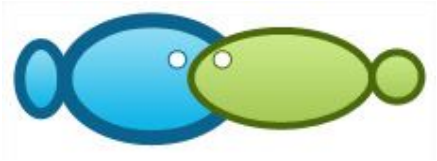

# Promoting sustainable fisheries: the policies and actions on combating illegal fishing in the North Natuna Sea of Indonesia

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**Abstract**. Indonesia is an archipelagic country with some marine water areas included in the "hotspots" of illegal fishing. One of the illegal, unreported, and unregulated (IUU) fishing hotspots is the North Natuna Sea, which is part of the Indonesian Fisheries Management Area (FMA-711). Illegal fishing in the North Natuna Sea causes economic losses, impacts natural resources and ecosystems that reduced fish resources, and encourages other crimes. The study aims to analyze the Government of Indonesia policies and actions in combating illegal fishing in the North Natuna Sea. The data were collected from the Ministry of Marine Affairs and Fisheries (MMAF) and Marine and Fisheries Agency Riau Islands Province Government, then analyzed by descriptive analysis. This study concludes that illegal fishing in the North Natuna Sea in 2017-2021 is predominantly performed by foreign fishing boats with 63% violations without permit documents and prohibited fishing gear. Furthermore, 37% of foreign fishing boats were without a valid license from the Government of Indonesia. The new foreign fishing boats modus operandi discovered is "hides and seeks" in the border area. Moreover, spread fishing operation is fishers strategy to avoid patrol fleet and make it there is no opportunity to be inspected and apprehended. In order to eradicate illegal fishing, the Government of Indonesia implemented some policies and activities to promote sustainable fisheries in the North Natuna Sea including issuing law number 10 of 2020 on Job Creation which is strengthening the administrative sanction of the illegal fishing perpetrator.
**Key Words**: fishing boat, illegal fishing, North Natuna Sea, surveillance.

**Introduction**. The illegal, unreported and unregulated (IUU) fishing can be affected by the ability of the water systems to provide ecosystem services and essential food resources (Ma 2020). Illegal fishing as a part of IUU fishing, which undermines fisheries management and conservation measures, has been an enormous problem in the Atlantic, Indian and Pacific regions It is estimated that lower and upper losses value caused by illegal fishing globally are between 10 and 23.5 billion USD per year or representing between 11-26 million tonnes of fish (Agnew et al 2009). Illegal fishing is a global problem, affecting both domestic waters and the high seas, and all types of fishing boats, regardless of their size or gear. Illegal fishing is harmful to current global fish stocks and undermines the effectiveness of measures adopted nationally, regionally, and internationally to secure and rebuild fish stocks for the future (Kasim & Widagdo 2019). Often the economic gains from illegal fishing are significant enough to motivate fishers to engage in IUU fishing (Sumaila et al 2006). Hence, illegal fishing generates harmful effects on economic and social welfare and further reduces incentives to comply with rules (Le Gallic & Cox 2006). Solihin et al (2016) expressed that IUU fishing will provoke conflict between domestic and foreign fishers, affecting capture fisheries and will reduce productivity caused by foreign boats. Moreover, according to Interpol, fisheries-related crimes are closely linked with IUU fishing operations. These include forged fishing licenses, tax evasion, money laundering, and unacceptable working conditions. More

serious crimes, such as drug trafficking, human trafficking, arms trafficking, and piracy, are linked to illegal fishing.

Indonesian waters divide into 11 Fisheries Management Areas (FMA) with about 12.01 million tons/year of fish stock potency based on the National Committee for Fish Stock Assessment result study (MMAF 2022). As an archipelagic country, Indonesia has many illegal fishing "hotspots" for domestic and foreign fishing boats. Wilcox et al (2021) analyzed the North Natuna Sea as part of the South China Sea (FMA-711), North Sulawesi Sea (FMA-716), Malacca Strait (FMA-571), and Arafura Sea (FMA-718) are four areas vulnerable to illegal fishing as shown at Figure 1.

The modus of illegal fishing in Indonesian waters include fishing without a license, destructive fishing gear, inappropriate fishing ground, illegal transhipment at sea, inactive VMS transmitter, and others. Those activities show that Indonesian or foreign fishing boats were not compliant to capture fisheries regulations in Indonesia. Regarding the fisheries compliance, Gunawan et al (2021) explained in the study of the purse seine fleet compliance strategy to fishing regulations at Nizam Zachman Fishing Port, Jakarta that the compliance level of purse seine fleets in Nizam Zachman Jakarta to the fishing zone in low-level status, when to the port bases was strong and with fishing gear was classified relatively strong.

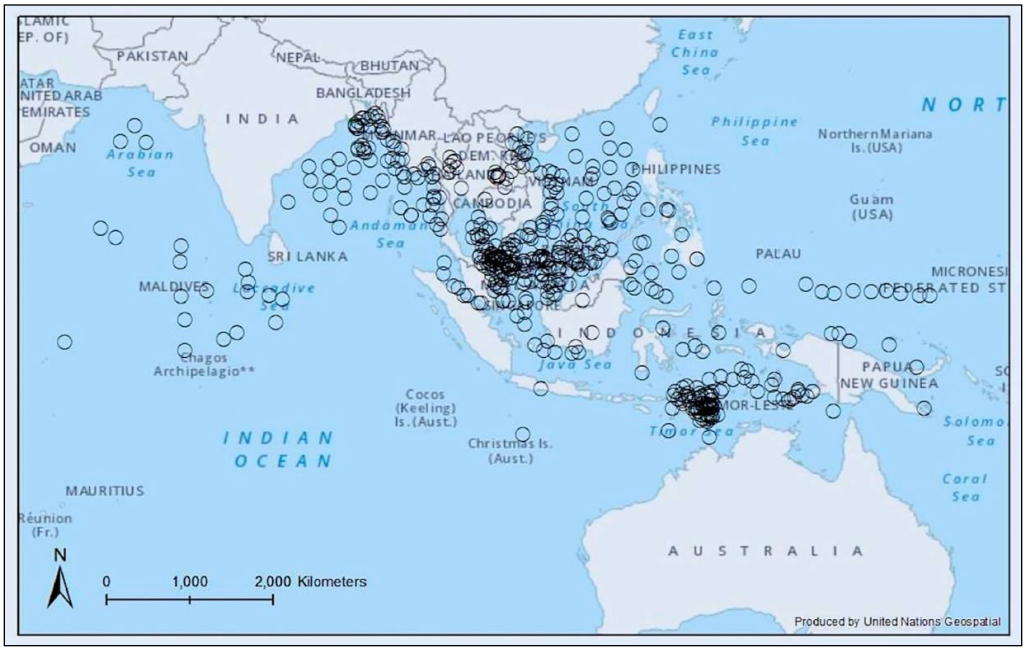


Figure 1. Illegal fishing hotspots identified in the regions of the Asia Pacific Fisheries Commission (APFIC) area of competence and adjoining areas (Wilcox et al 2021).

Illegal fishing in the North Natuna Sea caused losses for the Government of Indonesia, which is an economic disadvantage. Mahabror & Hidayat (2018) revealed potential economic losses due to illegal fishing in the economic exclusive zone (EEZ) of FMA-711 around 198 million USD in the period of May to December 2016. Meanwhile, Suherman et al (2020) said losses due to illegal fishing occur in the short and long term, not only losses from economic aspects but also social aspects, as well as damage to natural resources and ecosystems that have an impact on reduced fish resources, and also encourage other crimes. Krisnafi et al (2017) identified illegal fishing violations in FMA-711 predominantly committed by foreign fishing boats (FFB) than Indonesian fishing boats (IFB). The major violations committed by FFB in FMA-711 are without licensing documents in conducting fishing and the use of prohibited fishing gear. In the geopolitical aspect, the North Natuna Sea as part of the South China Sea has the potential conflict between countries in the region, one of which is due to illegal fishing activities (Anggraini et al 2018).

The Government of Indonesia has a high concern to combat illegal fishing either conducted by foreign or domestic fishing boats. The Government of Indonesia through the Ministry of Marine Affairs and Fisheries (MMAF) deployed patrol vessels and also air patrol in the North Natuna Sea for a year to protect fisheries resources from illegal activities. On the other hand, the Government of Indonesia has also implemented a vessel monitoring system to detect fishing activities for Indonesian fishing boats above 30 gross tonnages. In addition, combating illegal fishing in the North Natuna Sea is also supported by the community in the form of a surveillance community group (abbreviated in Indonesian "Pokmaswas"), which informs if there is detected illegal fishing. However, illegal fishing activities are still rampant in the North Natuna Sea. In Indonesia, illegal fishing activities are subject to sanctions under Fisheries Law Number 31 of 2004, Number 45 of 2009, and Law Number 11 of 2020 on Job Creation, which can be punished with administrative and criminal sanctions (MMAF 2004; MMAF 2009; MMAF 2020a).

This study aims to analyze the Government of Indonesia policies and its actions in combating illegal fishing in the North Natuna Sea. This study is also dedicated to enrich the information related to combating illegal fishing in the North Natuna Sea and supporting the Government of Indonesia to achieve sustainable fisheries.

**Material and Method**. This study outlines the policies of the Government of Indonesia in combating illegal fishing and describes the achievement, and strategies to counter illegal fishing in the North Natuna Sea. The data of fisheries surveillance vessels operated in the FMA-711 period 2022, apprehension of illegal fishing boats period 2017-2021, and current surveillance policies and actions were collected from the Directorate General of Surveillance for Marine and Fisheries Resources MMAF. Furthermore, the data of surveillance community groups were gathered from the Marine and Fisheries Agency (MFA) of the Riau Islands Province Government. The data collection was carried out from January to March 2022 and analyzed using descriptive analysis method.

## Results and Discussion

***The current Indonesian government policies on combating illegal fishing***. Law Number 31 of 2004 on Fisheries as amended by Law Number 45 of 2009 states that fisheries surveillance is carried out to ensure the orderly implementation of marine and fisheries business. The implementation of marine and fisheries business needs guidelines for actors on utilizing fisheries resources. In implementing fisheries surveillance and combating illegal fishing, the Government of Indonesia issued some regulations. The improvement of regulation is in line with the strengthening needs of the Monitoring, Controlling, and Surveillance (MCS) program. Flewwelling & Cullinan (2000) and Flewwelling et al (2002) said strengthening a MCS system is essential to reviewing the existing domestic legislation to ensure that it prescribes appropriate norms to achieve the desired fisheries management objectives and contains provisions that facilitate effective enforcement. In practice, the effectiveness of a MCS system in ensuring compliance with the law will depend very heavily on whether or not domestic laws provide appropriate mechanisms.

The regulations issued by the Government of Indonesia related to combating illegal fishing are as follows:

1) Law Number 31 of 2004 on Fisheries;
2) Law Number 45 of 2009 on Amendments of Fisheries Law Number 31 of 2004;
3) Law Number 10 of 2020 on Job Creation;
4) Government Regulation Number 5 of 2021 on Surveillance Based on Risk;
5) Government Regulation Number 27 of 2021 on Management of the Marine and Fisheries Sector;
6) Government Regulation Number 85 of 2021 on Non-Tax State Revenue in Marine and Fisheries Sector;
7) President of Republic of Indonesia Regulation Number 23 of 2016 on Ratification of Agreement on Port State Measures to Prevent, Deter, and Eliminate IUU Fishing;

8) Minister of Marine Affairs and Fisheries Regulation Number 39 of 2019 on Port State Measures Agreement (PSMA) Implementation Guidelines;
9) Minister of Marine Affairs and Fisheries Regulation Number 23 of 2021 on Legal Operation Standard of Fishing Boat and Vessel Monitoring System;
10) Minister of Marine Affairs and Fisheries Regulation Number 31 of 2021 on Implementation Procedure for Administrative Sanctions.

Law number 10 of 2020 on Job Creation as the latest regulation related to fisheries has a new paradigm for law enforcement. The law on Job Creation amended some of the criminal articles to the administrative sanctions. The administrative sanctions are an important policy to improve compliance with marine and fisheries resources utilizations. The essence of implementing administrative sanctions is law enforcement with a restorative justice approach. Pujiyono et al (2019) expressed that the restorative justice approach is considered more efficient, effective, and useful as an effort to restore the environment and avoid the impact of corporate crime on the worker, economic protection, and stability, and enhances community welfare.

According to the law on job creation, fisheries surveillance will be strengthened and implemented not only by MMAF but also by Regional Government, Special Economic Zone Administrator, and Free Trade Zone Agency. Another regulation is Government Regulation number 85 of 2021 on Types and Tarif Non-Tax Government Revenue at MMAF as a rule on determining types and the number of administrative fines (MMAF 2021a).

***Fishing surveillance mechanism***. In implementing fishing surveillance and combating illegal fishing in the North Natuna Sea, the Government of Indonesia, through the MMAF, implemented a surveillance mechanism for IFB and FFB. The surveillances are conducted in some stages mechanism. The surveillance for IFB includes inspection before fishing activity, while fishing, during landing, and post landing. While for FFB, namely operation at sea by patrol vessel, air surveillance, and monitoring supported by satellite technology.

The surveillance activity “before fishing” is conducted before the fishing boats sail to the fishing ground, which is done at fishing ports or other designated ports. This surveillance is done by checking administrative and technical standard requirements. When both requirements have been completed, the fisheries surveillance officer issues a legal operation standard of fishing boat (SLO), and vice versa if both requirements are not fully complete, the SLO is not issued. With the absence of SLO, fishing boats cannot carry out fishing activities. Whereas the surveillance “while fishing” occurs at sea. The fishing boats are found that carry out fishing and/or transport fish without the specified documents, the enforcement will be carried out by applicable laws and regulations. The implementation of surveillance at this stage is carried out by fisheries surveillance vessels, and aircraft, and supported by vessel monitoring system (VMS) technology as one of the satellite-based monitoring components. The VMS can provide preliminary information regarding fisheries activity and give an early indication of possible violation activity that will be enforced. Moreover, during the landing step, surveillance occurs in the fishing port when fish are unloaded. The fisheries surveillance officer inspects the fish composition to ensure compliance with the regulations. While in terms of surveillance of foreign fishing boats that allegedly enter and conduct illegal fishing in Indonesian waters, surveillance is carried out through fisheries surveillance vessel operations at sea, air surveillance, and monitoring by satellite technology.

The MMAF operated 8 units of fisheries surveillance vessels in the North Natuna Sea in a year, namely fisheries surveillance vessel (FSV) Hiu Macan 01 and Hiu 11 under command by Pontianak Marine and Fisheries Resources Surveillance (MFRS) Station, Hiu 03, Hiu Macan 05 and Hiu 17 under command by Batam MFRS Base, and Hiu Macan Tutul 02, Orca 2, and Orca 3 under command by Head Quarter of Directorate General of Surveillance for Marine and Fisheries Resources (SMFR). The details are presented in Table 1.

Table 1

Fisheries surveillance vessels operated in the FMA-711 including in the North Natuna Sea

| No | *Fisheries surveillance vessel* | | *LoA of FSV* | *Under command* |
|---|---|---|---|---|
| | *Name* | *Type* | | |
| 1 | Hiu Macan 01 | B | 36 m | Pontianak MFRS Station |
| 2 | Hiu 11 | C | 28 m | Pontianak MFRS Station |
| 3 | Hiu 03 | C | 28 m | Batam MFRS Base |
| 4 | Hiu Macan 05 | B | 36 m | Batam MFRS Base |
| 5 | Hiu 17 | C | 28 m | Batam MFRS Base |
| 6 | Hiu Macan Tutul 02 | B | 42 m | Headquarter DG of SMFR |
| 7 | Orca 2 | A | 60 m | Headquarter DG of SMFR |
| 8 | Orca 3 | A | 60 m | Headquarter DG of SMFR |

Source: Directorate General of Surveillance for Marine and Fisheries Resources (MMAF 2022).

***Apprehension of illegal fishing boats***. The Government of Indonesia through the MMAF, Marine Police, and relevant institutions have operated patrol vessels and air patrol in the North Natuna Sea for a year to protect fisheries resources from illegal activities. This is also expressed by Tienh & Ristyawati (2020) that the Government of Indonesia put special attention to protecting the North Natuna Sea from illegal fishing. The actions are strengthening maritime security and guarding the North Natuna Sea EEZ by advancing military bases in Natuna, adopting a ship-sinking policy, enforcing strict laws to combat illegal fishing, extends bilateral and regional diplomacy with neighbouring countries incorporated in the Association of Southeast Asian Nations to combat illegal fishing simultaneously.

Figure 2 shows that the apprehension number by fisheries surveillance vessel MMAF, Marine Police, and Indonesian Marine Security Agency (Bakamla) during 2017-2021 was as many as 244 fishing boats, with details of 26 Indonesian fishing boats and 218 foreign fishing boats (Vietnam and Malaysia). The number of illegal fishing boats apprehended fluctuated from 2017 to 2021. In 2017, as many as 100 boats consisted of 3 IFBs and 97 FFBs, in 2018 consisted of 7 IFBs and 44 FFBs. In 2019 as many as 28 FFBs, in 2020 as many as 24 FFBs, and in 2021 as many as 41 boats consisting of 16 IFBs and 25 FFBs (MMAF 2017; MMAF 2018; MMAF 2019a; MMAF 2020b; MMAF 2021b).

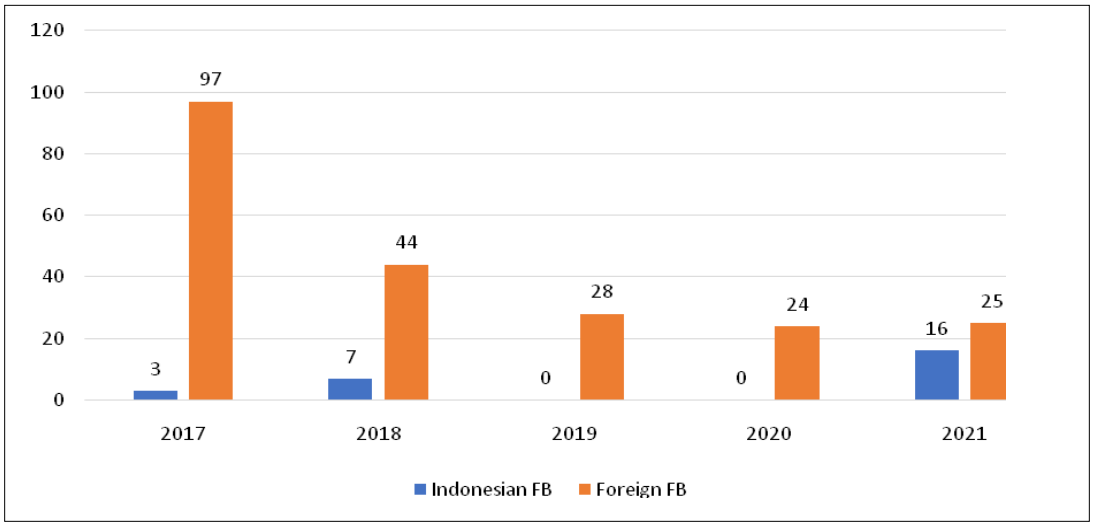


Figure 2. The apprehension number of illegal fishing boats during the period of 2017-2021 in the North Natuna Sea.

Furthermore, the comparison between FFB and IFB illegal concluded that FFB dominate as illegal fishing boats in the North Natuna Sea from 2017 to 2021. The data shows that 89% of illegal fishing activities were carried out by FFB, and 11% by IFB.

The violations committed by illegal FFB were as much as 63% of the boats fishing illegally in the North Natuna Sea without having a licensing document from the Government of Indonesia and using pair trawl as prohibited fishing gear in Indonesian waters. In addition, as many as 37% of FFB were without valid licensing from the Government of Indonesia. Fishing gear used by as many as 37% of foreign boats is quite diverse, including gill nets, fish traps, fishing rods, sea cucumber fishing gears, and squid nets.

***Vessel monitoring system (VMS)***. Recently, the Government of Indonesia has implemented fishing surveillance based on technology. VMS is one of the surveillance systems operated by MMAF. The VMS function monitors the movement and activity of fishing boats (above 30 gross tonnages) installed in the VMS transmitter. The fishing boats will be monitored continuously and detect the indication of law violations during fishing at sea. The implementation of VMS is also Indonesia's commitment to international, regional, and national provisions in terms of conservation and sustainable fisheries management. Since 2003, VMS has been implemented by installing transmitters on fishing vessels over 30 GT. In addition to knowing the movement of fishing vessels, VMS also ensures compliance of fishing boats to the applicable provisions.

According to the Regulation of the Minister of Marine Affairs and Fisheries, number 23 of 2021 on Legal Fishing Operational Standard of Fishing Boat and Vessel Monitoring System mentioned, VMS users can be subject to administrative sanctions in form of revocation of VMS transmitter activation certificate (SKAT) when committing violations. The regulation also specifies that VMS users who are subject to administrative sanctions in the form of SKAT revocation can reapply after carrying out all obligations imposed in administrative sanctions and declare to comply with all regulations.

The implementation of VMS in Indonesia involves 3 (three) parties, namely the government (the Directorate General of Surveillance for Marine and Fisheries Resources MMAF) as the VMS authority, fishing vessels owners as VMS users, and private companies as VMS providers. The transaction of purchasing VMS transmitters and payment of satellite services in airtime is carried out directly between the VMS user and the provider. The user can select the provider according to his wishes. The provider or user does the installation of a VMS transmitter because it is technically relatively easy to do. The fisheries surveillance officer will issue a SKAT for fishing boats that have installed a VMS transmitter.

In addition, VMS is also useful for fishing boat companies or boat owners to find out the position, movement, and activity of the fishing boat, increases efficiency in conducting fishing efforts, ensures the continuity of conducive fishing efforts, and rescues fishing boats that face problems at sea. Therefore, fishing boat companies or boat owners can access the VMS data.

The VMS data can also be useful for research and relevant purposes by stakeholders, including regional fisheries management organization (RFMO), Indonesian Navy, Indonesian Marine Police, and Indonesian Maritime Security Agency (BAKAMLA).

Implementing the vessel monitoring system at the North Natuna Sea is supported by the Regional Monitoring Centre (RMC), which is operated by Batam Marine and Fisheries Resources Surveillance Base and Pontianak Marine and Fisheries Resources Surveillance Base. The mechanism of Indonesian VMS is shown in Figure 3.

The implementation of VMS is to achieve sustainable fisheries in line with the FAO guidelines on responsible fisheries. As mentioned by FAO (1998) VMS is a very effective tool, especially in developing countries with limitations on financial and infrastructure resources aspects. On the other hand, the implementation of VMS by flag states is the most useful means of ensuring that vessels raising their flag do not conduct unauthorized fishing on the national jurisdiction, on high seas, or within areas under the national jurisdiction of other states.

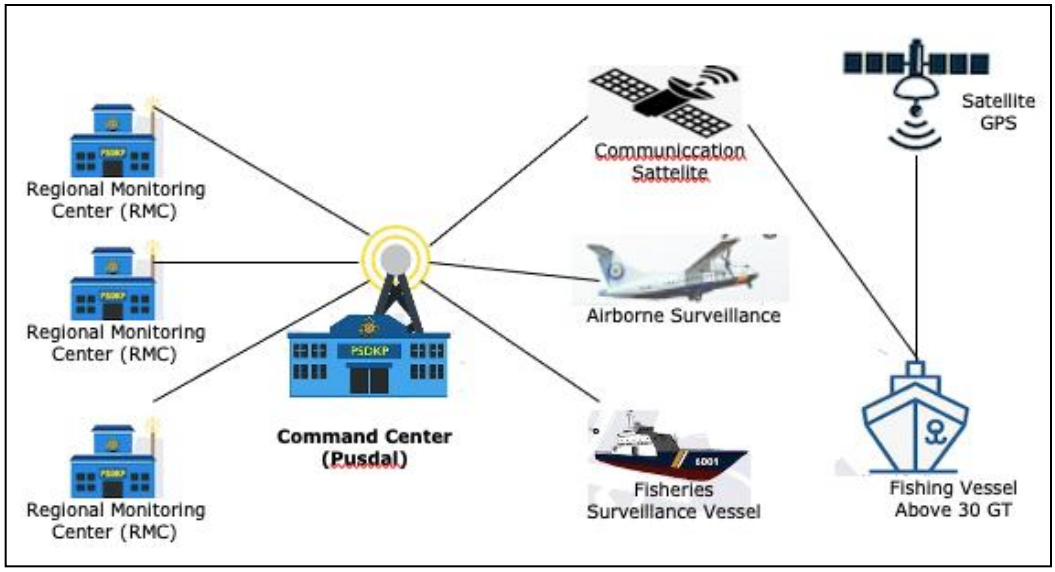


Figure 3. Indonesian vessel monitoring system scheme (MMAF 2019b).

***Community participation in combating illegal fishing***. Law number 31/2004 on Fisheries as amended by Law number 45/2009 Article 67 stated the fisheries surveillance can be supported by the community. The Ministry of Marine Affairs and Fisheries issued Minister Regulation number 58/2021 on Implementation Procedure on Fisheries Surveillance System based on Community Participation in Marine and Fisheries Utilization.

Marine and Fisheries Agency (MFA) of Riau Islands Province (2021) stated there are 114 surveillance community groups (termed as Pokmaswas), which consist of 28 groups of Bintan Regency, 4 groups of Karimun Regency, 33 groups of Natuna Regency, 5 groups of Lingga Regency, 13 groups of Anambas Islands Regency, 15 groups of Batam City, and 16 groups of Tanjungpinang City (Table 2).

Table 2

Surveillance community group (Pokmaswas) in Riau Islands Province 2021

| *No* | *District/city* | *Sum of group* | *Established year* |
|---|---|---|---|
| 1 | Bintan | 28 | 2007 |
| 2 | Karimun | 4 | 2005 |
| 3 | Natuna | 33 | 2007 |
| 4 | Lingga | 5 | 2008 |
| 5 | Anambas | 13 | 2010 |
| 6 | Batam | 15 | 2008 |
| 7 | Tanjungpinang | 16 | 2008 |
| | Sum | 114 | |

Source: Marine and Fisheries Agency, Riau Islands Province (2021).

The number of Pokmaswas in Riau Islands Province in particular in Natuna District shows the high willingness of the local community to support the government in eradicating illegal fishing. Chapsos et al (2019) in research related with the involvement of local fishing communities in policy-making to address illegal fishing in Indonesia showed a strong willingness by local fishers to be seen as knowledge agents who can assist solve the problem by better dissemination of information and collaboration between the local government and the capture fisheries communities. Community participatory surveillance was also mentioned by Flewwelling & Cullinan (2000) that is the concept of community-based fisheries management and the substitution of non-government sector personnel to act with local authorities; this could also be a cost-effective option worth considering for

monitoring purposes, e.g., observers, dockside monitoring, reef/coast watch programs. Privatization of many non-enforcement aspects of surveillance can be done successfully, but a very good representation between all involved stakeholders must exist, perhaps more than can be expected in some administrative matters.

***Strategy to strengthen combating illegal fishing in the North Natuna Sea***. The surveillance and combating of illegal fishing in the North Natuna Sea were carried out in line with fisheries surveillance in FMA-711. To strengthen efforts to end illegal fishing, several strategies were set by the Directorate General of Surveillance for Marine and Fisheries Resources. One of them is an institutional strengthening of the surveillance technical unit around the North Natuna Sea. The Natuna Surveillance office will be upgraded to be surveillance base level, Pontianak Surveillance Station will be upgraded to a surveillance base. The upgrading of the office level will be followed by the addition of human capital, infrastructure, and financial aspect. According to the Regulation of Minister of State Apparatus Empowerment and Bureaucratic Reform number PER/18/M.PAN/11/2008 on Implementing Technical Unit Guidelines of Ministry or Non-ministry, a technical unit is an independent unit with the operational task and/or headquarters supporting task. An independent organization is defined as a work unit that is given the authority to manage its own staffing, finances, and equipment and its position are separate from the main organization. Therefore, if the Natuna Surveillance Base is completely formed it will become an independent organization tasked with carrying out surveillance in the North Natuna Sea. Furthermore, the Pontianak Surveillance Station will be upgraded to the base category. Therefore, if the process of improving the institutional status of the surveillance technical unit is completed, then FMA-711 in particular the North Natuna Sea will be monitored by three Surveillance Bases, namely Batam Surveillance Base, Natuna Surveillance Base, and Pontianak Surveillance Base.

Moreover, strengthening the participation of the surveillance community group in conveying information on alleged violations through SMS Gateway is part of combating illegal fishing strategies. Furthermore, the eradication of illegal fishing in the North Natuna Sea was conducted through increased fisheries surveillance operations at sea supported by air surveillance and an integrated surveillance system (ISS).

**Conclusions**. This study concludes that illegal fishing in the North Natuna Sea is dominantly conducted by foreign fishing boats without license documents and using prohibited fishing gear. The Government of Indonesia implemented some policies and activities to combat illegal fishing in the North Natuna Sea with some achievements. The number of apprehensions during the period of 2017-2021 shows that 89% of illegal fishing activities in the waters of the North Natuna Sea were carried out by foreign fishing boats, and 11% were carried out by Indonesian fishing boats. The new foreign fishing boat modus operandi is to hide and seek when in the border area while there is no Indonesian patrol vessel, also spreading one of the methods to avoid patrol vessel fleet and to make it there is no opportunity to be inspected and apprehended. Furthermore, Law number 10 of 2020 on Job Creation as the updated regulation related to fisheries has a new paradigm on law enforcement related to strengthening administrative penalty. To strengthen action on combating illegal fishing, several strategies are set by MMAF, namely institutional improvement of the technical implementing unit, enhancing the participation of the surveillance community group, increasing fisheries surveillance by local governments, and optimizing fisheries surveillance vessel and air surveillance supported integrated surveillance system (ISS).

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

## References


Agnew D. J., Pearce J., Pramod G., Peatman T., Watson R., Beddington J. R., Pitcher T. J., 2009 Estimating the worldwide extent of illegal fishing. PLoS ONE 4(2):e4570.

Anggraini S. D., Kusumawardhana I., Ramadhan I., 2018 The Implication of Indonesia's IUU fishing policy in Natuna territorial waters towards South China Sea geopolitics. Jurnal Hubungan Internasional 7(2):118-132.

Chapsos I., Koning J., Noortmann M., 2019 Involving local fishing communities in policy making: addressing illegal fishing in Indonesia. Marine Policy 109:103708.

FAO (Food and Agriculture Organization), 1998 FAO technical guidelines for responsible fisheries. Fishing operations. 1. Vessel monitoring system. Supplement 1, 58 pp.

Flewwelling P., Cullinan C., 2000 Guide to monitoring, control, and surveillance systems for coastal and offshore capture fisheries. FAO Fisheries Technical Paper No. 500, 200 pp.

Flewwelling P., Cullinan C., Balton D., Sautter R. P., Reynolds J. E., 2002 Recent trends in monitoring, control, and surveillance system for capture fisheries. FAO Fisheries Technical Paper No. 415, 200 pp.

Gunawan G., Purbayanto A., Solihin I., 2021 The compliance level of purse seine fleet toward fishing regulation at Nizam Zachman fishing port, Jakarta. AACL Bioflux 14(1):570-579.

Kasim N., Widagdo A., 2019 Combating illegal, unreported, unregulated (IUU) fishing in Indonesia. AACL Bioflux 12(6):2243-2251.

Krisnafi Y., Iskandar B. H., Wisudo S. H., Haluan J., 2017 Optimization of fisheries surveillance vessel deployment in Indonesia using genetic algorithm (Case study: Fisheries Management Area 711, Republic of Indonesia). AACL Bioflux 10(3):565-577.

Le Gallic B., Cox A., 2006 An economic analysis of illegal, unreported, and unregulated (IUU) fishing: key drivers and possible solutions. Marine Policy 30(6): 689-695.

Ma X., 2020 An economic and legal analysis of trade measures against illegal, unreported, and unregulated fishing. Marine Policy 117:103980.

Mahabror D., Hidayat J. J., 2018 [An analysis of economic losses due to illegal fishing in the exclusive economic zone of Natuna waters]. Proceedings of the National Seminar on Marine and Fisheries IV, 3 September 2018. [in Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2004 [Law number 31, 2004 on Fisheries]. [in Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2008 [Minister of State Apparatus and Bureaucratic Reform Regulation Number PER/18/M.PAN/11/2008 on Implementing technical unit guidelines of ministry or non-ministry]. [in Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2009 [Law number 45, 2009 on Amendment of law number 31, 2004 on Fisheries]. [in Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2017 [The data of marine and fisheries crime law enforcement, 2017]. Unpublished. [In Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2018 [The data of marine and fisheries crime law enforcement, 2018]. Unpublished. [In Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2019a [The data of marine and fisheries crime law enforcement, 2019]. Unpublished. [In Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2019b [Vessel Monitoring System]. Available at: https://kkp.go.id/djpsdkp/infografis-detail/2729-sitem-pemantauan-kapal-perikanan-vessel-monitoring-system. [In Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2020a [Law number 11, 2020 on Job Creation]. [In Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2020b [The data of marine and fisheries crime law enforcement, 2020]. Unpublished. [In Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2021a [KKP promotes restorative justice and strengthens synergy for supervision of fisheries natural resources]. Available at: https://kkp.go.id/djpsdkp/artikel/33937-kkp-kedepankan-restorative-justice-dan-perkuat-sinergi-pengawasan-sda-perikanan. [In Indonesian]

MMAF (Ministry of Marine Affairs and Fisheries), 2021b [The data of marine and fisheries crime law enforcement, 2021]. Unpublished. [In Indonesian]
MMAF (Ministry of Marine Affairs and Fisheries), 2022 [Minister of Marine Affairs and Fisheries Decree number 19, 2022 on fish stock potency estimation, maximum sustainable yield, and utilization level of fisheries resource in Indonesian fisheries management area]. [In Indonesian]
MFA (Marine and Fisheries Agency) Riau Islands Province, 2021 [Surveillance for marine and fisheries resources utilization]. Unpublished. [In Indonesian]
Pujiyono, Rochaeti N., Airlangga A. B., 2019 [Corporate criminal liability through the concept of restorative justice]. Pembaharuan Hukum Pidana 2(3):1-20. [in Indonesian]
Solihin I., Wisudo S. H., Haluan J., Martianto D., 2016 The problems and capture fisheries development strategy in the border area (case study: Nunukan Regency, Indonesia). AACL Bioflux 9(6):1310-1322.
Suherman A., Santosa M. A., Ihsan Y. N., Wijayanto D., Juwana S., 2020 The eradication of IUU fishing in Indonesia for fisheries resources sustainability by the Task Force 115. AACL Bioflux 13(5):2522-2537.
Sumaila U. R., Alder J., Keith H., 2006 Global scope and economics of illegal fishing. Marine Policy 30(6):696-703.
Tienh A. L., Yuwanto, Ristyawati A., Soemarmi A., Saraswati R., 2020 The national defense strategy under the regime of the 7th President of Indonesia to protect the exclusive economic zone of the Natuna Sea overlapping with China's nine-dash line. AACL Bioflux 13(4):1993-2001.
Wilcox C., Mann V., Cannard T., Ford J., Hoshino E., Pascoe S., 2021 A review of illegal, unreported, and unregulated fishing issues and progress in the Asia-Pacific Fishery Commision region. FAO and CSIRO, 149 pp.

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