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Inclusive environmental performance through 'beyond-farm' aquaculture governance

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This paper examines the potential for improved environmental performance of smallholder aquaculture production through 'beyond-farm' governance. Smallholder aquaculture farmers face a range of systemic environmental risks related to disease and water quality that extend beyond the boundary of their farms. Yet most governance arrangements aimed at mitigating risks, such as certification, finance and insurance, are focused on the farm-level rather than the wider landscape within which farming takes place. In this paper we propose an integrated approach to area-based management of aquaculture risks that integrates collective action, risk assurance and transfer, and inclusive value chains. In doing so, we set a new research agenda for the integrated governance of mitigating production risks and producer vulnerability in global food production.

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Introduction

Sustainable food systems require new approaches to ensure that environmental, nutritional and social equity goals are met in the production of nutritionally and culturally acceptable food [1]. To address the inherent trade-offs in meeting these various goals, the governance of sustainable food systems will have to simultaneously address local agro-ecological processes and (adverse) conditions of inclusion into both domestic and global value chains [1,2].

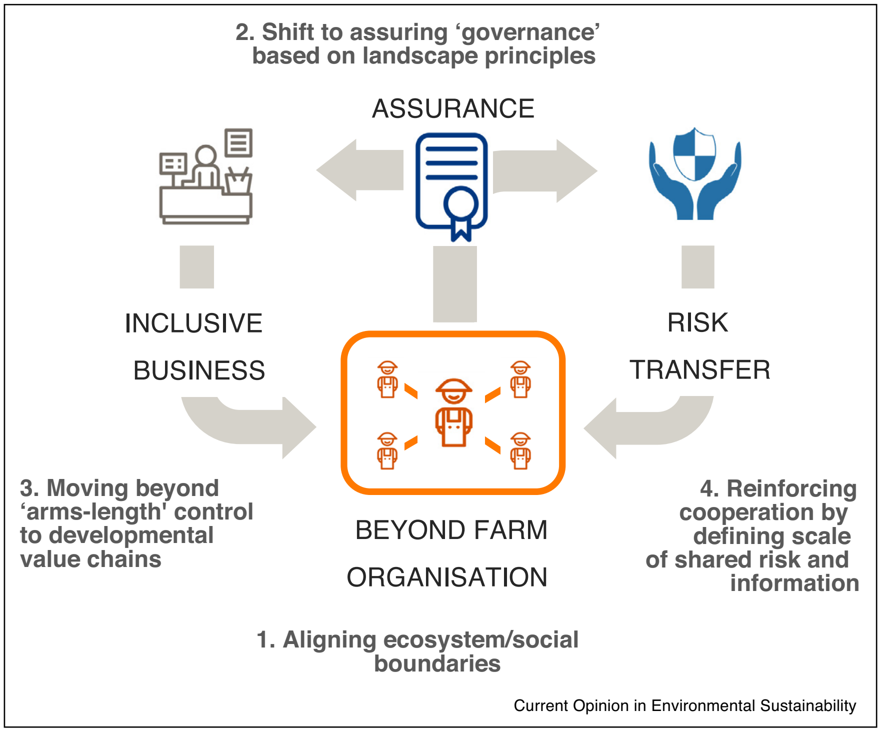
Aquaculture is a globally important food sector attempting to overcome these trade-offs. The aquaculture sector is growing fast, expanding globally at an annual average rate of 8.1% since 1970 [3], and contributing to the livelihoods of an estimated 117 million people [4]. Maintaining growth and meeting the expectations for aquaculture as a sustainable source of nutritious food requires addressing environmental risks such as habitat degradation and poor water quality [5], and social risks such as over-indebtedness, poor labour conditions and the weak competitiveness of smallholder producers [6].

To address these risks, a number of farm-level codes and standards have been developed to provide certified assurance over the environmental and social performance of aquaculture production. However, these codes and standards are limited by their focus on the farm-level and the burden they place on individual producers to meet their requirements. Despite considerable effort by NGOs, governments and companies, only 6% of global aquaculture production is currently certified [7,8]. The limited volume of certified aquaculture production is largely due to the systemic exclusion of smallholder producers. Despite representing the majority of global production, they do not have the financial and/or knowledge capacity to address the environmental or social risks that undermine the sustainability of their farm-level production practices [7,9,10].

Reflecting a wider turn in other food sectors, growing attention is being given to new modes of farmer organisation and assessment for beyond-farm management of food production, including ecosystem-based, landscape, zonal and area-based approaches [11,12]. While differing in their organisation, all of these approaches to beyond-farm management attempt to better integrate farm-level production decisions into the surrounding environments in which farms are located. In addition, some of these approaches also hope to foster more socially inclusive modes of environmental improvement [see Ref. 13] by superseding voluntary 'one-farm-at-a-time' compliance with various forms of collective on-farm and off-farm resource management.

This paper reviews four key elements that, we argue, can positively reinforce each other in any attempt to govern aquaculture beyond the farm-level (see Figure 1). First, effective modes of farmer organisation that enable both economic and environmental collective action. Second,

Figure 1



Inclusive beyond-farm sustainability governance.

new modes of assurance that disclose credible information about farmer practices and/or environmental status beyond the farm-level to regulators, markets, other farmers and other sectors operating in a given landscape. Third, inclusive business models in which buyers support the capabilities of suppliers to achieve sustainable, beyond farm-level, governance. Fourth, risk transfer models that incentivise producers to invest in governance beyond the farm by mitigating production and environmental risk. By bringing these four elements together 'beyond-farm' cooperation can foster the sustainable and inclusive production of nutritious food in aquaculture systems.

Beyond-farm cooperation

Approaches for fostering beyond-farm management in aquaculture can be broadly categorized into economic and ecosystem approaches.

Economic approaches to cooperation include a range of voluntary membership organizations created for the economic benefit of farmers. These organizations increase efficiency through, for example, improved purchasing power for key inputs, joint processing and marketing, upgrading farming technology and practices, implementing group training for better management practices and sharing cost related to certification [14,15]. Cooperation can take on various forms, including unregistered farmer organizations, membership-based organisations providing key services, and/or cooperatives owned by their members. Some cooperatives may take on environmental goals, but these goals tend to remain subordinate to economic goals of output efficiency and ultimately profitability.

The ecosystem approach to aquaculture (EAA), in contrast, explicitly goes beyond the economic goals of voluntary membership organisations. The EAA emphasizes the need to integrate farming practises into a given ecosystem and to develop aquaculture in the context of other sectors, "such that it promotes sustainable development, equity, and resilience of interlinked social-ecological systems" [16, p. 2]. As argued by Brugère *et al.* [12], the EAA has mostly been implemented through marine spatial planning in relation to disease control or competing uses of marine space. These include bay-management plans for salmon [e.g. 17], 'allocated zones for aquaculture' [e.g 18], and 'appropriate areas for aquaculture' [19].

Both economic and ecosystem approaches assume that farmers are intrinsically motivated to cooperate and coordinate their practices to minimise production risks. However, both approaches also present key trade-offs. Economic approaches emphasise that farmers, while critically evaluating risks, are more likely to make decisions that relate to 'on-farm' production rather than to shared risk [20•,21••,22]. In some major producing countries, such as Vietnam, there is even evidence that intensive farmers, who tend to have greater financial resources and higher-level managerial competences, are more likely to engage in voluntary economic cooperation (independent of the state or contracting buyers) than small-scale and/or extensive producers [23]. In contrast to economic cooperation, the EAA aims to coordinate farmers across broad ecological units within which off-farm risks are unequally distributed. However, in practise, aside from large scale offshore and coastal zoning [e.g. 24,25], the EEA's ecosystem goals are largely reduced to cooperation around risks that are more directly associated with improving short-term production efficiency, like disease management [26•,27].

The trade-offs between individual and shared, beyond-farm, risk mitigation raises two key points for further consideration. First, following Galappaththi and Berkes [28] and Bottema *et al.* [29••], effective beyond-farm management requires incentivising the management of shared and unequally distributed risks at a scale congruent with existing social institutions for common resource management. Second, there is a need for market measures to be incorporated into value chains that can effectively influence the adoption of on-farm practices as well as enable the management of shared risks [see Ref. 20•]. As we now go on to argue, implementing such economic incentives requires new models that can deliver credible assessments for both on and beyond-farm assurance, while at the same time strengthening rather than undermining farmer collaboration and market inclusion.

Assurance models

Assurance facilitates transparency on production, processing and trade practices in food production and passing this information on to buyers, consumers, NGOs, or the state [30]. This is done by facilitating the disclosure of credible information used to assess farmer practices and/or environmental status.

Most assurance models are farm-based; assessing production performance or on-farm risk-preventive behaviour [31] using farm-level data collection [see for e.g. 34]. First-party assurance involves self-declaration of performance, second-party involves declaration and/or assessment by a buyer or standard setter, and third-party assurance involves assessment by an independent actor/auditor [32••]. As more parties are involved, credibility of the assurance typically increases, yet at a higher cost.

Approaches for balancing cost and credibility include various models of self and external assessment [32••], and finding efficiencies through sensing technologies on and surrounding farms to create more efficient and potentially more trusted data collection [33]. Different models of group certification, based on collective information systems, were developed to reduce cost and overcome capacity constraints. Despite the rise of intermediaries who are blurring the lines between assessors, standard setters and those guiding producer compliance [34], third-party auditing continues to be demanded by buyers given their aversion to brand damage.

Achieving the wider goals of EAA, including the full range of ecosystem functions, human wellbeing, and equity and balance trade-offs with other sectors, requires new assurance models. The assurance approaches that are being developed link together established systems of provenance, traceability and new sampling and sensing technologies.

One such approach is verified sources areas (VSAs), as developed by the Sustainable Trade Initiative [35]. This approach blends landscape and provenance approaches to assurance by defining spatially explicit 'areas'. Within these areas, various public and private stakeholders collaborate under a 'sustainable improvement deal' or 'compact' that incorporates ecosystem services, wellbeing and equity across a range of sectors. The benefits, according to IDH, include pre-competitive cooperation between buyers who benefit from a more regular supply of 'sustainably' or 'responsibly' produced products.

The shift to VSA-like landscape or area-based models requires a mix of assurance approaches that can balance efficiency, credibility and the equitable inclusion of producers. Performance-based standards related to environmental status, labour, land tenure and transparency will likely persist in such a model given the ongoing need for some form of normative performance benchmark [see for e.g. 35]. However, if performance-based standards are applied with little reflection on the capabilities of a small and large holders in these areas to organise beyond-farm management, then many of the same limitations seen in farm-level and group assurance models may be replicated, only at a wider scale.

For VSAs to offer a fundamentally different approach to farm-level assurance, key landscape governance principles will need to be applied that focus on multi-stakeholder adaptive learning and improvement, rather than on performance assessment alone [36,37]. By emphasising process over performance, landscape governance-based principles may also facilitate collaboration between producers and other sectors. Not only could such collaboration help to achieve the ambitious goals of EAA, it may also increase aquaculture's social licence to operate by drawing in stakeholders in adjacent sectors (e.g. agriculture) that have a history of challenging the growth (or even existence) of aquaculture production in a given region or landscape [38–40].

Inclusive business

Buyers in major seafood importing markets, including the US and EU, have made a range of pledges to only source 'sustainable' seafood in response to a combination of NGO pressure and consumer demand [41,42]. However, to secure the supply of products that meet these requirements, buyers, both importers and retailers, are seeking new sourcing and assurance models.

Recognising the limitations of third-party certification, buyers are turning to 'developmental' sourcing models [43]. These models take different forms, but all involve a higher degree of engagement with and support to suppliers, aiming at more stable production that meets food safety and credence product requirements like responsible or sustainable production [9]. In doing so, they differ markedly from traditional forms of arms-length market coordination, mediated through certification, or captive coordination that binds suppliers to long term contracts [44]. Instead, developmental sourcing models involve buyer-driven provision of technological and organizational assistance, co-innovation, human capacity building, and financial and administrative advice, all aimed at helping suppliers to meet stringent product specifications. This model, it has also been argued [45], could also potentially improve the shared management of beyond-farm risks.

Buyers are already engaging in developmental sourcing to secure currently 'un-certified' farmed fish through 'aquaculture improvement projects' (AIPs). There are two general categories of AIPs [46]; they are either coordinated directly by buyers or with the support of NGOs. AIPs support producers to move towards certification by, for example, directly financing improved farm practices, providing support for training on stocking and pharmaceutical use, or paying for consultants to assist with the paperwork required to demonstrate improvement.

As outlined by Bottema [46], AIPs are already being applied in the aquaculture sector but face challenges in supporting beyond-farm producer organisation. First, developmental models like AIPs need to induce horizontal collaboration between farmers to manage area-level risk. However, there is some evidence that collaboration between farmers focused on farm-level improvements can also lead to landscape improvement [21••]. Second, it appears that models that do not address the risks that bind farmers together limit the capacity of leading actors to induce horizontal collaboration between farmers. Third, there appears to be a discordance between the scale at which production risk management is institutionalized by the private sector and the scale at which this is organized by farmers. This suggests that taking existing social networks as a spatial and institutional unit may be the most appropriate scale for managing shared area-level risk.

Inclusive business models are increasingly moving towards greater buyer engagement. However, to be successful at managing shared risk, buyers not only have to provide market incentives, but also organise support to farmers around the shared management of production risks. Following Bottema et al. [29••], this is likely to be more effective if support is based on the spatial and social characteristics of how farmers are already interacting while managing shared risk.

Risk transfer

The high variability of revenue from aquaculture, coupled with the lack of available risk management mechanisms, means that very few producers in the industry can transfer risk and mitigate economic losses [47••]. Risk transfer mechanisms, including formal insurance, value chain contracts and mutual funds, have been employed in North America and Europe since the 1970s [31], but remain particularly absent in major aquaculture producing regions such as Southeast Asia. Where risk transfer mechanisms like insurance have been piloted in Southeast Asia, it has been limited by weak subscription, weak transparency on the performance of production, a lack of reinsurance markets and, as a result, restrictively high premiums [48]. As a result, most aquaculture farmers have remained exposed to a range of production and price risks. Building on the above sections, we argue that enhancing the coverage of aquaculture producers can benefit from better integrated beyond-farm risk management.

The poor application of risk transfer mechanisms in the aquaculture sector is in large part due to the lack of information that both buyers and insurers have on production [48]. In regions like Southeast Asia, the poor availability of information is due to the large number of producers, the relatively non-transparent nature of value chain relations that transfer information on where, how and from whom seafood is bought, and the lack of monitoring and control over input water quality and disease outbreaks [48]. The lack of information is compounded by the relatively high turn-over of producers as they exit the industry. Without adequate information on the farm-level and/or the surrounding environment, it is not possible to adequately assess individual or regional yield-gaps and design possible risk transfer solutions. This is especially true for indemnity-based insurance and value chain contracts, but also holds for index-based insurance. Although the latter could entirely be based on readily available weather station or satellite data, insurers increasingly look for ways to reduce basis risk and use farm and regional data to design tailored index insurance mechanisms [49].

Production risks can still be insured if there is information available to assess the probability of yield loss across the majority of producers in a given area. The goal of collecting such information is to assess any inherent bias towards poor performers applying for insurance (*adverse selection*) and/or the emergence of riskier behaviour after risk transfer arrangements have been put in place (*moral* *hazard*) [50]. The quality of such information is closely linked to both farmer organisation and the assurance model in place. Eligibility to be a member of any form of farmer organisation can be based on standards that consider both farm and shared production risks. If the management and assurance of shared risks are linked (as seen with VSAs), greater transparency and accountability can demonstrate attempts to reduce moral hazard and adverse selection while also benefitting the availability of information. Such models can enable risk transfer and provide an added incentive for integrated beyond-farm aquaculture management.

Conclusion

There is growing attention to four separate but related elements of beyond-farm aquaculture governance that are in different stages of development and implementation. While each of these elements can individually contribute to reducing the production and environmental risk of aquaculture farmers, we argue that bringing these dimensions together can more effectively overcome many of the limitations of current improvement mechanisms like farm-level certification. In summary, we argue that farmer collaboration for shared, beyond-farm risk management within landscapes can be most effectively supported through the development of new assurance forms. Once established, beyond-farm assurance models can assist buyers and insurers to recognise, engage and ultimately support farmer-led attempts to collectively reduce production risks. Given the potential for the greater economic efficiency and larger spatial extent of collaboration and assurance, we also expect beyond-farm governance to be more inclusive of a wider range of producers across landscapes.

The multi-dimensional perspective we propose as a basis for beyond-farm governance goes beyond current farm-level market-based sustainability initiatives, including certification and traceability. Not only does it remove the burden on farmers to individually comply with standards, it also focuses directly on shared management practices for the shared water and land resources that underpin on-farm production risk. In doing so, beyond-farm governance scales up the organisation of environmental improvement beyond farm boundaries to address the ecosystem-level goals that are not currently achieved through farm-level certification. Finally, and overcoming a key limitation of on farm certification, beyond-farm governance appears more likely to reduce the vulnerability of aquaculture-dependent livelihoods through more inclusive market access and the development of risk transfer approaches that enable longer term production planning and investment.

Instituting a model of inclusive environmental improvement requires greater coordination amongst farmers, assurance bodies, buyers and insurers than currently exists. Further research is therefore needed to identify how to orchestrate and assure these new relations of beyond-farm governance. This might require new kinds of intermediaries that coordinate beyond-farm assurance, and in doing so, orchestrate information and finance flows between producers, buyers and actors facilitating risk transfer. Given the reliance of beyond-farm governance on cooperation and trust, there is also considerable scope for these actors to develop new information systems to facilitate transparency and disclosure between the elements and actors involved. For such new forms of organisation and actors to emerge in the aquaculture industry, a fundamental breach is needed from current models of farm-level sustainability governance.

Conflict of interest statement

Nothing declared.

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