Big Data analytics for sustainable fisheries in Sultanate of Oman- a case study

Moosa Ameen Al Balushi[1]

PG19F2084@mec.edu.om

Middle East College, Sultanate of Oman

Anjum Zameer Bhat[2]

azameer@mec.edu.om

Middle East College, Sultanate of Oman

Abstract

The economic contribution of marine fisheries all over the world is significant and billions of people all around the world are earning their livelihood from this sector. It is also important to note that fisheries are a very important sector for the Sultanate of Oman to develop in future coming days. As the Sultanate of Oman has the maximum dependency on Petroleum resources, it is of utmost importance to realize the need for the development of other sectors like fisheries. The demography of the Sultanate of Oman poses it very well to excel in this sector because the Sultanate of Oman has 3,165 km of coastline. However, it is very important to understand the requirement for modernization of fisheries in the Sultanate of Oman to not only cater to the local requirements however develop this sector to export the fisheries products to other countries as well. This research paper is a study related to fisheries in the Sultanate of Oman to enhance the production of fisheries by the implementation of technological aids like big data and big data analytics. This research study also emphasizes the introduction of new technologies to reduce the running cost of the vessels on an everyday basis to decrease the overall cost and as a result enhance significantly the benefits of the fisheries sector. The research paper provides a variety of aspects related to big data analytics that can be utilized for the benefit of fisheries in the Sultanate of Oman. This research paper is a mere effort to study and reflect the yields of big data analytics in fisheries in the Sultanate of Oman.

Keywords

Big Data Analytics, Big Data for Fisheries, Fisheries in Sultanate of Oman, Big Data analytics for sustainable fisheries

Introduction

In today's world, the data can be produced and implemented via different technologies like IoT, sensors, satellites and are growing in potential way. All interconnected devices are utilized in various sectors of life and providing benefits to the people such as health care, business, transportation, agriculture, communication etc. (Islam, Kwak, Kabir, Hossain, & and Kwak, 2015). The Internet of things has been utilized off late in almost every area and sector we can think of. Some of the examples of implementation of Internet of things and big data analytics can be clearly witnessed in the literature (Zameer, Saqib, Naidu, & Ahmed, 2019) (Muhsin, Bhat, Mohamed, & Khan, 2019) (Muhsin, Bhat, Ahmed, & Khan, 2019) (Bhat & Ahmed, 2016).

Big data analytics delivers high value of firms by reducing the expenses and creating new methods for innovation and creativity. However, the reason behind big data analysis exploitation is create the business knowledge to understand the related business process and its environment that can be used for decision making firms (Davenport, 2014)

Big data can be defined as a collection of large, complex and heterogeneous datasets that are difficult to process and evaluate using traditional tools and software. Typically, big data has different features to describe: volume (referred

to scale and quantity of data generated), velocity (the rate and speed at which the data is created and analyzed) and variety (different formats of structured and unstructured data) also additional characteristics like value (extracting valuable information from data), veracity (accuracy of data), variability (changing of data constantly) and visualization (reading and presenting data) (Erevelles, Fukawa, & Swayne, 2016). Moreover, different analytical methods and technologies for utilizing in the management and analysis of huge and complex of data sets for use of different applications (Kabanda, 2020)

Fishery in the Sultanate of Oman is most ancient and very important sector since 1960s and before oil was explored 80 percent of population lived on this sector and even today approximately 40 percent of people depend on this sector as source of income. Hence, the Sultanate of Oman has huge coastline which is more than 3,000 KM long from three different water bodies the Arab-Persian Gulf, the sea of Oman and Arabian sea (Al-Oufi, 2000). Furthermore, it has been considered as the second most valuable resource sector due to its role of growing the economic, also contribution of food security and employment generation. According to (Setlur, B. and Arbuckle 2015) fisheries in Sultanate of Oman is not economically productive and it's infancy. In 2016 the total production of fisheries sector was 280 thousand tons that worth 204 million Omani riyals and exports amount was 152,000 tons about 73 million RO. (*Omaninfo.Om* 2021) However, there is need to improve the fishery sector in the sultanate of Oman to be sustainable by using different king of technologies like Big Data, Internet of Things (IoT), Artificial Intelligence, Machine learning etc. Also, in order to achieve and implement the goals of Oman vision 2040 related to fishery:" to create a profitable world class sector that's ecologically sustainable and a net contributor to Oman's economy" (Setlur & Arbuckle, 2015)

Recent technologies revolution will assist to collect, manage and analyze the relevant data of fishery in order to provide appropriate solutions to make the sector more sustainable and reducing the costs and allowing adaptive responsive for management decision making (De Souza, Boerder, Matwin, & Worm, 2016)

The Proposed System

Technological and digitalization becomes an innovative for monitoring and tracing different activities for managing fisheries. However, different tools and systems used to maintain fisheries productivity and keep fishing data to observes the onboard of vessels movements. The system can be equipped with the storage and analysis capabilities on the cloud to perform the computing operation with the cloud infrastructure that is appropriate for such kind of tasks. Cloud computing has been utilized for a variety of such tasks in the past as well (Bhat A. , Role of Cloud Computing in higher education and implementation challenges in higher education establishments in Oman and India, 2018) (Bhat, Kameshwari, & Singh, MathCloud: A Discrete Cloud Implementation to Enhance Learning Experience in Mathematics, 2020) (Bhat, Singh, & Singh, Learning resources as a service (L r aaS) for Higher Education Institutions in Sultanate of Oman, 2017) (Bhat, Naidu, & Singh, Multimedia Cloud for Higher Education Establishments: A Reflection, 2019) (Bhat, Shuaibi, & Singh, Virtual private network as a service—A need for discrete cloud architecture, 2016) (Bhat, Singh, & Mohsin, Cloud Implementation to Assist Teachers of English to Speakers of Other Languages in HEI's in Sultanate of Oman, 2021).Many electronic monitoring systems like electronic logbooks, gear sensors, cameras, global positioning systems and many more can realize many information and data related to location of fishing, operations, duration of fishing, the number, type and size of fishes.

Electronic Monitoring

Traditionally the fisheries observers were used to collect the information of vessels activities. Accordingly, it was so difficult due to the additional costs and require more space onboard (Bartholomew, et al., 2018)

Electronic monitoring systems designed to record and monitor vessels activity in real time at the sea. Furthermore, EM systems are cost effective and capable to improve and surveillance by covering large area. The hardware part of EM system as shown in Figure 1 looks different usually a central computer attached to sensors and combination of (CCTV)camera, a hydraulic pressure and GPS to indicate fishing start time.
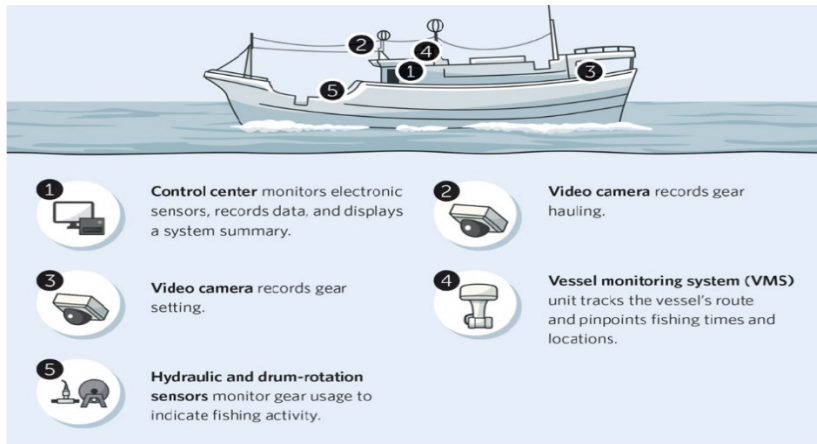
Figure 1 EM system for vessel

Study has been conducted for tracking the performance of EM for more than 25 thousand fishing days and it verified the accuracy of onboard logbooks, increase the data collection of bycatch, reduce the illegal and unregulated fishing and increase the ability of authorities to monitor of fisheries activities (Emery, et al., 2018)

Mobile Computing for fisheries

Mobile technologies are globally proliferated and it make advancement for fishery by dependent on data system. However, the mobile devices like smartphones and tablets are portable and ubiquity that can be helpful for collecting the data for fishery. In addition, those devices have many functions like GPS system, Camera, accelerometer and notepad functions for capturing data and storing it into cloud database (Gutowsky, et al., 2013). Those devices has incredible role for developing the socio-economic of fishermen by saving the cost, energy and time. Furthermore, it can be used to define the fishing spots by using GPS and fishermen can allocate the location to go the exact location either at day or neigh (Omar, Hassan, Shaffril, H.A., & and D'Silva, 2011)

Although, mobile technologies applications can collect a large amount of data then store it in cloud and analyze it as real time fishery data. Also, it can help for monitor, enforce and evaluate the fisheries activities to improve the sustainability and be more manageable.

Vessel Monitoring System (VMS)

The vessel monitoring system (VMS) is a satellite-based system and used to extend economy zone management surveillance, fisheries search control and rescue. However, it provides the user tools and resources to monitor the vessels movements and evaluate fishing fleet behavior such as finding fishing location by sending data via satellite to the system for analyzing in order to comply the vessels behavior for resource management purposes and law enforcement. Furthermore, VMS can be used to examine different fishing activities at higher temporal resolution for more precise estimate of efforts (Joo, Salcedo, Gutierrez, Fablet, & and Bertrand, 2015).

A research conducted by (Watson, et al., 2018) using VMS data to build probabilistic system for estimating the fishing duration and combing the results with VMS model with logbook data to derive fishing performance and activities for each trip and test increasing fishing efficiency with less efforts. Three data sources has been integrated to the modeling approach include observer, VMS and logbook data. After analyzing one million records made by 150 vessels to identify 4371 longline trips. After combining the VMS data with logbook information it's summarized that the vessels landed with more fish and generated higher revenues in less time with decreased costs and efforts.

Vessel Monitoring System (VMS) has been implemented in different countries across the world with multiple ranges of transceivers. However, some coastal states like Croatia and Albania have hybrid technology that allow to install VMS transceivers with lower costs compared to satellite technology. VMS can calculate fishing intensity by mapping

spatial distribution of vessels for example if fishing is prohibited in some area, the VMS information can be used to steer fishers away from designated areas. Furthermore, it can be used as cost effective tool to establish marine spatial planning to minimize the loss of revenues for fishers and to meet the conservation goals of marine protected areas (Gonzalez-Mirelis, 2014)

Conclusion

The fishery in Sultanate of Oman is considered an important sector for national economy and food security. However, the government plays an important role to get benefits of this sector and provide socio-economic goals to the users. Implementing technologies in fisheries to manage, monitor and evaluate in order to improve the effectiveness policies for the sustainability. Applying big data technologies in fisheries can be innovate monitoring for vessels in order to manage fish stocks. Many devices and systems used to collect and analyze data like electronic monitoring by using CCTV, different types of mobile computing, Vessel Monitoring System and many more. The role of those systems is clear to protect fisheries from suspect activities and protect to be more sustainable.

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