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Food systems see fish, not fisheries and aquaculture

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This paper contends that dropping the wild–farmed binary from development thinking and replacing it with a singular understanding of food fish can fundamentally change the way we understand and govern fish production landscapes. I articulate such a perspective by elaborating the key processes shaping and linking fish production, distribution, and consumption in the Ayeyarwady Delta of Myanmar. By reflecting critically on fisheries and aquaculture development projects in this space, I open up avenues for reflection on how development policy and action could deliver aquatic food security in a more equitable and sustainable way.

Keywords: Food systems, fisheries, aquaculture, Myanmar, development

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Introduction

It is increasingly recognized that addressing food insecurity without further compromising environmental sustainability and social welfare requires systemic change (Ericksen, 2008; Ingram, 2011). Food systems approaches enable the identification and diagnosis of complex interactions among multiple simultaneous processes operating across scales that shape how food is produced, distributed, and consumed (Ingram, 2011; HLPE, 2017).

A food fish system approach as introduced by Tezzo *et al.* (2018) integrates the roles that distribution and consumption play in shaping different demands for fish as food and consequently, its production (see also Jennings *et al.*, 2016). A food fish system approach as such contrasts with the pervasive productivist perspectives and the corresponding duality observed in development agendas currently shaping the expansion of fish production in the global South. As summarized by Little *et al.* (2016), the first agenda stresses trajectories of decline in wild capture fisheries and promotes their management while the second agenda focuses on booming aquaculture developments in meeting the growing future demand for fish. Neither of these agendas effectively explores how farmed and wild fish are actually traded and consumed in combination, thereby limiting how policy makers understand and leverage associated dynamics of change. This productivist *status quo* is particularly unsettling in contexts of rapid societal transitions, such as Southeast Asia, where fast-paced urbanization dynamics are accompanied by rising incomes and changing diets (Reardon & Timmer, 2014; Béné *et al.*, 2016).

By considering how fish production is shaped by trade and consumption, a food fish system perspective challenges the dominant productivist assumptions surrounding fish production in the global South. I elaborate the value of a food fish system perspective by reflecting on the conventional wisdom underpinning the development of aquaculture and fisheries production in the Ayeyarwady Delta, the most important fish

production landscape in Myanmar. I argue that development practitioners and policymakers seeking to sustainably govern aquatic food security need to conceive of wild and farmed fish as being part of interrelated production, distribution, and consumption processes unfolding in the same system rather than being part of two separate worlds.

My argument is developed in three steps. I start by explaining how this article came about, where I stand on the issue, as well as the methodological approaches used. Second, I use a food system perspective to elaborate the key processes shaping and linking fish production, distribution, and consumption in the Ayeyarwady Delta. I then contrast this illustration of fish production in the Delta as an integrated food fish system with the pervasive productivist agenda in the international donor community that continues to single out fisheries and aquaculture as separate development strategies. Finally, I argue that by breaking down the wild–farmed binary, a food system perspective can fundamentally change the way we understand and govern food fish to deliver aquatic food security for all in a way that is more equitable and sustainable.

Methods

This article, which serves as the final chapter of my doctoral thesis (Tezzo, 2024) effectively originated from my extended work and life experiences around aquatic food systems in Myanmar. I describe here some of the methodological approaches underpinning my argument.

First, my argument is developed around a region that can be considered one of the most appropriate places to appreciate fish as food. Located in the southern part of Myanmar, the Ayeyarwady Delta is formed by the Ayeyarwady River, one of the largest rivers in Southeast Asia, and is characterized by an extensive network of rivers, canals, and wetlands. The delta has historically played a central role in food production for the country and the wider region, earning it the nickname, "rice bowl of Asia" (Vicol & Pritchard, 2021: 1). Although primarily a rice-growing region, the Ayeyarwady Delta is also the most important fish-producing region for both wild and farmed fish, making it an ideal place to explore the relationships between the two.

This article is based on qualitative observational methods reflecting on my personal experiences in the Ayeyarwady Delta. From 2013 to 2022, I was professionally involved with an international development organization in Myanmar, working on both fisheries and aquaculture development projects. This position, and the networks it enabled, provided ongoing access to information within the Department of Fisheries as well as continuous engagement with key stakeholders. My observations have taken place in a variety of settings, ranging from corridor discussions between colleagues, conversations with key actors during my regular visits to the Ayeyarwady Delta, participation in political and academic fora, as well as a continuous dialogue with civil society. Over the years I have meticulously recorded these first-hand observations in my notebooks and I have been able to re-examine them for this article.

These observations are complemented by primary and secondary sources. I have used a range of primary sources such as official and unofficial reports from the Department of Fisheries (DoF) and my organization, local media publications, as well as various interviews that were conducted as part of my doctoral research. Many encounters I have had over these nine years in Myanmar have been opportunities not only to develop but also to present, test, and refine the overall argument put forward in this article. Finally, a number of secondary sources, including academic articles, books, and

reports listed in my references, were used to contextualize and reflect on the relevance of my argument. In the following section, I use a food system perspective to elaborate key processes shaping and linking fish production, distribution, and consumption in the Ayeyarwady Delta.

Conceiving of the Delta as a food system

An integrative food fish system perspective draws attention to three current transformations shaping fish production in the Ayeyarwady Delta: (1) the privatization of fish production landscapes, (2) the restructuring of fish supply chains, and (3) the changing fish consumption practices. From a food fish system perspective, none of these processes can be linked solely to capture fisheries or aquaculture. Each, instead, demonstrates that these two allegedly distinct modes of production fundamentally influence each other in both material and immaterial ways.

First, there is a gradual shift from common to private ownership of fish production landscapes and grasping the magnitude of this transformation requires going beyond the wild–farmed binary. In Myanmar, this shift has notably materialized through the privatization of freshwaters, a process which began during British occupation as a way to generate rents. It was reinforced much later by the subsequent military regimes (see Reeves *et al.*, 1999; Tezzo *et al.*, 2017; 2018) but now, it is driven mainly by a rapidly growing urban demand for aquatic food. As the capital city of Yangon is expanding, so too is the demand for a steady and reliable supply of fish and fish products (Belton *et al.*, 2018b; Tezzo *et al.*, 2021; Tezzo *et al.*, 2024). As observed elsewhere in the region, this rapidly growing demand is being met by a sustained increase in human control over land and water resources, a dynamic that is leading to the increasing privatization of these resources (and similarly, in other countries of Southeast Asia, e.g. Saguin, 2016; Arthur *et al.*, 2021). When viewed from a productivist perspective, the privatization of fish production landscapes is being driven by two distinct processes. The first of these is the spatial expansion of fish farming, as aquaculture by definition implies individual or corporate ownership (see FAO, 2015). In practice, this expansion results mostly in the establishment of new fishponds throughout the Delta, a dynamic which is somewhat visible (see Belton *et al.*, 2018b). The second process, in some ways a more subtle variant of privatization, is the progressive enclosure of common property land and water resources. The latter is less a matter of a physical alteration of the production landscape than of a legislative change leading to a shift in the access rights to the resources. Yet these two privatization processes are fueled by the same growing urban demand and both are accompanied by an increasing artificialization of fish production, including stock enhancement, supplementary feeding, etc. (see Tezzo *et al.*, 2017; 2018; Soe *et al.*, 2020). The connections between these two processes are further compounded by the fact that land and water resources are shared by both wild and farmed fish production. Thus, I argue that they are effectively two facets of the same dynamic—the gradual appropriation of common resources underpinning fish production landscapes into private ownership.

Second, trade dynamics in the Delta's food fish system further break down the divide between wild and farmed fish. In response to growing urban demand, and under the set of policies enacted in the wake of the belated economic liberalization, the distribution of fish has undergone rapid improvements in terms of roads and cold chain infrastructures (see Belton *et al.*, 2018a). Over the same period, the aforementioned privatization of land and water resources combined with cronyism within the state (see

Ford *et al*., 2016) has enabled political and business elites to increase their control over the trade of fish (see Reeves *et al*., 1999; Nyein & Zimmermann, 2015; Campbell, 2019). Large and vertically integrated companies operated by members of these elites now control significant portions of both wild and farmed fish supply chains, from upstream input and grow-out operations to downstream processing, distribution, and wholesale operations (Belton *et al*., 2018b). As a result, and in contrast to the historically localized nature, fish trade now extends over large distances to predominantly urban centers where it is either consumed or redistributed on to other urban centers or diffused across large rural swathes of the country. This is evidenced by the presence of fish originating from Yangon's central wholesale market on local fish markets scattered across the Delta (Tezzo *et al*., 2024). As observed elsewhere in the region (see Gaja-Svasti *et al*., 2022), the restructuring of supply chains in response to increased farmed fish production and demand has meant that wild fish, traditionally consumed close to landing sites by fishers and their families, are increasingly indistinguishable from the wide availability of farmed fish in these markets.

Third, and underpinning the other two transformations, are changing practices of consumption shaping the demand for multiple forms of food fish. Even though there is still very little documentation about how fish is actually consumed across the Ayeyarwady Delta, evidence from urban areas demonstrates rapid reconfigurations of everyday fish consumption practices (see Tezzo *et al*., 2021; Scott *et al*., 2023). As observed in other parts of Southeast Asia (see Saguin, 2014), urban consumers do not simply eat more fish; they attach more importance to the convenience of year-round and consistent fish supply allowed by aquaculture. At the same time, however, they continue to refer to a set of food codes largely inherited from the historical dependence on capture fisheries. For instance, urban consumers across the Delta display a growing tendency to eat fish away from home and increasingly consume it in new processed forms. These new practices tend to distance consumers from the fish they eat and render different forms of fish (particularly farmed) more acceptable. Although wild fish tend to become rare delicacies consumed by wealthy urban consumers in the process, they continue to form the historic and cultural foundation from which new fish consumption practices emerge. Fish balls (*nga chit* in Burmese) are a case in point. This traditional dish, seasonally made from wild fish, has gradually integrated farmed fish, transforming it into a mass-consumption fish product (see Tezzo *et al*., 2024). Hence while the original fish ball has become an authentic luxury treat in the capital's restaurants, its farmed equivalent has contributed to broaden urban demand for second-grade fish originating from more intensive production systems. Thus, even though increasing production across the Delta is mostly due to the growth of only one (or a few) species that best lend themselves to controlled culture, changing fish production landscapes cannot be understood without considering the broader, underlying socio-cultural value system that was historically shaped by capture fisheries.

In highlighting these three transformative processes, the central message is that changes occurring in the production of both wild and farmed fish in the Delta occur in the context of, and in relation to changes in patterns of fish consumption and fish trade that exert similar forces on both sets of products. Put differently, the food fish system shapes fish production. Despite this, development strategies continue to isolate production from the wider food system, meaning that fisheries and aquaculture are still seen as distinctly separate forms of production. In the next section, I go on to contrast my systemic perspective with the productivist accounts that continue to inform development strategies around fish in the Ayeyarwady Delta.

Overcoming the wild–farmed binary in development strategies

In contrast to the systemically integrated nature of fish production in the Ayeyarwady Delta outlined above, prevailing policy and development narratives continue to separate fisheries and aquaculture into distinct production-driven industries. The following section builds on a review of all major international development projects operating in Myanmar as of 2018, i.e. all projects implemented in cooperation with the Department of Fisheries with funding in excess of $1 million. My review explores how these projects addressed fish production in the Delta, including how they problematized constraints and directed resources for expansion.

All four projects reviewed[1] demonstrate how capture fisheries and aquaculture are persistently used as distinct and separate categories. Among them, only one incorporated both wild and farmed fish in its scope, but treated them as two distinct components with different issues that demanded different development strategies. Of the remaining three projects, two looked exclusively at aquaculture and one was solely focused on capture fisheries. This division of capture fisheries and aquaculture sets up a binary that favors discrete technical interventions associated with aquaculture over systemic management-oriented interventions in fisheries (as variously seen in other parts of Southeast Asia, see Bailey, 1985; Bush, 2004a). The projects reviewed in Myanmar highlight this continuing division. From a total investment of US$32.6M by international donors in the Ayeyarwady Delta in 2018, approximately 85 per cent was directed exclusively to aquaculture development, which was typically identified as the most promising (if not the only) solution to aquatic food security in the region, owing to the fact that 'wild stocks have rapidly declined over the past decades' (GIZ, n.d.). This observation runs counter to the food systems perspective described above, and is problematic for three reasons, discussed below.

First, the wild–farmed binary underlying development strategies wrongly supposes that fisheries and aquaculture occur in distinct fish production landscapes. As such, it is typically assumed that aquaculture supplements and never impedes fisheries production. This misconception was notably challenged by local authorities participating in the project from the review that focused solely on capture fisheries. This project aimed at improving the benefits of fish-dependent communities by focusing exclusively on the governance of capture fisheries. Along the implementation of the project in Maubin, a target township neighbouring Yangon which accounts for over half of fish pond area in the Delta, an internal report from the DoF prepared by the township officer for the central office reported over 50 cases of aquaculture ponds directly encroaching on fishing areas in this township alone. This confidential report, which the project was able to obtain, documented impacts of aquaculture on fish migration and access to fishing grounds by local communities (DoF, pers. comm.). Yet the project found it very challenging to effectively address these constraints. Its capture fisheries mandate prevented it from integrating the politically sensitive context of illegal appropriation of waterways by aquaculture businesses (Project Manager, pers. comm.). This example illustrates the risks and consequences for development practitioners of considering wild and farmed fish separately, thereby overlooking important privatization dynamics and political economy issues impacting fish production landscapes throughout the Delta (Nyein & Zimmerman, 2015; Nyein *et al*., 2018; *Frontier Myanmar*, 2018; Campbell, 2019; Ivars & Venot, 2020).

Second, the wild–farmed binary reflects an inadequate understanding of the many intermediate forms of fish production that cannot be distinctly labelled as aquaculture

or fisheries. Reflecting on earlier work by Welcomme and Bartley (1998), hybrid production systems such as 'enhanced fisheries' or 'culture-based capture fisheries' are widespread yet poorly documented and underappreciated in Myanmar (see Tezzo *et al.*, 2017; Oo & Mackay, 2018) and across Southeast Asia (De Silva, 2003, 2016; Pounds *et al.*, 2022). This limitation was relatively well illustrated by the adjustments made to the strategy of one of the two aquaculture-focused projects, which aimed at improving the income, food and nutrition security of smallholders through the dissemination of aquaculture technologies. This project built on earlier studies that had characterized aquaculture in the Ayeyarwady Delta as composed almost exclusively of large and commercial farms with almost non-existing small-scale aquaculture operations (see FAO & NACA, 2003; Johnstone *et al.*, 2012). It adopted the strategy of assisting small-scale agricultural farmers to excavate new ponds throughout the Delta. Over time (thanks to the increasing characterization studies of the Delta), came the realization that a significant number of ponds had effectively gone under the radar not only because of their small size, but also because of their primary functions of harvesting rainwater and sometimes trapping migrating wild fish (Belton *et al.*, 2015; Soe *et al.*, 2020). From this late observation, the strategy of the project was successfully reoriented towards leveraging this rich network of homestead ponds throughout the Delta, thereby enabling better efficiency of investments (project manager, pers. comm.). Hence, better identifying hybrid forms of production and overcoming the reductive nature of the wild–farmed binary is not only a statistical issue, it is also a matter of more systemically and effectively harnessing opportunities in fish production landscapes for development practitioners.

Third, because of their focus on production, there is a tendency for both fisheries and aquaculture development projects to overlook the influence of domestic consumption and trade. In the case of fisheries, this underappreciation reflects a general lack of attention to supply dynamics and the underlying assumption that catches are still only serving consumption close to the landing sites (see Tezzo *et al.*, 2021). In the case of aquaculture, the disregard for urban consumption has more to do with the pervasive idea that farmers either produce for their own households to ensure their food and nutrition security, or for international markets to generate higher income (Tezzo *et al.* 2021; Veldhuizen *et al.*, 2020). In both cases, the root of the problem lies in the fact that consumption is still mainly observed from the perspective of the producer. Of the four projects reviewed in the Delta, only the second aquaculture-focused project had a dedicated supply chain component. The overall rationale of that was to intensify aquaculture production and establish a conducive policy to facilitate the distribution and access to farmed fish over the country. Yet even there, the logic was not to document and capitalize on inherent consumption and trade dynamics, which I have argued have been historically shaped by capture fisheries, but rather to 'ensure a better access to farmed fish in fish-deficit areas' (GIZ, n.d.).

In summary, development projects concerned with food fish in the Ayeyarwady Delta in Myanmar clearly do not overcome their bias of approaching farmed and wild fish as two separate domains. Understanding production in food system terms would require some profound rethinking to transform the way commonly used categories are perceived. This means that 'production' cannot be seen in isolation from the wider food system, including trade and consumption. It also means that aquaculture cannot be seen in isolation from the social and ecological dynamics of capture fisheries when viewed across complex aquatic landscapes, and that aquaculture cannot be seen as having no effect other than increasing supply. I argue that these changes can only be

made if the wild–farmed binary is dropped from development thinking and replaced with a singular understanding of 'food fish' that would effectively be a function of combined practices of production, trade, and consumption.

Conclusion: implications for development strategies and policies

A food fish system approach to policy and development sees fish, not fisheries and aquaculture. Overcoming the wild–farmed fish binary therefore opens up significant opportunities for development strategies and policies to improve the role of food fish in delivering aquatic food security. From such a perspective, it becomes possible to rethink the governance of food fish system 'efficiency' (see Benton & Bailey, 2019) in terms that go beyond making fish more abundant and cheaper, and instead understand key trade-offs between food and nutrition security in the context of wider socio-economic and environmental change. As a first step, development policy and action should integrate three strategies for putting a food fish system perspective into practice.

First, moving beyond the wild–farmed binary has implications for the way we problematize and address aquatic food security. A more integrated logic focused on food fish would suggest that development strategies and policies move away from their current producers-centered approaches. This would mean broadening the scope of development interventions to a broader range of consumers, from just fish farmers and fishers. Doing so would allow for a better appreciation of food fish culture. For instance, development projects could put more efforts in understanding and leveraging the penetration of processed food fish products such as dried fish, or other important fish foods that are often culturally preferred and more easily accessed by vulnerable consumers (Belton & Thilsted, 2014; Tezzo *et al*., 2020). In this process, development interventions would then prospectively improve the livelihoods of a larger number of actors taking part in these value chains (see Belton *et al*., 2022).

Second, integrating wild and farmed fish lays important foundations for improving our social understanding of fish production. As illustrated by our description of the Delta, fish production landscapes are subject to important power dynamics and it is crucial that development strategies and policies stop turning a blind eye to these. This reassessment could effectively start from a substantial decompartmentalization and cross-fertilization of prevailing fisheries and aquaculture expertise. Yet, as noted in the case of the Delta's food fish system, to genuinely integrate political economy, development actors must go a step further, moving beyond local level management solutions to initiate and influence more sensitive regional and national level debates around the appropriation of natural resources. As observed by others in the Delta (see Ivars & Venot, 2020; Vicol & Pritchard, 2021) and also elsewhere (see Bush, 2004b; Ansoms & Rostagno, 2012; Berhanu & Poulton, 2014), it is only by recognizing and better comprehending the underlying political economy that development strategies will be able to introduce improved equity in food production landscapes.

Third, and finally, moving beyond the wild–farmed binary allows for a better integration of environmental sustainability in development strategies surrounding fish production in the global south. As illustrated by the case of the Delta, development policy and action are mostly guided by the blue revolution agenda, under which the ambition is too often limited to the intensification of aquatic food production. At a time when there is an increasing interest in the global north for "nature-based solutions" to improve the sustainability of food production (see Girardin *et al*., 2021), I join Costa-Pierce (2002) in contending that traditional food fish systems across Asia should be

considered an integral part of our common planetary wisdom and cultural heritage. In this respect, their plurality, not only in terms of production methods (e.g. species diversity, level of human domestication) but also in terms of traditional processing and consumption practices (e.g. aspects of seasonality) most likely hold some important takeaways to improve the sustainability of our food systems at large.

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Endnote

1 Only projects with funding over $1 million in Myanmar as of 2018 were considered.

References

Ansoms A, Rostagno D (2012) Rwanda's Vision 2020 halfway through: what the eye does not see. *Review of African Political Economy* **39** (133), 427–50.

Arthur RI, Skerritt DJ, Schuhbauer A *et al.* (2021) Small-scale fisheries and local food systems: transformations, threats and opportunities. *Fish and Fisheries* **23** (1), 109–24.

Bailey C (1985) Blue revolution: The impact of technological innovation on third world fisheries. *The Rural Sociologist* **5** (4), 259–66.

Belton B, Thilsted SH (2014) Fisheries in transition: food and nutrition security implications for the global south. *Global Food Security* **3** (1), 59–66.

Belton B, Bush SR, Little DC (2018a) Not just for the wealthy: rethinking farmed fish consumption in the global south. *Global Food Security* **16**, 85–92.

Belton B, Hein A, Htoo K *et al.* (2018b) The emerging quiet revolution in Myanmar's aquaculture value chain. *Aquaculture* **493**, 384–94.

Belton B, Johnson DS, Thrift E *et al.* (2022) Dried fish at the intersection of food science, economy, and culture: a global survey. *Fish and Fisheries* **23** (4), 941–62.

Béné C, Arthur R, Norbury H *et al.* (2016) Contribution of fisheries and aquaculture to food security and poverty reduction: assessing the current evidence. *World Development* **79**, 177–96.

Benton TG, Bailey R (2019) The paradox of productivity: agricultural productivity promotes food system inefficiency. *Global Sustainability* **2**, e6. Available at: 10.1017/sus.2019.3.

Berhanu K, Poulton C (2014) The political economy of agricultural extension policy in Ethiopia: economic growth and political control. *Development Policy Review* **32** (s2), 197–213.

Bush SR (2004a) A Political Ecology of Aquatic Living Resources in Lao PDR (PhD Thesis). School of Geociences, University of Sydney, Sydney.

Bush SR (2004b) Scales and sales: changing social and spatial fish trading networks in the Siiphandone fishery, Lao PDR. *Singapore Journal of Tropical Geography* **25** (1), 32–50.

Campbell S (2019) Reading Myanmar's freshwater fisheries: postcolonial literature as theoretical lens. *Inter-Asia Cultural Studies* **20** (1), 2–18.

Costa-Pierce BA (2002) Ecology as the paradigm for the future of aquaculture. In *Ecological Aquaculture: The Evolution of the Blue Revolution*, 339–72. Blackwell Science, Oxford, UK.

De Silva SS (2003) Culture-based fisheries: an underutilized opportunity in aquaculture. *Aquaculture* **221** (1-4), 221–43.

De Silva SS (2016) Culture based fisheries in Asia are a strategy to augment food security. *Food Security* **8** (3), 585–96.

Ericksen PJ (2008) Conceptualizing food systems for global environmental change research. *Global Environmental Change* **18** (1), 234–45.

FAO (2015) Responsible stocking and enhancement of inland waters in Asia. FAO Regional Office for Asia and the Pacific, Bangkok, RAP Publication 2015/11.

FAO, NACA (2003) Myanmar Aquaculture and Inland Fisheries. Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific, Bangkok.

Ford M, Gillan M, Thein HH (2016) From cronyism to oligarchy? Privatisation and business elites in Myanmar. *Journal of Contemporary Asia* **46** (1), 18–41.

Frontier Myanmar (2018) Fishy business in Ayeyarwady as industry reforms scuppered. Soe HK, 19 February. Available at: https://www.frontiermyanmar.net/en/fishy-business-in-ayeyarwady-as-industry-reforms-scuppered/.

Gaja-Svasti S, Baird IG, Manorom K (2022) The value of wild fish: diet and livelihoods in two rural villages in the Mun River Basin, northeastern Thailand. *South East Asia Research*, **30** (3), 287–307.

Girardin CA, Jenkins S, Seddon N *et al*. (2021) Nature-based solutions can help cool the planet—if we act now. *Nature* **593** (7858), 191–4.

GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH) (n.d.) *Sustainable Aquaculture Development in Myanmar*. Available at: https://www.giz.de/en/worldwide/63918.html.

HLPE (2017) Nutrition and food systems. A report published by The High Level Panel of Experts on Food Security and Nutrition. Rome, Italy.

Ingram J (2011) A food systems approach to researching food security and its interactions with global environmental change. *Food security* **3** (4), 417–31.

Ivars B, Venot JP (2020) Claiming and re-claiming the Ayeyarwady Delta, time and again: the case of Nyaungdone Island, Myanmar. *Journal of Political Ecology* **27** (1), 517–38.

Jennings S, Stentiford GD, Leocadio AM *et al*. (2016) Aquatic food security: insights into challenges and solutions from an analysis of interactions between fisheries, aquaculture, food safety, human health, fish and human welfare, economy and environment. *Fish and Fisheries* **17**, 893–938.

Johnstone G, Puskur R, Pant J *et al*. (2012) Ayeyarwady Delta Scoping. MYFISH 24-29 November 2012 (Unpublished scoping report).

Little DC, Newton RW, Beveridge MCM (2016) Aquaculture: a rapidly growing and significant source of sustainable food? Status, transitions and potential. *Proceedings of the Nutrition Society* **75** (3), 274–86.

Nyein Y, Zimmermann W (2015) Enforcing Right to Fishing Through Collective Actions of Small-scale Fishers (Thesis), The Graduate Institute Geneva.

Nyein Y, Gregory RG, Thein AK (2018) Myanmar-fisheries governance: confusion, uncertainty. *Samudra Report* (**80**), 28–30. Available at: https://icsf.net/samudra/confusion-uncertainty/.

Oo SM, MacKay KT (2018) Small-scale aquaculture of wild fish in Myanmar: a preliminary report from the Bago region. *Aquaculture Asia Magazine* **22**, 19–26.

Pounds A, Kaminski AM, Budhathoki M et al. (2022) More than fish—framing aquatic animals within sustainable food systems. *Foods* **11** (10), 1413. Available at: https://doi.org/10.3390/foods11101413.

Reardon T, Timmer CP (2014) Five inter-linked transformations in the Asian agrifood economy: food security implications. *Global Food Security* **3** (2), 108–17.

Reeves P, Pokrant B, McGuire J (1999) The auction lease system in lower Burma's fisheries, 1870–1904: implications for artisanal fishers and lessees. *Journal of Southeast Asian Studies* **30** (2), 249–62.

Saguin K (2014) Biographies of fish for the city: urban metabolism of Laguna Lake aquaculture. *Geoforum* **54**, 28–38.

Saguin K (2016) Blue Revolution in a commodity frontier: ecologies of aquaculture and agrarian change in Laguna Lake, Philippines. *Journal of Agrarian Change* **16** (4), 571–93.

Scott JM, Belton B, Mahrt K *et al*. (2023) Food system transformation, animal-source food consumption, inequality, and nutrition in Myanmar. *Food Security* **15** (5), 1345–64.

Soe KM, Baran E, Grantham R *et al*. (2020) *Myanmar Freshwater Fisheries and Aquaculture: A Decade in Review*, Monograph no. 209. Australian Centre for International Agricultural Research, Canberra and WorldFish, Yangon.

Tezzo X (2024) Everyday Aquatic Food System Transformations in Myanmar (PhD Thesis). Wageningen University. Available at: 10.18174/641809.

Tezzo X, Kura Y, Baran E *et al*. (2017) Individual tenure and commercial management of Myanmar's freshwater fish resources, 111–21. In Song AM, Bower SD, Onyango P, Cooke SJ, Chuenpagdee R (eds) *Inter-sectoral Governance of Inland Fisheries*. TBTI Publication Series, E-01/2017. Too Big To Ignore-WorldFish, St. John's, Newfoundland.

Tezzo X, Belton B, Johnstone G *et al*. (2018) Myanmar's fisheries in transition: current status and opportunities for policy reform. *Marine Policy* **97**, 91–100.

Tezzo X, Bush SR, Oosterveer P *et al*. (2020) Food system perspective on fisheries and aquaculture development in Asia. *Agriculture and Human Values* **38** (1), 73–90.

Tezzo X, Aung HM, Belton B *et al*. (2021) Consumption practices in transition: rural-urban migration and the food fish system in Myanmar. *Geoforum* **127**, 33–45.

Tezzo X, Bush SR, Belton B *et al*. (2024) Changing fish trade practices in Myanmar's rapidly transforming food system. *Human Organization* **83** (1), 55–69.

Veldhuizen LJ, Giller KE, Oosterveer P et al. (2020) The missing middle: connected action on agriculture and nutrition across global, national and local levels to achieve Sustainable Development Goal 2. Global *Food Security* **24**, 100336. Available at: https://doi.org/10.1016/j.gfs.2019.100336.

Vicol M, Pritchard B (2021) Rethinking rural development in Myanmar's Ayeyarwady Delta through a historical food regimes frame. *Singapore Journal of Tropical Geography* **42** (2), 264–83.

Welcomme RL, Bartley DM (1998) Current approaches to the enhancement of fisheries. *Fisheries Management and Ecology* **5**, 351–82.