MEDWIN PUBLISHERS
Committed to Create Value for Researchers

International Journal of Oceanography & Aquaculture
ISSN: 2577-4050

Precision Aquaculture with Inclusion of Commodity Smart Phones and Collective Learning

Nadi F[1] and Rastegari H[2]*

[1]School of Information Technology, UNITAR International University, Malaysia

[2]Higher institution center of excellence (HICoE), University Malaysia Terengganu, Malaysia

***Corresponding author:** Hajar Rastegari, Higher institution center of excellence (HICoE), Institute of Tropical Aquaculture and Fisheries, University Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia, Email: h.rastegari@umt.edu.my

Opinion

Volume 7 Issue 4

Received Date: November 01, 2023

Published Date: November 10, 2023

DOI: 10.23880/ijoac-16000281

Abstract

The rising demand for seafood has led to a growing interest in aquaculture, requiring careful attention to aspects of the cultivation process like stocking, feeding, and safeguarding against predators and disease for success. Precision aquaculture offers promising advancements, but its high initial costs pose challenges. Collective learning and smartphone technology provide accessible solutions for all farms to benefit from data-driven insights and collaborative disease management. Despite the potential long-term benefits in terms of production efficiency and resource management, full implementation of precision aquaculture remains economically infeasible for individual and small-scale farmers. However, there are some technologies such as collective learning and commodity smartphones that offer opportunities to benefit both precision and non-precision aquaculture farms, enhancing data-driven decision-making and collaboration.

Keywords: Precision Aquaculture; Collective Learning; Smartphone; Artificial Intelligence

Introduction

Since demand for seafood is constantly growing, interest in aquaculture is on the rise. On the other hand, meticulous attention to various aspects of the cultivation process, such as stocking, feeding, and safeguarding against predators and disease is mandatory for the success of aquaculture [1,2].

Precision aquaculture is a concept that advocates for the integration of emerging technologies to enhance the efficiency and productivity of aquaculture farms [3]. It encompasses various aspects of aquaculture, including automatic feeding, water quality measurement, disease detection, and more. The use of advanced sensors, data analytics, and automation systems enables real-time monitoring and targeted interventions to optimize production and minimize risks.

Nevertheless, implementing a precision aquaculture farm can be expensive due to the need for advanced technologies and infrastructure [4]. Statistically speaking, a significant number of aquaculture farms falls within the category of small to medium-sized farms, often managed by individuals with moderate to modest incomes [5].

Although, it needs to be mentioned that the potential long-term benefits in terms of improved production efficiency, resource management, and profitability should be considered when evaluating the feasibility and cost-effectiveness of precision aquaculture. Technological advancements and research breakthroughs have also successfully addressed many of the challenges associated with implementing precision aquaculture farms, painting a promising picture for the future [6]. Nevertheless, despite that, implementing a precision aquaculture farm is usually economically infeasible for individual farmers and small sized farms.

In the following two technologies will be highlighted that may benefit both farms with and without precision aquaculture. First, collective learning will be presented as a technology that helps training artificial intelligence algorithms with richer data. Second, commodity smartphones will be introduced as an enabler for small farms without precision aquaculture.

Collective Learning

One of the emerging technologies that can be integrated into precision aquaculture is the use of machine learning algorithms. Typically, training these algorithms with high-quality and extensive data is a common requirement, which can pose a challenge when the algorithm is intended for specific use cases with limited available sample data [7]. An effective solution to address this challenge is the utilization of collective learning algorithms.

Collective learning algorithms are referring to a family of algorithms where the goal is to train a high-quality centralized model while training data remains distributed over many clients [8]. Federated learning as one of these algorithms is a decentralized learning framework that allows participating sites to collaborate and share data, models, and training processes [9].

Such technology can be utilized among existing farms to train machine learning models that are trained on collective data from all participant farms which results in more accurate models due to richness of data. It's important to note that data sharing needs do not infringe upon privacy concerns, as existing technology can effectively address these issues. There could be many applications for these systems in aquaculture such as early detection of aquatic diseases that is one of the main challenges that farmers face. Moreover, other information such as information about the spread of a disease for example could help both farmers and policy makers to plan appropriately.

Consider a scenario where a disease is spreading within a specific geographic area. Early detection will become possible if it reveals that many farms in a neighborhood are detected with a disease. In such cases if the information is shared between other farmers, they can benefit from it and take necessary actions to protect their farm and maybe stop the spread of disease to other farms. While it's true that not all data from one farm is directly applicable to another due to unique factors at play in each farm, there's still valuable information to be gleaned.

Potential of Smartphones

It's important to highlight that the integration of collaborative learning can be considered a step towards adopting precision aquaculture. This can be accomplished in two ways: participating in collective learning by contributing data or utilizing models trained with data from other farms. This feasibility is largely attributed to the widespread availability of affordable smartphones with adequate computing capabilities.

In addition to the mentioned applications, there are numerous other potential use cases for smartphones that can benefit small and medium-sized farms by harnessing technological advancements. Government and non-government agencies can offer valuable information to farmers through mobile apps, facilitating effective communication and support.

Conclusions

While not all farms can afford implementation and benefiting from precision aquaculture, there are some enabling technologies that allow these farms to benefit from some crucial aspects of it. Collective learning helps training of machine learning models train by rich amount of data shared by all participating farms. This data sharing is not only limited to farms with precision aquaculture but also by farms without precision aquaculture thanks to the wide accessibility of smartphones these days. A crucial application of these technologies could be early detection and localization of viral diseases that can easily transfer between different farms.

References

1. Zamora-Garcia I, Correa-Tome FE, Hernandez-Belmonte UH, Ayala-Ramirez V, Ramirez-Paredes JP (2021) Mobile digital colorimetry for the determination of ammonia in aquaculture applications. Computers and Electronics in Agriculture 181: 105960.

2. Prapti DR, Mohamed Shariff AR, Che Man H, Ramli NM, Perumal T, et al. (2022) Internet of Things (IoT)-based aquaculture: An overview of IoT application on water quality monitoring. Reviews in Aquaculture 14(2): 979-992.

3. O'donncha F, Grant J (2019) Precision aquaculture. IEEE Internet of Things Magazine 2: 26-30.

4. Boyd CE, Tucker CS (2012) Pond aquaculture water quality management. Springer Science & Business Media.

5. Leow BT, Tan HK (2020) Technology-driven sustainable

aquaculture for eco-tourism. WCFS2019: Proceedings of the World Conference on Floating Solutions, Springer, pp: 209-218.

6. Rastegari H, Nadi F, Lam SS, Abdullah MI, Kasan NA, et al. (2023) Internet of Things in aquaculture: A review of the challenges and potential solutions based on current and future trends. Smart Agricultural Technology.

7. Li D, Du L (2022) Recent advances of deep learning algorithms for aquacultural machine vision systems with emphasis on fish. Artificial Intelligence Review 55: 4077-4116.

8. Konečný J, Mcmahan HB, Yu FX, Richtárik P, Suresh AT, et al. (2016) Federated learning: Strategies for improving communication efficiency. arXiv, pp: 1-10.

9. Kalra S, Wen J, Cresswell JC, Volkovs M, Tizhoosh H (2023) Decentralized federated learning through proxy model sharing. Nature communications 14: 2899.