Application of GIS to define a juridical bay as part of Indonesia's internal waters

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Abstract. Indonesia is an archipelagic state bordered by archipelagic baselines. Based on the Law of the Sea Convention (LOSC), Indonesia has two maritime zones within the baseline, namely internal waters and archipelagic waters. It is necessary to make clear boundaries because there are different jurisdictions between the two areas. This study aims to identify Indonesian internal waters and draw a closing line in the juridical bay. GIS software is used to identify the juridical bay, referring to the terms of the juridical bay in LOSC. The results of the research show that (1) several bays in Indonesia do not meet the criteria of juridical bays, (2) a juridical bay can consist of several smaller bays, (3) a large bay cannot be fully claimed as a juridical bay because there are limitations of the maximum length of the closing line, and (4) there are several juridical bays that do not have the name.

1. Introduction

Indonesia is a country that proposed the recognition of archipelagic state internationally through a statement by the Indonesian government on December 13, 1957, known as Wawasan Nusantara in the Djoenda Declaration 1957, ahead of the United Nations on the Law of the Sea Conference on 1958 [1]. After the Djoenda Declaration, in 1960 Indonesia issued an Act to draw a straight line between the outer islands as Indonesia's baselines and declare the waters in it 'internal waters' [2]. The act referred to Government Regulation in Lieu of Legislation on Indonesian Waters, which states that Indonesia has full sovereignty over two maritime zones at that time, namely the Territorial Sea (sea area with the closest boundary is the baseline and the farthest boundary is a distance of 12 nautical miles from the baseline) and internal waters (all waters within the baseline). In addition to introducing the concept of an archipelagic state, the Djuanda Declaration, which attracted protests from various countries, also stated that foreign ships wishing to pass were granted innocent passage as long as it is not prejudicial to or violates the sovereignty and security of Indonesia [3].

To fight for the proposal of an archipelagic state, Indonesia actively participated in conferences related to the law of the sea, namely the United Nation Conference on the Law of the Sea (UNCLOS) I in 1958, UNCLOS II in 1960, and UNCLOS III which lasted 1973-1982 and produced Law of the Sea Convention (LOSC) [4]. Indonesia ratified the 1982 UNCLOS in 1985 through Act no. 17 of 1985. As a follow-up, the Indonesian government issued several legal regulations, including the Law that regulates Indonesian Waters (Law number 6 of 1996) and Government Regulation which regulates Indonesian baselines (Government Regulation Number 38 of 2002 and Government Regulation Number 37 of 2008).

There are several maritime areas that can be owned by an archipelagic country according to LOSC, namely internal waters, archipelagic waters, territorial sea, contiguous zone, exclusive economic zone, and continental shelf as illustrated in figure 1. The boundary between archipelagic waters and territorial sea (TS), contiguous zone (CZ), exclusive economic zone (EEZ), and continental shelf (CS)
is measured from the archipelagic baseline. Meanwhile, the boundary between archipelagic waters and internal waters is a closing line of rivers, bays, and harbors.

Several conditions can make a bay designated as internal waters. To become internal water, a bay must meet the requirements of a juridical or historical bay. This research is specific in determining the juridical bay. The purpose of this research is to identify the condition of the bay in Indonesia to determine whether the bay is a juridical bay so that it can be designated as internal waters.

![Figure 1. maritime territory of an archipelagic country [5]](image)

2. Methods

2.1. Research Data

The data used in this study are the Indonesian coastline, the baselines of the Indonesian archipelago, and toponym data from the Geospatial Information Agency. The baseline data for the Indonesian archipelago is a line connecting the base points of the outer islands of Indonesia. The main toponym data is bays, headlands, and islands throughout Indonesia, which are used to identify bays and their mouths. In this study, 500 bays and coastal indentation in Indonesia were identified to determine whether they are eligible as juridical bays or not.

2.2. Identify juridical bay

Identification was carried out using GIS software along the Indonesian coastline. Identification of internal waters refers to the juridical bay requirements in article 10 of LOSC 1958 as follows:

a) A bay is an indentation of the coast where part of the water juts into the beach. The two points at the end of the bay (the mouth of the bay) can be connected to form a closing line, and the closing line is considered as the diameter for drawing a semicircle. In comparison, the area of the bay must be equal to or wider than the area of the semicircle (paragraph 2).

b) The bay area has a boundary for the bay cover line and a low water line along the coast (paragraph 3).

c) If there are islands inside the bay, then the islands are considered as part of the water and the islands area is included as the bay area (paragraph 3).
d) If there are islands between the mouth of the bay, then a bay cover line is drawn connecting the islands, and the length of the line used as the diameter is the line connecting the island and the mouth of the bay (paragraph 3).

e) The bay cover line shall not exceed 24 nautical miles (paragraph 4).

f) If the length of the bay cover line is more than 24 nautical miles, another line shall be drawn within the bay so that the length does not exceed 24 nautical miles (paragraph 5).

Article 10 paragraph 2 of the LOSC is illustrated in Figure 2, and Paragraph 3 is illustrated in Figure 3. Closing line in Figure 2 and line AB & line CD in Figure 4 must be below 24 nautical miles.

![Figure 2. Juridical Bay in LOSC, modified from [6]](image_url)
![Figure 3. Bay closing line, modified from [7]](image_url)

Technically, the selection of the starting point for determining the mouth of the bay is obtained from the alignment of two lines representing the coastline as illustrated in Figure 4. Tangent is a line that represents the general direction of the coastline. The angle that is formed between the two tangents is divided in half, then straightened to the low water line on the beach which is the mouth of the bay. The point obtained is the starting point (entrance point) which becomes the mouth of one side of the bay. The same treatment was applied to the other mouth, to get the closing line.

![Figure 4. Entrance point selection, modified from [8]](image_url)

3. Result and Discussions

3.1. Internal waters in archipelagic states

A country has a territorial sovereignty / complete spatial jurisdiction over internal waters, archipelagic waters, and territorial sea [9]. Moreover, the differences in regimes for the three zones, especially in the conditions of other countries' vessels are presented in Table 1. Table 1 shows that it is important to identify internal waters and drawing lines between internal waters and archipelagic waters. Some violations can be committed by other countries (such as secretly entering internal waters in secret,
smuggling, illegal fishing, human trafficking, and others) because internal waters are bordering archipelagic waters [10].

Table 1. Different regimes in internal waters, archipelagic waters, and territorial sea [11]

| Regime of Sovereignty | Internal waters | Archipelagic waters | Territorial sea |
|-----------------------|-----------------|---------------------|-----------------|
| Right of passage of foreign ships | Absolute | Right of archipelagic sea lane passage & innocent passage | Relative |
| Rights of other countries | Does not exist | Yes (pipes, submarine cables, etc.) | Yes (traditional fishing rights of other countries) |
| Access to the port | Yes | In the innocent passage: - Yes, if the ship aims to stop over and enter internal waters - No, if it's just passing through | In the innocent passage: - Yes, if the ships stop by and enter the internal waters - No, if it's just passing through |
| Sea & shipping closure by the state | Yes, if the coastal state considers it vital and necessary | No | Yes, on condition that they provide notification to the user's country |
| Jurisdiction | National laws of the coastal state | International law of the sea | International law of the sea |

Apart from Indonesia, there are several countries that are archipelagic countries (Antigua & Barbuda, Comoros, Cape Verde, Philippines, Grenada, Kiribati, Papua New Guinea, Solomon Islands, Tuvalu, Vanuatu, St. Vincent & Grenadines, Trinidad & Tobago, Sao Tome & principle) as well as those that have potential as an archipelago (Bahamas, Bahrain, Cuba, Jamaica, Malla, Maldives, Mauritius, Seychelles, St. Kitts and Nevis, Tonga) [12]. However, there are archipelagic countries that cannot draw the archipelagic baselines because they do not meet mathematical criteria, for example, Japan [13]. Archipelagic countries that have defined boundaries between internal and archipelagic waters, namely Antigua and Barbuda through the Maritime Areas Act, 1982; and Fiji through Chapter 158A Ed 178 Marine Spaces [14]. The U.S. Department of State published studies assessing the maritime claims of internal waters in 20 countries as part of its Limits in the Seas series. Among the countries, the Indonesian archipelagic waters are bigger than all other archipelagic countries combined [15].

3.2. Juridical bays

Juridical bay in Indonesia is a bay that has an area larger than a semicircle formed from the length of the bay cover line (Figure 5). The selection of the entrance point considers the alignment of the shoreline from the method [8]. If there are islands inside the bay, the area of the island is included in the calculation of the area of the bay (Figure 6). If the position of the islands is between two entrance points (bypassing the closing line), the configuration of the closing line can be made in a similar way to get a wider bay (Figure 7).
There are several conditions of juridical bay found in this study:

3.2.1. A bay that the length of the closing line more than 24 nautical miles. In this case, the closing line is not drawn directly at the mouth of the bay, but rather indentations towards the shoreline. An example of this case is Buli bay (Halmahera island) in figure 8.
3.2.2. A large bay consisting of several coves. Figure 9 is an example of a large bay consisting of two smaller bays (Kacaplol bay and Kamampop bay). To draw internal waters boundaries, the bays can be identified as a single entity without change the toponym.

![Figure 9](image-url)

**Figure 9.** A juridical bay that consist of two smaller bays

3.2.3. Coastal indentation which can be defined as a bay but does not exist in the toponym data. In this case, the coastal curve is still identified as a juridical bay (Figure 10).

![Figure 10](image-url)

**Figure 10.** A juridical bay that doesn’t have a name

Previous studies have been conducted to find juridical bays in Indonesia. Mutaqqin et al (2017) used nautical charts to identify internal waters on the West Coast of South Sumatra [16], while Ramdhana et al. (2014) used Indonesian base maps to identify the Ekas Bay area on Lombok Island [17]. The last one is research by Rahmawan and Dhiaudin (2017) using Indonesian base maps to find juridical bays [18].

Baharu Bay in West Sumatra (figure 11) was identified as a juridical bay in Rahmawan and Dhiaudin's research (2017) by calculating the area using the UTM projection system, it is known that the bay has an area of 0.97 km2 [18]. The same bay appears in the research of Mutaqqin et al. (2017) which mentions Baharu Bay as Tarusan Bay with an area of 15.73 km2 [16], whereas through this study, it is known that Baharu Bay has an area of 18.88 km2. In this study, Baharu Bay intersects Teluk Dalam, as well as the research results of Mutaqqin et al. (2017). In Rahmawan and Dhiaudin's research (2017), Baharu bay and the small coves around it are defined separately. It can be concluded that different definition of bay will result in different bay area.
Of the 500 bays assessed, 357 bays meet the requirements as juridical bays. Some bays do not have names because they are not included in the toponym data. The total area of the bay is 24,918.37 km². Based on data from the Geospatial Information Agency, the area of Indonesian archipelagic waters (including internal waters) is 3.11 million km². So that the juridical area of the bay and internal waters obtained is 0.8% of the total area of the waters in the archipelagic baselines. This internal water boundary needs to be published to avoid the possibility of foreign seafarers violating Indonesian regulations and they can provide notification before entering an area that becomes internal waters [19].

The red areas in Figure 12 show bays that have been identified as juridical bays. These bays are scattered on the main islands (Sumatra, Java, Kalimantan, Sulawesi, Maluku, Papua) and the small islands around them. However, there are still many bays outside the 500 bays which are the limitations of the research.
3.3. Not juridical bay
Many bays in Indonesia do not meet the juridical bay requirements, which are divided into two conditions as follows:

3.3.1 An indentation of the coastline that has a bay toponym but does not meet the requirements of a juridical bay. Several bays in Indonesia that do not meet the criteria cannot be identified as internal waters (For example, Membalong bay and Balok bay in Figure 13). The bay area is smaller than the semi-circle area whose diameter is the line drawn across the mouth of the indentation. Referring to the international law of the sea, these bays cannot be called juridical bays although they can still be recognized as bays by the local community.

3.3.2 Large bay. There are many large bays in Indonesia, one of which is Bone Bay which is located in Sulawesi (Figure 14). This bay has a cover line length of more than 24 nautical miles, so it does not meet the juridical bay requirements. Juridical bay that can be identified is only the coves that are inside Bone bay. However, Bone Bay can still be designated as an internal waters if it meets the historic bay requirements.

The international law of the sea does not address the specifics of historical bays. However, several studies have been conducted, such as Gulf of Taranto in Italy [20], Encounter Bay, Lacepede Bay, Rivoli Bay, and Anxious Bay in South Australia [21], and the Gulf of Sidra in Libya [22]. This can be used as a reference for Bone bay and other large bays in Indonesia so that they can be identified as historic bays.

4. Conclusion
Indonesia has ratified the Law of the Sea Convention through Law Number 17 of 1985. As a follow up, Indonesia issued several regulations related to archipelagic waters and internal water boundaries, including Law Number 6 of 1996 concerning Indonesian Waters and Government Regulation of the Republic of Indonesia Number 38 of 2002, and Government Regulation of the Republic of Indonesia Number 37 of 2008. One of the maritime zones in the LOSC that has not been defined in Indonesian legislation is internal waters.

The identification of juridical bays can be done using GIS software. Nonetheless, there are several conditions affecting the juridical bay, including (1) a bay whose cover line is more than 24 nautical miles, the closing line is drawn back so that its length does not exceed 24 nautical miles; (2) a juridical bay may consist of several coves, but can be closed as a single entity; (3) There are several juridical bays that do not have name; and (5) Large bay that does not meet the requirements of a juridical bay can be designated as internal waters as long as it meets the historical bay regime.
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