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The Application of Landsat 8 OLI to Identification Shoreline Change in 2000 – 2020 in Muncar Sub-District, Banyuwangi, East Java

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Abstract

The shoreline is a confluence between land and seawater used to determine the boundaries of a zone. This research was conducted on the coastline of Muncar Subdistrict, Banyuwangi, which aims to identify changes in the coastline of Muncar Subdistrict in 2000-2020 using Landsat image 8 OLI / TIRS, map the rate of changes in the coastline of Muncar Subdistrict in 2000 and 2020, and know the changes in the coastline in Muncar Subdistrict is more likely due to abrasion or accretion. The research methodology used for this study uses the NDVI analysis and the DSAS Shoreline analysis system. The identification takes 20 years with Landsat imaging in 2000 and 2020. The results of this study demonstrate that shoreline alterations are caused by abrasion, accretion and human activity. This change in shoreline results from abrasion and accretion factors. The coastline change in 2000-2020 in the subdistrict of Muncar can be concluded that there are six villages. These include the villages of Kumendung, Sumbersewu, Tembokrejo, Kedungrejo, Kedungwringin and Wringin Putih. However, the village most seriously affected by abrasion and accretion is Wringim Putih Village. The village of Wringin Putih reported that the level of abrasion and accretion could be considered 50 per cent abrasion and 50 per cent accretion. So the change in shoreline can result around the Muncar Subdistrict coastal area, such as reduced coastal areas, lost colonies, and damage to marine ecosystems

Keywords:
Landsat 8; Shorelines; DSAS.

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1. Introduction

This Indonesian archipelago consists of 17,805 islands with the second-longest coastline in the world, 95,181 km (Valderrama-Landeros & Flores-de-Santiago, 2019). The Indonesian archipelago is formed because of geological processes that affect coastal morphology and coastal areas. This coastal area has a dynamic nature so that later it will experience continuous changes (Kasim & Salam, 2015). These changes are caused by this coastal area, including the category of areas vulnerable to natural phenomena that occur to affect the change in the coastline.

The coastline is the limit of seawater when there is the highest tide (Suharyo & Hidayah, 2019). So it can be said that the coastline is a meeting between land and seawater used to determine a region's borders. Changes in the coastline or often called the evolution of coastline on a scale of seconds to millions of years (Prameswari dkk., 2014). This change in coastline also depends on the level of the tide of the beach. The coastline/sea can change due to natural factors that affect the condition of the coast, namely the onset of waves and currents that cause abrasion and sedimentation so that these factors affect the change in coastline and river conditions that empties into the water (Suharyo & Hidayah, 2019).

This coastline change often occurs in Indonesia, one of which is in the Muncar Subdistrict, Banyuwangi Regency. Muncar subdistrict is located in the eastern coastal area of Banyuwangi Regency and is directly adjacent to the Bali Strait. Banyuwangi itself has a beach length of 13 km. Changes in the coastline in Muncar Subdistrict are caused by abrasion and accretion factors. We know for ourselves that the consequences of abrasion and accretion are very influential on the condition of the coast and surrounding areas. These coastal and coastal areas will be unbalanced so that it will affect the damage in the coastal area itself, and the coastline will increasingly experience negital changes.

This change in coastline can also be caused by non-natural factors such as human activities that utilize the potential of nature excessively, industrial development and other extravagive activities that are excessive. Those, directly and indirectly, impact environmental conditions and the utilization of coastal areas that change due to unbalanced coastal ecosystems that result in damage. This change in coastline needs to be explicitly considered because this coastal change impacts various aspects of the coastal area. To identify this coastline change, this needs to use some advanced technology, namely remote sensing and Geographic Information Systems (GIS). Identifying and detecting these shoreline changes requires samples with a period of 10-20 years to get changes in the coastline in a matter of centimetres or even tens of meters (Nugraha dkk., 2017). Identification of changes in the coastline of Muncar Subdistrict in 2000-2020 using Landsat 8 OLI / TIRS. This Landsat image has an advantage in the field of spatial resolution of 30x30 meters (Nugraha dkk., 2017). This Landsat 8 image is designed to carry an OLI imaging sensor with one near-infrared channel and seven reflective-looking canals. So that this Landsat can record the wavelength reflected by the earth's surface object with a spatial resolution of 30 meters, so this Landsat 8 can produce data continuity for infrared channels that are not imaged by OLI (Sitanggang, 2010). The implementation of Landsat 8 aims to identify the rate of change in the coastline in the Muncar Subdistrict, Banyuwangi Regency.

2. Methods

2.1 Study Area

The scope of the research area is the administrative area of Muncar Subdistrict, Banyuwangi. Located at latitudes at coordinates 08°.10'- 08°.50'LS and 114°.15'- 115°.15' BT (Aida Nurus Suroyya*), Imam Triarso, 2014). Muncar district has a land area of 146.7 Km^2 which is divided into ten villages/villages. As for some villages that belong to the Muncar subdistrict area, namely Blambangan Village, Kedungrejo Village, Kedungringin Village, Kumendung Village, Sumberberas Village, Tambakrejo Village, Sumbersewu Village, Tapanrejo Village, Tembokrejo Village, and White Wringin Village. Muncar area is also passed by several rivers, namely Binau River, Bomo River, and Lumbun River. While demographic conditions, especially residents in Muncar subdistrict, is the most populous category of the population than other sub-districts in Banyuwangi Regency. Judging from the area of 2.52 per cent of the total area of Banyuwangi, Muncar District is a category of inhabited areas with a population of 136,425 people or 7.98 per cent of the population of Banyuwangi (Penduduk, 2021).

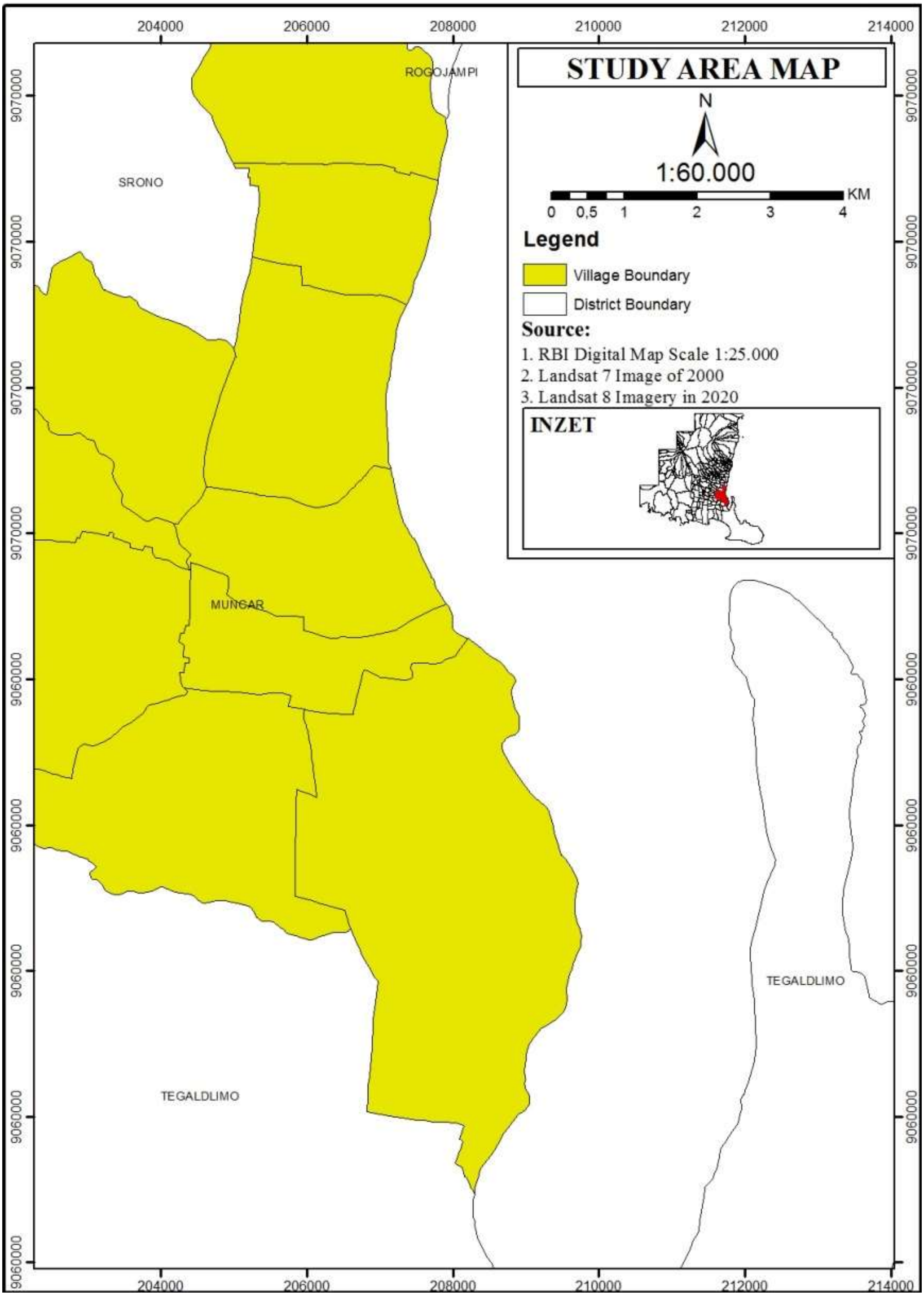

Fig. 1. Muncar District Administration Map

2.2 Remote Sensing Data

The data used to identify the change in the coastline is by using Landsat 7 and Landsat 8 OLI / TIRS. This Landsat 8 image has an advantage in the field of spatial resolution of 30x30 meters. This Landsat 8 image is designed to carry an OLI imaging sensor with one near-infrared channel and seven reflective-looking canals.

2.3 Normalized Different Vegetation Index (NDVI)

Processing Landsat image data also utilizes ENVI 5.3 management using the NDVI method. NDVI is used to determine the index that describes the greenish level of a plant. The entire process of the study is shown in Figure 1 in detail.

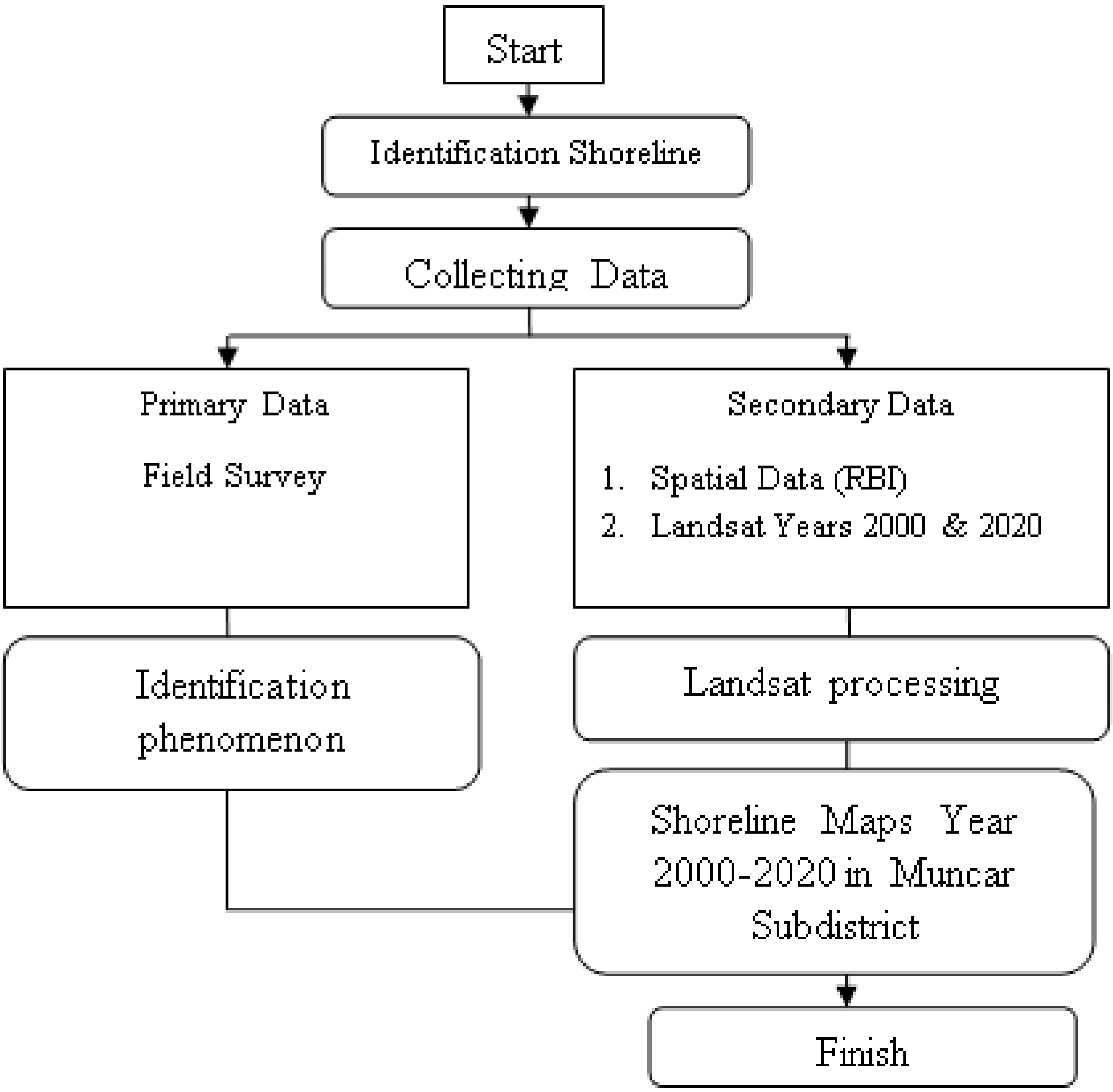

Fig. 2. Research Flowchart

3.2 DSAS Analysis

The study used the Digital Shoreline Analysis System (DSAS) method. DSAS is ArcGIS software developed by USGS (Department of the Interior U.S. Geological Survey, 2016; Roy dkk., 2018). This DSAS analysis is used to determine changes in coastline, in managing changes in coastline requires a sample of Landsat imagery data spanning 10-20 years. In this DSAS analysis, several statistics are analyzing it, namely SCE (Shoreline Change Envelope), NSM (Net Shoreline Movement), End Point Rate (EPR) and LRR (Linear Regression Rate) (Mutaqin, 2017).

3. Result and Discussion

Monitoring of coastal zones related to shoreline extraction and detection of the rate of change at various times is needed (Nassar dkk., 2019). Identification of coastline changes in Muncar District in 2000-2020 uses several advanced technologies, namely remote sensing and Geographic Information Systems (GIS). To identify the change in the coastline in Muncar Subdistrict with Landsat image in 2020 using Landsat image 8 OLI / TIRS. This Landsat image has an advantage in the field of spatial resolution of 30x30 meters. This Landsat 8 image is designed to carry an OLI imaging sensor with one near-infrared channel and seven reflective-looking canals. So that this Landsat can record the wavelength reflected by the earth's surface object with a spatial resolution of 30 meters, so this Landsat 8 can produce data continuity for infrared channels that are not imaged by OLI (Sitanggang, 2010). While the characteristics of Landsat 8 have two sensors, namely the operational land imager (OLI) sensor and the Thermal infrared sensor (TIRS). This difference lies in the number of channels carried by each sensor. Landsat 7 ETM only has 9 bands, while Landsat 8 has 11 bands, and Landsat 8 is more sensitive to radiometric processing because it has a higher bit value than Landsat 7 ETM.

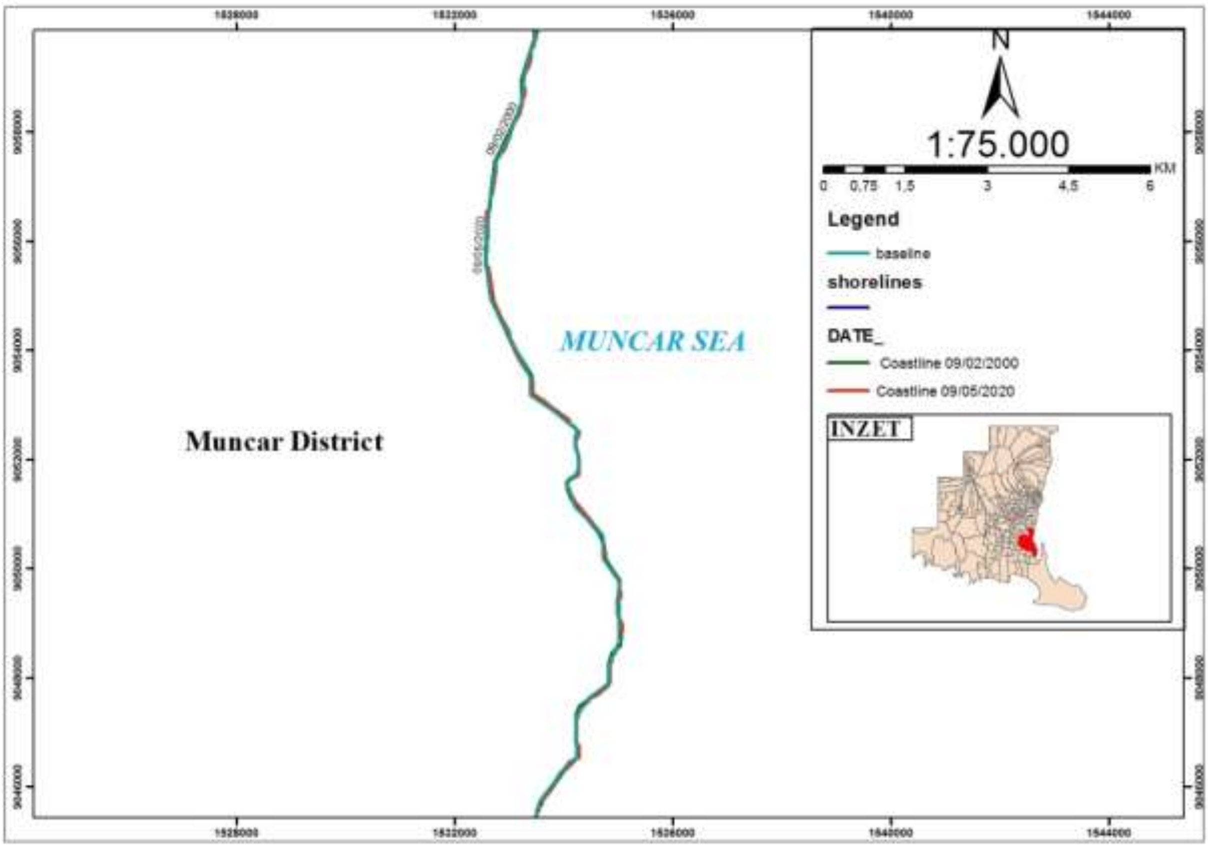

Fig. 3. DSAS Processing (Baseline and Shorelines)

Identification this time aims to find out the changes in the coastline in Muncar Subdistrict is more likely due to abrasion or accretion. In identifying this coastline in 2000, the author used Landsat 7 imagery that used band 1, band 2, band 3, band 4, band 5, and band 7. As for the 2020 coastline change uses Landsat 8 imagery using band 2, band 3, band 4, band 5, 6, and band 7, band 10, and band 11. There are several stages in processing Landsat image data in 2000-2020 to find out the changes in the coastline, namely the first step in processing Landsat image data using the ENVI 5.3 (64 bit) application. This initial stage processes all the data by determining several parts, such as layer stacking, radiance, reflectance, TOA, DOS, masking and this final stage processes DOS data processed using the NDVI formula, and the final stage is data processing in ArcGIS, which is then digitized to find out the change in the coastline in Muncar Subdistrict.

However, there are differences in processing imagery in Landsat 7 and Landsat 8. There is a difference in the band used, then at the reflectance stage in Landsat 7 we have to arrange the formula with the actual existing metadata. So in this stage of reflexivity, we must compile the formula d^2 (earth-sun distance), sun azimuth, and sun elevation. So that it can be concluded in its processing is easier to use Landsat image 8 OLI / TIRS. The next stage is the management of NDVI data to be analyzed using the DSAS shoreline analysis digital system (Figure.3).

Identification of coastal changes in Muncar Subdistrict, Banyuwangi with the final step of digitization and DSAS analysis using ArcGIS shows that the above map can be categorized that the factor of changes in the coastline in the Muncar region is to be caused by abrasion and accretion factors, and human activities (Figure 3). As for the factors that affect the cause of abrasion, namely mangrove forest damage in coastal areas. If this mangrove forest is damaged, it will result in abrasion. Mangrove forests can be said as one of the foundations in preserving the coastal environment.

Another factor that causes changes in the coastline is accretion. This accretion is usually due to the process of sedimentation of land/river towards the sea. Usually, this sedimentation occurs due to the clearing of land areas, and in addition, heavy rain can also cause freshwater runoff (river water) experiencing sediment from the river to the sea. That leads to siltation that occurs in the sea. The results of the map analysis above show the shoreline change envelope (SCE) in Muncar district in 2000, which is 16896.60383 m, while the coastline in 2020 along 17674.794046 m so that the Net Shoreline Movement (NSM) is 778, 190216 m. The categories of coastline change influenced by abrasion and accretion are shown in Table 1.

Table 1

Village categories classified as Abresi and Accretion

No.	Village	North	South
1.	Kumendung	accretion	Slight abrasion
2.	Sumbersewu	accretion	accretion
3.	Tembokrejo	accretion	Slight abrasion
4.	Kedungrejo	abrasion	A little accretion
5.	Kedungringin	abrasion	abrasion
7.	Wringin Putih	abrasion	accretion

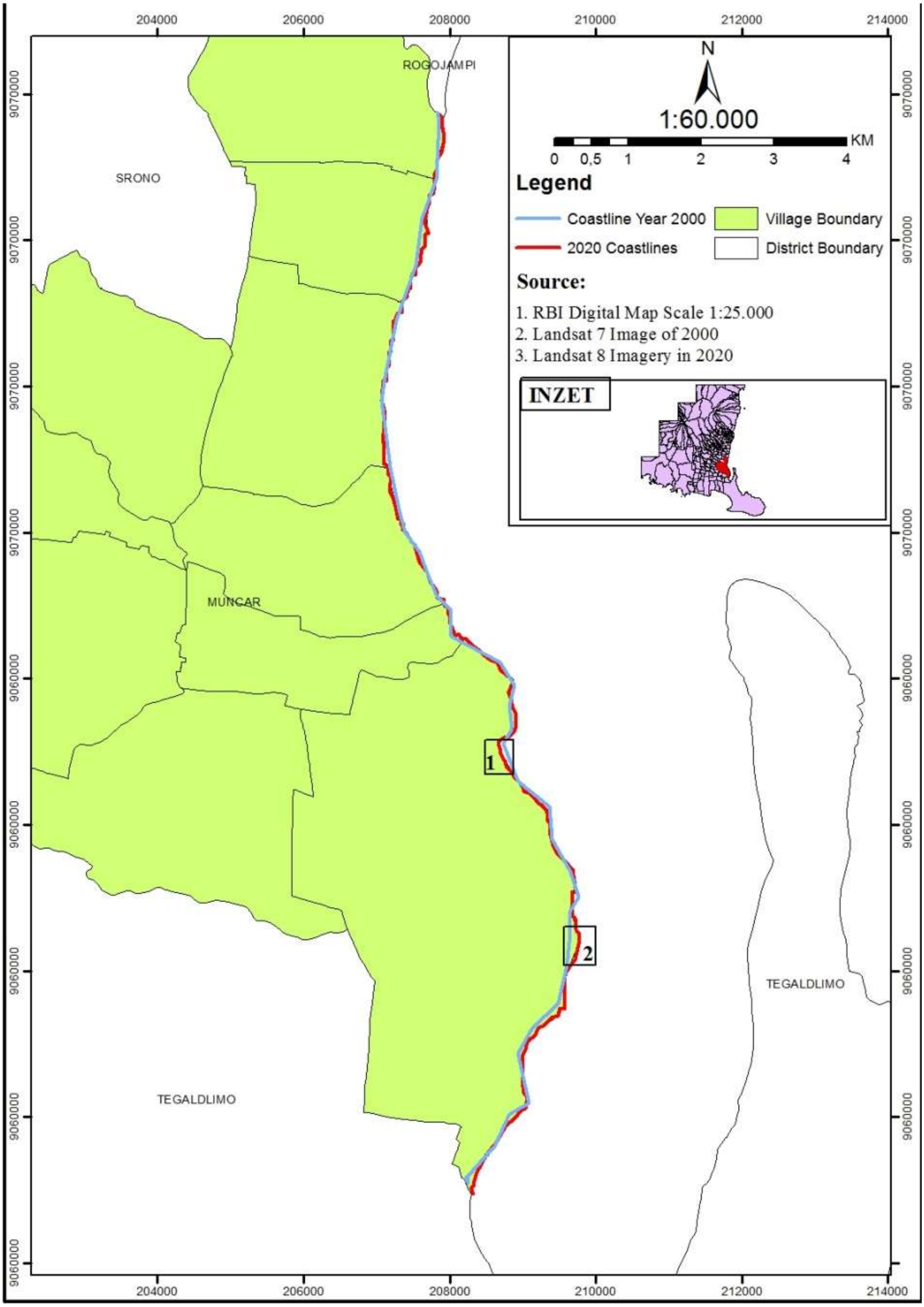

Fig. 4. Coastline Map Change Year 2000-2020 in Muncar Subdistrict

So we can see from the change in the coastline from 2000 to 2020 is experiencing changes. Identifying the change in the coastline for the Muncar Subdistrict is classified as two causes, namely abrasion and accretion. Figure 1 shows the rate of change due to abrasion, while Figure 2 indicates the rate of change caused by accretion. However, judging from the map of severe coastline changes located in Wringin Putih's village, the area shows 50% abrasion and 50% Accretion. In addition to natural factors, there are also caused by non-natural factors, namely human activities, such as the opening of land areas such as ponds (Figure 5).

Fig. 5. Field Survey

4. Conclusion

Changes in the coastline in Muncar District, Banyuwangi are caused by natural and non-natural factors, namely abrasion, accretion, and human activities. If the human has experienced this abrasion must be handled with the creation of breakwater buildings and levees, and judging from the map of the changes in the coastline in 2000-2020, it can be concluded that six villages experience changes in coastline due to abrasion and accretion. The village worst affected by abrasion and accretion is Wringim Putih Village. Wringin Putih village is pointing out that the rate of abrasion and accretion can be 50% abrasion and 50% more accretion so that this change in coastline can result in coastal areas such as reduced coastal areas, lost settlements, and damage to marine ecosystems.

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