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Big Data for Indonesian Marine Fisheries
A Preliminary Research Plan

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ABSTRACT
As a maritime country, Indonesia has a wider water area than the land area, but the number of fishermen has decreased every year which indicates the welfare of fishermen has also decreased. On the other hand, the growth and development of marine data from various institutions in Indonesia have increased rapidly, supported by streaming data. However, these data have not been managed optimally or just left alone. The data can be used to help the performance of the fishermen so that they can improve their standard of living. The huge and diverse amount of data requires the use of technology to extract data from many sources so as to analyze it in order to find potential problem-solving solutions. This study proposes an initial design for big data technology with an architecture designed to be able to overcome the problems of Indonesian marine fisheries.

Keywords: *Big Data, Big Data Application, Oceanographic Data, Maritime Applications.*

1. INTRODUCTION

Indonesian waters are so vast and have great potential in the field of fisheries [1], supported by the fact that the territorial waters owned by Indonesia are wider than the land area. The potential of these waters has been managed for a long time but has not been maximally carried out and is still struggling with old technology. One of the reasons is the lack of rapid technological renewal in the Indonesian fisheries sector.

Based on the Agricultural Census Data Excerpt by the Central Statistics Agency (BPS) in the 2018 Ministry of Maritime Affairs and Fisheries (KKP) annual report, it showed a decrease in the number of Fishery Households from 1.6 million (2003 Agricultural Census) to 868.41 thousand (2013 Agricultural Census). This decrease indicates a change in public interest in the fishing industry and the inability of fishermen to meet their daily needs [2].

Gross Domestic Product (GDP) of Fisheries is estimated at Rp.62.31 trillion in Q1-2019 113.08 percent in May 2019, Fishermen's Exchange Rate (NTN) 113.08 percent in May 2019 [3]. This fantastic value is not accompanied by an increase in the welfare of fishermen, where most of the fishermen live on the poverty line [2]. Lack of efficiency in fishing is one of the causes of the lack of fishermen's income; the absence of recommendations for fishing paths, times, and locations makes fuel and fisherman supplies more expensive than the profits obtained from the catch.

Fishing lanes sometimes have to intersect with shipping traffic, not infrequently collisions occur between fishing boats and other ships. This can be avoided by regulating sea traffic lanes, so as to reduce the risk of loss of life and property.

Fishing time is also a problem in itself, where there is a surge in catching one type of fish that affected the market price of that type of fish. The decline in selling prices also causes losses for fishermen. It is necessary to determine the points of catching certain types of fish based on the changing seasons, weather, and potential fishing locations. If there is stability in the number of catches, it will benefit fishermen in selling prices and reducing fishing costs.

In 2017, the value of Indonesian fishery exports had reached $70.9 trillion [2]. It is possible that this achievement can be increased by the potential use of satellite imaging technology; prediction of fish migration, weather, and fishing locations; tracking illegal fishing and legal fishing. To give birth to big data technology for maritime purposes, a technology that is able to handle very large amounts of data in real-time is needed, where the technology that is able to overcome this issue, namely the big data technology.

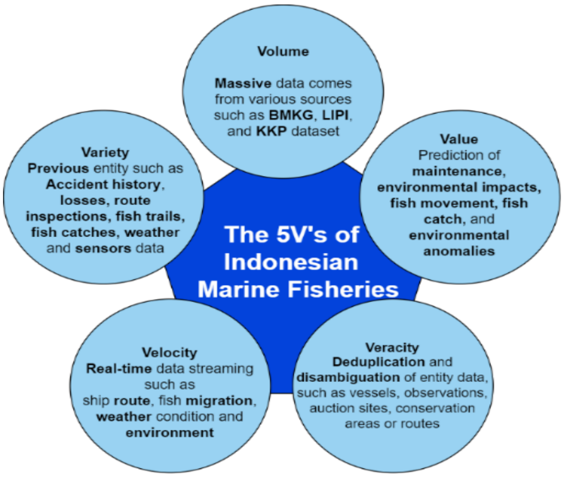

Figure 1 5V in Indonesian Marine Fisheries.

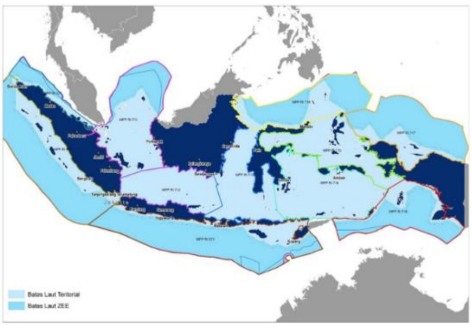

Figure 2 The 11 Areas of Fisheries Management of the Republic of Indonesia [2].

2. LITERATURE REVIEW

Information technology related to the fishing industry includes mapping of fishing activities and good fishing grounds using satellite imaging technology [4]; satellite imaging uses hotspots as predictions of fish activity [5].

Studies related to the use of Big Data in the field of fisheries include: prediction of the crab season for cancer magister [6], big data management to help fisheries in China [7]. Broader big data management that covers all oceans in the European Union and several parts of the world has been carried out, where big data management helps determine shipping lanes, detect weather and water anomalies, maritime conservation [8], and map marine biota [9].

Several technologies owned by KKP have been used to assist the development of the fishing industry, namely the visible infrared imaging radiometer suite (VIIRS) and boat detections (VBD) with a vessel monitoring system (VMS). The VIIRS system is able to detect illegal fishing across the 11 Indonesian Fisheries Management Areas (WPPNRI) [9] as depicted in Figure 2.

3. METHOD

3.1 Data

The data sources used come from several institutions, namely the Meteorology, Climatology and Geophysics Agency (BMKG) has sources for data on cloud movement, air movement, changes in seawater temperature, changes in ocean currents and waves; The Indonesian Institute of Sciences (LIPI) has sources for regional mapping as well as data on the distribution of ammonia, carbon dioxide, sulfur, etc.; The KKP has sources for data on catches, specifications of fishing vessels, vessel movements, mapping of fishery areas, fish auction centre points, and fish prices at each of the corresponding points.

The data used are SQL data, GIS data, and Stream data. SQL data contains fishing boat information data. GIS data contains regional mapping data. Data Stream is related to data that changes every time, such as cloud movement, air movement, temperature changes, ocean waves, and chemical changes. This stream feature uses a continuous model.

3.2 The Proposed Architecture

The big data architecture proposed in the study can be seen in figure 3. Batch, SQL, and Stream data will be handled by respectively MapReduce, Spark and Hive to simplify installation and its compatibility. Streaming data management capabilities, analysis of unstructured data as well as the management and storage of very large volumes of data are the focus of this section. Another side that is not less important is data security, where the security that will be used is the Apache Knox gateway. The Apache Knox Gateway is a system that provides a single point of authentication and access for Apache Hadoop services in a cluster.

In order to fulfill the capability aspect regarding the proposed architecture, Cassandra is used to support the performance of Apache Spark since it has the ability to store data in the form of multiple columns. This is necessary because the data obtained from the relevant agencies may not be complete. Besides Cassandra can be used as a data warehouse and data storage, Spark integration requires the use of Scala or Java.

The data analysis process will be carried out by considering aspects such as weather, water flow movements, and ship traffic. However, Spark's performance for data analysis is not very good, thus to overcome this, Hive is used instead of Spark. Hive is considered in which it has better performance than Spark. This relates to the real-time system required by this design. The analysis process is also carried out using Mahout to strengthen Machine Learning. Visualization of the results will utilize the Spark and Tableau.

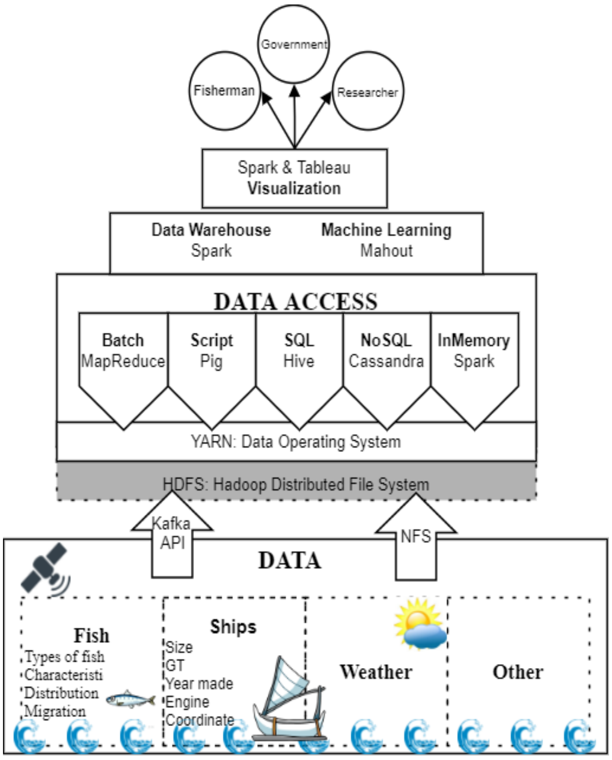

Figure 3 The Proposed Big Data Architecture.

3.3 Big Data Process

The data obtained from various sources are then processed to produce predictions and display the performance of fishermen, as well as to help show whether a policy has a good impact or not. An overview of the process is shown in Figure 3. Data collection on types of catches and catches is carried out by stream through Kafka, which is continuous. Furthermore, the data will be processed into Cassandra. The data will be used as a reference by Mahout to predict the position and distribution of fish catch types. For example, if a fisherman is going to catch a type of *longfin tuna*, the fisherman will be recommended to sail to the southern part of the Indonesian Sea (depicted in Figure 4), then based on the fishing history, the bait drop points will be predicted using Mahout.

Ship movements are monitored using the Global Positioning System (GPS) live streaming using Kafka to avoid unwanted things and to help provid recommendations for the best route or path to catch fish. An illustration of the position of fishermen and their surrounding conditions is shown in Figure 5. The vessel is in the form of a trapezoid, where the vessels will send their coordinates to the system so that recommendations for safe fishing routes comply with international law.

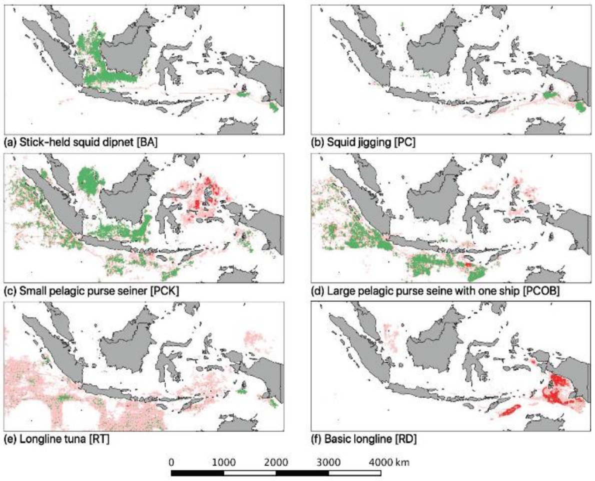

Figure 4 Distribution Patterns of Certain Types of Fish and Recommended Fishing Techniques to Fishermen [9].

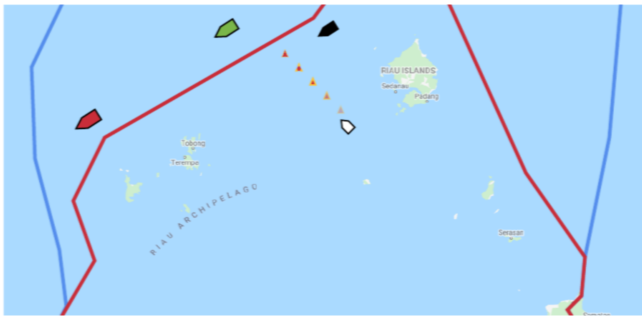

Figure 5 Illustration of Fishermen's Position and Surrounding Conditions With Mapping Based on UNCLOS (1982).

Spark visualization for data warehouse and Tableau for visualization in real-time with several options including, for fishermen, a map of shipping routes will be displayed, fish movement predictions, recommendations and opportunities for types of fish catches, recommendation points for certain fish catches, fish auction points along with the latest prices, etc.; for the government and researchers: the quality of the catch, welfare of fishermen, illegal fishing, stabilization of certain fish prices, fish export flows, etc., will be displayed.

4. RESULT AND DISCUSSION

4.1. Business Perspective

The implementation of big data aims to assist fishing efficiently so as to reduce costs and environmental impacts caused by fishing. If all these goals are realized, the welfare of fishermen will certainly be elevated. This fact will also give an endorsement in creating job opportunities in the fisheries sector. However, there are several impacts that will be faced by fishermen, such as the need for capital to equip and training for fishermen in using this technology. On the other hand, new fishermen will be very dependent on this technology, so it is very unfortunate if the knowledge of local wisdom passed down from generation to generation in coastal families will gradually disappear. The advantage for the government is that this proposed architecture will give support in the process of monitoring new policies, water traffic, fishing activities both legal and illegal, avoiding encroachment by fishermen. The cost incurred by the government to build this design is not cheap, it takes good maintenance and system updates to make this design as a long-term investment.

4.2. Technical Perspective

The development and construction of this proposed architecture can lead to innovation and research related to the use of big data in the maritime sector, especially in Indonesia. It is not impossible that new architectural ideas will emerge that are better than this architecture. In terms of business processes, several processes can be cut by developing this design, such as cutting time both from weather forecasting and water conditions, trimming the shipping traffic communication process, avoiding stopover events by fishing boats to fish auction places just to find the best price. Although there has been use of Knox to answer security problems on this design, the security problem itself is still an issue related to how the system can be guaranteed security in maintaining the data collected inside.

5. CONCLUSION

This design of big data implementation in marine fisheries is that it opens up new possibilities for many parties involved: fishermen, government, and researchers. Improved operational efficiency, improved customer satisfaction, drive for innovation, and maximizing profits, opening up opportunities to make better decisions, and increasing productivity and efficiency in terms of maritime purposes are only a few among the many benefits of this proposed design if it has been implemented.

Although it has amazing potential to improve our marine fisheries, this design is still open up for open to continuous improvement. The implementation of this design requires cooperation and joint commitment between related institutions in Indonesia. The data sources needed for this design also involve many parties and many sources.

There are many possibilities for further studies that can be carried out related to big data design architecture for the benefit of marine fisheries. Given that this study is a proposed design, this design still requires further review, implementation, and adequate funding.

ACKNOWLEDGMENTS

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