ACIAR Rice-Fish Systems Symposium Proceedings August 2018

Contents

Foreword

Preface

Rice and fish are important components of livelihood strategies and diets in South East Asia and have been for centuries. Rice and fish can be integrated in a variety of ways, ranging from systems involving capturing wild fish in rice fields, to fully integrated intensive rice-fish culture systems. Integrating rice and fish culture has been documented to provide benefits to household income, and food and nutrition security for smallholders. Apart from the nutritional and economic benefits for humans, research has suggested it is more environmentally friendly than rice monoculture and provides a range of ecosystem services. The presence of fish in the rice field contributes to nutrient recycling, pest control, and reduces the need for and costs associated with agro-chemicals. In spite of the documented benefits, rice-fish systems are often undervalued and more research is required to fully understand the barriers to adoption and potential opportunities, especially in Myanmar.

The ACIAR Myanmar Rice-Fish project is aligned with the research program FISH CRP, led by WorldFish and partners. The main objectives in this program are (1) to optimise fish production systems to produce healthy, nutritious food products, (2) reduce inefficiencies in value chains and optimise resource use, and (3) to address barriers that impede the inclusion of fish in the diets of mothers, infants, and young children. Organising an international symposium on Rice-Fish Systems (RFS) fits within the overall objective to spread technologies with the support of public and private sector stakeholders in order to improve governance and natural resource management.
The objectives for the symposium are (1) to share knowledge and experiences around the diversity of existing rice-fish systems overall, in Myanmar, and in countries in the region, (2) to present the current status of Myanmar's policies related to rice-fish systems and to provide an evidence base for policy changes, and (3) to inform decision- and policy makers about the potential benefits of shifting towards integrated fish-agri-food systems. The main questions that the participants tried to answer through their presentations and panel sessions were "what are the key factors contributing to productivity and profitability of RFS?", "what does the current range of existing RFS in Myanmar look like and how does this compare to other SE Asian countries?", "what is the current legal and policy framework regarding RFS and how can existing barriers be addressed?", and "how can RFS contribute to equitable distribution of benefits, to improved nutrition (particularly for women and children), and to women's empowerment?".

Agenda

SE ASIA RICE-FISH SYSTEMS SYMPOSIUM (RFS) NAYPYITAW MYANMAR 6-8 AUGUST 2018		
DAY 1: 6 AUGUST A REVIEW OF RICE-FISH SYSTEMS CURRENTLY IN USE		
Workshop opening *08.30 - 09.00*	SYMPOSIUM OPENING (MC - Ms. Kay Khine Tint (DoF)	
	Opening speeches	Welcoming H.E. Minister - Dr. Aung Thu
		H.E. Australian Ambassador to Myanmar – Mr. Nicholas Coppel
		Dr. Ann Fleming, Research Program Manager Fisheries at ACIAR
		Mr. Michael Akester, Country Director, WorldFish-Myanmar
	Introduction to the symposium agenda	Master of Ceremony
RFS AND THE SDGs		
SESSION 1 *09.00 - 10.15* *including Q&A*	Michael Phillips	The FISH CRP RFS and WorldFish's strategy towards the SDGs
	Ann Fleming	The ACIAR ten-year strategy 2018-2027
	Grant Singleton	Rice in Rice-Fish Systems
10.15 - 10.45	*TEA BREAK and Seminar Group Photograph*	
RFS: NUTRITION, GENDER & COST-BENEFIT		
SESSION 2 *10.45 - 12.00* *including Q&A*	Sonali Senaratna	Flood Based Food Production Systems
	Weimin Miao	Promote innovative integrated rice-aquaculture for improved livelihoods
	Shakuntala Thilsted	RFS and Improved human nutrition
	Cynthia McDougall	The role of gender in RFS
12.00 - 13.15	*LUNCH BREAK*	
RFS: PANEL SESSION: Costs and Benefits of Integrated Production Systems		
SESSION 3	*3 KEY PANELLISTS*	*A facilitated discussion*
13.15 - 14.15	*Plenary*	*Opinions from the floor (plenary)*
RFS: mapping multifunctional landscapes		
SESSION 4 *14.15 - 15.30* *including Q&A*	Mike Akester	The importance of improving integrated farming systems in marginal areas
	Rick Gregory	Characterization of RFS in the Ayeyarwady Delta
	Shwu Jiau Teoh	GIS & RFS
	John Conallin	Flood plain river connectivity: the role of fish passes
	Tanya Huizer	ARCADIS Spatial Atlas of the AD
15.30 - 15.45	*TEA BREAK*	
RFS: PANEL SESSION: Integrated Planning in Multi-functional Landscapes		
SESSION 5	*3 KEY PANELLISTS*	*A facilitated discussion*
15.45 - 16.45	*Plenary*	*Opinions from the floor (plenary)*
16.45 - 17.00	WorldFish	A short wrap-up of Day 1
18:30 - 19:30	*Cocktail Kempinski Hotel*	

DAY 2: 7 AUGUST COUNTRY PRESENTATIONS in SE Asia and MYANMAR RFS		
MYANMAR RICE-FISH SYSTEM DEPARTMENT OF AGRICULTURE MoALI		
SESSION 6 *09.00 - 10.30* *including Q&A*	**RFS: CURRENT STATUS MYANMAR**	
	Ministry of Agriculture, Livestock, and Irrigation	Department of Agriculture
		Department of Fisheries
		Department of Agricultural Research
		Irrigation and Water Utilization Management Department
10.30 - 11.00	*TEA BREAK*	
SESSION 7 *11.00 - 12.30* *including Q&A*		
	Nilar Shein & Alex Stuart	Results from a rice-fish trial Maubin Myanmar
	Aung Kyaw Thein	PRA vulnerability study: floodplains
	Omar Myint	Diversity of fish in paddy ecosystem and local ecological knowledge: Implication for management strategies
	Moe Moe Dwe	Study of Fish Species Occurrence and Types of Fishing Gears Applied in Rice Fields in Taungoo Environs, Bago Region
	Dr. Myint Sein	Paddy-Fish System in Maubin Township
12.30 - 1.45	Lunch break	
RFS: LAND USE POLICY & TENURE IN SE ASIA		
Session 8 *13.45 - 15.30* *including Q&A*	Dr. Benoy Kumar Barman	Rice - freshwater prawn production systems in Bangladesh
	Mam Kosal	RFS linked to floodplain fisheries and community ponds in Cambodia
	Thavee Vipthanumas	Fish culture in rainfed rice fields: status after two decades in Thailand
	Châu Thị Tuyết Hạnh	Rice-Shrimp systems in the Mekong delta, Viet Nam
15.30 - 15.45	*TEA BREAK*	
RFS: LAND USE POLICY & TENURE STATUS and VISIONS in Myanmar		
Session 9 *15.45 - 16.30* *including Q&A*	Department of Agricultural Land Management and Statistics	Information on land and water tenure as applied to RFS and aquaculture
16.30 - 16.45	WorldFish	A short wrap-up of Day 2

DAY 3: 8 AUGUST LAND USE TENURE AND POLICY		
08.45 - 09.00	A short reflection on Days 1 and 2	
	Introduction to the day 3 policy discussion agenda	
RFS: LAND USE POLICY & TENURE panel discussions - status and opportunities - Myanmar		
SESSION 10 *09.00-11.00*	*3 KEY PANELLISTS*	*A facilitated discussion*
	Plenary	*Opinions from the floor (plenary)*
11.00 - 11.15	*TEA BREAK*	
	WRAP UP CONCLUSIONS AND RECOMMENDATIONS FOR THE WAY FORWARD	
11.15 - 11.45	Follow on from panel session : The Naypyitaw agreement	
11.45 - 12.00	*CLOSING REMARKS*	
12.00 - 13.15	*LUNCH*	

Participant list

No	Name	Position	Organization
1	U Ba Myo Thein	Chairman	Farmer Advisory Committee
2	Dr. Win Myint	Secretary	Agriculture, Livestock, and Fisheries Development Committee
3	U Khin Myo Win	Member	Agriculture, Livestock, and Fisheries Development Committee
4	U Kyaw Than	Member	Agriculture, Livestock, and Fisheries Development Committee
5	Daw Ma Ma Lay	Member	Agriculture, Livestock, and Fisheries Development Committee
6	U Thet Naing Soe	Member	Farmer Advisory Committee
7	U Khin Maung Maw	Director General	Department of Fisheries
8	U Myint Zin Htoo	Deputy Director General	Department of Fisheries
9	U Htun Win Mying	Director	Department of Fisheries
10	U Saw La Phaw Wah	Director	Department of Fisheries
11	U Aung Nyi Toe	Director	Department of Fisheries
12	U Nyunt Win	Deputy Director	Department of Fisheries
13	Dr. Aung Naing Oo	Deputy Director	Department of Fisheries
14	Dr. Nilar Shein	Deputy Director	Department of Fisheries
15	Daw Ohn Mar Moe	Deputy Director	Department of Fisheries
16	U Win Ko Ko	Fisheries Officer	Department of Fisheries
17	Daw Myat Khine Mar	Fisheries Officer	Department of Fisheries
18	Daw Kyu Kyu Thin	Deputy Officer	Department of Fisheries
19	Daw Kay Khine Tint	Deputy Officer	Department of Fisheries
20	U Zaw Linn Tun	Deputy Officer	Department of Fisheries
21	U Zay Yar Min	Assistant Officer	Department of Fisheries
22	Daw Khine Thazin	Assistant Officer	Department of Fisheries
23	U Kyaw Min	Fisheries Officer	Department of Fisheries
24	Dr. Nyunt Wai	Regional Fisheries Officer (Ayeyarwaddy Region)	Department of Fisheries
25	U Sai Kyaw Myint	Regional Fisheries Officer (Bago Region)	Department of Fisheries
26	Dr.Yin Yin Moe	Regional Fisheries Officer (Nay Pyi Taw)	Department of Fisheries
27	U Tin Mg Oo	District Officer (Pyapon)	Department of Fisheries
28	Dr.Win Myint	District Officer (Bago)	Department of Fisheries
29	U Thet Aye	District Officer (Taungoo)	Department of Fisheries
30	U Aung Than Oo	Assistant Director	Department of Fisheries
31	U Zaw Than	Assistant Director	Department of Fisheries
32	U Tun Ngwe Oo	Township Officer	Department of Fisheries
33	U Tin Mg Phone	Township Officer	Department of Fisheries
34	Dr. Ye Tint Tun	Director General	Department of Agriculture
35	U Ko Ko Gyi	Director (Rice)	Department of Agriculture

No	Name	Position	Organization
36	U Naing Kyi Win	Director General	Department of Agricultural Research
37	U Thant Lwin Oo	Deputy Director General	Department of Agricultural Research
38	Daw Khin Mar Mar New	Director	Department of Agricultural Research
39	Daw Wint Thida Oo	Assistant Research Officer	Department of Agricultural Research
40	U Myint Lwin	Deputy Director	Department of Agriculture
41	U Thein Aung Than	Assistant Director	Department of Agriculture
42	U Hlaing Moe Hein	Assistant Officer	Department of Agriculture
43	U Win Oo	Regional Officer	Department of Agriculture
44	Daw Tin Mya Lwin	Assistant Director	Department of Agriculture
45	Daw Khin Khin Sein	Officer	Department of Agriculture
46	Daw Kyi San	Officer	Department of Agriculture
47	U Tay Zar Lin	Officer	Department of Agriculture
48	Daw Aung Aung Naing	Officer (Rice-Fish)	Department of Agriculture
49	Daw Phyu Lay Mying	Officer	Department of Agriculture
50	U Htay Lwin	Deputy Officer	Department of Agriculture
51	U Tin Maung Aye Htoo	Deputy Director General	Department of Irrigation Water Utilization Management
52	U Thet Naing Oo	Director General	Department of Agriculture Land Management and Statistics
53	U Hlwam Moe	Deputy Director General	Department of Agriculture Land Management and Statistics
54	Mr. Nicholas Coppel	H.E. Australian Ambassador	Australian Embassy, Yangon
55	Mr. Michael Akester	Country Director	WorldFish- Myanmar
56	Dr. Khin Maung Soe	National Program Advisor	WorldFish- Myanmar
57	Dr. Mark Dubois	Aquaculture & Small-Scale Fisheries	WorldFish- Myanmar
58	Dr. Manjurul Karim	Aquaculture Program Manager	WorldFish- Myanmar
59	Dr. Donald Griffiths	Project Manager (Inland MYSAP)	WorldFish- Myanmar
60	Daw Aye Aye Lwin	Project Manager	WorldFish- Myanmar
61	Quennie Vi Rizaldo	Nutrition Specialist	WorldFish- Myanmar
62	Jessica Scott	Gender Specialist	WorldFish- Myanmar
63	Daw May Wah Htwe	Training & Communication Coordinator	WorldFish- Myanmar
64	Daw Nay Thar Paw	Grant & Partner Officer	WorldFish- Myanmar
65	Daw Phyo Haymar Win	Program Accountant	WorldFish- Myanmar
66	Daw Hsu Mon Aung	Research & Admin Officer	WorldFish- Myanmar
67	Daw Soe Pyae Sone Win	Admin Assistant	WorldFish- Myanmar
68	Daw Phyo Ohmar Win	Grant & Partner Assistant	WorldFish- Myanmar
69	Daw Moe Thida Oo	Field Manager	WorldFish- Myanmar
70	Girija Page	Volunteer	WorldFish- Myanmar
71	Kimio Leemans	Internship	WorldFish- Myanmar
72	Fernando	Internship	WorldFish- Myanmar
73	U Kyaw Win Khaing	Field Training Coordinator	WorldFish- Myanmar

No	Name	Position	Organization
74	Daw Moe Kyi Phyu	Field Training Coordinator	WorldFish- Myanmar
75	Dr. Ann Fleming	Research Program Manager	ACIAR, Head Office, Australia
76	Dr. Grant Robert Singleton	Principal Scientist	IRRI, Philippines
77	Dr. Alexander Stuart	Scientist	IRRI, Philippines
78	Dr. Thavee Viputhanumas	Inland Aquaculture Expert	Department of Fisheries, Thailand
79	Dr. Weimin Miao	Aquaculture Officer	FAO, China
80	Dr. John Campbell Conallin	Freshwater Research Consultant	CSU, Australia
81	Dr. Mam Kosal	Inland Fisheries Expert	WorldFish, Phnom Penh, Cambodia
82	Dr. Shakuntala Thilsted	Senior Nutrition Expert	WorldFish, Phnom Penh, Cambodia
83	Dr. Benoy Kumar Barman	Senior Scientist	WorldFish, Bandgladesh
84	Dr. Shwu Jiau Teoh	GIS Manager	WorldFish, Penang, Malaysia
85	Dr. Cynthia Mcdougall	Gender Research Leader	WorldFish, Penang, Malaysia
86	Dr. Chau Thi Tuyet Hanh	Officer	Department of Fisheries, Vietnam
87	Dr. Myint Sein	Director	Myanmar Fisheries Federation
88	U Win Kyaing	Secretory General	Myanmar Fisheries Federation
80	Dr. Toe Nandar Tin	Vice- Chairman	Myanmar Fisheries Federation
90	Sonali Senarathna	Technical Expert,	IWMI, Yangon
91	Tanya Huizer		ARCADIS
92	U Zaw Lunn	Marine Biologist	FAUNA&FLORA INTERNATIONAL
93	U Than Aye	Advisor	IRRI
94	U Aung Myo Thant	Agronomist Researcher	IRRI
95	U Tun Zaw Htay	Agriculture Officer	HELVETAS
96	Paul De Wit	Policy Officer	FAO, EU
97	Annalisa Noach	Food & Nutrition Security	FAO, EU
98	U Htin Aung Kyaw	Senior Technical Advisor	GIZ, MYSAP
99	Dr. Tariqul Islam	County Representative	BRAC
100	U Kyaw Thu Aung	Fishery Officer	NAG
101	U Nay Tun	Coordinator	LIFT
102	U Nay Myo	Agri and Livestock Officer	LIFT/UNOPS
103	Dr. Myint Myint Aye	Lecturer	Zoology Dept., Pathein University
104	Dr. Omar Myint	Lecturer	Zoology Dept., Yangon University
105	Dr. Sandar Win	Associate Professor	Zoology Dept., Maubin University
106	Dr. Nwe Nwe San	Professor	Zoology Dept., Taunggyi University
107	Dr. Khin Soe Win	Head of Professor	Zoology Dept., Monywa University
108	Dr. Htwe Htwe	Head of Professor	Zoology Dept., Pakokku University
109	Dr. Thant Zin	Head of Professor	Zoology Dept., Mandalay University
110	Dr. Htay Khaing	Lecturer	Zoology Dept., Monywa University
111	Dr. Moe Moe Dwe	Professor	Zoology Dept., Dagon University
112	Dr. Soe Soe Thein	Pro-Rector	Yezin Agricultural University
113	Dr. Aye Aye Myint	Professor	Yezin Agricultural University

Session 1. Rice-Fish Systems and the Sustainable Development Goals

The first session outlined the research strategies of WorldFish, CGIAR, ACIAR, and IRRI and how their research can contribute to the SDGs. Michael Phillips presented the key outcomes WorldFish aims for through the CGIAR research program: FISH, which are reduced poverty, improved food and nutrition security, and improving natural resources and ecosystem services. These research outcomes then in turn help contribute to the Sustainable Development Goals (SDG). The goal of FISH is to achieve sustainable increases in the gender and socially inclusive production and equitable distribution of nutritious fish to improve the livelihoods and nutrition of poor households in priority geographies. Globally, rice-fish farming has been recognized as potentially important for food security and improved nutrition for smallholder farmers. The spectrum of different rice-fish systems covers both small-scale fisheries and aquaculture and have the potential to contribute to multiple SDGs, e.g. SDG 2 (no hunger), SDG 3 (good health and wellbeing), SDG 14 (life below water), and SDG 15 (life on land).

Figure 1: Sustainable Development Goals that Rice-Fish Systems can contribute to

The main benefits that can be derived from Rice-Fish Systems (RFS) relate to poverty reduction and improvements in human nutrition (especially for women and children). Paddy rice production and fisheries on their own are a less efficient use of land and water, and are less efficient at nutrient recycling than integrated rice-fish systems. Fish in rice fields can serve as an Integrated Pest Management strategy, reducing the need for pesticides and contributing to personal and ecosystem health, and to food safety. The implications and results of engaging in RFS should be assessed both at the "farmer level" as well as at a "landscape level" in order to gauge the full extent of derived benefits. However, rigorous research studies are required of integrated rice-fish production systems on profitability, food and nutrition security, the ecosystem services provided by fish in a rice production system, and the increase in resilience of systems affected by different levels of salinity through synchrony in cropping season and fresh water availability, use of targeted varieties of rice and species of fish for different landscapes.

Ann Fleming presented the outline for ACIAR's ten-year strategy, which will focus less on hard science (80%, down from 90%) and incorporate more capacity building and learning activities. ACIAR has set six high-level objectives for the research portfolio on agri-food systems, in line with the Australian Government's aid policy and the 2030 agenda for Sustainable development. The number of projects that ACIAR leads will be reduced, in order to focus on fewer but more in-depth projects, rather than leading numerous superficial studies. More attention will be paid to cross-cutting issues such as gender, nutrition, capacity building, business development, and climate change.

Figure 2: ACIAR high-level objectives for the research portfolio on agri-food systems (ACIAR Ten-year strategy 2018-2027)

Grant Singleton presented the role of rice within the CGIAR Strategy and Results Framework and the future research questions related to rice within rice-fish systems. In Myanmar, rice farming covers approximately 8 million ha and involves more than 5 million rural households. Although less than 15% of the rice land is irrigated, there are also vast tracts that have ample access to water during the monsoon season. Rice production can be improved by introducing Better Management Practices, building the capacity of farmers, local government staff, and by promoting collaboration between the public and private sectors. The current study contributes to the CGIAR research program on Rice: "Rice Agri-food systems", and builds on the outcomes of a 5-year study funded by ACIAR on best management practices for lowland rice. Future research questions that IRRI will focus on regarding rice-fish systems are: determining the effects fish have on fertilisation of rice, determining which rice varieties are best suited for RFS, and designing a RF model that optimises resource and water use.

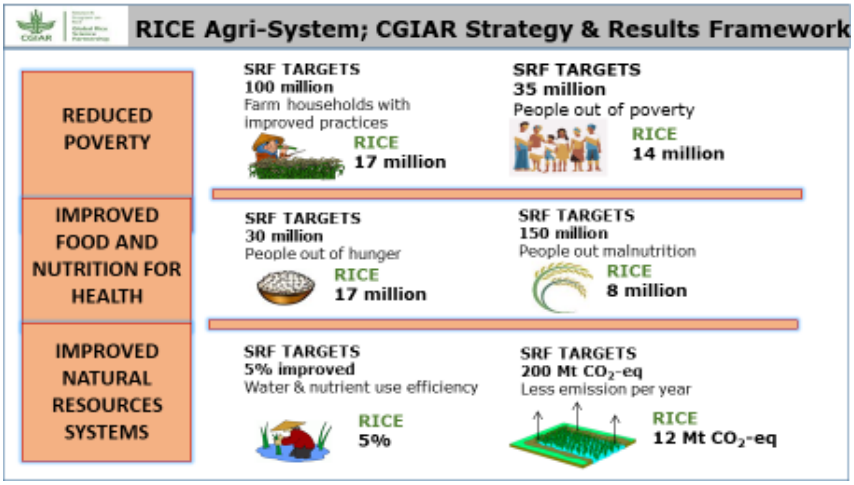

Figure 3: contribution of the RICE CRP to the CGIAR SRF

All speakers in this session highlighted the need for partnerships in researching and developing rice-fish systems development as it is situated on the nexus between agriculture (rice) and fisheries (aquaculture and capture fisheries). Particular attention was given to the local and regional specificities of rice-fish systems, which require on the ground research in order to develop systems that are in line with the needs and wishes of the local community.

Attention should be paid to the socio-economic context in which rice-fish systems occur and how to they contribute to livelihoods in rural areas. Technical research has been carried out as part of an IRRI project and at test sites managed by IRRI and WorldFish. Recommendations towards which rice variety, fish species, size of fish, refuge area and water management can be made on the basis of the results obtained in the aforementioned projects.

The FISH CRP RFS and WorldFish's strategy towards the SDGs

Michael Phillips

Globally, approximately 800 million people depend on fisheries and aquaculture for their livelihoods. WorldFish works to help the poor, who often rely on fishing as a primary source of income, to develop sustainable, productive fisheries and aquaculture. Fish, particularly small fish, is rich in micronutrients like vitamin A, iron, calcium, zinc and essential fatty acids. WorldFish strives to make fish available and affordable to the poor, to help combat malnutrition and alleviate nutritional deficiencies that often occur in developing countries. Rural women have a major role in fisheries and aquaculture, but they often have unequal access to the resources and services they need to be successful. By closing this gender gap, WorldFish helps to improve productivity and increase incomes and food security. WorldFish research shows that adopting new technologies alone is not the magic bullet for improving productivity. Using natural resources efficiently, pursuing innovation and having access to credit to invest in business activities, especially for the poor, are also vital. Overfishing, ineffective management practices, industrial development, agricultural pollution and the effects from climate change have reduced fish stocks. WorldFish promotes a sustainable approach to fisheries and aquaculture to ensure that fish stocks are available for future generations. WorldFish works with an extensive network of partners to create change for the millions who depend on fish in the developing world. Partnerships are essential to bring technologies and innovations to scale and achieve development impact. (taken from *https://www.worldfishcenter.org/landing-page/worldfish-and-sustainable-development-goals*)

The ACIAR ten-year strategy 2018-2027

Ann Fleming

All countries in the Indo-Pacific region are grappling with the complex challenges of how to grow more food and reduce poverty using less land, water and energy. Since 1982 the Australian Centre for International Agricultural Research (ACIAR) has made a significant contribution to meeting these challenges. By leveraging international agricultural partnerships, ACIAR seeks to promote more productive and sustainable agricultural systems for the benefit of developing countries and Australia. Building on its sound track record, ACIAR's Ten-Year Strategy 2018-2027 provides a clear direction for the organisation in to the future and remains closely aligned with the key objectives of the Australian Government's aid policy and the 2030 Agenda for Sustainable Development. *(*taken from *https://www.aciar.gov.au/publication/Ten-Year-Strategy)*

Rice in Rice-Fish Systems

Grant R. Singleton, Alexander M. Stuart, U Than Aye, Aung Myo Thant, Su Su San

Rice-fish systems (RFS) range from traditional capture of fish in rice-dominated landscapes through to controlled farming of fish in lowland irrigated or favourable rainfed rice fields. This talk will concentrate on controlled farming of fish within a predominant rice cropping system. We will identify some important gaps in our knowledge of how the introduction of farmed fish into a rice cropping system influences the management of nutrients, pests, diseases, and water for rice production.

In Myanmar, rice farming covers approximately 8 million ha and involves more than 5 million rural households. Although less than 15% of the rice land is irrigated, there are also vast tracts that have ample access to water during the monsoon season. Rice-fish systems were established in the mid delta in the mid 1990s with mixed results. The potential of managed rice-fish systems in Myanmar requires further research. The current study contributes to the CGIAR research program on Rice: "Rice Agri-food systems", and builds on the outcomes of a 5-year study funded by ACIAR on best management practices for lowland rice.

Session 2: Rice-Fish Systems: Nutrition, Gender & Cost-Benefit & Session 3: PANEL SESSION: Costs and Benefits of Integrated Production Systems

The rice fish symposium was importantly opened with the necessity of our unified efforts in achieving the sustainable development goals (SDG's). Session two presentations on nutrition, gender and better management practices provide insights into how and why rice fish systems can contribute to reduced poverty, hunger and improved gender equality - SDGs one, two and five respectively. This session commenced with two presentations looking at the resource management and technical aspects of rice-fish systems, which lead into opportunities for synergistic fish-agri-food systems; shifting the focus from food as energy production to instead increasing micronutrient provision; and through the lens of gender as a driver in the impact pathway to achieve the desired outcomes for improved human nutrition and livelihoods.

Dr. Sonali Senaratna Sellamuttu commenced this session with the benefit of flood-based farming systems (FBFS), examples including deep water rice and floating rice. Highlighting how these farming and flood techniques are "environmentally friendly, with no agro chemicals, and can serve as biodiversity hotspots for fish and other aquatic animals." Multidisciplinary cross-centre collaborations can further combine mapping of floods (and water?) rice suitability and identify marginal rice areas that also consider impacts and opportunities for fisheries. Through including community level focus, approaches can avoid unintended consequences such as marginalising those who depend on these naturally integrated systems.

Dr. Weimin Miao also discussed the need and importance for innovations in relation to the ancient traditional rice-fish farming. He raised that barriers to uptake and an existing lack of innovation could be due to farmers perceptions that cultivating fish will decrease rice production. Though the results of their FAO trials reported that income can instead be increased from the profits of the fish, benefiting famer's total profits. In addition to increased system profits that an improve livelihoods, RFS offer improved efficiency in natural resource management and positive flow on effects of ecological benefits and symbiosis between paddy and fish. Both presenters describe these opportunities for increased biodiversity, which-by increases cultured fish and aquatic animals available for food.

As there is a shift in development and innovations toward integrated rice fish systems, this also complements advances in nutrition and gender responsive approaches to achieve the SDGs. Dr. Shakuntala Thilsted introduced this shift in thinking from production and diet quantity (energy) to quality (micronutrients), an important measure required to combat the hidden hunger of micronutrient deficiency. Such shift in nutrition strategies is critical to address the nutritional problems in Myanmar; where 1 in 3 children are stunted, high incidence of micronutrient deficiencies prevail and only 16% of children achieve a minimum acceptable diet (ref). Rice fish systems can increase the diversity of food and nutrients available from a production system. With the addition of fish to the rice field as an animal-source food, and the return of natural stocks of micronutrient rich SIS that can be eaten whole along with a range of aquatic animals.

Gender equality is a critical driver in the agriculture to improved nutrition impact pathway, as well as, increasing global food supply and agriculture productivity by 20 -30% (FAO ref). Dr Cynthia McDougall presented the role of gender through a “driver model” in optimizing production and achieving these improved systems and development outcomes. Understanding how women and men operate in these sectors is an important foundation. In Myanmar, both women and men have distinct roles in rice and fish farming, furthermore, these roles have flow on effects such as on the household decision making power from these income sources. Ignoring these dimensions, could put the success of the production system at risk, at the household level the transitioning of production to improve human nutrition at risk, and achieving gender equality (SDG 5) within in its own right.

The panel discussion captured a range of responses and views regarding the presentation topics and application to the Myanmar setting. In synthesising with the above presentations, the following key points emerged as ways forward:

- Innovations and scale out of better management practices (BMP) and integrated pest management can improve biodiversity, including a natural fish stocks and aquatic animals.
- Fish-agri food systems, via RFS can increase food and nutrition security; through BMP for continued rice production, addition of fish as animal source food and integrated vegetable production.
- Gender equality and women are key drivers in agricultural production; though these gender dimensions, and the question are women ‘already empowered’ and equality are not well understood in the Myanmar context.

This session highlighted the need for multi-layered-multidisciplinary strategies for the opportunity of RFS to materialize in contributions to achieving the SDGs.

Supporting flood-based farming systems in the Ayeyarwady Delta

Sanjiv de Silva, Mansoor Leh, Moet Palal, Lisa Rebelo, Nikola Schulte-Kellinghaus; Sonali Senaratna Sellamuttu

Deltas, with their dynamic water regimes and diverse agro-ecological conditions, are multi-functional landscapes that support a range of production systems that underpin food security, livelihoods and provide a range of other ecosystem services. In the Ayeyarwady Delta, deep water rice and floating rice (FR) are examples of a flood-based farming system (FBFS) with unique rice varieties grown under deep water conditions (> 50 cm). They are known for their quick adaptation to flooding conditions by stem elongation at rates of up to 20-25 cm/day in order to float safely above water surface (Kende et al., 1998; Nguyen and Pittock, 2016). FBFS are considered environmentally friendly since they can be farmed without the use of agrochemicals and serve as biodiversity hotspots for fish and other aquatic species (Nguyen and Pittock, 2016). They are known to provide a number of ecosystem services including supporting, provisioning, regulating and cultural services. Supporting services include the maintenance of water regime and siltation for soil formation. In addition to rice production, other provisioning services include serving as a source for inland fish, frogs, snails and other aquatic animal production. Regulating services include flood regulation, providing and preserving habitat and biodiversity and soil and water quality maintenance (Neang, 2015; Nguyen and Pittock, 2016). FBFS production in Southeast Asia has however been on a steady decline over the last three decades. In Myanmar a loss of 42% between 1990 and 2015 is reported and attributed to a number of factors.

As part of an international program on FBFS funded by the International Fund for Agricultural Development (IFAD), IWMI is coordinating a project to investigate how FBFS in Myanmar can be supported in a rapidly evolving bio-physical and socio-economic environment. Rapid development and modification of natural landscapes and processes (including water regimes), can have profound implications for FBFS and the households that depend on them. By explicitly recognizing interactions between sectoral interests, and focusing on opportunities to optimize emerging trade-offs, the project proposes to enhance the capacity of decision makers, extension officers and local communities to realize a balance between rapid development and maintaining the multi-functionality of the delta. This has involved understanding the status of FBFS in the Ayeyarwady Delta; trends and their drivers, and opportunities to sustainably strengthen FBFS contributions to human development in the Delta and broader national development objectives. We are using remote sensing and GIS techniques to characterize the long-term variability of the flooded area in the Ayeyarwady Delta, and to understand how FBFS can adapt to change and minimize risks. Most importantly, we value the development of collaborations through with the project can support the work of other actors in furthering common perspectives and goals with respect to the future of this delta, and how it can continue to contribute to national development objectives including the SDGs.

Promote innovative integrated rice-aquaculture for improved livelihood and sustained rice production of Asian rice farmers

Weimin Miao

Integrated rice-fish farming has a history of over 2000 years. In the past several decades, rice-fish has been promoted for better utilization of natural resources, symbiosis in between fish and rice, integrated pest management and improved nutrition of rural communities.

With the changing environmental and socioeconomic context in many countries in the region, integrated rice-fish farming can play more important role in the rural development. In addition to its usual benefits, integrated rice-fish can contribute significantly to improved income of traditional rice farmers, who are typically small-scale and support them to sustain the production of rice, the most staple food for most Asian countries with a more attractive livelihood. In broad sense, promote integrated rice-fish farming can enable the traditional rural farmers to live happily in their homeland and reduce the impact of migration from rural to urban. To achieve the new objective, it requires substantial innovations to tradition rice-fish farming system and practices and as well as new development strategy to scale up innovative rice-fish farming.

The presentation explains what innovative rice-fish farming is and why it is needed. The presentation elaborates the key innovations to traditional rice-fish farming for adapting to the current socioeconomic context and achieving desired environmental and socioeconomic benefits. The presentation will also introduce the important strategy to promote innovative rice-fish farming in the region and FAO's recent work to support member countries in demonstrating and scaling up innovative rice-fish farming in the region.

RFS and Improved human nutrition

Shakuntala Thilsted

The International Conference on Nutrition (1992) called for specific measures to prevent and control specific micronutrient deficiencies (hidden hunger). At the time, supplementation and biofortification were put forward as ways of addressing hidden hunger. A shift in diets towards safe and nutritious foods was overlooked at the time, but now nutrition sensitive agri-food systems are transforming from production of staple foods to diversification and integration of different food types. Integrated rice-fish systems can be seen in that regard. Where the bioavailability of micronutrients in rice is lower, fish on the other hand are rich in essential micronutrients (including vitamin A, vitamin B12, calcium, iron, zinc). Furthermore vegetables - which are also rich in micronutrients- can be integrated into rice-fish farming systems increasing diet diversity. The burden of malnutrition in Myanmar is multifactorial and presents in the form of stunting and micronutrient deficiency including anemia, with a high prevalence especially seen in rural poor populations, women, and children. The integration of small fish into the rice field could benefit the poor in particular, increasing the availability of small fish, which are often sold in smaller portions than large fish thereby reducing household food expenditure, and small fish can be cooked in mixed dishes suitable to share within the household. The presence of fish in the meal enhances bioavailability of other foods and increases diet diversity. Rice-Fish systems can be implemented as nutrition sensitive approaches to address malnutrition, hidden hunger, and improve the dietary status particularly of women, children, and the rural poor. To ensure success, national food and nutrition, agriculture, and health policies should include actions to implement integrated fish agri-food systems to provide well-liked, diverse, nutritious, safe, and affordable foods.

The role of gender in RFS

Cynthia McDougall

It is against a backdrop of rural poverty, outmigration and child malnutrition that the need for substantive transformation in Myanmar's agricultural systems is self-evident. A shift from the existing rice monoculture to integrated rice-fish systems has the potential to lessen the need for pesticide use, contribute to livelihood diversification, and offer a source of nutrient-rich fish and vegetables. Yet for its promise to be realised and for such a transition to be truly sustainable it is essential that social nuances, namely those regarding gender, are not drowned out by focuses solely on the technical and policy aspects of development.

Through literature review and preliminary gender analysis in three demonstration farm villages we examined the perceived impact pathways along which increased productivity and rural development can be facilitated. Gendered discussions remain notably absent from the rice-fish discourse in labour-scarce, poor, and vulnerable areas, yet gender equity and women's empowerment constitute a critical link in establishing increased productivity and subsequent achievements in livelihood and wellbeing outcomes, including improved nutrition. Whilst observed gender differences and normative barriers highlight that fishing and rice farming are understood as a men's domains, women were, however, recognised as large contributors to the fish value chain (in some contexts with 90% of sellers and processors being women). It is within this space that women have access to income otherwise entirely male-held due to the decision-making power afforded by rice farming.

It is, therefore, this understanding and harnessing of both women and men's agency through the addition of fish to existing rice farm systems that could, with continued research on both the gendered and broader vulnerability dimensions of integrated rice-fish systems, offer a more sustainable livelihood opportunity for the rural poor in Myanmar

Session 4: Rice-Fish Systems: mapping multifunctional landscapes & Session 5: PANEL SESSION: Integrated Planning in Multi-functional Landscape

Inland rice field and small-scale fisheries operate in highly complex ecological, social and institutional environments (Jentoft and Chuenpagdee, 2009). The Fish CGIAR research program proposal states that "productivity and sustainability are often undermined by underperforming governance," […. and that the primary challenge …] "is to improve [fisheries] governance in ways that ensure ecological sustainability, build the resilience of fishery-dependent communities, and "[…..]" increase livelihood opportunities for poverty reduction and food security." A key hypothesis in natural resources governance research is the requirement for a robust intersectoral planning system that identifies and acknowledges the often-competing demands placed on social and ecological systems within a development context.

Five presenters from a range of disciplinary backgrounds shared a diversity of research approaches addressing this central question, and all grounded in the Myanmar national context. The session addressed the implications of promoting integrated farming systems in marginal areas, an agro-ecological characterization of rice fish systems, a GIS based spatial analysis of suitability of rice cum fish systems in Ayeyarwady Delta, habitat fragmentation as a consequence of competing development initiatives and mitigation innovations for same, and, a multi-layered and multisectoral analysis (atlas) of the AD. Taken together the presentations informed a panel session which explored the role and crucial function of integrated, intersectoral planning in managing floods - by juxtaposing perspectives on 'living with the flood' and 'holding back the tide'. This issue was used as an analytical tool to unpack the complexity of sectoral responses and impacts to different land and water use management regimes and the role of integrated planning in multi-functional landscapes.

Michael Akester in his presentation explained the concept of marginal areas and discussed the importance of improving integrated farming systems in these areas. He explained that paddy land productivity and profitability in Myanmar are low compared to the rest of SE Asia and that improved land and water use is crucial for quality food production. Michael also discussed the potential for shifting the policy focus from only paddy production to integrated agriculture development and the overall benefits of such a shift such as the increase in net profits for small holder farmers, improved biodiversity, enhanced employment opportunities and increase quality food (fish) from rice fish systems. Rick Gregory in his presentation explained which agro-ecological zones in the delta, and for which types of farmers, RFS are a viable avenue for enhancing livelihoods and nutrition. Rick also cautioned that 'we need to be aware that in Myanmar rice-fish systems are not all about culture, but also wild capture fisheries in rice-based landscapes. A question was asked from the floor about whether Introducing fish culture in the natural rice-fish systems will disturb the ecological balance and impact the natural habitat of other species. There were differences of opinion as to what the impact would be highlighting the importance of understanding the crosswalk between aquaculture based and wild capture-based systems.

Shwu Jiau Teoh presented the role of GIS in identifying marginal areas as well as the potential for rice fish culture based on flood mapping. Shwu Jiau explained that GIS can help in identifying influencing factors/criteria to promote sustainable Rice-Fish System (RFS), give a broader picture to zoning and spatial planning, and thereby be used to improve agriculture research, policy planning, and decision making. Tanya Huizer another presenter agreed, further emphasizing that GIS can be a useful tool for delineating and compiling specific data layers, in order to build up a comprehensive analytical picture of the issues and trends such as deforestation as well as potential for forecasting these trends and their application in delta planning and decision making. The Delta Atlas she said is envisaged as a living document to be updated as new information becomes available thereby ensuring it can be a really useful resource. A questioner asked what the governments' opinion of the atlas was and Tanya responded by informing the participants that the atlas had been approved by the government of Myanmar.

John Conallin concluded the presentations by communicating research on floodplain river connectivity and the role fish migration and fish passage play in maintaining productive rice-fish systems. John explained that where river systems were fragmented, reinstating connectivity between a fish migratory pathway to rice production on a floodplain formerly blocked by many human-built structures can increase the catch rate of native fish, reduce the need stocking and lower dependency on alien species. A questioner asked about the viability of the fish passages for multiple species as well as whether the system is economically viable. John replied by stating that the cost of the passage was 150,000AUD and whilst not 100% would allow multiple species to migrate and return after spawning in certain contexts. He further mentioned that it is more cost effective to build a fish passage/ladder incorporated with infrastructure at the time of construction as opposed to after it has been built.

Further discussions and comments eluded to the lack of cooperation between Ministry of Construction and Department of Fisheries in terms of planning, especially to what effect building a dam or reservoir would have on the fisheries sector. It was further suggested that large infrastructure projects must consult a broad range of stakeholders including fisheries institutions existing reported ecosystem impacts from large infrastructure projects worldwide.

The final panel session on the role of spatial planning was conducted in the style of an electoral TV debate. Two of the presenters John Conallin and Tanya Huizer were invited as panellists to a session facilitated by Mark Dubois. After a brief introduction by Mark on perspectives around adapting to and living with the flood and a question was posed 'can we utilize flood for development?' In order to stimulate discussion both panellists took up a clear position (not necessarily reflecting their actual position) and Tanya Huizer from ARCADIS responded by stating that 'We must fight the flood because we really need the land. It is crucial, the Ayeyarwady delta has a large and increasing population and is changing a lot.' The response from John Conallin – from Charles Sturt University focused on the fishery and that the fishery needs a flood to maintain production and thereby

sustain peoples' income and food security. Flooding is important to reduce salinity he said, if do not have a flood, you have land salinization. There were a variety of inputs from plenary with Dagon University stating that flooding is a negative impact for human society, but good for aquatic biodiversity. This was countered by a response from Cambodia where it was said that flooding is the lifeline of our country, natural floods are very important for fisheries and the economy and food security. 'If you look at the national statistics, if there is a high flood year, it is a high catch year thereafter, if low flood low catch.' The questioner continued to say "without floods, fish will not be triggered to spawn, affecting food systems, therefore If we modify flood regimes too much, we will have a problem.", and "managing floods needs a broad consultative process engaging all relevant stakeholders and agencies".

The session concluded by stating that the GoM has had to take positive steps to promote integrated land and water use for food production and employment possibilities through for example the Agricultural Development Strategy (ADS) which seeks a better balance between former rice centred policies and diversification of agrarian production (livestock and fishpond cultivation are important contributors to this diversification strategy) and MoALI´s contribution to the Multi Sector National Plan of Action for Nutrition (MS-NPAN) which also focuses on diversification of production systems, and on creating an enabling environment to achieve this.

Part of this enabling environment we heard about included identifying opportunities for e.g., deep water rice and fish systems in marginal areas, and mitigation measures to obstructions in the natural connectivity of the landscape also refer clearly to the important role of spatially (GIS) based decision support tools which consider the multi-functional aspect of land uses e.g., for agriculture, aquaculture, and beyond; for industry, transport and many others. This is also reflected, we have learned, in the need to consider climate variability and change, e.g., to the risks of flooding and landscape fragmentation. Finally, the Myanmar Fisheries Federation spoke on the need for a comparative economic value assessments and trade off analysis, and stated they expected this to play an important role in supporting improved decision making and inter sectoral planning and development for the AD.

Key outcomes

- Paddy land productivity and profitability in Myanmar are low compared to the rest of SE Asia and that improved land and water use is crucial for quality food production.
- The importance of maintaining floodplain river connectivity and environmental flows in maintaining ecosystem services such as productive rice-fish systems.
- lack of cooperation between Ministry of Construction and Department of Fisheries in terms of planning, especially to what effect building a dam or reservoir would have on the fisheries sector.
- The requirement for a robust intersectoral planning system that identifies and acknowledges the often-competing demands placed on social and ecological systems within a development context. And the crucial role of GIS in the above and DSS
- the potential opportunities for shifting the policy focus from only paddy production to integrated agriculture development and the overall benefits of such a shift such as the increase

in net profits for small holder farmers, improved biodiversity, enhanced employment opportunities and increase quality food (fish) from rice fish systems.

- the importance of understanding the crosswalk between aquaculture based and wild capture -based systems.

The importance of improving integrated farming systems in marginal areas

Mike Akester

Myanmar is going through a process of rapid change. Since the return towards democracy in 2012 and democratic elections in 2015, GDP growth has been between 5.87% (2016) and 8.43% (2013) per annum. Currently estimated at 6.9% (2018) and predicted to rise gradually to 7.37% by 2022. This growth was initially driven by the Agriculture sector with value added (% of GDP) reported at 25.46 % in 2016 (World Bank), down from 31% in 2012 and declining. This reduced dependence on agriculture as a contributor to Myanmar's GDP demonstrates the growing importance of industrial and service industries. It also highlights an associated need to improve land and water use for quality food production. At present agriculture uses 91% of the current water available (6% domestic and 3% industrial), while only 5% of the water potential is in use (56km3). Seasonality of water supply and climate change are constraints. Cultivable land is 17.7 M ha while irrigated land only 12% at 2.2 M ha. Annual water use for crop irrigation is 39.55km3. Better use of irrigated and rainfed areas for improved human nutrition could be made by adding fish to rice systems, especially in marginal areas where rice yields are low due to a range of factors notably flood and saline intrusion where deepwater or salt resistant rice varieties could be used.Low agricultural productivity is also due to soil degradation. Soils in Myanmar are often low in nutrients and organic matter (feralsols and arenosols) although the delta and Shan uplands are fertile: gleysols and cambisols.

Fish in integrated production systems have been shown to improve nutrient levels and soil organic matter. The better use of nutrients with Rice-Fish systems will improve the environment (lower pesticide use and improved biodiversity of aquatic animals in seasonal floodplain areas), ensure that gender inclusive employment options in rural areas are maintained: including opportunities for small-medium enterprises for youth opportunities. The latter will help to reduce the migration trend towards urban areas (currently 70% of the population live in rural areas – however this is changing). While the importance of agriculture as a contributor to GDP is in decline, Myanmar's capture fisheries are also in decline – both inland and marine. Inland fisheries used to provide most of the 25kg per capita of fish consumed in Myanmar. While consumption levels remain at this level, or even higher, the fish now comes increasingly from freshwater aquaculture – currently close to 30% of the total fish production and rising.

WorldFish and partners (including the CGIAR International Rice Research Institute (IRRI) and International Water Management Institute (IWMI) are now helping the Myanmar Government Ministry of Agriculture Livestock and Irrigation (MoALI) to promote improved inland fisheries management in flood-based farming systems which include leasable floodplain fisheries and seasonal (marginal) rice production areas. The Australian Centre for Agricultural Research (ACIAR) is providing funding for both rice-fish and improved inland fisheries projects in addition to a pilot level fish passage project in Lao PDR, Cambodia and Myanmar.

Characterization of RFS in the Ayeyarwady Delta

Rick Gregory and Khin Maung Soe

Rice field fisheries have been studied extensively in several other SE Asian countries, in particular in Cambodia, and their importance to rural community food security and household incomes. However, in Myanmar, despite its vast lowland rice field resources, few if any such studies have been done. In mid-to-late 2017, Worldfish in cooperation with the Myanmar Department's of Fisheries, and supported by the Departments of Agriculture and Agriculture Research, carried out a preliminary study of farming communities in freshwater, brackish and saline zones of the Ayeyarwady Delta; Myanmar's most important inland fishery region, to begin to understand the contribution that rural communities derive from the collection aquatic animal foods from rice fields.

As expected, the study showed that between 70-80 % of both landless and landed households practiced the regular collection of fish and other aquatic animals from rice fields, providing them with essential food and incomes. For poorer households, the importance of rice field foods to nutrition in the early wet season (traditionally, a food deficit period), was an important coping mechanism. Black fish species, (climbing perch. snakehead & *Clarias* catfish) were common in freshwater and brackish zone catches and were highly favoured as food items. Field crabs, shrimp and mullet dominated catches in the saline zone, for consumption and incomes. Findings suggest that rice field fisheries in the brackish water zone may be of lesser importance to farming communities.

The high nutritional value of many of the smaller indigenous fish was not widely recognized by respondents. However, the importance of small fish in the diet of children for their cognitive development was widely known.

For many decades, Myanmar's agriculture policies, which have included restrictions on digging ponds/canals in rice fields, have done little to encourage the sustainable management of rice field fisheries. Respondents in all three zones report a steady decline in rice field catches which they blame on over-fishing, (especially electro-fishing) and the use of pesticides and herbicides for rice production. As Myanmar's economy grows, many youths and adults from poorer Delta families are migrating to Yangon for casual employment rather than turning to the traditional coping mechanisms, such as rice field fishing that have been practiced for generations.

GIS and Spatial Planning for Rice-Fish Systems in Ayeyarwady Delta

Shwu Jiau Teoh and Ando Mariot Radanielson

Rice-fish system has the potential to increase productivity in more challenging marginal rice production areas. More strategic and well-supported targeting with relevant information about the opportunities and limitations faced in these areas are then needed. In this presentation, we will share the use of GIS in performing spatial analysis integrating various data sources to derive new informative maps on the potential and constraints for promoting rice-fish systems in Ayeyarwady Delta. In recent decades, WorldFish has successfully developed GIS modelling for determining recommendation domains, for a particular target aquaculture in a number of countries of Asia and Africa (Kam et al., 2008; NDFA, 2012; Sankoh et al., 2018). We attempted to adapt this model to address key questions in rice-fish planning and management in Ayeyarwady Delta. Through literature review, consultations with aquaculture specialists and local experts, we identified key determinant biophysical and socio-economic factors/criteria driving rice-fish farming systems in the delta. Data represents these factors were collected and had been processed at similar resolution for integrating in the model. As we will continue to refine the GIS modelling for rice-fish suitability, new collected data will be integrated. Multi-stakeholder consultation and ground truthing will be conducted for validation of the maps prior its use for policy planning and decision making.

Floodplain river connectivity: the role of fish passes

John Conallin, Lee Baumgartner, Thun Thein, Nyunt Win, Maung Maung Lwin, and Zau Lunn

Fisheries plays a vital role in the culture and socio-economic life of Myanmar and are one of the most important sources of animal protein and micronutrients. The average consumption levels are approximately 30 kg/person/year, second only to rice. Migratory fish make up an important component of the inland capture fisheries, but little is known about the migration patterns of any of the inland fish species. But the impacts of river development are having significant impacts on the long-term sustainability of this important resource.

Whilst the proliferation of irrigation infrastructure has helped to secure farming sustainability, it has adverse impacts on fish. Dams, weirs and other regulating structures can block important access to feeding, spawning and nursery habitat. In many areas where construction has progressed, migratory species have declined. Maintaining connectivity for endemic wetland and river species is therefore paramount to maintain productivity in rice-fish systems. Many fish friendly weir design and fish passage technology have been developed to mitigate the threat of river and wetland regulation, and allow fish to complete their migratory lifecycle.

Charles Sturt University is working with the Ministry of Agriculture, Livestock and Irrigation led by the Myanmar Department of Fisheries on initiating a fish passage project in the Bago River Basin. The project builds on 10 years of fish passage work from Laos, and will identify and prioritise different fish migration barriers, and build a small demonstration fishway. The project aims to increase the knowledge and capacity of Myanmar professionals to identify and incorporate fish passage design into existing and future river and wetland infrastructure.

Ultimately, by better understanding the migratory patterns of important fish species in Myanmar in combination with engineering innovation can be used to increase productivity in rice-fish systems in the long term. Research and capacity in and around fish migration and fish passage technology will be critical to ensuring sustainable fisheries.

ARCADIS Spatial Atlas of the AD

Tanya Huizer

The Ayeyarwady River basin and associated delta are very important for socio-economic developments in Myanmar, such as agricultural production and river transport. The complex and vulnerable system is subject to mangrove degradation, salinization, cyclones, floods. These factors combined with underdeveloped infrastructure, land areas with limited accessibility, limited access to markets and financial credit lead to minimal agricultural production within the Delta area. Climate change and future socio-economic developments can aggravate these issues.

The objectives of this project were to develop a future plan for the development of a safe, prosperous and sustainable Delta. This plan would then serve as the basis for the development of an adaptive Integrated Ayeyarwady Delta Strategy (via Adaptive Delta Management), considering the current situation and expected or possible future trends, developments, and uncertainties. Local counterparts will be involved in the practical implementation of the above-stated plan, in order to build their capacity through Learning by Doing. The strategy will include short-, middle, long-term measures that will be incorporated into adaptive development pathways.

A baseline survey has been conducted in which existing data and models were screened to assess their applicability for the development of the Delta Strategy. This baseline data was subsequently used to develop the Ayeyarwady Delta Atlas. The goal is to design alternative strategies for the Delta region by identifying possible socio-economic and demographic trends, impact of climate change and changes in the physical environment. Measures taken in the Delta will be inventoried to produce a 'toolbox' of measures, which will be described and analysed based on expert judgment. The analysis will consist of assessing the founding principles of the proposed measures, potential socio-economic and environmental impacts, estimating associated construction, operational, and maintenance costs, and other factors relevant to the involved stakeholders.

Session 6: Rice-Fish Systems: Ministry of Agriculture, Livestock, and Irrigation department presentations

In session 6 the point of view from the different government departments was given. There were presentations by the Department of Agricultural Land Management and Statistics (DALMS), Department of Agricultural Research (DAR), Department of Agriculture (DoA), and the Department of Fisheries (DoF).

The Department of Agricultural Research outlined the priorities for the Ministry of Agriculture, Livestock, and Irrigation (MoALI), which include improving food and nutrition security, as well as per capita income for Myanmar's population. To achieve these goals, DAR has been developing improved high-yielding varieties adapted to local ecosystems, rice and other food crops with good resistance against biotic and abiotic stress factors, high-quality food crops, and several hybrid crop varieties (e.g. rice, maize, cotton). Crop management has also been part of their research focus, focussing mainly on developing environmentally friendly crop management schemes, conservation and management of genetic variability, and identifying management strategies that reduce yield variability resulting from climate impacts. The Myanmar government has trialled rice-fish systems in the early 1990s in cooperation with IRRI during the Myanmar-IRRI Farming Systems (MIFS) project. The characteristics DAR aim to promote in RFS are resistance to flooding, tolerance to pests and diseases, a rice variety with dormancy character, systems that are suitable for loamy soils.

Department of Agriculture presented the importance of agriculture in Myanmar and the vision and priorities of MoALI. The priorities for MoALi are food and nutrition security, production and provision of high-quality crop seeds, providing training and education, and research and development. The presenter then highlighted the different methods of rice farming and then elaborated on the rice-fish trials that have recently been conducted in Bago and Ayeyarwady regions. The DoA would like to implement RFS in irrigated lowland areas, deepwater, and flooded areas. The research should focus on adaptable varieties, cultivation methods, fertiliser application, pest management, and water management.

The Department of Fisheries then went on to present the role of fish in RFS and the importance of fish in Myanmar. The priorities of the DoF are to develop the fisheries sector in a sustainable way to ensure food and nutrition security, as well as improving the socio-economic status of the rural population. The concrete objectives of the DoF are to implement and enforce fisheries laws, to make quality information publicly available and collect statistical data, implement fisheries co-management systems, develop the aquaculture industry, conduct fisheries research, provide extension and awareness services to fisherfolk, and capacity development of department staff. Two trial projects have been set up and are jointly run by the DoF in cooperation with the Freshwater Fisheries Research Center of Chinese Academy of Fisheries Science (FFRC) in Naypyidaw Region.

In conclusion, session six highlighted the priorities for the different government departments housed under the Ministry of Agriculture, Livestock and Irrigation. The main priority is to increase and diversify food production in order to improve food and nutrition security in rural communities. The second priority is to improve and diversify livelihood strategies, particularly for vulnerable, rural communities. The government departments also mentioned there is a need to adapt farming and fishery systems to prevent or mitigate the expected effects of climate change.

Department of Agricultural Research (DAR)

The Department of Agricultural Research falls under the umbrella of the Ministry of Agriculture, Livestock, and Irrigation. The vision of the department is to contribute to food and nutrition security for the people of Myanmar. They have six divisions within the department: rice & cereal crops; oil seed crops and food legumes; industrial crops and horticulture; soil, water utilization, and agricultural engineering; agronomy, agricultural economics, and statistics; biotechnology, plant genetic resources, and plant protection. Several crop research centres and satellite farms are set up across the country and being managed by DAR.

The main research activities of the department include developing high yielding varieties, developing crops whose yields are not affected by biotic and abiotic stressors, develop high quality food crop varieties, develop hybrid varieties of economically valuable crops. Crop management is another research focus for the department. The priorities in this domain are to develop environmentally-friendly crop management systems, conservation and management of plant genetics resources, identify crop management options to reduce yield variability. Research outcomes are shared with farmers through field demonstrations, farmer education channels, and international and national development projects.

Department of Agricultural Research has been involved in the MYRice-Fish project on the development of the rice-fish system. DAR has provided recommendations on the rice characteristics and varieties that are suitable for RFS.

Department of Agriculture (DoA)

Myanmar is rich in natural resources, land, water, and has favourable weather conditions for agriculture. More than 70% of the population, mainly residing in rural areas, depend on agriculture, livestock or fisheries for their livelihood. The vision of the Department of Agriculture is to improve food security and nutritional status of Myanma citizens, to double income for farmers, and to improve the quality of agricultural products to meet international standards. The main agricultural crops in Myanmar are: rice, maize, groundnut, sesame, black and green gram, pigeon pea, cotton, and sugarcane. Rice is the most important crop and the aim is to triple income rice farming for smallholder households. Rice production has been increasing over the last few years, after seeing a drop from its highest point in 2011. A similar trend can be seen for sown area, reaching a peak in 2011, dropping off the next year, and increasing over the last few years. Most rice production takes place in rainfed or irrigated lowlands.

The Department of Agriculture has been involved in rice-fish farming as a partner on the MYRice-Fish project. The Rice Division of DoA was the focal division involved in this project, together with extension staff from the townships where the demonstration sites were located. Irrigated lowland, deepwater, and flooded areas were identified as suitable areas for rice-fish. in order for RFS to be sustainable attention should be paid to the varieties and cultivation practices used, field management, agro-chemicals application, and water management.

Pilot Scale Integrated Farming of Rice-cum-Fish - Department of Fisheries (DoF)

Rice and fish are two important food products in Myanmar. The main source of animal protein for people in Myanmar is fish in different forms: fresh, dried, salted, fermented, and fish paste and fish sauce. The main vision for the Department of Fisheries is the sustainable development of the fisheries sector, in order to contribute to food security, and socio-economic development of rural communities and the country as a whole. The main tasks of the DoF are conservation of fisheries resources, collection and compilation of fisheries data and statistics, extension services, fisheries research, and supervision of the fisheries sector. The plans for the future are to develop genetically improved species and developing climate-smart breeding techniques, conserve indigenous fish species, promote freshwater and marine aquaculture, and preventing and controlling disease.

The Department of Fisheries has been involved in several rice-fish projects. Currently it is working with the Freshwater Research Center of Chinese Academy of Fisheries Science (FFRC) on a rice-fish culture project in two villages, Tar Gone and Thet Hnin Inn. The goal of the project is to contribute to rural development and alleviate poverty.

Session 7: Rice-Fish Systems: Current Status in Myanmar

In session 7 the current status of different rice-fish systems operated in Myanmar was presented. Firstly, the results of a rice-fish trial conducted by WorldFish and IRRI in collaboration with DoA, DAR, and DoF, were presented. The aim of the project was to identify and develop improvements to rice-fish production and management systems, compare production and profitability of different rice varieties integrated with and without fish, and lastly to strengthen the capacity and enabling environment for research. The results for two trial sites were presented, one in Maubin and one in Letpadan. The main conclusions were that implementing Better Management Practices (BMP) for nitrogen improved rice yield compared to neighbouring farmers, addition of a fish refuge area to the rice plot did not negatively affect rice production, and rice-fish systems had a higher net income than rice monocropping. Further research is needed to develop different options based on local conditions.

Next was a presentation highlighting the findings of a Participatory Rural Appraisal-Vulnerability study conducted by the Pyoe Pin Institute in fishing communities in the Ayeyarwady Delta. Communities in the AD are exposed to a range of natural disasters (e.g. floods, saline water intrusion, storms, etc.). Institutional factors such as overexploitation of natural resources, corruption, and poverty also contribute to the vulnerability of a community. Maubin and Hinthada were found to be the most vulnerable townships. Thabaung, Labutta, and Dedaye were less vulnerable, access to fishing grounds was a key factor in reducing vulnerability in these villages. Remoteness of a village/community plays a major role in determining the vulnerability of said township/community. The primary causes of vulnerability are loss of land and loss of fishing grounds. Co-management of fishing grounds appears to reduce vulnerability of fishing communities. The DoF is cautiously positive about co-management at this moment and urges for a slow and careful introduction. Other factors affecting vulnerability were (lack of) access to credit, household size, and household health status. Climate change effects are likely to impact communities negatively and changing weather patterns make it harder for communities to plan ahead, increasing their vulnerability even further. Social protection measures are lacking in most townships and a gender disparity between male- and female-headed households exists in terms of vulnerability. Female-headed households are usually more vulnerable than male-headed households. Suggestions to reduce community vulnerability include a more coordinated approach regarding aquaculture, agriculture, and capture fisheries, investing and improving public infrastructure and services, setting up formal social protection systems.

The University of Yangon and Dagon University gave presentations on fish diversity in paddy fields, the variety of fishing gears used, and the implications for management strategies. Paddy ecosystems are man-made, dynamic systems that provides food (rice) and income to local populations. Paddy fields also serve as a shelter, spawning, and nursing grounds to a number of plant and animal species. Diversity of fish and other aquatic animals depends on the environmental condition of the paddy field (aquatic, semi-aquatic, or terrestrial dry land), as well as on the distance and connection

to natural water bodies. Most of the species found in paddy fields were small indigenous species. Fishing in rice fields is being carried out year-round, with peak activity recorded in rainy season and the lowest activity in dry season. The presenter from Dagon University then presented the range of habitats that local communities fish in, which species they catch and their seasonality, and the types of fishing gears that are being used. Some of the gears currently used could potentially have a negative impact of fish stocks. Local communities have noticed a decrease in fish availability and attribute it to overuse of pesticides, overfishing, and climate change effects. Local ecological knowledge could be used to inform management and conservation strategies based on the communities' perspectives and priorities. Fish can play an important role for local communities both as a source of income and a source of nutritious food. As an alternative to rice field fisheries, fish culture can be integrated into rice farming and provide a number of positive environmental outcomes such as pest control, weed control, and rice fertilisation, next to the benefits derived from fish production. It was concluded that paddy fields are important for fish diversity and conservation, and that fish resources are important for local communities.

Finally, this session was ended by Dr. Myint Sein, who is the manager of ORCHARD Company Limited, presenting the rice-fish system ORCHARD currently operates. The system consists of a large central area where fish and rice are cultivated surrounded by two rings of embankments. On the outer embankment bamboo trees are planted, which serve as a natural fence, stabilise the soil and provide oxygen to the fish channels, and can be used to construct bamboo items. On the inside of the outer embankment and on the inner embankments fuelwood trees and fruit trees are planted, which provide construction or firewood and fruits for consumption or sale. Water from the fish pond is used to fertilise the rice-growing and fruit tree areas. This system, with bamboo embankments, has a higher initial cost, but prevents soil erosion and flooding, and produces additional sources of income (firewood, other fruit trees). It has the potential to mitigate effects from natural disasters, as well as increasing production and income for local communities.

In session seven the importance of paddy fields for wild fish diversity was highlighted by the university speakers and the potential considerations this brings into designing and implementing conservation and management strategies. Furthermore, the importance of fish as food item and fishing as livelihood strategy for rural communities was highlighted. Integrating fish into rice culture can provide an additional source of nutritious food, as well as increasing income for farmers. Different systems currently exist or are being trialled by the government, in cooperation with other governments or international NGOs, as well as by the private sector. There exists a spectrum of different rice-fish systems, ranging from rice field fisheries to integrated rice-fish culture, where each provide a specific range of benefits. Effective conservation and management of the diversity of systems will ultimately contribute to achieving the goals set out by the Myanmar government in order to reach the targets set in Sustainable Development Goals.

Integrating rice and fish in Myanmar: preliminary results from a rice-fish field trial

Nilar Shein, Alexander M. Stuart, Grant R. Singleton, Michael Akester, Manjurul Karim, Aung Myo Thant, Than Aye, Su Su San

Integrated rice-fish farming systems have great potential in Myanmar given the extensive water availability and wild fish resources in many of the rice agro-ecosystems in the country. It may also present a good opportunity for women's economic empowerment and improving the nutrition of the family (consuming more fish and more protein food) as women in Myanmar traditionally play a great role in selling fish and they have more decision-making power in food choice and distribution. From November 2017 to June 2018, the first season of an integrated rice-fish field experiment was implemented in Tar Pet West Village, Maubin Township, Maubin District, Ayeyarwady Region and in Chanthar Kone village, Letpadan Township, Tharyarwady District, Bago Region. The objective is to test, develop and identify improvements in rice-fish production and management systems to improve productivity and profitability of rice-fish systems in Myanmar.

In each township, a Randomized Complete Block Design was established in 1-2 farmers' fields, with 6 treatments replicated three times. The treatments were rice with fish and without fish, plus recommended N input, 50% recommended N input and zero N fertilizer input. Each treatment plot (225m^2) was then planted with three different rice varieties. In each rice and fish plot, a 14.5 x 2 x 1.2 m fish refuge trench (13% of the plot area) was constructed and stocked with rohu and silver barb fish seeds at a density of 2 fish/ m^2. Rice yields were measured using 10m^2 crop cuts.

The preliminary results of the field experiments indicate that following the first season of data collection, rice yields increased with higher fertilizer rates, with no difference in rice yield between fish and no-fish treatments and rice varieties. An average production of fish was 700 kg/ha with a 71% survival rate in Maubin, and 940 kg/ha with an 82% survival rate in Letpadan. Overall, the integrated rice and fish system improved the gross profit margin of rice farmers by 41% in Letpadan and by 9% in Maubin. The field trials will continue for several more seasons and the lessons learned will be used to identify improvements for rice-fish systems in Myanmar.

Participatory Rural Appraisal vulnerability study: floodplains

Rick Gregory, Romain Langeard; Aung Kyaw Thein, Mike Akester, Florence Poulain

The FAO is exploring evidence of the linkages between poverty, social protection and natural resource management with a view to implementing programmes to empower rural communities in the transition to sustainable natural resource management and poverty reduction. In Myanmar, it commissioned analyses of social protection needs and opportunities in the context of rural development (across all agricultural sectors) and poverty reduction with a view to enhancing understanding of the role of social protection in the transition to sustainable natural resource management and poverty reduction. Initial work highlighted that priority should be given to vulnerable fishing communities for poverty reduction and rural development, particularly to increase their access to social assistance, with a focus on natural resource management, climate change and livelihood diversity. In line with these findings, FAO and the WorldFish carried out a participatory-based vulnerability study to assess the state of social protection and poverty dimensions in the Myanmar fisheries sector. In early 2018, the study assessed the social protection and poverty dimensions at five locations in the Ayeyarwady Delta in Myanmar. The research started with the design and field-testing of site-specific Participatory Rural Appraisal (PRA) instruments including wellbeing and livelihood analyses.

Diversity of fish in paddy ecosystem and local ecological knowledge: Implication for management strategies

Omar Myint, San San Myint, Nobuhiro Ohnishi

Myanmar is an agricultural country where rice and fish are the staple foods in the country. In Myanmar, the majority of rice (60%) is grown in rain-fed lowland, and rice and fish are commonly grown in paddy fields, intentionally or not. Flooded paddy fields offer a suitable environment for fish and other aquatic organisms and paddy fields serve as fishing grounds for both farmers and fishers. Hence, the paddy ecosystem is of importance for the livelihoods of the local people. The paddy ecosystem provides a rich biodiversity, and food and nutrition security, especially for local people. Sustainable development of paddy fish is important for the local people and it might highly depend on the knowledge and the perception of local people regarding biodiversity conservation. However, little is known about the importance of paddy ecosystem and its functional link between the biodiversity, culture, and livelihoods of the people. The current study had been conducted to explore the diversity of fish in the paddy ecosystem and to assess the local ecological knowledge and the different points of view on biodiversity conservation. In this study, a total of 47 species from 40 genera belonging to 25 families were recorded. Most of them were native to Myanmar. Most of the villagers depend on fishing (53%) and cultivation of rice (43%) for their livelihood. The majority of the villagers (59%) were poorly educated. However, 70 per cent of the villagers were found to have local ecological knowledge and 84 per cent of the villagers had identified the problems causing the decline of fish populations, which is important information for fisheries management. The results from this study clearly show that paddy ecosystems are important for fish diversity and for the livelihood, culture, and food security of local people. In addition, local ecological knowledge is important in biodiversity conservation and it might be accomplished by increasing the awareness of local people and applying proper management strategies.

Study of Fish Species Occurrence and Types of Fishing Gears Applied in Rice Fields in Taungoo Environs, Bago Region

Moe Moe Dwe, Htay Htay , Khin Shwe Myint

A total of 44 fish species, belonging to 32 genera of 17 families under six orders, were recorded from rice fields and irrigation channels between April 2011 and October 2013 at different study areas. All fish species were indigenous small fish species, except for *Barbonymus gonionotus* and *Oreochromis niloticus*. During the present investigation the order of dominance and percentage composition is as follows Cypriniformes (17 species, 39%) > Perciformes (11 species, 25%) > Siluriformes (9 species, 21%) > Symbrichiformes (5 species, 11%) > Osteoglossiformes (1 species, 2%) = Beloniformes (1 species, 2%). Out of these, 33 species were observed in rice fields of Nyaunggaing village and Lebu village and all 44 species were only observed in rice fields near Silaung Inn (Seik Kyi Kone village, Kok Ko Bauk village, and Do Inn village). The number of fish species occurring in rice fields near Silaung Inn was higher than in Nyaunggaing and Lebu. This may be due to the existence of Silaung Inn and the partial connectivity to Sittaung River through some small water channels. Fourteen fishing gears (*Nga mhyar tan*, eel trap, five kinds of fish traps, portable cast net, portable lift net, man push net, stationary net filter trap, stationary bamboo fish filter trap, bonlon-sel, and bag net) were utilized to catch fish in the study sites. The last four fishing gears were used to catch fish for commercial purposes. The remaining ten were mostly used to catch fish for family consumption. Most fish species migrate to spawn in rice fields from Sittaung River through water channels and Silaung Inn during the onset of raining season. During the spawning period, stationary net filter trap, stationary bamboo fish filter trap, bonlon-sel, and bag net were frequently used throughout water channels leading to Silaung Inn and rice fields from Sittaung River. The distance between rice field and water channels and/or Silaung Inn plays a crucial role in determining species richness and population size. This in turn depends on the existence of a natural river system nearby. To conserve or improve species richness and population levels in the study areas, a long-term monitoring and fishery management strategy should be developed and implemented.

Paddy-Fish System in Maubin Township

Dr. Myint Sein

Orchard Company Limited has implemented a paddy-fish system in the Ayeyarwady Delta in Myanmar. Depending on the rainfall, this region is subject to flooding. The design of the paddy-fish system is such that it has two rings of embankments to prevent flooding and to store water within the system. Paddy cultivation is only possible during the *summer* and *winter* seasons, fish is cultured during the monsoon season. Bamboo, firewood trees, and fruit trees are planted on the embankments. These provide a number of advantages to the system, such as soil strengthening and reduced soil erosion, shading and aeration of the fish pond, bird habitat, income from timber and fruit products.

The paddy-fish system developed by Orchard can contribute to increased income through the provision of not only rice and fish, but also timber and non-timber forest products. Although the initial investment costs associated with planting trees is higher than paddy or fish culture, the benefits include ecosystem services (e.g. soil strengthening, reduced erosion, bird habitat, protection from natural disasters) as well as economic benefits (e.g. increased income, job opportunity creation). Implementing this model has the potential to contribute to household income, employment opportunities, and environmental benefits.

Session 8: Land Use Policy & Tenure in SE Asia

Rice - freshwater prawn production systems in Bangladesh

Dr. Benoy Kumar Barman

Rice fish production systems have developed and diversified over the years in Bangladesh. This diversification has taken place due to changes in the agro-ecology, climate, social, economic and political reasons in response to increased demand for 'rice and fish' as staple food for a population of 160 million people. The traditional system of rice fish production, in which production of rice and fish take place concurrently, has a low level of adoption mainly due to difficulties in the use of technologies, competitiveness with other agricultural production systems and conflicting uses of resources such as land, water, inputs and management practices.

The major diversified systems of rice fish production are *gher*-based production systems in coastal areas in Khulna, rice-field fisheries in seasonally flooded rice fields in the freshwater areas in Barisal, fish culture in water logged areas in Noakhali, alternate rice fish culture in lowlands in Daudkandi, Comilla and large rice field fisheries connected to low lying lands in the floodplains in the Haor area in the north-eastern region of Bangladesh. Since its initiation in the 1980s highly productive rice fish systems dependent on production of fish seed (fry and fingerlings) have been developed and adopted by large numbers of farmers in the northwest region of Bangladesh. There is evidence that these rice fish culture systems have been successful in production of carp and mass production of small indigenous fish (mola) creating win-win solutions both for rice production and seasonal rice field fisheries (e.g. Dhulia Beel). Further, a system of alternate rice fish production has been developed in lowland areas '*Beels*' using community-based approaches that brought a lot of success in terms of increased production of both stocked and un-stocked fish, income and employment for large numbers of poor people, including fishers, in the north and north-western regions of Bangladesh.

Advances in aquaculture technologies and support services have accelerated the transformation of rice fields to ponds throughout the country. Large proportions of land in Mymensingh and Jessore have been converted to ponds over the years. The same trend is currently observed in the Barind Tract area and may have negative impacts in the longer term, similar to those that the Green revolution, with its exclusive focus on producing cereals, had on aquatic production. In the context of the challenges currently emerging in relation to the 'Blue revolution' the development of diversified systems of rice fish culture as well as development of rice field fisheries could be a solution. Diversification of the rice fish system has several advantages compared to the traditional system. It strikes a balance between the complete transformation of the rice fields to ponds only for fish production, and retaining complementary benefits of using the systems for rice and other crops including fish while increasing productivity and production of fish through aquaculture.

The potential area for scaling out diversified rice-fish production systems in Bangladesh is around 3 million ha. The main challenges to scaling out these systems are governance and access to land. Strategic planning and development of policies and application of R &D are priorities in order to realize the full potential of sustainable rice-fish production in Bangladesh.

RFS linked to floodplain fisheries and community ponds in Cambodia

Mam Kosal and Sarah Freed

During this presentation, we will share the experience of Rice-Fish Systems in Cambodia, including their environment, culture, policies, and lessons learned. While Rice-Fish Systems often refer to rice and fish culture, in Cambodia, Rice Field Fisheries are more common than fish culture. Rice Field Fisheries are an important source of food and income for rural households and are essential to the Cambodian government strategies for fisheries, food and nutrition security, and climate change. We provide an overview of the importance of Rice Field Fisheries, the physical and management measures taken to enhance the fisheries, and the enabling policies for fisheries and their management. We also demonstrate that improving fish habitat and connectivity of rice field-water bodies can enhance Rice Field Fisheries productivity. We identify several requirements for effective fisheries enhancement: a clear definition and purpose for rice field water body management, allowing multiple uses for water and maintenance of fish habitat; coordination of mandates, policy, and actions to protect habitats; and careful planning for rice field fishery to co-exist with land use change, including wetlands fragmentation, rice intensification, and competing demands for water in the dry season.

Fish culture in rainfed rice fields: status after two decades in Thailand

Thavee Vipthanumas

Rice-fish culture has been implemented in Thailand since 1948. But it is not so popular with Thai farmers because the farmers are interested in intensive culture, which gives a higher production and profits. Over the last 20 years, the fish production in the rice-fish culture was highest in 2004 at about 34,900 tons and the production declined remarkably every year to about 9,200 tons in 2014. Fortunately, the world interest is gradually shifting towards organic products. The Department of Fisheries (DoF) should take this opportunity to persuade and promote fish culture in rice fields to farmers in the coming years. The objectives of this project are 1) to increase the household consumption and income and 2) to promote organic fish products together with organic rice. Rice-fish culture includes both extensive and semi-intensive systems. Rice growing has been slightly mentioned, while fish growing are on details. Mostly, the land ownership is held by the private sector. While the water tenure varies depending on the water source. Natural water is free of charge, but for irrigation water a fee needs to be paid. Seed, feed, and practice are mentioned in rice-fish culture. To improve and develop rice-fish culture in the near future, attention should be paid to management, food safety, and Co-management.

Rice-Shrimp systems in the Mekong delta, Viet Nam

Châu Thị Tuyết Hạnh

Vietnam has about 27.3 million ha land for Agriculture production of which about 3.8 million ha of rice cultivation that is a large potential for rice-fish farming development. Since 2000, Vietnamese government has policy allowing converting inefficient land into aquaculture practice. So far, there were 377,269 hectares of land have converted to aquaculture purposes of which mostly based in the Mekong Delta (reached 310,841 ha). The most common rice-shrimp farming systems in Mekong Delta 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 culture species in paddy field vary depending on the ecological system and purposes of uses. In 2017, area for rice-shrimp farming reached about 185.000 ha accounted for about 30% of the total shrimp farming area in Mekong Delta, the average yield of shrimp about 300-500 kg/ha, even the yield of shrimp can reach more than 1,000 kg/ha. There have about 150,000 direct labours in the region involving in rice-shrimp farming. It is also providing considerable amount of high-quality black tiger shrimp for market. In the context of climate change, especially the impacts of drought and saltwater intrusion, rice-shrimp integrated farming in the Mekong Delta provinces is regarded as one of the smart, environmentally friendly and sustainable practice models in Viet Nam. However, the current rice-shrimp system in Mekong Delta still need to be improved for its proper operating such as the culture species composition, proper stocking density, appropriate design/rehabilitation of rice paddies to be favourable for rice-shrimp farming etc. Besides, it is also necessary to reorganize the production, create linkage with the market to ensure sustainable development of the rice-fish farming models.

Session 9: Land Use Policy & Tenure Status and Visions in Myanmar

Information on land and water tenure as applied to RFS and aquaculture

Department of Agricultural Land Management and Statistics

Myanmar is located in Southeast Asia bordering India, China, Thailand, Laos, and Bangladesh and has a surface area of 676,578 km^2. There exist 4 land use categories in Myanmar: agricultural land (e.g. paddy, other crops, garden, seasonally flooded land, etc.), non-agricultural land (mining, pasture land, roads and railways, etc.), forest land, and virgin, fallow, and vacant land. The land use category determines what government body is responsible for the management of that land. Lands on which it is unable to grow crops are managed by the relevant ministry based on the land use type (e.g. industrial zones are managed by the Ministry of Industry). Agricultural lands are managed by the Department of Agricultural Land Management and Statistics (DALMS). Forest land is managed by the Ministry of Natural Resources and Environmental Conservation (MoNREC). The Virgin, Fallow, and Vacant (VFV) lands are managed by the Central Land Use Management Committee, which is chaired by the Union Minister of the Ministry of Agriculture, Livestock, and Irrigation (MoALI).

Agricultural land falls under the Farmland Law, which was adopted in 2012. Landholders fall under Article 12 of the Farmland Law, in which the rights and responsibilities are set out. According to that article landholders should manage their lands in accordance with the law, land transfers (rent, sale, gift) are allowed but should be registered with DALMS and the required registration fees should be paid. The Farmland Law states that farmers are only allowed to grow the designated crop on their land (e.g. if paddy is the main crop mentioned on the land use certificate, a farmer shall grow rice and no other crops), and no other uses than growing crops are allowed on agricultural lands. In case landholders would violate any of the stipulations under Article 12, the Ministry can open an enquiry, stipulated under Article 19, to determine which violation has been committed. If found guilty of violation, the penalties include a monetary fine, reverting to the land use/crop type that is mentioned on the land use certificate, land confiscation, and the removal of any constructions on the land. Farmers who don't resolve their case before the set deadline risk facing penal charges in court. Violators can be sentenced to 6 months up to 2 years in prison and a fine ranging from 300,000 to 500,000 MMK.

Landholders wishing to convert agricultural land into fish ponds can only do so after acquiring the necessary certificates under Article 30 of the Farmland Law. Currently, only 31% of aquaculture ponds that have been established on agricultural lands have the required documentation, 69% of fish ponds have not been officially licensed.

Next to the Farmland Law, there is a separate law governing Virgin, Fallow, and Vacant lands called the Virgin, Fallow, and Vacant Land Law. This land category falls under the management of the Central Committee and they have the authority to determine the land use type for these lands: 1) agricultural crops, 2) livestock, 3) mining, 4) other uses. Under Article 10 of this law, up to 1,000 acres of VFV land can be allocated for aquaculture ponds. The landholder to whom the land is allocated is required to pay 3000MMK/ac as registration fees. So far, only 33 operators have been allocated land under this law. Food security is a priority for the Myanmar Government, as the population is increasing. Therefore, the government urges operators to develop livestock or aquaculture operations on VFV lands and apply for allocation and registration of these lands. Land Use Committees at the regional and union level are tasked with the management of these applications.

Session 10: Land Use Policy & Tenure - status and opportunities in Myanmar

The situation regarding the use of land for agricultural purposes in Myanmar is complex. U Thet Naing Oo, Director General of Department of Agricultural Land Management and Statistics (DALMS) within the Ministry of Agriculture Livestock and Irrigation (MoALI), states that land allocated for rice culture must be used for that purpose and should not be converted to any other use without seeking permission from the authorities at Union level[1]. WorldBank statistics indicate that Myanmar has the lowest rice yield per unit area in Southeast Asia, in addition to very low profitability. Over the period 2000 to 2017 the contribution of agriculture to Myanmar's GDP halved from 57% to 26% following a development trend seen globally (Fig.1.) Arable land as a percentage of total land area remains stable at 17% with rice production areas being 34% of all arable land. Rice production in 2018 is expected to increase by 4% to 13.2 MMT over the 2017 level 12.65 MMT due mainly to favourable weather and the expectation of more irrigated water being provided for farmers (2018 USDA GAIN Report Number BM8003 here).

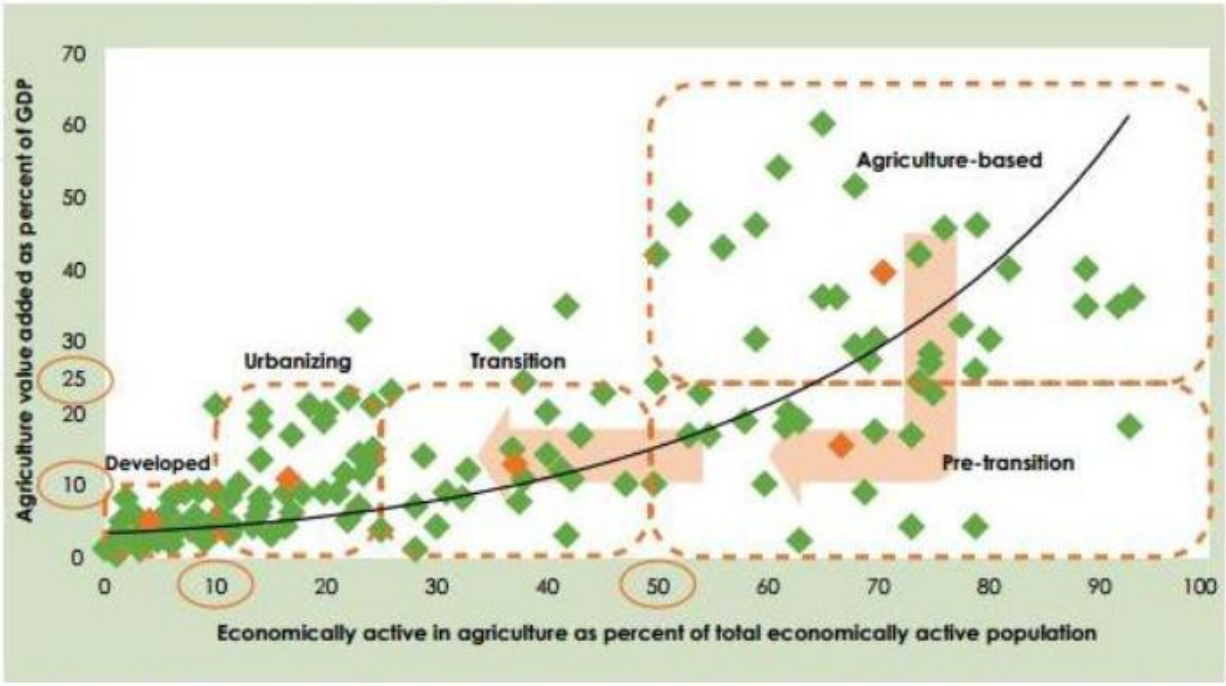

Figure 1: Country segmentation based on the contribution of agriculture to GDP (source World Bank Group 2015 here)

Options for land use reform exist within the current legal framework in Myanmar under the control and management of MoALI Departments. During his presentation Dr. Paul De Wit, from the FAO-EU FIRST Program[2], makes specific reference to the Farmland Law (2012). Options for land use reform using this legislation include:

[1] The Under decentralized government State/Region authorities can degree land use change as long as modification leads to improved productivity and profitability for those farming te land.

[2] FIRST = The Food Security Impact, Resilience, Sustainability and Transformation Programme is a policy assistance facility that operates under a partnership between the European Union (EU) and the Food and Agriculture Organization of the United Nations (FAO). FIRST contributes to ending hunger, food insecurity and malnutrition.

1. Integrated agriculture promotion by DALMS - Central Administrative Body of the Farmland (CABF)-MoALI by means of an Administrative Order/Directive on the basis of the Farmland Law Instructions Article 42b. The suggested action would be to consider the classification of smallholder rice-fish-vegetable units as an integrated agriculture rice system for land use certification (Form 7) purposes as rice land; and
2. Small-scale aquaculture involving action by the MoALI Cabinet to issue an amendment to the Farmland Law (Farmland Law Instructions Article 42a) to either: a) issue a specific and simplified instruction for paddy into pond conversion (up to 2 acres) or b) consider flexible Land Tenure regularisation for smallholders (up to 5 acres).
3. Inter-Ministerial work with the Ministry of Health and Sports (MoHS) has led to the Multi-Sectoral National Plan of Action for Nutrition (MS-NPAN 2018-2022) add link. In addition, the Agriculture Development Strategy (ADS) is now in place 2018-2022. The latter has three pillars: 1) Governance, 2) Productivity and 3) Market linkages and competitiveness and notes at article 42 that: *"… rather than an excessive focus on rice, there is a need to think in terms of rice-based farming systems that will encompass a range of non-paddy options depending on location"*. Article 49 states that: *"The Farmland Law builds on the constitutional principle of the 'Right to Ownership' and provides a tool for farmers to register their land, albeit as a land use right, over which a Land Use Certificate (LUC) can be issued. Although the state continues as the allodial title holder (*absolute ownership*), certified farmland can be mortgaged, sold and transferred. While consistent with other reforms that are moving Myanmar towards a market-based system, there is growing concern that the Farmland Law does not provide sufficient security of tenure for smallholders. First, the law only applies over 'farmland' which is narrowly defined and does not include all agricultural production systems such as agro-forestry or shifting and rotating agriculture. In addition, the farmland law does not cover other important agrarian production systems that are important for food security and especially nutrition like fishponds, grazing lands and home gardens in rural settlements. Second, the issuance and holding of a LUC over farmland is conditional to crop choices; unauthorized changes may result in land confiscation, landlessness and loss of livelihoods. The law includes administrative mechanisms to request crop and land use changes, but these are cumbersome, and the authorization of such requests is strongly centralized, especially for lands classified as paddy fields".*

Fig. x Paul De Wit, FAO/EU FIRST Programme - Senior Land Tenure Consultant, MoALI – Agricultural Policy Unit, outlines possible land use reform options which could be instigated by MoALI using existing legislation.

The 2018 Agriculture Development Strategy, with its recommendations for a comprehensive set of land reform initiatives, is to be implemented by a committee chaired by the MoALI Minister.
On August 8 2018 a key product of the International Rice-Fish Symposium is the five point *'Naypyitaw Integrated Rice-Fish Agreement – August 2018*'. This is endorsed by His Excellency Dr. Aung Thu, Minister MoALI, when he encourages the Departmental Directors to implement the following immediate actions for the long-term strategy:

1. Integrated agriculture (rice-fish-vegetables) should be actively promoted, incorporating best management practices for both rice and fish with no pesticide application to provide nutritious food from sound water-managed agro-ecological conditions with enhanced native species biodiversity;
2. Scientific research results in Myanmar and experience from neighbouring countries show that improved integrated rice-fish management practices, incorporating innovative thinking, require minimum paddy modifications and yield the same amount of rice/ha as rice-only practices;
3. Integrated rice-fish agriculture practices produce sufficient fish/ha to reduce incentives for rice farmers to illegally shift to aquaculture-only practices. This will maintain the national rice-production targets while increasing the livelihoods of farmers and gender equitable employment opportunities, especially in marginal rice producing areas;
4. For the medium to long term policy and legal review; a MoALI land use policy and legal reform working group should be established immediately with international experts invited to provide assistance based on national, SE Asia and global integrated agriculture and Integrated Water Resources Management (IWRM) experience; and
5. Wherever possible the promotion of integrated rice-fish practices should be included in key strategic planning documents like the Multi-sectoral National Plan of Action on Nutrition (MS-NPAN) 2018/19 – 2022/23 to assist with the process of Sustainable Development Goal target achievements in Myanmar.

Add Bago Minister statement.

https://www.adb.org/countries/myanmar/economy
https://www.theglobaleconomy.com/Burma-Myanmar/arable_land_percent/
http://ap.fftc.agnet.org/ap_db.php?id=891
https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Grain%20and%20Feed%20Annual_Rangoon_Burma%20-%20Union%20of_4-6-2018.pdf

Fig. y Daw Kyi Kyi Than, rice plot owner and a potential beneficiary from land use reform, Maubin, Ayeyarwady Delta. She is seen replanting rice after monsoon floods have damaged her rice field.

Three key points from this Land Use Tenure & Policy session are:

1. One of the main concerns by the government in Myanmar is that rice production should not be lost: Myanmar must be self-sufficient in rice and be able export an excess;
2. Rice-Fish research, carried out by WorldFish-IRRI-MoALI Departments, has clearly demonstrated that Integrated agriculture (Rice-Fish) can maintain or increase rice yield, in modified rice fields to incorporate fish, by applying Best Management Practices (BMP) for rice, fish and water use; and
3. For Myanmar to attain the benefits from integrated agricultural systems in the form of rice-fish systems there has to be policy reform based on possible modifications to existing laws and the directive provided by the MoALI Minister as a result of the Rice-Fish Symposium. Logically this reform process would start in areas deemed to be 'marginal' (low-productivity) due to a range of factors including, but not limited to, climate and soil type.

Conclusion

The first day of the symposium was centred around three main sessions: Rice-Fish Systems and their contribution/relation with the SDGs, the role of Rice-Fish systems in nutrition, gender and the cost-benefit of rice-fish systems, and lastly about rice-fish systems and mapping multifunctional landscapes. There were several common threads found across all sessions, most notably the contribution of RFS in nutrition, gender outcomes, and the underlying challenges associated therewith. The positive message resonating throughout the sessions was that most actors understand and recognise the challenges (land tenure, technical issues, labour requirements) and potential benefits (increased nutrition, improved livelihoods, balancing gender roles) of RFS and are working towards common goals.

In the second session, the contribution of rice-fish systems to rural livelihoods, improved nutrition, and gender balancing were highlighted. Rice-fish systems can provide other ecosystem services in the form of flood-risk management, by utilising flood-based farming systems. These systems can also be applied in marginal rice areas, creating added value to the systems by the addition of fish. The benefits of RFS are not limited to creating added value in marginal areas alone. They have a range of ecological benefits to the community, e.g. integrated pest management (IPM), increased efficiency in the use of natural resources, and jobs are created all along the rice-fish value chain in rural areas.

In the third session, the various roles of RFS in multifunctional landscapes were presented. By developing RFS in marginal areas, there is potential to reduce outmigration pressure on rural areas by providing valuable livelihood opportunities. it can have an effect on local biodiversity by serving as refuge areas for wild fish, or lead to an increase in biodiversity in wild fish due to a reduction in pesticide use. Rice-fish systems can serve as an important link between river systems, enhancing connectivity and preserving migratory fish routes.

Shifting from paddy cultivation to rice-fish systems requires specific technical knowledge and support. The need for capacity building in rural communities was highlighted across presentations by multiple actors. Capacity building can be achieved by innovation and integration: developing new techniques and methods that are adapted to the local environment, and ensuring that people receive the necessary technical training to implement said strategies. Technical support alone will not be sufficient to ensure the sustainability and success of rice-fish systems. In order to achieve long-lasting benefits, the focus of development interventions has to be shifted from purely technical interventions to holistic, inclusive approaches. Rice-fish systems have the potential to address these issues due to its flexibility and multifunctionality. Attention has been drawn to the fact that successful implementation of RFS will require collaboration between different stakeholders. Going forward, research priorities in both natural and social sciences will need to be set by the involved stakeholders, considering the current global challenges, such as climate change or migration, to continue perfecting the implementation of RFS.

The second day focused on examples and experiences from countries in the region and on land tenure and policy affecting rice-fish systems. The key message is that reducing the area under rice cultivation to create a fish culture area does not negatively affect rice yields. A lot of progress has been made towards optimising RFS, however, local conditions play an important role and this makes it impossible to define a "one-size-fits-all" approach. This highlights the need to carry out case-specific assessments when designing rice-fish systems.
The first session mainly outlined the vision and strategies employed by the different government departments of the Ministry of Agriculture, Livestock and Irrigation (MoALI) involved in RFS. The departments highlighted what research they had been undertaking that could contribute to the design and implementation of RFS adapted to local conditions. In the past, not much attention was paid to rice-fish systems. The focus was almost entirely on rice production.

In the next session, civil society organisations and universities presented their research about rice-fish systems, ranging from vulnerability studies of rural households and RFS as a potential coping strategy to the types of fishing gears that are used in floodplain fisheries. The main message was that paddy fields are rich in biodiversity, because they serve as a habitat for different species in different seasons, depending on their water level. They could also be featured as part of a policy intended to reduce household vulnerability. Rice-fish systems provide a wide variety of ecosystem services, because they are on the intersection between agriculture, aquaculture, and fisheries. Households could engage in RFS as a coping strategy to climactic and socio-economic change. The session was closed by a private company presenting a practical example of how to develop marginal land into a productive RFS.

Representatives of countries in the region (Thailand, Bangladesh, Cambodia, and Vietnam) then presented the background and evolution of RFS in their respective countries. The main idea is that experience from these countries can serve as both an example of how to develop RFS as well as a warning about interventions that weren't successful. A wide variety of systems exist in SE Asia, ranging from rice-shrimp systems in Bangladesh and Vietnam, over floodplain community fisheries in Cambodia, to rice-fish culture systems in Thailand. This session showcased the fact that systems in those countries developed in relation with their natural environment. It is noteworthy that most systems had some degree of community management or at the very least community involvement.

The current land tenure policy in Myanmar doesn't allow for the conversion of paddy fields to rice-fish systems. This policy is based on the assumption that reducing the area under rice cultivation would negatively impact national rice production, and food and nutrition security. Evidence from other countries in the region has shown that RFS won't necessarily have a negative effect on rice yields. Pilot tests were carried out in the Ayeyarwady Delta and showed that rice yield is not negatively affected and it could lead to higher income overall. Further high-quality research is needed to develop a system that is relevant to the environmental and socio-economic conditions in Myanmar. Lessons can be learned from other countries and data exchange should be encouraged to improve the understanding of the wide range of rice-fish systems present in SE Asia.