Moral Obligations of Aquaculture

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As a student conducting aquacultural research, I now find myself pondering the "story" of my purchase when I shop for fresh seafood. After a few inquiries of my fishmonger, I have found that most of my favorite seafoods are local aquacultured product, grown in North Carolina. This fact is a pleasant surprise; however, it is no secret that aquacultured seafood is quickly becoming one of the world's largest animal production industries (Bostock et al., 2010). Nevertheless, along with aquaculture's steady ascent comes specific challenges regarding the moral obligations of the industry to local communities, the environment and aquatic systems, and concerning the handling of live aquacultured product.

Aquaculture is the cultivation of aquatic life. The National Oceanic and Atmospheric Administration further defines aquaculture as "breeding, raising, and harvesting fish, shellfish, and aquatic plants" (National Oceanic and Atmospheric Administration, 2021). The most recent data shows that aquacultured "fish, crustaceans, molluscs, and other aquatic animals excluding aquatic mammals, reptiles, seaweeds, and other aquatic plants" represents 52% of all seafood production globally (FAO, 2020). While the burgeoning industry has greatly profited large food manufacturing industries, investors, non-profit organizations, and other groups, small-scale fisheries, and seafood businesses, especially those in developing countries, have not fared so well. Many small-scale seafood and fishing operations have complained that their livelihoods are being threatened by the aquacultural industry due to the involvement of larger groups in wholesale seafood purchasing, industrialization of marine and coastal waters, and regulations preventing fishing for conservation purposes (Bavinck et al., 2017; Cohen et al., 2019; Said et al., 2017). One way larger aquacultural entities can abate the financial woes of small-scale operations is through collaboration. Through education and investment in innovative farming techniques and useful technology, extensive operations can support modest aquacultural industries. In addition, larger groups may even help develop small-scale aquaculture hubs in a particular location. It has been noted that while wild-caught fishing may yield greater gains at times, aquaculture provides more predictability in both time and economic value (Slater, 2017). This also provides job opportunities for the local community and creates an industry that is close to home for fishermen and other workers. Since every human has the right to nutritious foods, like lean and protein-rich seafoods, cooperation amongst larger operations is

paramount for the progression of aquaculture worldwide. In addition, aquaculture businesses have a duty to protect aquatic resources.

The damaging effects of overfishing of the world's ocean have been vast. Coastal and marine ecosystems have suffered such impacts like extinction of marine vertebrates, reductions in aquatic plants, and eutrophication (Jackson et al., 2001). Jackson et al. (2001) explains the ecological cycles of aquatic environments have not only been disturbed by large operations but also smaller native groups that utilize these water systems. Aquaculture combats overfishing by giving aquatic organisms time to naturally reproduce and replenish, subsequently restoring the natural balance of life in water ecosystems. The aquaculture industry also allows for some extent of management of aquatic life unlike products of the wild-caught industry. Since aquacultured product is often maintained in man-made systems (e.g. tanks, upweller systems, and caged systems), we can use these operations to "work for us". For example, oysters are filter-feeding creatures that are known to pump in surrounding water. If oyster aquaculture systems are grown in water negatively affected by eutrophication, they can help clean the water and feed human consumers. Aquacultured products like oyster reefs and kelp forests provide habitats, food, and coastal protection which contributes to a healthy biodiversity in the earth's oceans (Theuerkauf et al., 2019). Another advantage of aquaculture for the environment is that the practice can help ease stress on terrestrial land systems. Aquaculture facilities require less land than livestock and agricultural farming because aquatic creatures are "extremely efficient at converting feed to biomass for human consumption" (University of California - Santa Barbara, 2018). Thorough planning and execution of environmentally favorable aquaculture facilities and systems are currently needed to reap potential gains in the future.

Likewise, ethical aquaculture establishments should also consider the welfare of aquatic animals. Animal welfare is centered on "the animal's condition, on its subjective experience of that condition and/or whether it can lead a natural life" (Huntingford et al., 2006). This topic has been well debated and there has been concerns about whether or not fish can feel pain (Ashley, 2007). For some time, there has been concern on the stock density of live fish, for example. When fish are overloaded in transport tanks , the fish sometimes exhibit defensive behavior toward one another and can even spread disease amongst

the group. While some distributors may be fully aware of overstocked tanks, some will proceed because more product transported results in more money gained. This malpractice is even evident in the final seafood product. Stresses experienced in the muscles of the fish due to transportation, capture, and management precede *rigor mortis* and contribute to the final product's quality (Nathanailides et al., 2011).

Live, aquatic animals should be provided enough space for the creature to move around freely as if in its natural environment because confined animals are also more likely to spread disease. A previous study showed that water-borne pathogens can spread amongst aquatic creatures at a faster rate than pathogens terrestrial systems if not properly managed (Leung & Bates, 2012). Finally, the type of species of aquatic life should also be considered before containment and transportation. It has been previously suggested that aggressive aquatic species should not be held with docile species due to the possibility of violence toward the weaker animals. A previous study noted that aggressive aquatic species fared better in larger holding tanks with complex habitats (Oldfield, 2011). Aquaculture operation hubs, not just limited to the coasts but inland as well, could also reduce transportation times for aquatic animals. Increasing the amount of aquacultural facilities would provide more harvesting sources for distributors closer to the product's end destination, thus reducing the amount of time creatures are kept in storage tanks. Overall, aquaculture, if considered carefully could offer many benefits for the seafood industry and society at large.

Though there are no clearly defined rules regarding ethical practices in aquaculture, we should strive to enhance humanity and steward the earth's resources in a responsible manner. All beneficiaries, employees, and contributors to the aquacultural industry should seek to benefit local communities and economies, aquatic ecosystems, and aquatic life. The aquacultural industry is steadily growing, so new challenges lie ahead; however, with good intent, growing knowledge, and hard work, the fruits of modern aquaculture can be assets for future generations.

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