

# Need for application of innovative disruptive technologies to meet the future demand from fisheries and aquaculture sector

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## Abstract

This paper gives an overview of new and promising technologies to better manage fisheries and aquaculture sector to meet the future demand of fish. The paper also discusses the latest development and application of Artificial Intelligence, Internet of Things, Blockchain technologies and Big Data Analytics in fisheries and aquaculture sector for managing the fisheries resources in a sustainable manner right from stocking to consumer's plate. In addition, scope of application of technologies like, Robots, Drones, Sensors, Artificial intelligence, Augmented reality (AR), Virtual reality (VR), 3D printing and Blockchain is discussed aiming possible scenario of next generation to aquaculture. For application awareness and knowledge of immerging advanced technologies like underwater image recognition, seaborne drones, light and laser technology, commercial fishing, fish behavior science, seabed research, fisheries management and big data is the need of the hour for application in the fishery sector. The concept of "Aquaculture 4.0" is introduced for applying industry strategy to fisheries management.

## Introduction

Food and Agriculture Organization(FAO) of the United Nations(UN) anticipates that an additional 27 million tons of fish production will

be needed just to maintain the present level of consumption in 2030(FAO,2015).For this additional enhanced sustainable production from our fisheries, oceans and freshwater resources we must think beyond today's widely used technologies. Further with increased consumer consciousness of health, the sustainability of the seafood sector is the target of constant scrutiny world-wide. Against this backdrop, to combat the situation, the knowledge of immerging advanced technologies like underwater image recognition, seaborne drones, light and laser technology, commercial fishing, fish behavior science, seabed research, fisheries management and big data is the need of the hour for application in the fishery sector. Moreover, it is widely accepted that disruptive technology can affect and drive fish industry transformation. This paper gives an overview of new and promising technologies while discussing the potential of innovative monitoring technologies to better manage fisheries and aquaculture and related areas. The paper also discusses the latest development and application of Big Data Analytics, Artificial Intelligence, Internet of Things and Blockchain technologies in fisheries and aquaculture sector for managing the fisheries resources in a sustainable manner right from stocking to consumer's plate.

## Methods

The study is based on scooping of secondary research information available so far in various

literatures. The available results compiled and presented for next generation researchers.

### Results and Discussions

A thorough survey of existing literature reveals the following technologies that are used for efficient management of fisheries and aquaculture aiming sustainable enhanced production.

#### Application of Disruptive Technologies in Fisheries and Aquaculture Sector:

Disruptive technology' is defined as techniques, skills, methods and processes that achieve an objective better than what went before it, yielding significant benefits to its key stakeholders, and has the potential to be implemented and scaled up in a big way. It is accepted "disruptive technologies" as a term which refers to i. Blockchain technology ii. Internet of Things (IoT) iii. Artificial intelligence (AI) and machine learning (ML) iv. Biometrics v. Drones vi. Virtual, augmented and mixed reality vii. 3D printing. It is felt that applying industry strategy to fisheries management if applied through digitalization and automation of the manufacturing process, based on the integration of disruptive technologies may lead to intelligent, autonomous and decentralized plants which communicate and cooperate with each other and with humans in real time. In line with "Industry 4.0", the concept of "Aquaculture 4.0", can be extended to fishery management strategies that include data collection and exchange between connected nodes, and real time cloud computing processes.

#### Digital Technologies to Disrupt Aquaculture and Fisheries:

As per an available report the following eight technologies are having a profound impact on aquaculture and fisheries sector in the days to come (Altech.2017).

- I. Robots to farm our fish
- II. Drones dare to take on dangerous dives for data
- III. Sensors for smarter, more sustainable aquaculture
- IV. Artificial intelligence empowers aquaculture decision-making

- V. Augmented reality (AR) adds a new dimension to dives
- VI. Virtual reality (VR) is opening the eyes of the next generation to aquaculture
- VII. Blockchain verifies sustainability, improves transparency from fishery to finished plate
- VIII. 3D printing

#### Emerging Technology for Intelligent Aquaculture:

The 4th Generation of Aquaculture takes care of Low labor productivity, Aquaculture Water Utilization Rate, Per Capita Water Resources and Labor productivity and solutions for fish farming as the future of aquaculture is based on Resource conservation, Output efficiency, environmentally friendliness and Product safety. Therefore, emphasis will have to be on upgrading equipment, intelligent networking and unmanned operation. Now scientists associated with the industry are looking for the way to apply the most advanced and cutting-edge technology to aquaculture production to achieve better levels of efficiency, profitability and resource savings like i)Use of big data to optimize production in aquaculture facilities ii)Use of blockchain technology for the traceability of high-value fishery production (Nandini.2018).iii)Deep learning techniques for biomass estimation in aquaculture cages and iv)Use of the Internet of Things for the modernization of the control systems of aquaculture plants. Aquaculture is still far from developing as other agro-food industries in the world are doing, where advances in technologies such as Big Data, robotics, Internet of Things (IoT) or simulation, are increasingly frequent within the production process. All these new Information and Communication Technologies (ICT), and the Operational developments through last generation sensors are intended to serve as a lever to the applications based on Artificial Intelligence (Lee Bruno.2018; Smith 2018;Godfrey.2019). In the future, all fish and crustacean farms on land will be run by an application of ICT so called Smart Farming, where the aquaculture farmer will have accurate, real-time knowledge of what is happening to the working environment and its animals replacing decisions based on

empiricism at present (Dagustin.2019). With these sensors, it is possible to know precisely the hours of maximum feed demand, how much they eat and how long, and how variations in oxygen and temperature affect their behavior. These data conveniently stored and analysed can provide information that facilitates continuous production improvement. The most important of all will be to take to the market products of higher quality, efficiency, performance and preventive maintenance (Daoliang, 2019).

**Generation of Big Data:** Big data is created every day by the interactions of billions of people using computers, GPS devices, cell phones, sensors and medical devices, data-intensive areas such as atmospheric science, genome research and 'astronomical studies. Real time sensors for aquaculture are used in both freshwater and sea water. Generally, sensors are used to monitor critical environmental parameters such as dissolved oxygen, temperature and pH. They are also used to measure nutrient levels and the build-up of wastes such as ammonia (NH<sub>4</sub><sup>+</sup>) and carbon dioxide (CO<sub>2</sub>). Such sensors are particularly vital in systems where water is recirculated and are often linked to alarms triggered when parameters such as dissolved oxygen or temperature are measured outside of safe limits. Oxygen sensors are linked to oxygen or aeration banks to supply supplementary oxygen when needed. In hatcheries or facilities for production of juveniles sensors are deployed within ponds or tanks within buildings. Big data is generated from fisheries include smart weighing at sea, Radio-frequency identification (RFID), smartphones for monitoring, drones, on-board cameras Today big data opens huge opportunities to those who can use it effectively. Now realizing the great importance of big data, many analytical companies are engaged in finding hidden information in big data. According to internet experts the present technological advances to collect and analyze massive sets of data is likely to lead to revolutionary changes in business, and society. Big Data analytics refers to tools and methodologies that aim to transform massive quantities of raw data into information and

knowledge. Big Data offers the opportunity for an improved understanding nature and habitat through i) Early warning ii) Real-time awareness and iii) Real-time feedback.

**Big Data Technologies for Monitoring of Fisheries:** Facing tremendous increase of data for fisheries monitoring, control and surveillance, the Big Data can help in sorting out data coming from new technological tools. Today, data is created and processed on the cloud and displayed in near real-time on mobile devices. Big Data comprises customer transaction records, production databases, web traffic logs, automation, satellites, sensors and IoT. For example, new web-based technology platform e.g. Global Fishing Watch was launched by Oceana, SkyTruth Google in 2015 combining data from AIS sources (terrestrial and satellite) with powerful algorithms to isolate suspect vessel behaviours. In addition, The Eyes on the Seas Project was developed by Pew in partnership with Satellite Applications Catapult, which unites satellite monitoring and imagery data with fishing vessel databases and oceanographic data to help authorities detect suspect fishing activity in MPAs or globally (Anon.2019).

**Big Data to Fight against Illegal, Unreported and Unregulated (IUU) Fishing:** IUU fishing costs the world economy up to 23 billion US dollars a year, poses a threat to the sustainability of fishing in our oceans, and contributes to human rights violations. Collaborative data analyses on shared datasets improve public-private partnerships for research, e.g. the use of hackathons in various parts of the world. Such collaborative efforts contribute to increasing transparency especially when E-reputation of fishers, lenders, insurers, marketers can be made and un-done on the internet, prompting them to follow best practices from fear of consumer boycott (Leory,2016;). Research study on Big Data Analytics to fight challenges of fisheries and aquaculture sector is well reported (Roy, 2019).

**Blockchain for Transparency and Traceability of Seafood Industry:** As per

FAO, Global Fish Production has hit 171 million tons in 2016, 88 percent for human consumption. FAO estimates that by 2030, global fish consumption will be 20 percent higher than 2016 levels. Fishshine and many other prominent scientific agencies believe that this can lead to one of the most valuable industries on the planet. It drops to the weight of its own growth. That is why lending is a key partner in their cooperation with Fishcoin. This makes acceleration of the move towards the more sustainable seafood production of the Unified World Food Program's SDG2 Advocacy Hub. Fishcoin activity expects to understand detectability challenges in first mile for economical fish creation. Singapore-based Eachmile Technologies has created Fishcoin, a blockchain-based detectability framework that it accepts can build the dependability and security of the fish business. Fishcoin's white-colored white farming industries argue that the data is used to increase "efficiency and innovation", and behind this concept and behind the development of this seafood (Lim Guan Yu.2019; Nandini Jaya. 2018).

The FAO depicts a blockchain as a data innovation that goes about as a common record for advanced capacity and following of information related with an item or administration, from the crude creation stage until it lands in the buyer's hand progressively. Blockchain is an advanced, carefully designed record of data, open to everybody. The innovation presently being tested in fisheries and in the sanitation area that holds significant potential to improve market access, particularly for little scope fishers and fish ranchers. The trouble of debasing data in the blockchain fortifies the discernibility of fish items along the worth chain, which will empower more fisheries, hydroponics ranches and fish handling offices to meet import necessities, for example, the nation of source and phytosanitary principles of numerous nations. Improved discernibility will likewise make it conceivable to satisfy developing purchaser interest for lawfully and capably sourced fish. In certain fisheries and hydroponics ranches, it will help with meeting affirmation prerequisites.(Ramsden Neil.2018). Presently seafood consumer wants to know

exactly where her fish comes from and also how it was raised, whether it is safe to eat and the details of how it got from its home to her grocery store seafood case. Top suppliers know that it is essential for doing business in the 21st century. Some even say sustainability and traceability are pulling even with product quality as the top consideration in consumers' minds. Casey Marion, director of sustainability initiatives and quality management systems for Jacksonville, Florida-based Beaver Street Fisheries, says the concept of traceability is related to food safety and quality and being able to follow back an issue to a plant, ranch, or vessel dependent on a specific part or shipment number. Straightforwardness regularly includes gracefully chain planning and really understanding all that goes into a specific retail item. In today's seafood industry there must be full traceability and transparency all the way through the supply chain(Andy .2020).

#### **Conclusion:**

The fisheries sector supplies the principal source of dietary protein for about 3.2 billion people. The FAO predicts the world will have to produce at least 60-percent more food relative to 2006 to feed an estimated global population of 9 billion by 2050. As per FAO the combined global workforce of wild and farm fishermen now hovers at around 60 million people, but that number is expected to skyrocket. Technological and digital advances now allow innovative monitoring equipment to better manage fish stocks, which are used in all stages of the value chain. New technologies, including Big Data, the internet of things (IoT), sensors, robotics, data storage and transmission has become more compact and cheaper thus encouraging their use for efficient management of fisheries resources. Huge data generated from fisheries include smart weighing at sea, Radio-frequency identification (RFID), smartphones for monitoring, drones, on-board cameras and new data processing technologies like big data analytics, block chain, artificial intelligence, data mining are gainfully employed to extract valuable information out of those huge data. The Blockchain technology now being trialed

in fisheries and in the food safety sector that holds considerable potential to improve market access, as it strengthens the traceability of fish items along the worth chain, which will empower more fisheries, hydroponics ranches and fish preparing offices to meet import prerequisites, for example, the nation of cause and phytosanitary guidelines of numerous nations. It is expected that application of emerging disrupting technologies will enrich future researchers about the latest development to carryout research aiming sustainable fisheries and aquaculture management that in turn will meet the nutritional requirement and job opportunities to millions in in future.

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