The future of aquaculture in Indonesia: A transformation toward increased sustainability

WorldFish

To combat current high levels of malnutrition and stunting, the Indonesian government has set ambitious targets for aquaculture growth up to 2030. Fish already fundamentally contributes to the well-being of Indonesians by offering an affordable source of nutritious animal protein. However, to reach these targets, production will have to more than triple. Along with the impacts of climate change, this is expected to reduce Indonesia's capture fisheries landings, which currently are the main source of seafood for human consumption as well as a source for fishmeal and fish oil.

However, meeting the production targets will come at a cost for the environment. Research has shown that widespread negative environmental consequences will result from reaching the proposed production targets using current farming practices. Consequently, more sustainable farming practices are needed that do not jeopardize the function of Indonesia's valuable coastal ecosystem. The research looked at potential aquaculture interventions and innovations across several impact categories that would allow the aquaculture sector to grow without compromising the environment (Figure 1).

Interventions

Farm performance data collected during the past few years has shown a yield gap among Indonesian farmers. Feed conversion ratios (FCRs) and productivity were often far from optimal and compared unfavorably with many neighboring countries. Consequently, we shortlisted three readily available and affordable interventions (AqI) that could greatly improve the performance of the Indonesian aquaculture sector (AqI1–3). We also included three more comprehensive reforms that would require changes in national and international demands (AqI4–6):

AqI1. Lower FCRs for whiteleg shrimp, carp and tilapia by 20 percent by using better quality feeds, improved strains, better quality seed and better farming practices.

AqI2. Sustainably intensify milkfish and Asian tiger shrimp polyculture (Tambak) systems within existing ponds using commercial feeds.

AqI3. Shift grouper farms away from using low-price whole fish as feed toward pelleted feed.

AqI4. Transition toward renewable electricity nationwide, driven by international pressure.

AqI5. Shift demand from shrimp toward omnivorous finfish species.

AqI6. Reduce food waste and increase use of by-products.

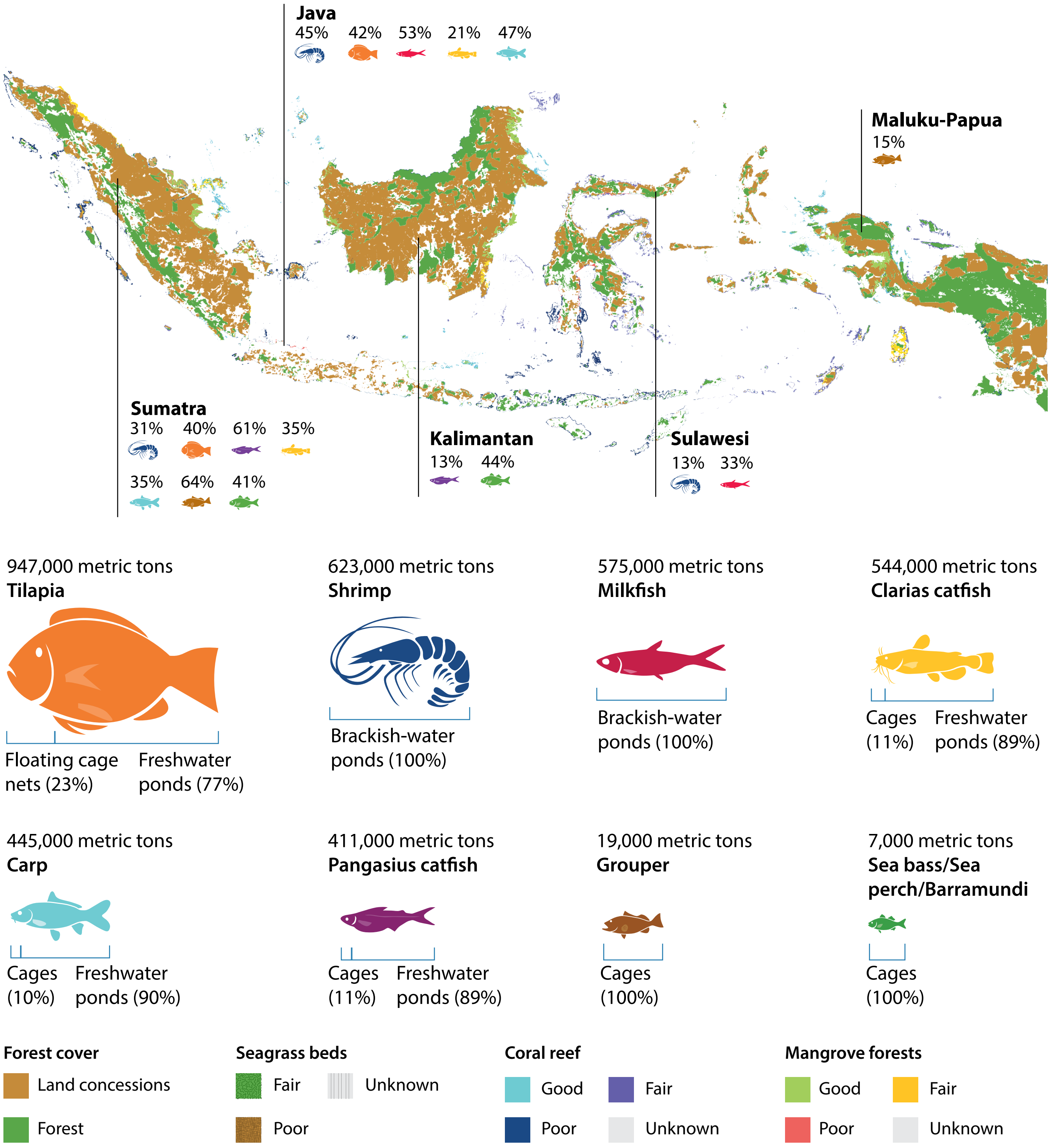

Figure 1. Current aquaculture production and estimates of their contribution towards each product group across the Indonesian archipelago and ecological status.

Innovations

In combination with these interventions, more innovative approaches need to be embraced. For example, several novel feed ingredients have been developed over the past decade. Among these are single-cell proteins, microalgae and macroalgae, all of which have great potential for upscaling in Indonesia and could enable the aquaculture sector to lower its dependence on wild fish for feed and raw material imports.

Innovative farming techniques such as offshore aquaculture would allow expansion of mariculture without competing for coastal space and ecosystem services. However, such systems would still depend on investment in infrastructure and feed resources, and increased farming costs may only allow for targeting higher priced species.

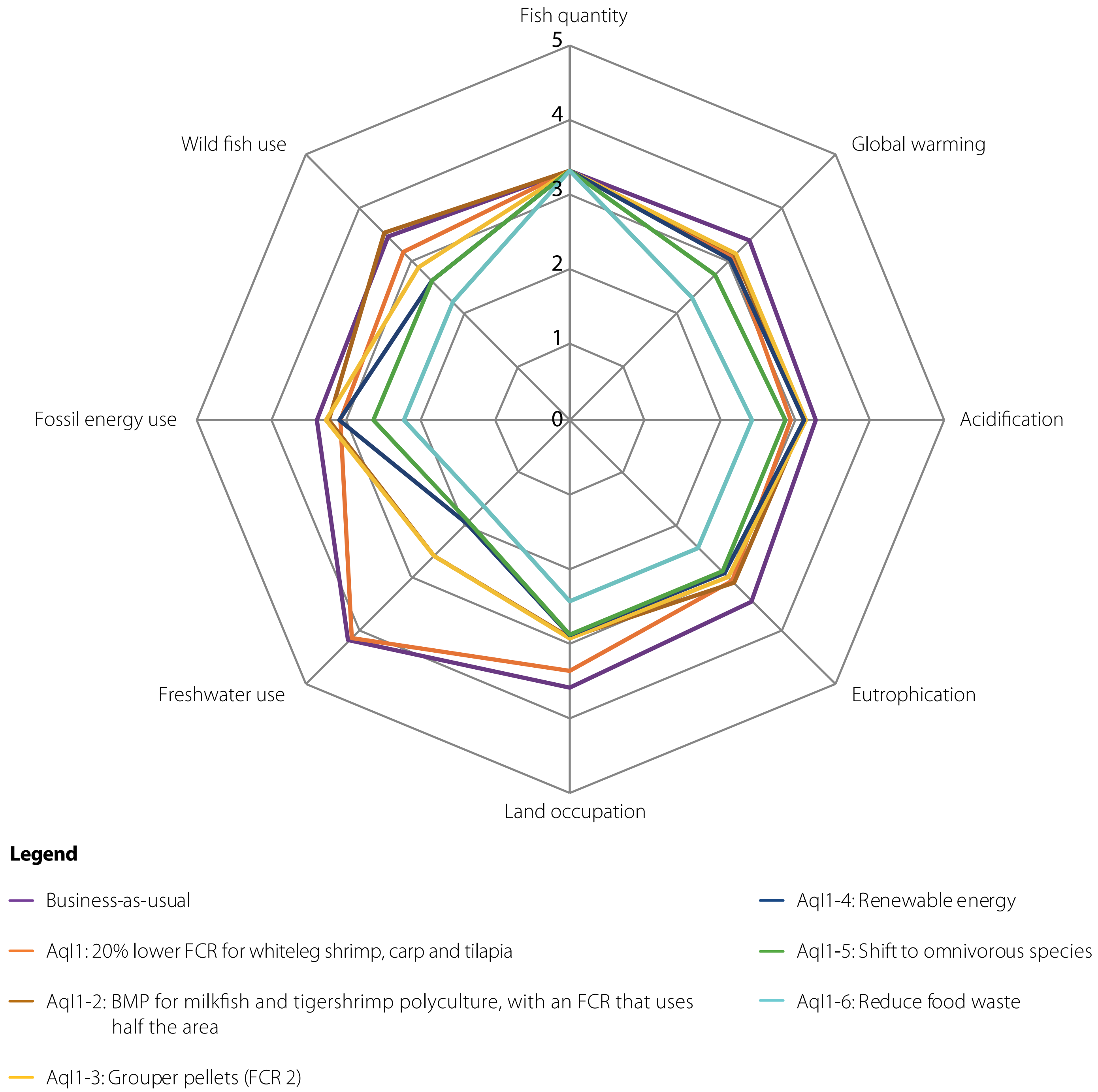

Figure 2. Cumulative mitigation potential for Indonesian aquaculture using six interventions.

Spatial planning

Greenhouse gas emissions from the conversion of mangrove forestation to aquaculture ponds are larger than from farming itself. This highlights the need for spatial planning to better account for ecological hot spots, including not only mangroves but also tropical forests and seagrass beds.

Conclusions

We show that interventions and innovations could likely allow Indonesia's aquaculture output to double by 2030 within its current environmental footprint. The main challenge for achieving this outcome will be to change farmer practices across the country and perceptions throughout value chains. Many farmers, however, do not have access to the capital, resources or extension services needed to implement these changes. Moreover, nationwide measures to increase renewable energy and reduce food waste will be essential for meeting the UN's Sustainable Development Goals.

Production targets will, in the meantime, need to be revised, as earlier research shows that these will be physically impossible to meet in terms of freshwater consumption and land occupation. Emphasis needs to shift away from species aimed primarily for export, as these usually cause more environmental impacts, are more resource demanding, and may impair nutritional security. Domestically consumed species should be improved by development of better genetic strains, innovative feeds and farming practices. Processing and market diversification, including deboned milkfish and other semi-finished food products, will be important for value-adding. This would also centralize the availability of by-products, which then could be reduced for other uses, such as fishmeal.

The Indonesian aquaculture industry faces large challenges but also offers potential. Decision-makers need to carefully navigate the different tradeoffs between short-term monetary gains and long-term environmental destruction. Our modeling provides some insight into where resources are best invested and the scale of the resources needed. More elaborate models that offer more plasticity and account for interactions with other sectors are, however, recommended.

Key references

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