementation of social protection activities and programmes is a fragmented affair, with both overlap and unmet needs.

**Agricultural Policy**

MOALI has prepared an Agricultural Policy to guide the implementation of the Second Five-Year Plan. The policy has various objectives and programs of work. The objectives include the following:

- To improve food security and safety, and balanced diets intake during the period of the second Five Year Plan.
- To ensure that farmers are enjoying their rights fully and experiencing the emerging economic benefits in person.
- Small-scale farmers, livestock keepers and fisher folks gathered into groups or cooperatives aiming to modernize and improve performance of the entire sector based on the newly gained knowledge and experience and in which women participation is incorporated.
- Planning and implementing programmes of rural road construction, rural infrastructure development, land use management and small scale production industry with the intention to sustain the development of existing farmers’ socioeconomic situation.
- To assist in securing needed technologies and financial assistance from local and external sources for further improvement and development of crop, livestock and fish production sector as well as the cooperative sector.
- To assist the enhancement of producing high quality grain, meat and fish products for external markets.
- To assist the improvement and development programme of agro-based industry, small scale industries, and vocational education.
- To assist in increasing access to local and external investment sources for agriculture sector.
- To support the coordination work to ensure full participation all stakeholders involved in poverty alleviation programme, agriculture sector development programme, and sustainable rural development programme.

**Individual adoption**

The main institution providing finance to the rural sector has been the Myanmar Agricultural Development Bank. This is not commercial bank; it is a financial institution providing subsidized credit to farmers. A large number of the farming and rural population rely on microfinance institution and the informal sector - traders, shopkeepers and moneylenders for their credit needs usually at very high rates of interest. The Myanmar Agriculture Development Bank has an interest rate of 8 percent/year, and provides only one-year loans. Hence, a rapid expansion in rural credit instead of short term rural credit both medium and long-term credit will be needed if agriculture is to take off rapidly. Microfinance will also need to be developed.

The cooperative sector has two on-going projects; a USD 400 million nationwide loan project from CHINA EXAM Bank for Micro-finance for rural development and poverty reduction; and a USD 100 million nationwide loan project towards increased agriculture mechanization. The interest rate of cooperative is 18 percent/year. Mechanization was relied on by private sector.
Agriculture and food production has environmental impacts, and this sector is affected importantly by environmental impacts from other sectors. Collective decisions must be made to balance needs for growth and income generation across the economy relative to short and long-term environmental and social impacts. Increase in productivity through adoption of new practices and technology must ensure sustainable use of natural resources, primarily land, soil, water, and forestry.

In Myanmar, the growth in the number of farmers pursuing non-agricultural work has increased. As more people are want to leave their villages to cities to seek work. Agriculture returns from the land are typically much smaller than what can be earned from working in cities. Migrant farmers are posing threat to the country’s food security. In addition to migrant farmers will be encouraged to return to their villages and set up their own business including rice-fish culture. Myanmar is strongly recognizing the importance of rice-fish culture in view of its contribution to people’ food security and livelihood creation.
COUNTRY REPORT THE PHILIPPINES

Introduction
The Philippines is an archipelago composed of about 7,100 islands with an area of 300,000 km, of which 298,170 km is land and 1,830 km is water. Luzon, Visayas, Mindanao are the three largest groups of islands in the country. It has two distinct seasons; the wet is from June to December, and dry season is from December to May.

The Philippines is predominantly an agricultural country of which the typical diet mainly consists of rice, vegetables and fish. Fish is one of the nature’s best nutritional gifts and it is becoming more important in people’s diet. However, fish from the wild continues to be decreasing and aquaculture is seen as a potential means to meet the increased demand for fish. Researchers and experts have developed aquaculture technologies, which are focused mainly on increased production.

The fishing industry’s contribution to the country’s Gross Domestic Product in 2015 was 1.5 percent and 1.7 percent at current and constant 2000 prices, respectively. This translates to P’195.7 billion for current prices and P128.1 billion for constant prices of the country’s GDP of P13 285 billion (constant prices). The industry also accounted for 14.3 percent (P195.7 billion) and 17.8 percent (P128.1 billion) of the Gross Value Added (GVA) in Agriculture, Hunting Forestry and Fishing Group of P1 364 billion and P719.3 billion at current and constant prices respectively, the largest next to agricultural crops (BFAR Website).

The industry employed 1,614,368 fishing operators nationwide (NSO 2002 Census for Fisheries) of which the municipal fisheries sector accounted for more than one million (1,371,676) operators while the commercial and aquaculture sectors added some 16,497 and 226,195 operators, respectively (BFAR website). The total volume of fisheries production in the Philippines in 2015 reached 4,649,313 tonnes, valued at P240 billion. The annual performance of the fishing industry was attributed to the production of the three sectors: Commercial with 26.2 percent, Aquaculture with 50.5 percent and Municipal with 23.3 percent (BFAR Website).

China is the leading country in fishing and aquaculture output, which accounts 30 percent of world fish production in 2014. The Philippines ranked 8th with 4.69 million tonnes, which is equivalent to only 2.4 percent only of the world’s production. In terms of world aquaculture production, which is 73.8 million tonnes, the Philippines ranked 11th with a 1.07 percent share (Sawe, B. E 2016).

Aquaculture now provides half of all the fish for human consumption and fish continues to be one of the most traded food commodities worldwide. Oceans and inland waters have the potential to contribute significantly to food security (FAO Website). Aquaculture activities are done in fresh, brackish or salt-water environment using pond, cages, pen or integrated fish farming method.

One option for sustainable development in farming is small-scale integrated agri-aquaculture. The diversification that comes from integrating crops, vegetables, livestock, forestry and fish imparts stability in production efficiencies in resource use and conservation of the environment (Lightfoot, C and Gonsalves J, 1992).

Integrated agri-aquaculture systems are defined as the concurrent or sequential linkage between two or more agricultural activities of which at least one is aquaculture (Little and Edwards, 2003). It has been promoted as a way of increasing food production, conserving the environment and ensuring food security (Zajdband, A.D 2012). The most common agro – aquaculture systems in the Philippines include: fish-duck farming, chicken-fish farming, fish-pig farming, gabi (taro, Colocasia esculenta)-fish farming and rice-fish farming.

7 Philippine Piso (PHP): USD 1 = PHP52
Rice-fish farming is an integrated rice field, or rice field and pond complex, where fish are grown concurrently or alternately with rice. It allows the production of fish and other aquatic animals as well rice from the same rice field area and generally without causing reduction in rice yields (http://www.fishbase.org).

Previous interventions on integrated agro-aquaculture
Experiments were conducted by Freshwater Aquaculture Centre and Central Luzon Agricultural Research Centre between 1974 and 1978. Seventy-four experiments were completed. This research was directed at developing appropriate, low-cost technologies. They mainly used high yielding improved rice varieties, Nile tilapia and common carp, which were found to be the most suitable for rice-fish culture. Stocking densities of 3 000 fish/ha for common carp and 5 000 fish/ha for Nile tilapia were found appropriate for monoculture without supplemental feeding. Polyculture of common carp and Nile tilapia at a stocking rate of 2 000 and 4 000 fish/ha respectively gave the highest yields with a production ranging from 78–303 kg/ha (Sevilleja, 1992).

Results of these research programmes were tested nationally starting in 1976 by the then Ministry of Agriculture and Natural Resources. The promising results obtained between 1977 and 1978 led to a pilot phase in May in 1979 (dela Cruz et.al, 1992). In 2005, farming system modules (rice + ducks + fish; rice + gabi & vegetables; rice + vegetables + swine) were found to give a higher net income and productivity than the usual rice + rice cropping system.

Farm-level costs and returns showed that growing fish simultaneously with rice crops could be a profitable venture (Tagarino, 1985). However, constraints such as risks of pesticide contamination, higher management requirements, and biased management practices towards rice as the primary crop, the problem of poaching and the non-adherence of adopters must be resolved.

National Rice-Fish Culture programme known as “Palay-Isdaan” was launched by the Department of Agriculture in May 1979. The programme covered 931 hectares in selected provinces in the country. The programme aimed to increase the income of rice farmers and to improve their nutritional status providing protein through the fish produced in their rice fields. Farmers adopted the technology for concurrent rice-fish culture as recommended by the Freshwater Aquaculture Center. The rice field was modified by constructing a center trench running lengthwise with the dikes made slightly higher and wider than in rice monoculture. A screened gate was provided on the dike to prevent entry of wild fish and escape of stocked fish. The fish species used were the Nile Tilapia (Oreochromis niloticus) or common carp (Cyprinus carpio) (Sevilleja, 1992).

Save our Terraces Program (STP), which included a rice-fish farming system component, was launched by Department of Agriculture in 1984 through the then National Food and Agricultural Council (NFAC). The objectives of this programme were to increase the farm productivity and income of rice terraces farmers and improve the nutritional conditions and status of the population.

Current agro-aquaculture integrated farming systems being used

Rice-Fish Farming Systems
In the Philippines, fish are traditionally allowed to enter the rice fields with the irrigation water and are later harvested with the rice. In the Cordillera Philippines, elders believed that the Japanese stocked rice fields with the Japanese weather loach (Misgurnus anguillicaudatus) in the 1930s before World War II and the fish adapted well in the rice terraces. Bocek (1982) stated that the farmers did not modify their ricefields for the cultural requirements of the fish because it grew perfectly well with rice in the paddies. In addition, farmers used to catch mudfish (Channa striatus) in rice fields but due to changing farming practices, catch has tremendously reduced (Ramsey, 1983). On paper, the earliest mention of stocking fish in a rice field in the Philippines was made in 1954 (Villadolid and Acosta 1954 in Culture of Fish in Ricefields edited by Halwart and Gupta).
Simultaneous/concurrent culture system of rice-fish
The simultaneous or concurrent system considers the growing of fish simultaneously with rice. Trenches are dug in the rice paddies to provide retreats for fish during periods of temperature extremes or when pesticides and fertilizers are being applied. The two types commonly used by farmers in the lowland areas are the peripheral and centre trenches, while the pit type is used in the upland areas. The peripheral trench is constructed along the four sides of a paddy, while the centre trench is dug across a paddy and pits are dug at the centre of for the same purpose. The stocking rate being used in this system is 2 000–3 000 fingerlings of common carp or 5 000 fingerlings for Nile tilapia per hectare in a monoculture system. In a polyculture system, stocking of 3 000 tilapia and 2 000 common carps per hectare is used.

Alternate rice-fish culture system
The alternate rice-fish culture is the rotational production of rice and fish in a paddy. This kind of system considers fish as a second crop. The stocking rate of fish depends on the water depth of the paddy. For shallow paddies of about 0.30 to 0.50 meter, the stocking rate is 3 000–5 000/ha, while for paddies of 0.7 to 1 meter water, the stocking rate is up to 10 000/ha.

Modified rice-fish culture system
The modified rice-fish culture is the construction of a fishpond in a rice field area, utilizing 10 percent of the total field area of which the remaining 90 percent will be planted with rice. The water stored in the ponds can be used to irrigate the rice area and extend crop production into dry season. The stocking rate recommended for this is 10 000 fingerlings per hectare.

Integrated Mangrove-Aquaculture Systems
The culture of mudcrab (*Scylla* sp.) in mangrove areas is popular in areas brackish water. SEAFDEC AQD successfully implemented the culture of mudcrabs in mangrove areas in Gigantes Island in Carles, Iloilo and in Cauayan, Negros Occidental. This proved that the adoption of aquaculture as a tool in coastal management enables the efficient use of limited resources, as well as a strategy for poverty alleviation and environmental conservation.

Fish-fruit and fish-vegetable farming systems
Fishponds are used for irrigating backyard fruits and vegetables. Pond water is usually richer in nutrients than other sources because it contains nitrogen-fixing blue-green algae, which can improve soil fertility. The sludge from the fishpond after harvest is rich in nutrients. In the Philippines, these are usually shoveled into the banks planted with vegetables. The enriched water is also used to water the plants. It was also observed that fruits planted in the pond dikes grow fast and bear fruits in season. Roots of matured mangoes can seep water from the ponds.

Vegetable from the system is not usually quantified and recorded although almost all small-scale fisherfolk practice the system.

In a case study of integrated farming in Northern Luzon in 2010, a fishfarmer with a 1 ha fish farm produced a total of 180 kg of assorted vegetables that were planted in the pond dikes with a gross income of five thousand pesos (P8 200). He also has five bearing mango trees that yielded 2 300 kg of fruits with a gross income of one hundred thousand pesos (P115 000). In addition, 26 heads of goats were strategically located in the pond dikes that sold fifty-eight thousand (P58 000) pesos.

Fish-livestock farming
To maximize production through optimum utilization of resources the government has directed efforts towards developing production systems and strategies that would give maximum returns to the fish farmer. The following integration are being practiced in the Philippines:

Fish-goat farming System
Goats are raised in the pond dikes and feed on the grass that grows on the dikes.
Fish-pig farming
In the past, pigpens and fishponds were located within the farm. The pigpen was constructed on top of the dikes of the fishpond, or the entire building or part of it constructed over the pond. A fishfarmer can produce more than 4,000 kg of fish per hectare by using fresh pig manure instead or inorganic fertilizer and feeds (Hipolito, S. 1984). However, due to health and sanitation concerns, modifications were made wherein pigpens are constructed away from the fishponds. A settling pond is constructed near the pen where the wastes are dumped, and the green water produced is channeled to the fishponds.

Fish-duck farming
The benefit of combined culture of fish and duck is more animal protein produced in the same area. The ducks benefit from the pond, and fish growth is accelerated by the duck manure, which provides a continuous supply of organic matter. The ducks eat the soft weeds in the pond and thus control the wild growth of harmful plants; they also eat the snails, tadpoles and bigger water bugs in the pond, which are un-utilized by the fish.

With the advent of the Philippine Good Aquaculture Practice (PHILGAqP), it was mandated that the layout and design of fishponds should be segregated from livestock activities. Livestock production is not allowed unless done in distinct (fenced) areas within the farm. Wild and domestic animals should be excluded from pond and harvesting areas. Proper segregating devices for livestock should be installed to avoid contamination.

Aquaponics
Aquaponics is a technology that combines the two well-established practices of aquaculture and hydroponics to yield a method of food growing that greatly reduces the use of water resources, demands no soil at all, and produces high yields of fresh nutritious crops and fish.

Home based aquaponics owes its origin to Tom and Paula Spreeno of Michigan, USA who wrote a how-to-manual in the early 1990s. It became a springboard for many home based systems built throughout the world through the internet.

Integrated Agro-Aquaculture under the Palayamanan Project
“Palayamanan” is defined as a diversified integrated rice-based farming system with rice as the base crop, integrated with other farming ventures in a synergistic manner, implemented by the farm family based on their available resources and the existing environment to attain family goals and aspirations. The project’s main objective is to promote diversified and integrated rice-based farming systems/modules directed at improving the resource base, sustaining productivity and uplifting the socio-economic conditions of small-scale rice farm families.

Palayamanan models farms were established in selected areas of the Bicol region, showcasing backyard vegetable and animal production, rice-watermelon production, continuous vegetable production, cash crop production, rice-gabi-fish culture, and small farm reservoir cum fishpond and pomology.

In Barangay Del Pilar, San Fernando, Camarines Sur, a new farming system module was introduced to farmers, which integrated Rice + Swine + Fish + Vegetable + Duck/Native Chicken + Ragidwiw (Rhycospora corymbos, a marshy weed). The intervention obtained an average income (Table 6) of P172,608 while similar module with the addition of orchard obtained a net income of P351,190. The inclusion of fish (hatchery) + livestock into the Farmer Field School module generated an income of P472,198. The hatchery is now a source of fingerlings to other farmer partners and other communities.
Table 6: Cost and return analysis of farmers’ rice-based farming systems in San Fernando, Camarines Sur (2017)

<table>
<thead>
<tr>
<th>FFS Module</th>
<th>Gross income (P)</th>
<th>Variable cost (P)</th>
<th>Net Profit (P)</th>
<th>ROI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice + Fish + Vegetable + Duck + Native Chicken + Swine + Handicrafts</td>
<td>271 808</td>
<td>99 200</td>
<td>172 608</td>
<td>1.74</td>
</tr>
<tr>
<td>Rice + Fish + Vegetable + Livestock + Poultry + Orchard</td>
<td>452 690</td>
<td>101 500</td>
<td>351 190</td>
<td>3.46</td>
</tr>
<tr>
<td>Rice + Fish + Vegetable + Livestock (hatchery)</td>
<td>678 398</td>
<td>206 200</td>
<td>472 198</td>
<td>2.29</td>
</tr>
</tbody>
</table>

Palayamanan in Pinit, Ocampo, Camarines Sur is an upscaling activity of the Community Based Participatory Action Research at barangay Hibago, Ocampo, Camarines Sur.

Goats, hito (catfish) fingerlings and ducks were awarded to the farmers. Adopting modules on rice and duck obtained an ROI (Table 7) of 554.57% while integrating goat and hito had Return on Investment of 130 percent and 486 percent, respectively.

Table 7: Return on investment of farming system modules adopted in Pinit, Ocampo Camarines Sur

<table>
<thead>
<tr>
<th>Farming System Module</th>
<th>Return on Investment, % After the Implementation</th>
<th>Increase in Base Crop, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice + Ducks</td>
<td>262</td>
<td>212</td>
</tr>
<tr>
<td>Rice + Goat</td>
<td>107</td>
<td>122</td>
</tr>
<tr>
<td>Rice + Hito (catfish)</td>
<td>171</td>
<td>284</td>
</tr>
</tbody>
</table>

Upcoming interventions on integrated agro-aquaculture

Introduction of the Circle of Life Technology in the Urban areas.

The Circle of Life Technology is composed of two (2) circular tanks: Tank A holds the water for fish culture while Tank B is used to grow vegetable such as kangkong (Ipomoea aquatica), eggplant, and gabi. In the system, the dirty nutrient-filled water from Tank A is transferred to Tank B where the vegetables make use of the nutrients in the water. After, the aerated water is re-circulated back to Tank B. This system uses the same basic ideas and concepts as aquaponics.

The re-circulating water is solar powered connected to the water motor on a re-circulating system with venturi technology. The venture is a “T” shaped device, which has an air inlet in the “T” branch. It is perceived that venturi is an essential piece of equipment in not only aquaponics but also other aquaculture operations with recirculating systems.
Other upcoming interventions include:

- Develop and utilize energy saving structures and facilities (e.g. solar panels, windmills).
- Identify and evaluate packages of IAA farming systems that are suitable for small-scale farmers.
- Convert water logged areas to IAA farming systems.

**Stakeholder involvement**

The following have been involved in the development and dissemination of agri-aquaculture technologies and interventions:

- The Department of Agriculture, through the Bureau of Fisheries and Aquatic Resources as lead fisheries agency in the Philippine Government has a general mandate to protect, conserve and sustain the management of the country’s fishery and aquatic resources (RA 8550, 1998);
- State Universities that have research program(s) on integrated farming systems;
- Fisheries Aquaculture Centre based at the Central Luzon State University;
- Department of Environment and Natural Resources;
- Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development of Science and Technology coordinates and funds the conduct of researches on natural sciences;
- Bureau of Agricultural Research under the Department of Agriculture coordinates and funds researches on agriculture and fisheries;
- Southeast Asian Fisheries Development Centre (SEAFDEC);
- International Centre for Living Aquatic Resources Management (ICLARM) now World Fish Centre has supported rice-fish initiatives in the country in the 1980s; and
For any future intervention to be successful, the following should be involved:

- Department of Agriculture; associated national programmes and local government units with capacity for FFS interventions available/functional in the entire nation;
- Bureau of Fisheries and Aquatic Resources;
- Fisheries Aquaculture Centre, based at the Central Luzon State University;
- Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development of Science and Technology coordinates and funds the conduct of researches on natural sciences;
- International Centre for Living Aquatic Resources Management (ICLARM) now World Fish Centre;
- Philippine Council for Agriculture and Fisheries;
- Bureau of Agricultural Research;
- Bureau of Soils and Water Management;
- Agricultural Training Institute;
- Agricultural Credit Policy Council;
- Fertilizer and Pesticide Authority;
- National Fisheries Research and Development Institute;
- Philippine Rice Research Institute (PhilRice);
- Philippine Crop Insurance Corporation;
- International Rice Research Institute;
- State Universities and Colleges;
- Local Government Units;
- Farmers and fisherfolks;
- Farmer Groups e.g. Association, Cooperatives;
- National Nutrition Council under Department of Health; and
- Non-Government Organizations.

**Extension approach used**

Generally, new agro-aquaculture technologies and practices developed are introduced through conduct of technology adaptation and verification trials under on-farm research activities and through technology trainings, fora and establishment of technology demonstrations and pilot projects under the development and extension aspects of the Research, Development and Extension continuum. Farmer Field Schools have proven especially useful at promoting and helping farmers to explore and learn about integrated farming systems.

**Possible role/involvement of other agencies such as:**

- Department of Health - should be concerned with possible health (food and feed) hazards that can be associated and/or encountered in the integrated production of crops and fish, especially under an intensive and/or semi or commercial scale and on nutrition concerns.
- Department of Public Works and Highways (Rural Infrastructure) - should contribute towards development and/or establishment of sustainable, climate-resilient and gender-sensitive structures adaptable for agro-aquaculture integration systems.
- Department of Education - may need to consider incorporating integrated agri-aquaculture and other farming systems approach in its curricula, particularly in the primary and secondary levels. A good example of this is the “Gulayan sa Paaralan” project introduced by Department of Agriculture to Dept. of Education. Now it has been institutionalized by the agency.
- Department of Energy, in relation to Rural Infrastructure - should also allocate considerable resources to enhance renewable energy sources utilization such as solar panels and windmills, development of energy-savings structures and facilities particularly along irrigation/pond water generation, collection and conservation.
- Department of Labor and Employment - may provide assistance in the development of capabilities of farmers, fisherfolk, landless farm workers and other labor sector that maybe involved in the development, operation and maintenance of a sustainable agri-aquaculture farming system.
Enabling environment
Legal Framework for Aquaculture

Aquaculture in the Philippines are governed by four major laws of the land, these are:

- The Philippine Environment Code (1988) provides measures dealing with fisheries and aquatic resources and requires the government to establish a system of rational exploitation of these resources.
- Republic Act 8550 as amended by Republic Act 10654 highlights conservation, protection, and sustained management of fishery and aquatic resources, poverty alleviation, and provision of supplementary livelihood, improvement of aquaculture productivity, optimal utilization of offshore and deep-sea resources, and upgrading of post-harvest technology.
- Republic Act 8435 or the Agriculture and Fisheries Modernization Act which is geared toward industrialization and full employment based on sound agricultural development and agrarian reform and promotes the utilization of national resources in the most efficient and sustainable way possible by establishing more equitable access to assets, income, basic support services and infrastructure.
- The Local Government Code of 1991 mandated the devolution of the legislative powers of the national government in favor of the local cities and municipalities who administers and do the actual management of their own resources.

Other Support Laws/Policies

- Republic Act 10068, or the Organic Farming Act, which aims to strengthen the state’s policy to promote, propagate, develop further and implement the practice of organic agriculture. The principles of organic farming promotes integration of crops, livestock and fish because of the absence of harmful chemicals used in farming.
- The Water Code of the Philippines states that water can be appropriated for the culture of fish as a commercial enterprise.
- Reorganization Act of the Department of Environment and Natural Resources (DENR, 1987). The Fisheries Code contains provisions in which the jurisdiction of BFAR and DENR cross such as the classification of rare, threatened or endangered species of aquatic flora and fauna or the classification of fishery areas. For instance, BFAR has the responsibility of granting Fishpond Lease Agreements for public lands to fisherfolk cooperatives/associations which normally is a jurisdiction of the DENR.
- The Philippine National Aquasilviculture Program was initiated to address BFAR’s mandate to ensure the development, management and conservation of the country’s fisheries and aquatic resources.
- TARGET or Targeted Actions to Reduce Poverty and Generate Economic Transformation. The Bureau makes use of its database through the Fisherfolk Registry System and Boat Registration. Crossmatching of the FishR database with that of the Department of Social Work and Development or DSWD’s NHTS-PR (National Household Targeting System for Poverty Reduction) and the RSBSA (Registry System for Basic Sector in Agriculture) of the Department of Budget and Management are undertaken to enable qualified registered fisherfolk access to social benefits and in identifying priority beneficiaries for the BFAR livelihood program.
- The Philippine National Standard for Organic Aquaculture encourages polyculture production system, promotes the use of indigenous/endemic species under the extensive and semi-intensive culture system reduces/minimizes inputs of artificial ingredients, prohibits the use of genetically modified organisms, and considers ecological conditions necessary for sustainable aquaculture production.
- The Philippine National Standard for the Code of Good Aquaculture Practice, which aims to prevent or minimize the risk associated with aquaculture production. It covers food safety, animal health and welfare, environmental integrity and socio-economic development.
- There is free Irrigation Service Fees. The collection of ISF was stopped on the 1st cropping season of 2017. 2 billion pesos, which is equivalent to National Irrigation Administration (NIA) annual ISF collection, was included in their 2017 budget.
Republic Act No. 9710 or the Magna Carta of Women, in keeping with the Convention on the Elimination of All Forms of Discrimination Against Women, mandating among others, that the plan shall be formulated and integrated in the regular activities of the agencies with funding of at least 5 percent of their budget.

Challenges, constraints, policies and circumstances that may prevent wide-scale adoption
- Deforestation of upland and mangrove forest;
- Intensified resource use competition and conflict among fisher groups and other economic sectors;
- Uncompetitive products due to inferior quality and safety standards. Most often in integrated system, there is a major crop. Therefore the “minor crop is not given much attention making the product inferior;
- Limited research, development and extension efforts on agri-aquaculture;
- Limited institutional capabilities, from the local up to the national levels of governance;
- Climate Change. Uncertainty of weather condition;
- There are no policies preventing the use of irrigation water for fishponds. But some Irrigator’s Associations have internal policy of discouraging the use of irrigation water in some service areas where there is limited available water supply, especially during dry season;
- Inadequate/inconsistent policies that promote conducive environment for sustainable development;
- Introduction of exotic species; and
- Post-Harvest losses.

ISSUES AND CONCERNS ON INDIVIDUAL ADOPTION
- Low farmers acceptance of the technology. Integrated farming system died naturally due to the lack of awareness of most farmers;
- The starters were taught but these learnings were not passed on;
- Farmers will not try what they are not familiar with;
- Lack of understanding of the technology by farmers, hence cannot appreciate its economic benefits;
- The rise of western technology have changed the farming patterns;
- Priority commodity of most farmers is rice;
- Some farmers also lack motivation to enhance work and social habits to grow fish with rice;
- Intensive use of pesticides, some farmers indiscriminately use pesticides, which have an irreversible damaging effect to humans and fish;
- Smaller fish at harvest because of the short fish culture period especially with the simultaneous rice fish culture;
- Poaching – most integrated agri-aquaculture farms are far from houses.

INVESTMENT FRAMEWORK
The following are the types of agricultural loans available to farmers through the Agricultural Credit Policy Council (ACPC) of the Department of Agriculture:

Survival and Recovery Assistance Program
- The program aims to provide immediate relief to small farmers and fisherfolk through a loan and grant assistance package. The areas to be covered are those declared under a state of calamity by the concerned local government units and as validated by the Department of Agriculture and/or local office of the National Disaster Risk Reduction and Management Council to have sustained considerable damage in agriculture due to natural calamities.
  - Survival Grant Assistance – Assistance in the form of grant fund amounting to P10 000 per affected household to address the immediate and emergency requirements of affected small-scale farmers. Calamity-affected farmers can be eligible to avail of the Survival Grant Assistance only if they will avail of the Recovery Loan Assistance.
Recovery Loan Assistance – Interest-free loan to finance the requirements of rehabilitating the farming and/or fishing or livelihood activities of the affected farmers.

Sikat Saka Program
- The Sikat Saka Program is an integrated financing program jointly implemented by the Department of Agriculture and Land Bank of the Philippines. The program aims to help more rice and corn farmers to access timely, adequate, and affordable production credit and improve the viability of agricultural production by ensuring availability of irrigation services, extension, links to markets and providing a favourable economic environment.
- Interest Rate
  - Fifteen percent per annum (inclusive of all other finance charges)
  - Declining interest rates for borrowers who establish a good credit standing
  - In the first two cropping cycles, the interest rate will be pegged at 15 percent, which will be reduced by 1 percent every succeeding cycle starting from the 3rd cycle onward until it is reduced to 9 percent per annum.

Program for Unified Lending to Agriculture
- Track 1: Special Lending Facility for Marginal Farmers and Fisherfolk
  - This special credit facility is designed to address the financial needs of marginal farmers and fisherfolk for fast, convenient and affordable credit. Non-collateralized loans for agro-fishery production and agri-microfinance will be provided under the programme through cooperatives and non-government organizations as credit delivery channels (lending conduits) of credit funds in extending loans to marginal farmers and fisherfolk.
  - Interest Charge:
    - Six percent per annum payable on due date
    - Interest shall not be deducted in advance from the loan

Agriculture and Fisheries Financing Program – Cooperative Banks Agri-Lending Program - Phase II
- Cooperative Banks Agri-Lending Program – II Entails the extension of stable, low-cost funding support to small farmers and fisherfolk at full credit risk using their existing workable agricultural loan products. The funding support, which shall be in the form of loans, shall be matched by eligible cooperative banks with their own counterpart funds equivalent to at least the amount of loans availed for lending to individual small farmers and fisherfolk.
  - Finance Charge: The finance charge of cooperative banks to small farmers and fisherfolk borrowers shall not exceed 15 percent per annum.

Agriculture and Fisheries Financing Program – Climate Change Adaptation Financing Program
- The Climate Change Adaptation Financing Program serves as a pre-disaster intervention focused on prevention and preparedness to complement the Survival and Recovery Assistance Program that serves as a post-disaster, quick response mechanism focusing on rehabilitation and recovery of agricultural households affected by extreme weather events and calamities.
  - Finance Charge: The finance charge of coopbanks to small-scale farmers and fisherfolk borrowers shall not exceed 15 percent per annum.

Agriculture and Fisheries Financing Program – Land Bank of the Philippines – Agri-Financing Program
- The Agricultural Fisheries Financing Program aims to contribute to inclusive growth by catering to small farmers and fisherfolk registered under the RSBSA. In increasing access to financing of small-scale farmers and fisherfolk, the programme enhances the capacity, competitiveness, and earning potential of small-scale farmers and fisherfolk. The program also provides credit enhancements and support services such as technical assistance, marketing support, and crop insurance.
  - Interest Rate: Fifteen percent (15%) per annum.
Agriculture and Fisheries Financing Program – Value Chain Financing Program
- The Value Chain Financing Program aims to improve credit access from institutional sources of small farmers participating in agribusiness value chains.
- Funding support is extended in the form of loans to partner financial institutions that shall match the fund with its own counterpart fund equivalent to at least the amount of loan availed under the program in extending value chain financing to intended borrowers. Under this financing scheme, the partner financial institution shall utilize the proceeds of loan, including its counterpart fund in extending financial services to farmer-producers anchored on existing buyer-seller business relationships. By capitalizing on the existing business linkage relationship, the partner financial institution is able to reduce credit risk associated with lending to producers.
- Finance Charge: The total finance charge of partner financial institution to borrowers shall not exceed 15 percent per annum.

Agrarian Production Credit Program
- The Agrarian Production Credit Program aims to achieve sustainable crop production and increase incomes of agrarian reform beneficiaries and their households through the provision of credit and capacity building assistance.
- Interest Rate:
  - For Short-Term Loan: 8.5 percent per annum;
  - For Term Loan: 9.5 percent per annum

Production Loan Easy Access
- The Department of Agriculture and Fisheries has included in its 2018 National budget proposal the amount of P50 billion, which would be used as a seed fund for an easy access loaning program for farmers and fisher folks to improve their production.
- The loaning program called Production Loan Easy Access program will offer a non-collateralized credit carrying a 6 percent interest rate per year with a maximum loanable amount of P50,000 per farming and fisher folk household. Under the Program, farmers and fisher folks will be registered and provided Accreditation Cards, which would contain all of the information about him. A Geo-Tagging program would also identify the area where his farm or fishing ground is located and all of this would be entered in a national database.
- All those accredited will be covered by the Philippine Crop Insurance Program to ensure that the government financial exposure would be recovered in case of calamities. Farmers and fisher folks who will participate in the program will be organized so that the DAF could provide them with additional processing facilities to add value to their products and help them in the marketing.
- The Program will then identify a local credit cooperative or a rural bank, which would serve as a conduit for the loans at a rate of 6 percent, and a commitment to release the loan applied for in a maximum period of three days.
- All the credit cooperatives and rural banks, which will participate in the loaning program, will be included in a national network to ensure that a farmer or fisherfolk who has already been granted a loan by a credit cooperative in his area, will no longer be able to apply for another loan in a neighbouring area.
- The 6 percent interest payment will go to the conduit cooperatives or rural banks.

References
Agriculture Credit Policy Council at www.acpc.gov.ph
Romeo M. Lopez, National Irrigation Administration
COUNTRY REPORT VIET NAM

Introduction
Viet Nam has a total farmland area of 27.3 million hectares, of which 3.81 million hectares is rice paddies, with great potential for IAA production (about 200 000 ha of rice-shrimp and over 100 000 ha of rice-fish farming). The integration of fish and rice paddy originated about 2 000 years ago in China, then it was expanded to Viet Nam, Thailand, India and many other countries in the world. In the context of Viet Nam, especially in the Mekong Delta in the south, the model of integrated rice-aquaculture has been developing for a long time; the effectiveness and productivity of this model has been confirmed, and has made considerable contributions to the livelihood improvement for the rural inhabitants.

Current status of integrated agro-aquaculture production
IAA production has been developing for long in the Mekong and the Red River Deltas, as well as some northern mountainous plain lands. In the 1990s, between 20 to 30 percent of the farmer households applied this model, and in ten years’ time this number increased to 70–80 percent. At the beginning, most farmers only made use of the water in the rice paddies to raise natural fish species after the rice harvest in order to increase their income. However, by now, the rice-aquaculture mixed farming has grown in both scale and techniques with increased fish productivity and production and other benefits of this model. The farmers may release to fish seeds with different species compositions and percentages with the view to making the best use of the farm area, supplementing feed (3–7% of the body weight), managing the environment and redesigning rice paddies to become favourable for fish farming purpose, as well as selecting different fish species for production.

The species for rice-fish mixed farming are quite diversified, mainly those that are omnivorous or feed on plankton and phytoplankton, which does not affect growth of rice. These species include:

- Java barb (Barbodes gonionotus)
- Snakeskin gourami (Trichogaster pectoralis)
- Tilapia (Oreochromis sp)
- Common carp (Cyprinus carpio)
- Giant gourami (Osphronemus goramy)
- Climbing gourami (Anabas testudineus)
- Silver carp (Hypophthalmichthys molitrix)
- Bighead carp (Hypophthalmichthys nobilis)
- Rohu (Labeo rohita)
- Giant river prawn (Macrobrachium rosenbergii)
- Tiger shrimp (Penaeus monodon)

At present, in the context of climate change, especially the impacts of drought and saltwater intrusion, rice-brackish water shrimp mixed farming in the Mekong Delta provinces is regarded as one of the climate smart models in Viet Nam.

When fish and rice are cultured together in a rice paddy, they do not compete for feed, but on the contrary, they complement each other and bring benefits. Rice paddy provides feed for fish: weed, rotten rice straw, fallen rice, grass seeds, pests and insects present in the paddy can all become feed for fish. That can save a lot of feeding costs. On the other side, fish can improve the growing conditions for rice: fish waste aggregated in the soil acts as fertiliser enriching the soil fertility. While searching for food, fish constantly dig into the mud, generating more oxygen to support the growth of rice. Fish feeding on pests and insects reduces disease risks for rice. Thus, rice production when mixed with fish culture helps farmers to reduce the labour cost, cost for pesticide and increase their average income per unit of farm area and high benefits.

The most common IAA production forms currently applied in Viet Nam are rotating 1-2 rice crops and one aquaculture stocking, or mixed farming of aquaculture and rice by releasing fish/shrimp into the paddy for culture 10-20 days after rice-sowing. The common forms of IAA farming are rice-fish farming,
giant river prawn-rice farming, tiger shrimp-rice farming. In the Northern provinces and the northern delta, the most common form is mixed rice-fish farming.

According to a WES survey in 1997, the high density of fish (ranging between 1.8 to 4.8 fishes/m²) may affect the productivity, yield and effectiveness of the mixed farming models leading to the slow growth and volatile productivity in the models (99–730 kg/ha) (Chi, 1997; Duong and Rothuis, 1998; and Sinh et al, 1997 - 2000). For extensive mixed farming, the highest cost for rice crop is for fertiliser and labour, and the highest cost for the shrimp harvest is for shrimp seeds and pond rehabilitation (Tables 8 and 9). For the improved extensive mixed farming, the level of farming has been improved over time, and in shrimp farming, more attention is paid toward industrial feed investment and high quality seed selection for culture, leading to higher shrimp productivity and economic performance. The highest cost of shrimp farming is to buy feed, shrimp seed and pond rehabilitation, while the highest cost for rice farming is still for fertiliser and labour (Tables 10 and 11).

Table 8: Economic and technical parameters of shrimp culture in the traditional extensive rice-shrimp models

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average area per household (ha/household)</td>
<td>1.8-2.1</td>
<td>1.8-2.5</td>
<td>1.8-2.7</td>
<td>-</td>
</tr>
<tr>
<td>Stocking density (PL/m²)</td>
<td>1-2</td>
<td>1.5-4</td>
<td>2-4</td>
<td>-</td>
</tr>
<tr>
<td>Pathogen checking by PCR</td>
<td>No</td>
<td>No (80%)</td>
<td>No (80%)</td>
<td>-</td>
</tr>
<tr>
<td>Feed supply &amp; Feed conversion ratio (FCR)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Survival rate (%)</td>
<td>1.3-4.2</td>
<td>10-20</td>
<td>25-32</td>
<td>-</td>
</tr>
<tr>
<td>Shrimp productivity (tonnes/ha)</td>
<td>0.12-0.2</td>
<td>0.15-0.25</td>
<td>0.15-0.3</td>
<td>-</td>
</tr>
<tr>
<td>Total investment (million VND/ha)</td>
<td>9.62</td>
<td>11.26</td>
<td>16.50</td>
<td>-</td>
</tr>
<tr>
<td>Total revenue (million VND/ha)</td>
<td>15.13</td>
<td>30.00</td>
<td>37.20</td>
<td>-</td>
</tr>
<tr>
<td>Profit (million VND/ha)</td>
<td>5.15</td>
<td>18.74</td>
<td>20.70</td>
<td>-</td>
</tr>
<tr>
<td>Profitability ratio (%)</td>
<td>0.53</td>
<td>1.66</td>
<td>1.25</td>
<td>-</td>
</tr>
</tbody>
</table>


Table 9: Economic and technical parameters of rice crop in the traditional extensive rice-shrimp mixed farming models

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Average area per household (ha/household)</td>
<td>1.7-2</td>
<td>1.1-1.6</td>
<td>1.3-1.9</td>
<td>-</td>
</tr>
<tr>
<td>Number of days/crop</td>
<td>110-120</td>
<td>95-120</td>
<td>95-123</td>
<td>-</td>
</tr>
<tr>
<td>Seed amount (kg/ha)</td>
<td>100-120</td>
<td>100-120</td>
<td>47-200</td>
<td>-</td>
</tr>
<tr>
<td>Inorganic fertilizer (kg/ha)</td>
<td>150-160</td>
<td>70-470</td>
<td>150-300</td>
<td>-</td>
</tr>
<tr>
<td>Rice productivity (tonnes/ha)</td>
<td>1.3-3</td>
<td>0.5-3.7</td>
<td>0.8-4.0</td>
<td>3.8-4.0</td>
</tr>
<tr>
<td>Total investment (million VND/ha)</td>
<td>1.55</td>
<td>9.83</td>
<td>7.40</td>
<td>-</td>
</tr>
<tr>
<td>Total revenue (million VND/ha)</td>
<td>3.75</td>
<td>18.75</td>
<td>8.60</td>
<td>-</td>
</tr>
<tr>
<td>Profit (million VND/ha)</td>
<td>2.20</td>
<td>8.92</td>
<td>1.20</td>
<td>-</td>
</tr>
<tr>
<td>Profitability ratio (%)</td>
<td>1.41</td>
<td>0.91</td>
<td>0.16</td>
<td>-</td>
</tr>
</tbody>
</table>

8 Vietnamese Dong (VND): USD 1 = VND22 753
**Table 10**: Economic and technical parameters of shrimp culture in the improved extensive rice-shrimp mixed farming models

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average area per household</td>
<td>1.2-1.9</td>
<td>1.3-1.8</td>
<td>1.4-1.5</td>
<td>1.4-1.5</td>
</tr>
<tr>
<td>Stocking density (PL/m²)</td>
<td>1.5-2.4</td>
<td>4-6</td>
<td>6-9</td>
<td>8-10</td>
</tr>
<tr>
<td>Pathogen checking by PCR</td>
<td>No</td>
<td>Yes (50%)</td>
<td>Yes (100%)</td>
<td>Yes (100%)</td>
</tr>
<tr>
<td>Feed supply &amp; Feed conversion ratio (FCR)</td>
<td>Self-made and pellet feed</td>
<td>Self-made and pellet feed</td>
<td>1.4-1.6</td>
<td>1.4-1.6</td>
</tr>
<tr>
<td>Survival rate (%)</td>
<td>14-22</td>
<td>40-50</td>
<td>48-53</td>
<td>60-70</td>
</tr>
<tr>
<td>Shrimp productivity (tonnes/ha)</td>
<td>0.3-0.4</td>
<td>0.3-0.5</td>
<td>0.7-1.3</td>
<td>0.7-1.3</td>
</tr>
<tr>
<td>Total investment (million VND/ha)</td>
<td>13.11</td>
<td></td>
<td>18.46</td>
<td>89.22</td>
</tr>
<tr>
<td>Total revenue (million VND/ha)</td>
<td>20.76</td>
<td></td>
<td>37.17</td>
<td>179.72</td>
</tr>
<tr>
<td>Profit (million VND/ha)</td>
<td>7.65</td>
<td></td>
<td>18.71</td>
<td>90.50</td>
</tr>
<tr>
<td>Profitability ratio (%)</td>
<td>0.58</td>
<td></td>
<td>1.01</td>
<td>1.01</td>
</tr>
</tbody>
</table>


**Table 11**: Economic and technical parameters of rice crop in the improved extensive rice-shrimp mixed farming models

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Average area per household</td>
<td>1.5-1.7</td>
<td>-</td>
<td>-</td>
<td>1.1-1.5</td>
</tr>
<tr>
<td>Number of days/crop</td>
<td>110-120</td>
<td>-</td>
<td>-</td>
<td>95-115</td>
</tr>
<tr>
<td>Seed amount (kg/ha)</td>
<td>100-120</td>
<td>-</td>
<td>-</td>
<td>110-120</td>
</tr>
<tr>
<td>Inorganic fertilizer (kg/ha)</td>
<td>150-160</td>
<td>-</td>
<td>-</td>
<td>300-450</td>
</tr>
<tr>
<td>Rice productivity (tonnes/ha)</td>
<td>1.78-3.02</td>
<td>3.8-4.5</td>
<td>4.8-5.5</td>
<td>5.5-6.2</td>
</tr>
<tr>
<td>Total investment (million VND/ha)</td>
<td>1.41</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total revenue (million VND/ha)</td>
<td>4.57</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Profit (million VND/ha)</td>
<td>3.16</td>
<td>-</td>
<td>-</td>
<td>30.25</td>
</tr>
<tr>
<td>Profitability ratio (%)</td>
<td>2.24</td>
<td>-</td>
<td>-</td>
<td>1.2</td>
</tr>
</tbody>
</table>


The results of a survey done by Can Tho University (2016) on integrated rice-fish farming models in Can Tho, Hau Giang, Dong Thap and Vinh Long show that: The main fish subjects for culture are common carp, bighead carp, silver carp, Silver barb, tilapia, snakeskin gourami. The yield of all fish species cultured in the integrated rice-fish farming in the provinces ranges from 597 to 734 kg/ha/harvest, average 720 kg/ha/harvest (Table 12).
Table 12: Some economic parameters of the rice-fish mixed farming in the Mekong Delta

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Year 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish yield (tonnes/ha)</td>
<td>0.72</td>
</tr>
<tr>
<td>Total investment (million VND/ha)</td>
<td>12.1</td>
</tr>
<tr>
<td>Total revenue (million VND/ha)</td>
<td>10.6-17.1</td>
</tr>
<tr>
<td>Profit (million VND/ha)</td>
<td>3.5-10.0</td>
</tr>
<tr>
<td>Profitability ratio (%)</td>
<td>1.56-1.66</td>
</tr>
</tbody>
</table>

Source: Can Tho University, 2016

For the above benefits, the IAA farming models have been constantly improved to increase yield and be developed throughout Viet Nam.

The stakeholders involved in technical interventions of rice-fish farming were from the academia like Can Tho University, Thu Duc Agro-Forestry University, Research Institute for Aquaculture No.2, Mekong Delta Rice Research Institute, in order to breed new rice varieties that are favourable for rice-shrimp culture (salinity tolerant rice). However, the current rice-aquaculture models still have several limitations that need to be improved, such as poor awareness of farmers and governance agencies of the need for fish/shrimp and rice ecological balance, not emphasizing too much on aquaculture. Some technical aspects also need to be improved, such as the proper ratio of culture species composition, stocking density, appropriate design/modification of rice paddies to be favourable for rice-fish farming, selection of rice varieties suitable for the integrated farming, researching new models of climate smart rice-fish farming models, etc. Besides, it is also necessary to reorganize the production, create linkages with the market to ensure sustainable development of the rice-fish farming models.

Some incentives for integrated agro-aquaculture development

Although there is no specific incentive policy on IAA development, many of the Government’s policies have helped promote this farming model in Viet Nam. Resolution No.09/2000/NQ-CP issued in 2000 allowed transformation of inefficient land areas (rice farms, salt production areas, and coastal swamps) into aquaculture. By 2005, as much as 377,269 hectares of farmland was converted to aquaculture, mainly in the Mekong Delta (310,841 ha). Next, the Government issued Decree No.35/2015/ND-CP in 2015 on management and protection of rice farmland, which allows the transformation of inefficient one-crop rice farmland into aquaculture without compromising the conditions for going back to rice farming when necessary, and allows lowering of the rice farm ground by 20 percent to be suitable for aquaculture. Most recently, at its 11th Session, the National Assembly passed the revised land use plan period 2016-2020, allowing an adjustment of total rice farmland from 3.81 million hectares down to 3.76 million hectares, which means nearly 400,000 hectares of low productivity rice farmland can be converted to aquaculture, other crops, or non-agricultural activities.

In addition, Decision No.899/2013/QD-TTg on restructuring the agriculture sector toward increasing added value, reorganizing the production and sustainable development, focusing on promoting freshwater aquaculture in the highlands, mountainous areas in order to reduce poverty.

A series of incentive polices for investment into agriculture include: Decree No.55/2015/ND-CP on credits for agricultural rural development allowing people to get soft credits for aquaculture development (seed production, logistics for aquaculture); and Decision No.62/2013/QD-TTg by the Prime Minister on support policy for cooperative development, provision of training for cooperative officers, land use tax incentives,… for the operations of cooperatives, etc.

Activities and network for model multiplication

The State authorities in fisheries (Directorate of Fisheries), crop production (Department of Crop Production), and husbandry (Department of Livestock Production) provide directions, identify relevant technological advances to be transferred and multiplied to the farmers. Supporting the effective technological transfer and multiplication is a broad network of agricultural extension officers from the central level (90 officers), the provincial level (all 63 provinces with 1,992 officers), district level
(596 extension stations with 4,240 officers), to the grassroots extension workers (9,181), as well as over 23,838 extension collaborators at the village level. Several NGOs provide support through technical training courses, technological transfer, and model development.

Supporting the research for technological improvements for rice-fish mixed farming, addressing the technological limitations and practical issues emerging during production are the academia institutions. These include Can Tho University, Thu Duc Agro-Forestry University, the Research Institutes for Aquaculture, Viet Nam Academy of Agricultural Sciences, Mekong Delta Rice Research Institute. One of the priorities is to generate new rice varieties, which are suitable to shrimp culture conditions (salinity tolerant rice).

The important thing is farmers can have access to technological knowledge and information, which matches the conditions of different regions. The produce has a stable market and the production models of rice-fish mixed farming can be multiplied and developed sustainably.

**Some achievements and lessons learnt**

Viet Nam’s fisheries industry is developing a plan for organic shrimp development, including shrimp-rice to 2020, vision to 2030, which focuses on formulating a favourable policy and legal framework for shrimp-rice farming promotion, improving technologies, increasing productivity and yield, reorganizing production.

Many national and provincial agricultural extension projects aim at multiplying the models of fish/shrimp-rice farming. The National Agricultural Extension Centre implements a project for developing the model of black tiger shrimp – rice farming in the Mekong Delta in 2016-2018 in 4 provinces, covering 240 hectares, with 20 hectares per demonstration site. There is a project on developing fish-rice farming models carried out in 12 provinces with 106 demonstration sites of fish-rice farming and a total area of 73 hectares. In this project, the fish yield was 1.5 tonnes/ha or higher (integrated farming), 5 tonnes/ha (rotating farming), 660 turns of trainees, 1,100 turns of farmers involved in the model finalization, 600 turns of farmers trained on model multiplication and have the capability to apply the fish-rice farming model at their households and localities, publishing over 1,800 leaflets and 1 technical manual on rice-fish farming. Many other provincial agricultural extension projects have been implemented.

**Lessons learned**

- It is necessary to have a consistent awareness and understanding among the farmers and the authorities of the benefits of this farming method; identifying that the key objective of rice culture over shrimp ponds is to rehabilitate the environment, not the opposite.
- It is necessary to have strong support from the relevant authorities and agencies in providing guidance, technological transfer to make sure of increased effectiveness, productivity and yield.
- The selection of households and farm sites is very important. This is also a crucial element for the success of the models, and thus the households selected must meet the criteria and conditions for fish rice farming. The selection must also be objective and done by the local authorities. The households selected should be prestigious and have the ability to convince other farmers to follow and actively develop the model.
- Technical officers guiding the models must have good experience and knowhow, high prestige and be willing to go deep into solving issues with the farmers. By so doing, the effectiveness of the models can be improved and multiplied faster.
- This farming method is suitable for farmers in the coastal areas with small capital to transform their production, rotate farming, increase number of crops/harvests, and generate much higher income than rice monocropping; and this method is also more sustainable than farming only shrimp.
- The households that have sufficient conditions for farming, such as: complete facilities, sufficient equipment, following the farming procedures correctly, combined with good management practices, then the production will surely be effective.
In order to make sure of high efficiency, it is necessary to comply with the technical procedures of rice farming over shrimp ponds, from the land preparation to management and care, with special focus on seed sowing at the same time.

Diversifying livelihoods with livestock production, other crops, combined with culturing other fish species to increase extra income and ensuring the capital for production recovery in case shrimp harvest is lost.
APPENDIX 4: GUIDELINES FOR BUSINESS PITCH

Instructions: This is a hypothetical exercise. Imagine that you are an agriculture extension agent and you want to convince a farmer to adopt IAA practices. Your task is to convince the farmer that adopting this practice is a good idea, and that it will increase their profitability and livelihood. This should include a description of the current challenges (e.g. farmers are not earning enough money), a description of the opportunities (e.g. adopt Rice-Fish culture), how much it will cost and how much the farmer will earn, and what are the concrete steps to be taken. Above all, you should demonstrate: What is the bottom line – how will the adoption of this practice improve their livelihood?

Please work with your country team to prepare a PowerPoint presentation, one slide for each question – to be presented on the last day of the workshop.

Name of Country

Brief of selected IAA system/practices:

Conditions for possible adoption of the selected IAA system/practices:

Benefits of selected IAA to farmers:

Requirement to household/farm for effective adoption of selected IAA system/practice (access to resources, availability of labour, availability of investment/access to credit, access to key inputs, access to market, community organization, access to extension services etc.):

How much is the initial investment?

What are the operation costs per production cycle? What are the major expenses (feed, seed, labour)?

How does the farmer access these inputs?

<table>
<thead>
<tr>
<th>Input</th>
<th>Amount required and cost</th>
<th>Where to access</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Feed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Seed/Fingerlings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Labour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Other?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Are hired workers required?
Where does the investment ($) come from? Can the farmers find a loan?

What training is necessary? How/where can the farmer get the training?

How much production is expected from the farm (kg per ha)?
How much of each product (fish/rice/etc.)?

Where will the product be sold? How much is it worth?

How can the farmer differentiate themselves from the competition? Any certification scheme available that can add the value to the products?

What are the next steps the farmer needs to take in adopting the selected IAA system/practice?

Step 1:

Step 2:

Step 3:

Step 4:

What other information would you share with the farmer to advocate for the adoption of this IAA practice?
APPENDIX 5: GUIDELINES FOR POLICY BRIEF

Instructions: Work with your country team to create a ‘policy brief’. A policy brief is a short document that presents the vision, goals and strategic objectives to a non-specialized audience. It is a medium for exploring an issue and distilling the lessons learned. It is a vehicle for providing policy advice – and can be used to advocate for changes in policy to create a more enabling environment.

Use the following worksheet to organize ideas, and then create a Word document – no more than 1500 words and 2-3 pages. Each country group will be invited to read their policy briefs to the group on the last day of the workshop.

Name of Country:

Executive Summary:
Distil the essence of the policy brief. Provide an overview and create curiosity to keep reading. *Write this section last*

Vision
Summary of selected IAA systems/practices and how can scaling up of IAA contribute to food security/nutrition and livelihood and socioeconomic and ecological benefits to the country;

Goals
Time-bound target for scaling up of selected IAA systems/practices and expected outcomes

Strategic objectives and specific strategies:
A) Enabling environment (legislative support)

B) Target group/beneficiary

C) Policy measures

D) Capacity building and supporting services

E) Access to natural resources and investment

R) Supply and value chain development

G) Improvement of related public infrastructure

H) Organizing the farmers
Describe the PEST factors (Political, Economic, Sociocultural, Technological)
Are any of these considered major barriers to carrying out your ideas?

Political:

Economic:

Sociocultural:

Technological:
## APPENDIX 6: FAO PORTFOLIO OF RELEVANT PUBLICATIONS

<table>
<thead>
<tr>
<th>Title</th>
<th>Citation</th>
<th>Direct Link</th>
</tr>
</thead>
</table>
APPENDIX 7: SELECTED PHOTOS

Plenary session of the Regional Training workshop on Innovative Integrated Agro-Aquaculture for Blue Growth in Asia-Pacific.

Panel of the opening session Regional Training workshop on Innovative Integrated Agro-Aquaculture for Blue Growth in Asia-Pacific.

Rice farmers in the terraced paddy fields in Hong He county, People’s Republic of China.

Landscape of the Globally Important Agriculture Heritage Site in Hong He county, People’s Republic of China.
Participants from the Lao People’s Democratic Republic preparing a business pitch on integrated agro-aquaculture practices.

Indonesian delegation preparing a policy brief on advocating for a more enabling environment for integrated agro-aquaculture.

Tour guide from the Hani people in traditional dress describing the terrace system and IAA practices to participants.

Unveiling ceremony of Hani Terrace Rice-Fish Integration Technology Demonstration Base of FAO Reference Center for Aquaculture and Inland Fisheries Research and Training.
This report describes the activities and outputs of the FAO technical workshop entitled “FAO Regional Training Workshop on Innovative Integrated Agro-Aquaculture for Blue Growth in Asia-Pacific”, an activity supported by the Strategic Programme on Sustainable Agriculture of FAO. The workshop was held in Kunming, China, from 12 to 17 June 2017.