

One Health Aquaculture: Integrating Sustainable Practices for Human and Environmental Well-being

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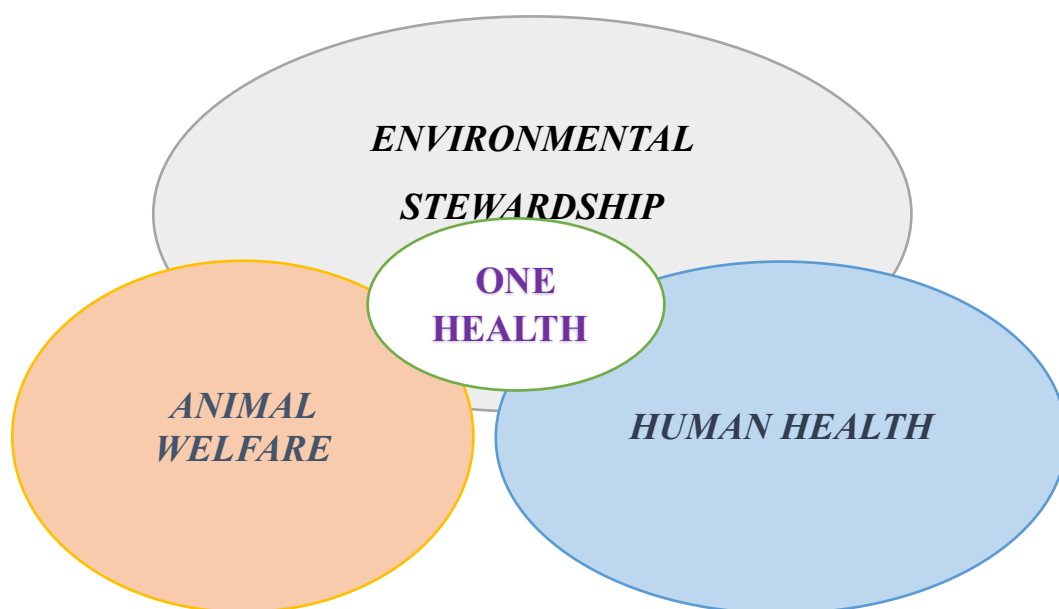
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The term 'One health' was first used in 2003-2004, and was associated with the

emergence of severe acute respiratory disease (SARS) in early 2003 and subsequently by the spread of highly pathogenic avian influenza H5N1, and by the series of strategic goals known as the "Manhattan principles"

derived at a meeting of wildlife conservation society in 2004, which clearly recognized the link between human and animal health and the threats that diseases pose to food supplies and economies.

This concept is a worldwide strategy that recognizes that public health is connected with animal health and the environment. It concerns multidisciplinary collaboration between physicians, veterinarians, environmental scientists, public health professionals, wildlife experts, and many others. With a multisectoral and transdisciplinary approach, public health threats can be better monitored and controlled. The resulting synergism enhances the knowledge of how diseases, known as zoonotic diseases, can be shared between animals and people with the goal of achieving optimal health outcomes. One Health is not a new concept, but it has become



The Principles of One Health Aquaculture

more important since 2006 as a result of emerging and re-emerging diseases.

Many One Health initiatives focus mainly on the relationship between humans and livestock or wildlife health, because several zoonotic disease pandemics and (re)emerging infectious diseases originated from these animal species. Examples of such infections are West-Nile virus, corona virus (SARS, Covid-19), zika virus, avian H5N1 influenza virus, Nipah virus, and Hendra virus [8]. The recently founded One Health European Joint Programme (OHEJP) also focuses on foodborne zoonoses, antimicrobial resistance and emerging threats, while companion animals are absent.

As the world grapples with the challenges of food security, population growth, and environmental sustainability, the concept of One

Health Aquaculture has emerged as a promising solution. One Health Aquaculture recognizes the interconnectedness of human health, animal health, and the environment, emphasizing the need for a holistic approach to aquaculture production. By integrating sustainable practices, this approach aims to maximize productivity while minimizing negative impacts on ecosystems and human populations. In this article, we will delve into the principles and benefits of One Health Aquaculture and its potential to shape the future of responsible aquaculture.

Environmental Stewardship

The most important element determining the aquacultural microflora is its environment. Improper disposal and recycling facilities in food-producing and processing plants would lead to an increased risk of the pest as well as insect population, resulting in food spoilage and contamination. The water temperature, harvesting techniques, season, and processing methods may also influence the spoilage. The predominant bacterial spoilage agents are located on the slime layer of the skin, gills, and intestine. As the tissues of fish contain higher levels of non-protein nitrogenous (NPN) compounds (trimethylamine oxide, free amino acids, and creatinine), proteins, and peptides, the growth of microbes results in the decomposition of proteins and production of metabolites which would result in spoilage.

Inappropriate aquacultural practices could result in environmental degradation; eutrophication and organic pollution constitute common adverse impacts. Together with chemical pollution, these could deplete oxygen, reduce water quality, coral death, and habitat disruption of water bodies. Such a hostile environment would sustain the growth of harmful microbes to aquatic life.

One Health Aquaculture promotes sustainable and responsible management of aquatic resources. It focuses on minimizing habitat destruction, conserving biodiversity, and reducing pollution associated with aquaculture operations. This includes employing ecosystem-based approaches, such as integrated multi-trophic aquaculture, where the waste products from one species are used as inputs for another, thus creating a balanced and more sustainable system.

Animal Welfare

Food production involves complex socio-ecological systems within an environment with a wide variety of species habitat. Farmed macrobiotic communities interact often with a wide range of eukaryotic as well as prokaryotic microbes inside the aquatic environment. Within the aquatic ecosystem involves a variety of known and unknown pathogens that may produce infection and disease. Hence, the crop-growing water bodies are regarded as artificial ecosystems that can act as a conducive environment for rapid propagation of pathogens and emergence of public health outbreaks. It is therefore, important to consider the stock management in terms of public health aspects, particularly biosecurity, zoonosis, therapeutic and/or interventional impact on the limited aquatic environment.

The intensive aquacultural practices have necessitated the use of chemicals (pond fertilizers, biocides, chemotherapeutics, and formulaic feeds) for improving stock performance. On the research front, microbial identification and hazard profiling employing sophisticated technologies such as metagenomic analysis or next-generation sequencing of water bodies, feed, and host tissues are attracting wide momentum. Such technological advancements could not only identify the

biosecurity risks associated with aquaculture but also prevent the pathogen spillover to the adjoining environment and wildlife.

Ensuring the health and welfare of farmed aquatic animals is a key principle of One Health Aquaculture. By providing optimal rearing conditions, including appropriate water quality, nutrition, and disease prevention measures, farmers can enhance animal well-being and reduce stress levels. This approach not only promotes animal welfare but also improves the overall quality and safety of aquaculture products.

Human Health

Food production systems can provide a wide range of public health as well as socio-economic benefits. The One Health principles can achieve investment and optimization towards productivity, welfare concerns, and ecosystem health. Practically, the market preferences or societal goals to tolerate health will play a crucial role. The ever-increasing population, as well as urbanising trends in the human population, may compromise the accessibility and nutritive quality of natural foods; therefore, the processed foods are of utmost importance. Aquaculture enterprises can solve this issue to a greater extent by providing locally available nutritious foods mainly in low- and middle-income countries, thereby opening up

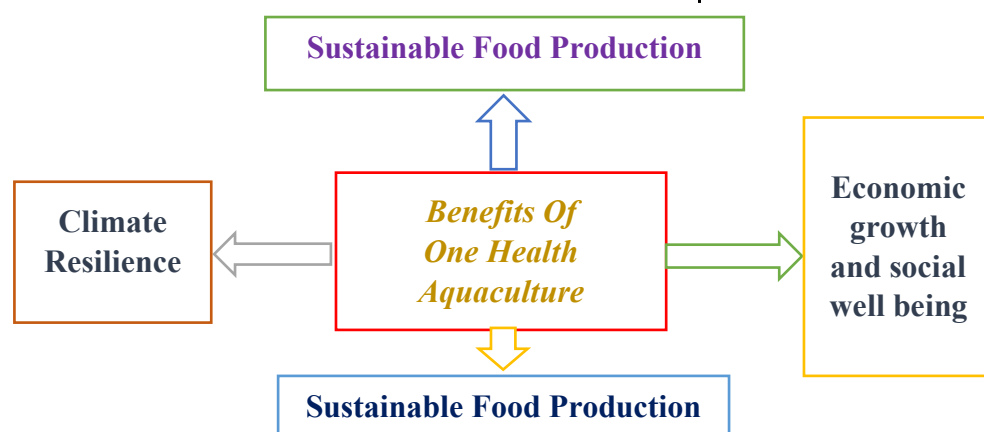
employment avenues to many. In short, scope for trade, opportunities for better employability, quality diet and better infrastructural facilities determine the success metrics of aquaculture. Moreover, a safe supply chain (farm- to- fork) is imperative to alleviate the burden of public health impacts and to enhance the economic stability of the society and nation. Hence, access to an optimum quantity of safe and nutritive food is pivotal for the sustenance of life, promoting better health and thereby stabilizing the economy.

While public health threats are emerging, early evaluation of such risks is essential to uphold the One Health principles. One Health Aquaculture recognizes the interconnectedness between animal and human health. By implementing robust biosecurity measures and strict quality control protocols, the risk of transmitting diseases from aquaculture products to humans can be minimized. Additionally, promoting a nutritious and balanced diet that includes sustainably farmed seafood contributes to improved human health and well-being.

Benefits of One Health Aquaculture

Sustainable Food Production

With global population growth and increasing demand for protein, One Health Aquaculture offers a sustainable solution to meet the growing food needs. By maximizing production efficiency and minimizing resource use, it provides a reliable and environmentally-friendly source of nutritious seafood.



Biodiversity Conservation

One Health Aquaculture prioritizes the protection of natural habitats and ecosystems. By avoiding overfishing and destructive fishing practices, it contributes to the conservation of wild fish stocks and the preservation of marine biodiversity.

Climate Resilience

One Health Aquaculture practices can be designed to mitigate the impacts of climate change. Sustainable aquaculture systems, such as land-based recirculating systems or carefully planned sea-based operations, can reduce the sector's vulnerability to extreme weather events and minimize its carbon footprint.

Economic Growth and Social Well-being

One Health Aquaculture has the potential to generate employment opportunities, particularly in coastal and rural communities. By supporting local economies, it can contribute to poverty reduction and enhance the social well-being of communities dependent on aquaculture.

The Future of One Health Aquaculture

By 2050, it is anticipated that aquaculture will supply the majority of aquatic dietary protein. Aquaculture's effects on the environment's integrity, the health and welfare of farmed organisms, and human health must be appropriately considered if it is to deliver greatly increased amounts of food in a sustainable way. As we look to the future, One Health Aquaculture holds significant promise in ensuring a sustainable and resilient seafood production system. However, its successful implementation requires collaboration among various stakeholders, including governments, aquaculture producers, researchers, and consumers. Governments need to enact supportive policies and

regulations, while the aquaculture industry must adopt best practices and invest in research and innovation. Consumers, on their part, can make informed choices by favoring responsibly farmed seafood and supporting sustainable aquaculture initiatives.

Aquaculture can mitigate the negative consequences associated with land-based food production systems particularly where land and water-based systems are integrated to protect terrestrial habitats from the impact associated with some current farming systems ^{54,55}. The One Health principles will facilitate increasing production of aquaculture species with efficient food production and sustainable environmental footprints, while supporting local socio-economic needs. If put into practice, the success metrics will serve as an example for the design and assessment of not just aquaculture, but whole food systems.

Conclusion

The food safety has now become a pressing and burning global issue. Hence, stakeholders from diverse domains (government agencies, industry experts, researchers, academicians, and the community) should involve themselves to simplify the food systems to uncouple the public health benefits of consuming good quality aquatic protein sources from adverse impacts on the environment, organism, and the society. Integration of good aquacultural practices with the existing regulations may deliver encouraging impacts. The convergence of various sectors in a holistic pattern under 'One Health umbrella' would facilitate increased production of aquaculture species for effective food production and sustainable environmental footprints meeting the regional socio-economic demands.

Taking leads from this approach and the past successes involved in various other domains like zoonotic infections, it is the need of the hour to inculcate a OH approach in food safety, especially the fisheries sector with an ultimate aim of achieving health and well-being for humans, co-existing non-humans and their communal environment for achieving planetary health.

One Health Aquaculture offers a comprehensive and sustainable approach to the production of seafood, addressing the intertwined challenges of environmental conservation, animal welfare, and human health. By embracing this holistic approach, we can create a future where aquaculture plays a vital role in meeting the global demand for food while safeguarding ecosystems and supporting the well-being of both animals and humans. By recognizing the interdependencies between these factors, we can pave the way for a more sustainable and resilient aquaculture industry that benefits present and future generations alike.

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