Global Fishing Watch System as a solution in the control of the fishing industry in Indonesia

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Abstract. This study aims to investigate the application of the Global Fishing Watch System as a potential breakthrough in the fight against illegal fishing and fishing that is not reported or regulated. This study utilized a socio-legal method by investigating the legal norms contained within legislation relating to the disclosure of public information and conducting interviews with actors from the fishing business. The findings of this investigation indicate that there is a requirement for government regulations to be able to remedy infractions in the fishing industry by making allowances for information technology. The Global Fishing Watch System is a piece of information technology that may be utilized, and it is open to the community for anyone to access. On the other hand, this goes against letter d of Article 17 of Law No. 14 of 2008, which states that information regarding Indonesia's natural resources cannot be disclosed to the general public. Consequently, the Global Fishing Watch System requires additional research before it can be put into effect effectively.

Key Words: fishing industry, implementation, public information disclosure, the Global Fishing Watch System.

Introduction. Indonesia is the largest archipelago country globally, has a coastline length of 81,000 km and a sea area of about 3.1 million km^2. The territorial sea area and archipelago waters cover almost 2/3 of the territorial area. Based on the United Nations Convention on the Law of the Sea 1982 (UNCLOS 1982), Indonesia obtained the right of authority to use the exclusive economic zone (EEZ) covering an area of 2.7 km^2 which involves the exploration, exploitation, and management of biological and non-biological resources, such as fish wealth, coral reefs and alternative resources that are below sea level (Darsono 1999). So, with this abundant potential, many fishery industries are found in Indonesia. Based on data from the Central Statistics Agency in 2018 (Soemarmi et al 2020a, b), the fishing industry in Indonesia experienced a very drastic increase; in 2016, there were 95 fishing industries, while in 2017, there were 122 industries, as shown in Figure 1.

Although fishing is one of the most widespread activities humans harvest natural resources, its global footprint is poorly understood and has never been directly quantified. Global fishing patterns have surprisingly low sensitivity to short-term economic and environmental variation and a strong response to cultural and political events such as holidays and closures (Kroodsma et al 2018).

Indonesia is a country with the second-longest coastline in the whole world (No title n. d.), but the export of marine resources is the only second rank in Southeast Asia; its potential for capturing fisheries in Indonesian public waters is estimated at 0.9 million tons of fish per year with a total area of around 54 million hectares which includes lakes, reservoirs, rivers, swamps, and other puddles (Regulation of The Ministry of Maritime Affairs and Fisheries 2012). Nevertheless, according to FAO data, Indonesia loses the US $ 50 billion per year due to illegal fishing (FAO 2012). Illegal fishing cases in Indonesia, both by the Indonesian and foreign fish boats, have become a classic problem in the Indonesian fishing industry. Government policies through the Ministry of Maritime Affairs and Fisheries continue to be issued, such as the addition of surveillance operation

vessels, strict legal action against violators, to other decisive efforts. These efforts are conventional and technological (Afriansyah 2018; Soemarmi et al 2020a, b).

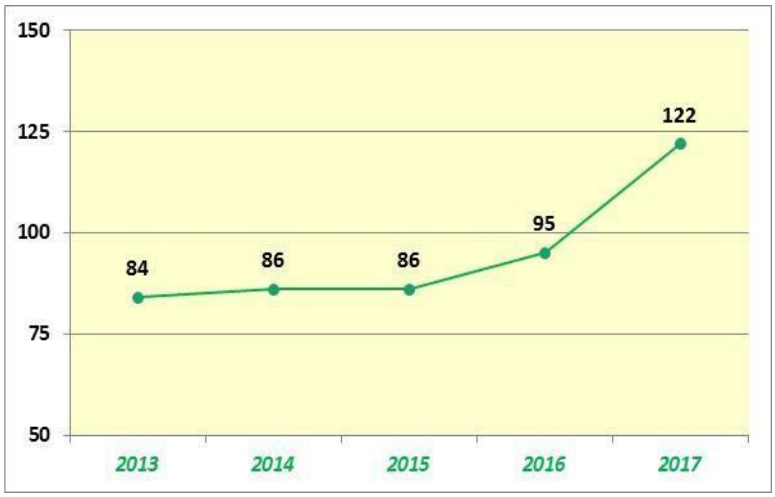

Figure 1. Total fishing industries in Indonesia from 2013 to 2017.

One of the technologies applied by Indonesia is the use of the Global Fishing Watch System (GFWS) as an effort to monitor the fishing industry digitally. This is in line with the current globalization and the era of the industrial revolution 4.0, which impacts the development of the fishing industry through the digitalization of the functions and uses of technological devices. In 2016, the GFWS technology was officially launched in the United States, and Indonesia became the first country to adopt the technology. Later, the monitoring data of the GFWS results will be accessible to the world community and government instruments in overseeing every fishing industry activity.

Wide-open access to information has received more attention from the Indonesian Traditional Fishermen Association because it is feared that it could threaten the sustainability of the fishing industry in Indonesia. The Government of Indonesia should place strict limits on the public accessing the fishing vessel surveillance data. Related to the open access to information, it must also be reviewed in terms of existing regulations. In Article 17 letter d of Law No. 14 of 2008 concerning Openness of Public Information, it is explained that "Every Public Agency is required to open access for every Public Information Applicant to obtain Public Information, except Public Information which if opened and given to Public Information Applicants can reveal Indonesia's natural wealth". It means that the Minister of Marine Affairs and Fisheries, as a public body, is not allowed to open access to information to the public if it would reveal Indonesia's natural wealth to the outside world.

The main objective of this study is to learn more about what is GFWS and the opportunities and challenges of implementing GFWS in the Indonesian fishing industry with the regulations relating to information disclosure.

Material and Method. The method used in this study is the socio-legal research approach because it refers to a combination of research sources in the form of legislation and opinions of experts who are prepared, described, and illustrated to obtain the results of the research (Soemitro 1990) with social science discipline in the form of the operation of law in society so that it becomes a single approach (Banakar & Travers 2005). This approach is carried out by examining the legal norms in the laws and regulations relating to public information disclosure and the policy for accelerating the development of the fishing industry, and the impact of implementing GFWS in overseeing the fishing industry in Indonesia. This study used combined primary data and secondary data. Primary data was taken from interviews with fisheries industry actors such as ship owners, crew, and related parties. Secondary data was obtained from library research and documentation, which is the result of research from previous researchers. Secondary data obtained from sources in primary legal materials consist of various legal instruments. The secondary

legal materials include books, scientific research, journal articles concerning the research topic, and tertiary legal materials, such as legal dictionaries and Indonesian language dictionaries (Soekanto & Mamuji 2006).

Results

Global Fishing Watch System technology. GFWS, a project from Oceana, Sky Truth, and Google, with generous support from the Leonardo DiCaprio Foundation, was created to decrease illegal ocean fishing. GFWS uses crowdsourced solutions, technology, and public engagement to accomplish its mission. GFWS was unveiled to the public in 2016, and its open web platform shares tracking data and information on 60,000 commercial fishing vessels in near real-time (Nugent 2019).

Seafood suppliers can keep tabs on the vessels they buy fish (Merten et al 2016). GFWS is making the impossible possible by providing the first open-source global near-real-time record of apparent fishing efforts. Citizens can use it to see whether their fisheries are effectively managed and hold their leaders accountable for long-term fishery sustainability.

Hundreds of millions of people worldwide depend on the ocean for their livelihoods, and many more rely on it for food. The public can act as watchers to improve the sustainable management of global fisheries. Responsible fishermen can use GFWS to show they obey the law. Researchers can access records of all fishing activities to conduct applied scientific research and thus policy goals for marine conservation. Collectively, the various applications of GFWS will help reduce overfishing and illegal fishing and help restore the ocean's abundance and ensure sustainability (Merten et al 2016).

GFWS is a consortium consisting of Google Earth Outreach, Sky Truth, and Oceana, which provides a visualization tool for global vessel movement activity based on an automatic identification system (AIS) combined with a vessel monitoring system (VMS). Google is a technology company that is big enough to provide Google Earth and Google Maps services to see the movement of fishing vessels around the world visually.

AIS itself is designed as a security platform for ships to avoid collisions at sea. The system displays the ship's identity, location, speed, and destination quite accurately. Meanwhile, VMS is a system in the form of a transmitter that must be installed and activated continuously on a ship size of more than 30 gross tons.

Although the GFWS coverage is relatively complete for the high seas at the global scale, there is significant variability in the extent of coverage in coastal waters and at regional scales. AIS data lacks small-scale fisheries and is biased toward industrial fisheries and wealthier nations. The vast majority of large vessels (> 24 m), more likely to carry AIS, are from upper-middle-income or high-income countries. AIS regulations exacerbate this: *"Reconstructions of the global fishing effort distribution using gravity models have been available for some time, but although very useful for the study of interannual effort distributions, these model-based reconstructions lack sub-annual temporal resolution. Recent improvements in satellite coverage and artificial intelligence analysis have made it possible to follow the fishing activity of industrial vessels through the monitoring of their Automatic Identification Systems (AIS), a security device implemented to prevent collisions. The GFWS project has collected these data since 2012, and developed convolutional neural network algorithms to distinguish fishing from non-fishing activities and identify the effort distribution for different fishing gear types at high spatial and temporal resolution. AIS has inherent limitations that restrict coverage largely to industrial vessels fishing offshore, and thus is less inclusive than some model-based reconstructions. Yet it complements earlier work by providing a direct empirical view of the seasonal variation of fishing effort worldwide".* (Guiet et al 2019).

The main objective of this study is to describe the seasonality of fishing effort by gear type in the GFWS dataset, including variation in the total effort, spatial characteristics, and variation as a function of the distance to the nearest port. We subsequently discuss the first-order mechanisms expected to contribute to ecological versus socio-economic drivers of the observed seasonality.

Until recently, most publicly-available estimates of global fishing effort relied on data aggregated at the country level from which spatial distributions were estimated using assumptions on the attractiveness of fishing grounds. The GFWS has recently revolutionized the availability of global effort data by analyzing the positions of boats tracked since 2012 using the AIS. AIS are safety devices used to avoid collisions between ships at sea. They broadcast information about their position and direction every 2 seconds to 3 minutes. This information can be received by ships in the neighborhood and by receivers in line of sight and low-orbit satellites. While regulations for fishing vessels vary by flag state, AIS is a compulsory device on almost all fishing vessels larger than 300 gross tons. It is becoming mandatory or otherwise widely adopted for many smaller vessels. GFWS collects these data to map the distribution of AIS-tracked fishing vessels at a high temporal resolution, providing a transparent image of global fishing activities. The AIS messages provide a series of positions for each vessel, which are then processed by two convolutional neural networks to characterize the vessel and detect periods of fishing activity (Guiet et al 2019).

We will mainly focus on the first five categories of gears. The first model characterizes fishing vessels and their gear type with 95% accuracy compared to labeled data. The second model identifies the periods of fishing activity and provides effort distributions for each gear type, namely trawled gears, fixed gears, drifting longlines, and purse seines, with respectively 96%, 97%, 94%, and 95% accuracy. For squid jigger vessels, the fishing activity is detected when they are standing still for more than 4 hours at night, more than ten nautical miles from shore. A sixth category, 'other', includes pole and line, trolled, and other less common types of gear. When the fishing vessel sizes are taken into account, the GFWS effort accounts for an estimated 50-70% of the total energy used by all fishing vessels beyond 100 nautical miles from land (Guiet et al 2019).

The GFWS estimate of effort used here is the number of fishing vessel days per 1.0^{o} grid cell. The number of fishing vessel days in each grid cell is determined at daily resolution by summing the number of vessels fishing at least once during a given day. The aggregation of fishing effort to a daily resolution is intended to smooth out differences in the proportion of time spent looking for prey vs actively fishing among different gear types. For example, a purse seiner targets schools of fish and will typically spend a large fraction of time searching before deploying a net, whereas longliners deploy their gear for several hours each day with little or no search time. We chose a resolution of 1.0^{o} (i.e., dimensions of roughly 110 x 110 km at the equator) because it corresponds to the approximate spatial dimension of a longline set (the most commonly used gear type in the open ocean) and the daily scale of movement of many industrial fishing vessels. Using a higher resolution would impair the detection of interannual seasonal signals due to low absolute vessel presence in each grid cell.

The spatial resolution of 1.0^{o} is of the same order of magnitude as previous model-based methods. However, temporal resolution is by day instead of a year and is directly observed rather than reconstructed (Guiet et al 2019). In contrast, lower resolutions impair the identification of fine seasonal spatial patterns.

Some of the strongest regulations are in European Union, where all fishing vessels 15 m or larger are mandated to broadcast AIS. In contrast, only a small fraction of the fleets of many developing nations are broadcasting, such as those in Africa, South Asia, Southeast Asia, or Latin America. An important region particularly lacks AIS data is Southeast Asia, including Indonesia, where AIS use by fishing vessels is low and where reception from satellites is poor due to signal interference from large non-fishing vessels using AIS in the region. In addition to coverage issues, AIS signals can be manually turned off, impairing the estimation of a global effort for some fleets. Because of these limitations, the dataset may be less inclusive than other effort estimates (Guiet et 2019).

Despite these caveats, the global scope of the GFWS dataset and high temporal resolution makes it an unprecedented source of information to assess the main drivers of fishing seasonality on a global scale. We consider GFWS effort distributions from 2015 through 2017, selecting only vessels that were continually active throughout the three years to remove any trend due to the gradual increase in adoption of AIS devices.

Since the first records of human fishing activity for pelagic species about 42,000 years ago, the face of global fisheries has changed significantly. Fishing vessels have progressed from small man- and wind-powered wooden boats fishing close to shore with handlines and nets to large, ocean-going, machine-powered vessels capable of circumnavigating the globe and using sophisticated technology to find and extract about 90 to 120 million tons of fish every year. The footprint of modern fisheries is stretching further than ever, covering more than half of the global ocean and reaching remote regions and depths exceeding 2,000 m. Fisheries play a vital role in the global economy and food security, supplying 17% of the human population with a significant share of their animal protein intake and, combined with aquaculture, meet an ever-growing demand for fish around the world: per capita fish consumption has more than doubled over the last 50 years, an increase exceeding that of meat consumption from all terrestrial animals combined, and shows no signs of decreasing shortly (Boerder 2018).

The industrialization of fisheries has sped up and intensified overexploitation on a global scale. While overfishing is no modern phenomenon, over 33% of all globally assessed stocks are overfished, and a further 60% are maximally sustainably (fully) fished. In contrast, underfished stocks have declined steadily to about 7% (Boerder 2018).

Catches have been mostly stagnating since the mid-1990s and possibly declining when accounting for illegal, unreported, and unregulated catches. Despite the increasing effort, overfishing is reducing the available seafood supply by an estimated 16.5 million tons per year (Pauly & Zeller 2016; Derrick et al 2017). Next to overexploitation, destructive fishing practices such as bottom trawling and illegal fishing are putting additional strain on fish stocks and marine ecosystems, raising concerns about the sustainability of global fisheries (Boerder 2018).

GFWS technology was first launched on Thursday, 15 September 2016, in Washington DC, United States. The launch was held on the sidelines of the implementation of Our Ocean Conference (OOC) 2016. Indonesia became the first country to adopt GFWS technology that can monitor fishing vessels in all fisheries management areas and be freely accessed by the public.

Through the Ministry of Maritime Affairs and Fisheries' collaboration with Google, Oceana, and Sky Truth, the Ministry of Maritime Affairs and Fisheries opened data on fishing vessels operating in 11 Fisheries Management Areas that can be freely accessed the public on the website www.globalfishingwatch.org.

According to Article 2 paragraph (1) of the Regulation of the Minister of Maritime Affairs and Fisheries No. 18 of 2014 concerning Fisheries Management Areas, eleven regions make up the fisheries management areas of the Republic of Indonesia. These regions are as follows:

1. Fisheries Management Area 571 covers the waters of the Malacca Strait and the Andaman Sea;
2. Fisheries Management Area 572 covers the waters of the Indian Ocean to the west of Sumatra and the Sunda Strait;
3. Fisheries Management Area 573 covers the waters of the Indian Ocean south of Java to the south of Nusa Tenggara, the Sawu Sea, and the West Timor Sea;
4. Fisheries Management Area 711 covers the waters of the Karimata Strait, the Natuna Sea, and the South China Sea;
5. Fisheries Management Area 712 covers the waters of the Java Sea;
6. Fisheries Management Area 713 covers the waters of the Makassar Strait, the Gulf of Bone, the Flores Sea, and the Bali Sea;
7. Fisheries Management Area 714 covers the waters of the Tolo Bay and the Banda Sea;
8. Fisheries Management Area 715 covers the waters of Tomini Bay, Maluku Sea, Halmahera Sea, Seram Sea, and Berau Bay;
9. Fisheries Management Area 716 covers the waters of the Sulawesi Sea and the northern part of Halmahera Island;
10. Fisheries Management Area 717 includes the waters of the Cendrawasih Bay and the Pacific Ocean;
11. Fisheries Management Area 718 covers the waters of the Aru Sea, Arafuru Sea, and East Timor Sea.

When opening the site, there is a blue map in the middle of a web page similar to the Google Earth application. Several dots with two colors, yellow and green, are scattered in several glasses of water in Indonesia, including those in the deep oceans in the Pacific and Indian Oceans. The yellow color indicates fishing vessels and commercial vessels from around the world. While the green color shows Indonesian ships using VMS. The public can see the movement of ships detected through the Google satellite. Information on the site is updated in real-time by Google, so the data displayed is updated and up to date and can be justified (Roan 2016).

Supervision of fisheries industries in Indonesia In the fisheries industry development system, supervision becomes very important. Through the Ministry of Maritime Affairs and Fisheries as an authorized stakeholder in the fishing industry, the government has several instruments that can be carried out to conduct surveillance of the fishing industry in Indonesia. One of them is through the use of supervisor speedboats. According to data from the Central Statistics Agency in 2016, the number of supervisory speedboats was 109 units (Soemarmi et al 2020a, b). The distribution of supervisor speedboats on the island of Sumatra is 27 units. Riau Islands Province has 9 supervisory speedboats. Java, Bali, and Nusa Tenggara have each 11 supervisor speedboat units. Kalimantan Island has 10 supervisory speedboat units, and West Kalimantan is the province with at least 5 units of supervisory speedboats. Sulawesi Island has 18 supervisory speedboat units. North Sulawesi and Central Sulawesi are the provinces with at least 4 units of supervisory speedboats. While for the Maluku Islands and Papua, there are 32 supervisory speedboat units, and Papua is the province with at least 15 units of a supervisory speedboats.

In addition, the number of supervisory ships placed in each management area also increased. From 2011 to 2015, escort crews had reached 1,623 people with 354 surveillance vessels, as shown in Figure 2.

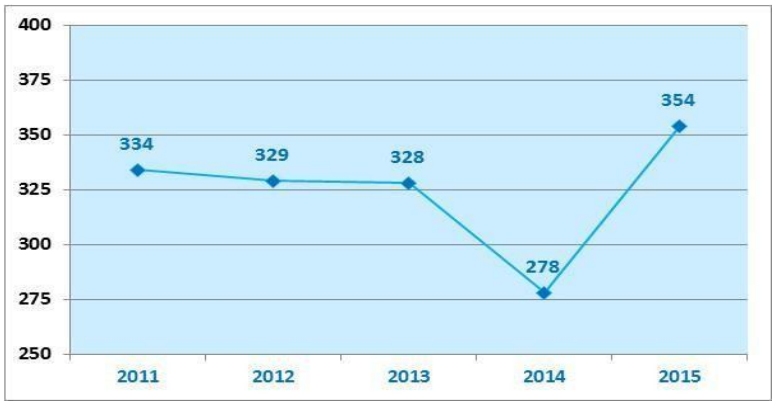

Figure 2. Number of surveillance vessels (Source: Ministry of Maritime Affairs and Fisheries).

The supervisory ship does its duty to conduct surveillance in each Fisheries Management Area to take action on violations that might occur. In this regard, the Ministry of Maritime Affairs and Fisheries also released data on the results of operations of fishery control vessels which can be seen in Figure 3.

In 2015, the results of surveillance ship operations increased from the previous year to 42 cases related to Indonesian fish vessels and 53 cases related to foreign fish vessels. The surveillance ship often finds several violations committed by Indonesian fishing vessels or foreign fishing vessels, such as illegal fishing, prohibited fishing gear, incomplete ship documents, or fake documents. The number of violations in the fishing industry is shown in Figure 4.

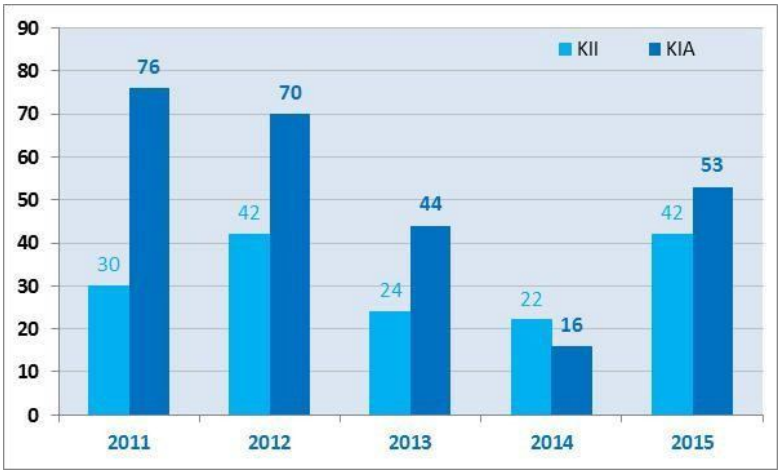

Figure 3. Result of supervision ship operations (Source: Ministry of Maritime Affairs and Fisheries).

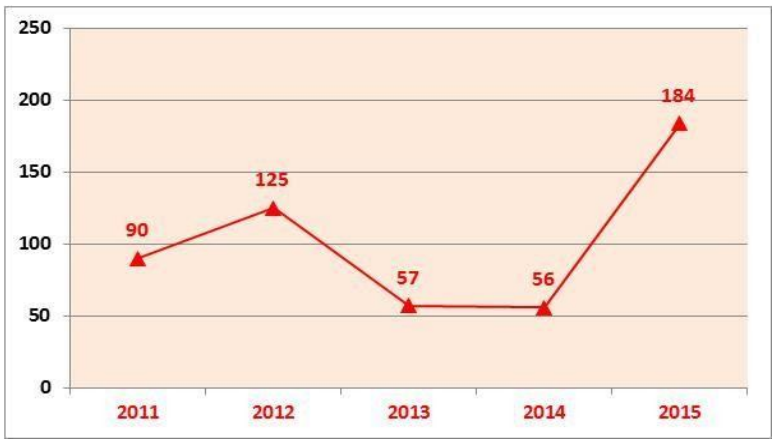

Figure 4. Number of fisheries violations in 2011-2015 (Source: Ministry of Maritime Affairs and Fisheries).

Based on data above, West Kalimantan is a province with the highest number of fisheries convictions with 50 cases. There is an interesting finding, in 2015 the number of fisheries violations increased dramatically to 184 cases while on the other hand the number of fishery control vessels also increased by 354 units. It can be said that the fishery supervisory ship carries out its duties to the maximum.

Discussion

Application of the Global Fishing Watch System technology in fisheries industry supervision. The application of GFWS technology, according to the ex-Minister of Maritime Affairs and Fisheries, Susi Pudjiastuti, has many benefits, which is an important step and a breakthrough for the Government of Indonesia, in this case, the Ministry of Maritime Affairs and Fisheries to encourage global law enforcement policies to free Indonesian waters from capture practices fish illegally, in addition to that technology in collaboration with Google, Oceana and SkyTruth will be effective and exemplary to eliminate illegal, unreported and unregulated fishing activities in the waters of Indonesia and other countries, because everyone can access the existence of fish to be consumed as a source of life. It can certainly be seen from the positive and negative sides as a government policy.

"Illegal, unreported and unregulated (IUU) fishing is one of the main challenges for sustainable fisheries governance. IUU fishing undermines the ability of fishery managers to make informed decisions on fisheries management threatens the food security and livelihoods of fishing communities. In recent years, it has also been linked to organised crime and human rights abuses. IUU fishing persists in large part because of its invisible

offshore nature, based on highly mobile fishers moving in, out and through national and high seas jurisdictions. To combat IUU fishing states and the fisheries sector have invested in monitoring, control and surveillance (MCS) systems under both national and multi-lateral fisheries management regimes Monitoring refers to the establishment of systems of 'for the measurement of fishing effort characteristics and resource yields' for stock management, while control refers to the conditions under which the exploitation of resources may be conducted, and surveillance to the degree and types of observations required to maintain compliance with the regulatory controls imposed on fishing activities. The development and proliferation of digital MCS technologies over the last decade has also opened up opportunities for private actors, including non-governmental organisations (NGOs), to voluntarily support states to (1) survey their territorial waters (2) close the (perceived) regulatory gaps in the high seas and/or (3) proactively demonstrate the traceability of fish products and/or good fishing practice" (Toonen & Bush 2020).

Then, the GFWS public can fully access data on fishing vessels in Indonesia and throughout the world. The data that can be accessed is entirely the latest and most up-to-date data that can be accounted for.

On the other hand, the policy of free data access in the application of the technology received more attention from the Indonesian Traditional Fishermen Unit According to KNTI; the policy was mistaken because it threatened the sustainability of the fishing industry in Indonesia. According the Chairperson of the Indonesian Traditional Fishermen's Central Board of Trustees, Marthin Hadiwinata revealed that Indonesia's Government should set strict limits on the public accessing fishing vessel monitoring data. Given limits, it will protect the national fishing industry. This has become a polemic because when Indonesia frees up fisheries data access to the world, several countries restrict access to such data, namely only for certain interests such as fisheries management, investigations, conservation monitoring efforts, and law enforcement alone.

According to Hadiwinata, superpower countries such as the United States, as long as it has a large fishing industry, still, limit fisheries data access. For the United States, VMS data in the fisheries business with a limited management system includes it as confidential. This is stated in the United States regulations, namely the Magnuson-Stevens Fishery Conservation and Management Act or the American Fisheries Conservation and Protection Act.

Juridical review of the Global Fishing Watch System data access openness. The disclosure of public information is governed by Law No. 14 of 2008 and is connected to access to GFWS information data; therefore, it can be linked to Article 17 letter d, which states, "Every Public Agency is required to open access for every Public Information Applicant to obtain Public Information, except Public Information which if opened and provided to the Public Information Applicant can reveal Indonesia's natural wealth".

Article 1, number 3 defines the function of the public body as follows: "Public bodies are executive, legislative, judiciary, and other bodies whose main functions and duties are related to the administration of the state, which partly or wholly funds come from the State Revenue and Expenditure Budget and/or Regional Revenue and Expenditure Budget, or non-governmental organizations for as long as part of or all funds sourced from the State Revenue and Expenditure Budget".

According to this definition, the Ministry of Maritime Affairs and Fisheries can be categorized as a public body because it is an executive institution. All of its funding comes from the State Budget and Expenditures. This makes it possible for the Ministry to be considered a public body. Therefore, if it is related to Article 17 letter d, the Minister of Marine Affairs and Fisheries as a public entity is not allowed to open and provide sensitive data that reveals Indonesia's natural wealth. This prohibition applies only if the letter d is associated with the article. This raises a legal concern because it is feared that this will cause information about Indonesia's natural wealth. The Global Fish and Wildlife Service maintain a database that is open to the public and from which this data can be extracted and acquired. It is feared that this will cause information about Indonesia's natural wealth, such as the potential of fisheries in a fishing area, patterns of movement of fishing vessels in Indonesia, and other important information that can threaten the security of Indonesia's resources.

Conclusions. The advancement of technology has repercussions that can be felt in various facets of daily life, including the fishing industry. The Global Fishing Watch System (GFWS) is the most cutting-edge technology currently available for monitoring the fishing industry on a global scale. The GFWS can be easily accessed by the global community through its website, allowing the global community to obtain vital information regarding the fishing industry. In 2016, Indonesia became the first country to implement the GFWS technology. Because open access to GFWS data that the world community can access can be an opportunity for other countries to learn about the potential of fisheries in Indonesia, the people of Indonesia have paid more attention to the development of the data. This is because of open access to GFWS data that the world community can access. This goes against the legal requirements outlined in Article 17 letter d of Law No. 14 of 2008 regarding the openness of public information. "Every Public Agency is required to open access for every Public Information Applicant to get Public Information, with the exception of Public Information that, if opened and given to the Applicant Public Information, can reveal Indonesia's natural wealth". Therefore, to accomplish the goals of Indonesian maritime sovereignty, it is necessary to give the utilization of the GFWS significant consideration and conduct in-depth research on it.

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Conflict of interest. The authors declare that there is no conflict of interest.

References

Afriansyah A., 2018 Indonesia's practice in combatting illegal fishing: 2015-2016. In: Asian yearbook of international law. Volume 22. Brill | Nijhoff, pp. 283-300.

Banakar R., Travers M., 2005 Theory and method in socio-legal research. Oregon and Portland: Hart Publishing, pp. 1-26.

Boerder K., 2018 Tracking global fisheries from space: patterns, problems, and protected areas. PhD dissertation, Dalhousie University, Halifax, Nova Scotia, 193 pp.

Darsono P., 1999 Pemanfaatan Sumber Daya Laut Dan Implikasinya Bagi Nelayan Warga. Oseana 24(4):1-9. [in Indonesian]

Derrick B., Noranarttragoon P., Zeller D., Teh L. C. L., Pauly D., 2017 Thailand's missing marine fisheries catch (1950-2014). Frontiers in Marine Science 4:402.

FAO, 2012 The state of world fisheries and aquaculture 2012. FAO, Rome, 209 pp.

Guiet J., Galbraith E., Kroodsma D., Worm B., 2019 Seasonal variability in global industrial fishing effort. PLoS ONE 14(5):e0216819.

Kroodsma D. A., Mayorga J., Hochberg T., Miller N. A. Boerder K., Ferretti F., Wilson A., Bergman B., White T. D., Block B. A., Woods P., Sullivan B., Costello C., Worm B., 2018 Tracking the global footprint of fisheries. Science 359(6378):904-908.

Merten W., Reyer A., Savitz J., Amos J., Woods P., Sullivan B., 2016 Global fishing watch: bringing transparency to global commercial fisheries. In: Bloomberg Data for Good Exchange Conference, pp. 1-4.

No Title (n.d.). Available at: https://www.worldatlas.com/articles/countries-with-the-most-coastline.html. Accessed: June, 2021.

Nugent J., 2019 Global fishing watch. Science Scope 42(5):22-25.

Pauly D., Zeller D., 2016 Catch reconstructions reveal that global marine fisheries catches are higher than reported and declining. Nature Communications 7(1): 10244.

Regulation of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia, Pub. L. No. 30 (2012). [in Indonesian]

Roan A., 2016 Report of data scientist Skytruth. Jakarta.

Soekanto S., Mamudji S., 2006 Penelitian hukum normatif: suatu tinjauan singkat. Rajawali Pers, Jakarta, 128 pp. [in Indonesian]
Soemarmi A., Indarti E., Pujiyono P., Azhar M., Wijayanto D., 2020a Teknologi vessel monitoring system (VMS) sebagai strategi perlindungan dan pembangunan industri perikanan di Indonesia. Masalah-Masalah Hukum 49(3):303-13.
Soemarmi A., Indarti E., Pujiyono, Wardhani L. T. A. L., Diamantina A., Ristyawati A., 2020b The use of the vessel monitoring system as fishery ship obligations in Indonesia. AACL Bioflux 13(3):1483-1494.
Soemitro R. H., 1990 [Legal research methodology and jurimetry]. Ghalia Jakarta, Indonesia, 20 pp. [in Indonesian]
Toonen H. M., Bush S. R., 2020 The digital frontiers of fisheries governance: fish attraction devices, drones and satellites. Journal of Environmental Policy and Planning 22(1):125-137.
UNCLOS, 1982 United Nations Convention on the Law of the Sea of 10 December 1982. Division for Ocean Affairs and the Law of the Sea. Available at: https://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm. Accessed: June, 2022.
*** Act of the Republic of Indonesia number 14 OF 2008 on Public Information Openness. House of representatives of the Republic of Indonesia. 25 pp.

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