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Location Characteristic of Seaweed Cultivation Based On Image Processing and People Perception in Amal Coast, Tarakan Island

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Abstract. Amal coast in Tarakan Island famous for seaweed production. This research aims to know the location characteristic of seaweed cultivation from people perception, and to know the connection of the people perception with certain factors such as: the family income, the length of stay, and the impact of seaweed cultivation on society and environment. Research location was based on the purposive sampling in Amal Coast which was the main location of seaweed cultivation. Furthermore, searching for additional data from informant who's recommended by key informant. This method based on snowball sampling. Location characteristic of seaweed cultivation seen based on Landsat 8 image processing. The data were compiled and validated by survey using question-answer method which was based on the research variables. Data analysis in this research was qualitative descriptive method, to provide a description and explanation of research variables. Interactive data model analysis from Miles and Huberman, which started with data collection process, data simplification, data presentation, and conclusion of research. Results from this study showed that people's perception determine characteristics of location for seaweed cultivation in Amal Coast, East Tarakan. Location that provide more income and more long-term business will be increasingly in demand.

1. Introduction

Indonesia has larger ocean area than its land area. The 70% of Indonesian territory is ocean with length of coastline is more than 99.093km² and consists of 13.466 islands [1]. The larger area of the ocean has an impact on the coastal resources which is make Indonesia has high potential of coastal resources. The efforts to manage the potential of Indonesia's marine resources are done by many things, one of them is by cultivation. Seaweed cultivation is one of coastal resources that has a high potential in economic which is adequate to give a hope for coastal societies to improve their living standards.

Seaweeds is one of export commodities that has high potential to be developing. Indonesia is one of exporting countries in Asia. Seaweed is exported in form of dried seaweed [2]. As much as 70% production of seaweed were exported to Europe (EU), China and Philippines. 30% of seaweed production is circulated in domestic market [3]. The type of seaweed that being cultivated by Indonesia people is *Eucheuma cottonii*. Species *Eucheuma cottonii* can be found in Amal Coast, Tarakan Island, North Kalimantan. Since 2009, In Tarakan Island, North Kalimantan especially In Amal's Coast, the local communities started to develop seaweeds cultivation. At first, seaweed cultivation is only alternative income for local communities beside of being fisherman. But apparently, seaweed cultivation business is very promising and growing rapidly. Seaweed cultivation has a pretty good prospect, because it already has their own market and now it has become one of Tarakan's main commodity beside fisheries, shrimps, and crabs.

Human perceptions of the environment is a spatial perception that is as an interpretation of a setting (space) by individuals based on the background, culture, reason and experience of the individual. Thus



each individual can have a different environmental perception of the same object because it depends on the background that is owned [4]. Environmental perceptions related to spatial perception play a role in decision making in the context of migration, communication and transportation.

Seaweed cultivation in Tarakan Island, can be able to increasing income of local communities. This study aims to know location characteristic of seaweed cultivation from people perception, and to know the connection of the people perception with certain factors such as: the family income, the length of stay, and impact of seaweed cultivation on society and environment.

2. Methods

The research location is around Amal Coast, Tarakan City in North Kalimantan which is determined purposively with the consideration that Amal Beach is the centre of seaweed cultivation and production in Tarakan Island. The research was conducted in July 2018. The method used in this research was image processing, and descriptive method.

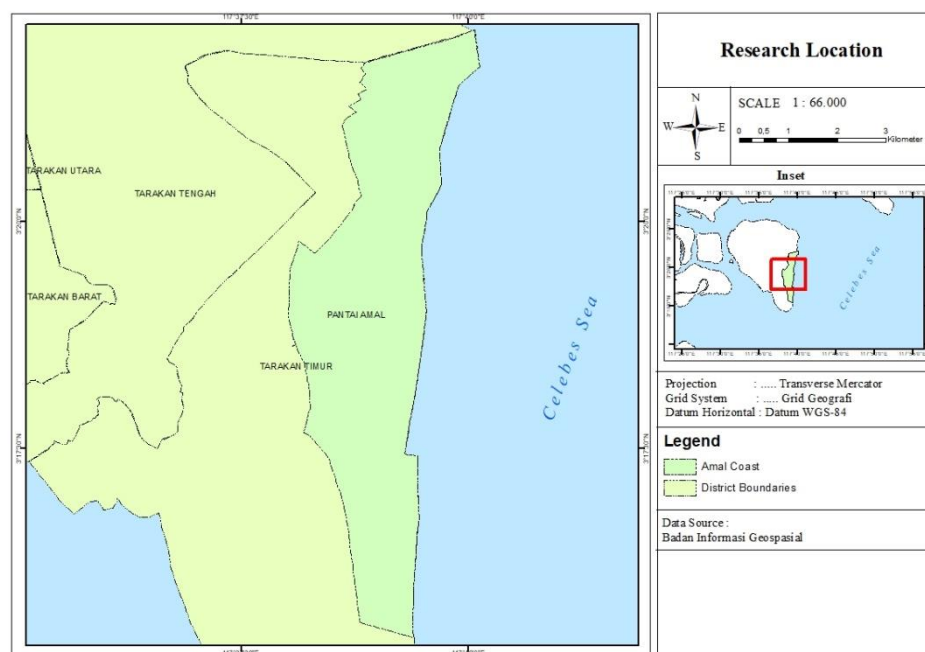


Figure 1. Study area in Tarakan Island, North Kalimantan.

Data that used in this research is Landsat 8 OLI image on August 28th 2015 (El Nino Condition) that downloaded from <https://earthexplorer.usgs.gov/>. Then, the data will be processed by algorithm imagery used *software* ArcMap 10.4. Variabel that used on this image processing is Dissolved Oxygen, Sea Surface Temperature, and Total Suspended Solid (TSS). Furthermore, to get a suitability area for *Eucheuma cottoni* cultivation, an *overlay analysis* was performed on each parameter by ArcMap 10.4.

The first stage after getting all the data, both primary data (image) and secondary data is to do radiometric correction. In radiometric correction, the steps taken are changing the Digital Number (DN) of the image to reflectance and radians. After radiometric calibration, radians image conversion is done to reflect the Top of Atmosphere (TOA) [4]. The main objective is to improve the difference in reflection values due to differences in earth-sun distance on each recording date. This difference can be significant due to differences in geographical conditions and image recording time.

Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) is used to correct the atmosphere on Landsat images [5]. In the atmospheric LEDAPS system, ozone is obtained directly from the TOMS data and the water vapor column was taken from NCEP data during the data

processing process. Aerosol optical depth values are lowered directly from the image and processed automatically so that directly obtained surface reflectance images for blue, green, red, NIR and SWIR canals are obtained. The next stage is calculate algorithm values.

Algorithm formula for image processing are mentioned below :

1. Dissolved oxygen

In its development there is a good relationship between the temperature approach of surface water and dissolved oxygen obtained from the lab test at Lake Nasser Egypt, so that the *Near Surface Water Temperature* (NST) algorithm will be converted to *Near Surface Dissolved Oxygen* (NDO) using the Ali El Battay *et al* [4] :

$$NDO = (-0.19 * (0.97 * SST)) \quad (1)$$

With :

NDO = *Near Dissolved Oxygen* (mg/l)

SST = Sea Surface Temperature

2. Sea surface temperature

Data on sea surface temperature obtained from the extraction of spectral radiances values, then find the value of radiances temperature for each pixel which is calculated based on the spectral radiances value using the following equation [5]:

$$T_R = K_2 / \ln(K_1 / L\lambda + 1) \quad (2)$$

With :

TR = Radian Temperature (K)

K2 = Constanta Calibration 2 (1321,08 K)

K1 = Constanta Calibration 1 (774,89 K)

Lλ = Spectral Radiance

3. Total Suspended Solid (TSS)

To find out suspended sediment concentration, that is by using an algorithm that has been developed from previous research, with algorithm by Budhiman [6]:

$$TSS = 8.1429 * \exp^{(23.704 * \text{red band})} \quad (3)$$

With :

TSS = Total Suspended Solid (mg/l)

Then, the results of image processing are analyzed with the results of a survey on people's perceptions on the Amal Coast. The results of this survey will be analyzed by descriptive analyzed. Variable for people perception are family income, the length of business, and impact of seaweed cultivation on society and environment. All of variable will be overlaid to determine location characteristic based on people perception in Amal Coast, Tarakan Island.

3. Result and discussion

3.1. Image processing

The calculation of dissolve oxygen, sea surface temperature, and TSS resulted in the following results.

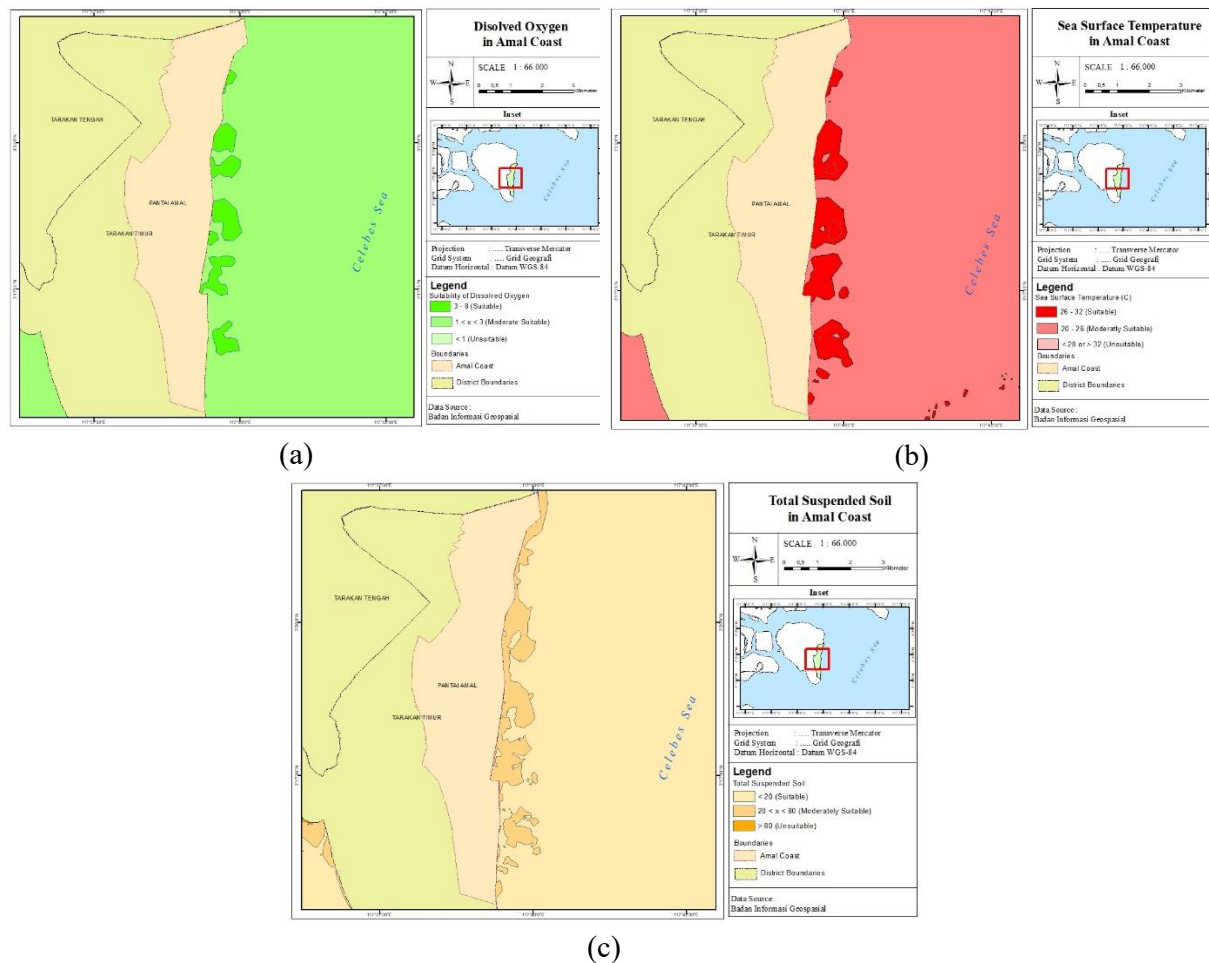


Figure 2. Water parameter analysis in Amal Coast: (a) dissolve oxygen result, (b) sea surface temperature, and (c) total suspended soil.

Seaweed cultivation requires land suitable for its development. The land suitable for seaweed cultivation is grouped into several parameters and levels. After algorithm calculation, the value grouped according to their suitability parameters. According to the Indonesian National Standard for Seaweed Cultivation 2010, the parameters of conformity of seaweed with the appropriate level, sufficiently appropriate, not appropriate are grouped. Under appropriate conditions, the development of seaweed will be maximal. So that it can improve the quality of life and land clearing of new jobs for coastal communities. The following are parameters for seaweed suitability.

Table 1. Seaweed suitability parameter.

No.	Parameter	Very Suitable	Suitable	Unsuitable
1	Dissolve Oxygen (mg/l)	3-8	$1 < x < 3$	< 1
2	Sea Surface Temperature (°C)	26-32	20-26	$< 20 \text{ \& } > 32$
3	Total Suspended Soil (mg/l)	< 20	$20 < x < 80$	> 80

Source : SNI, 2010 in Yudhanto 2016

After the algorithm is assessed, the results are overlayed and get the seaweed cultivation area. as seen in the figure 3 below.

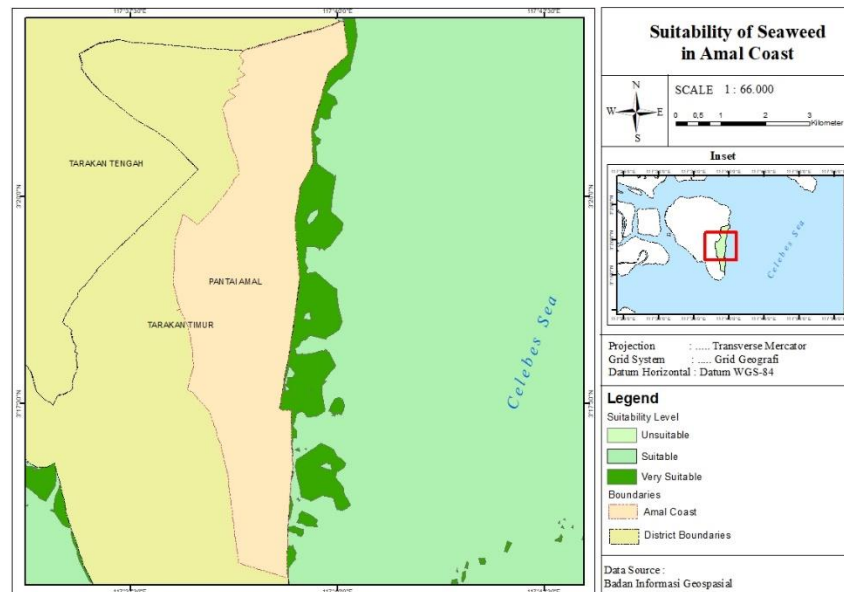


Figure 3. Suitability of seaweed cultivation.

Based on figure 3, can be seen that very suitable area for seaweed cultivation in Amal Coast is in the middle of Amal Coast Village. Getting to south, the area will be more unsuitable but getting to north is suitable but not much as middle Amal Coast Village.

3.2. People perception

Characteristics of respondents in this study based on length of stay, family income, and impact of seaweed cultivation on society and environment. All of this variable taken of neighbourhood in Amal Coast, because people in Amal Coast dividing their area by neighborhood.

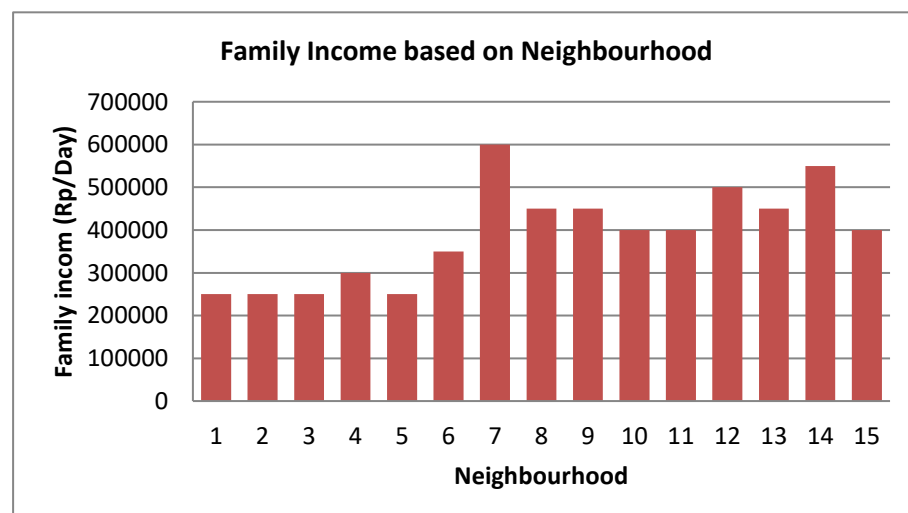


Figure 4. Family income.

According to BPS (Central Statistics Agency) income is all that is called both the formal and non-formal sectors involved in a certain period of time. Family income is total / real income from all household members donated to meet common needs and individuals in the household. In Amal Coast, family income can be related to the suitability of seaweed cultivation based on people perception.

Based on average of neighbourhood, RT 7 is the highest household income, and RT 14 in second position. This opinion can also be supported based on the population per household where RT 7 and RT 14 have the most population. With this large population, it indicates that seaweed cultivation in this household is quite advanced with the large number of people in this area. While, in RT 1 until RT 3, people work more as trawlers than cultivation, because residents of RT 1 also think that seaweed cultivation in the area is not good anymore. Those makes the income in RT 1 until RT 3 fairly small.

RT 1 until RT 3 is an old Amal Coast area that is already quite long known for its seaweed cultivation. While, for RT 15 it is a division area of RT 8. According to data from Kaltaranews, since 2012 there has been an increase in the population caused by the potential of seaweed that occurs on the Amal Coast. In the news, the head of RT 12 stated that before 2012 the population of RT was only around 100 people, but after the seaweed issue spread on the Amal Coast, the population of RT 12 reached 355 people. However, RT 1 until RT 3 which is considered to be a old Amal is rarely the growth of seaweed, this is due to the large number of people in the area while seawater in the area has no potential for seaweed cultivation. this makes residents from RT 1 until RT 3 become more trawlers or move cultivation locations to the north.

In this study, there are 3 parts of questions in the questionnaire which are about condition of seaweed yield, quality of seaweed yield (both count for last 5 years), and other activities besides cultivation.

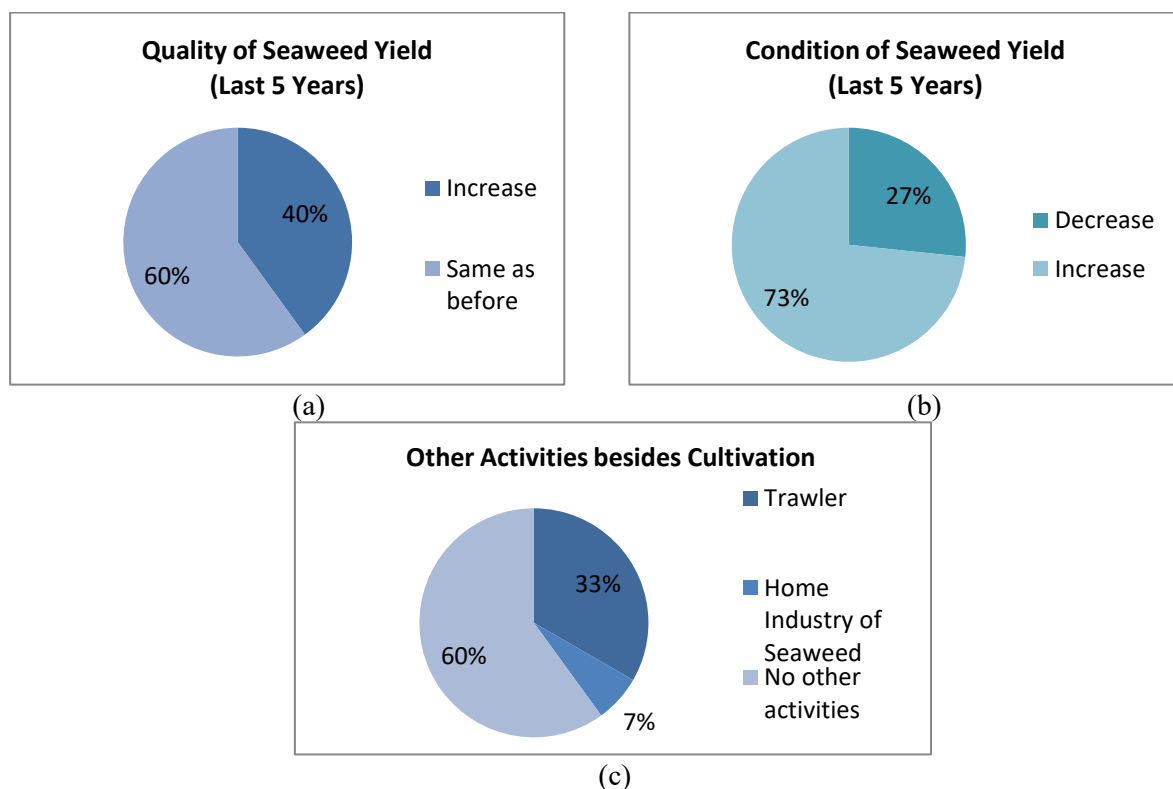


Figure 5. Graphic for people perception: (a) quality of seaweed yield, (b) condition of seaweed yield, and (c) other activities.

The results are obtained based on questions from 15 RTs which are then averaged based on the percentage results. From the graph it can be seen that the yield conditions of seaweed cultivation have increased over the past 5 years. But 27% decreased at RT 1, 2, 3, and 4. However, family income in RT 4 was helped by the presence of the seaweed home industry. Then the quality of seaweed cultivation is the same as the previous 5 years as much as 60%, this shows that the waters on the Amal

Coast have not been polluted. Even so, 40% of the informants believed that there was an increase in what happened at RT 6, 7, 8, 9, 11, and 13.

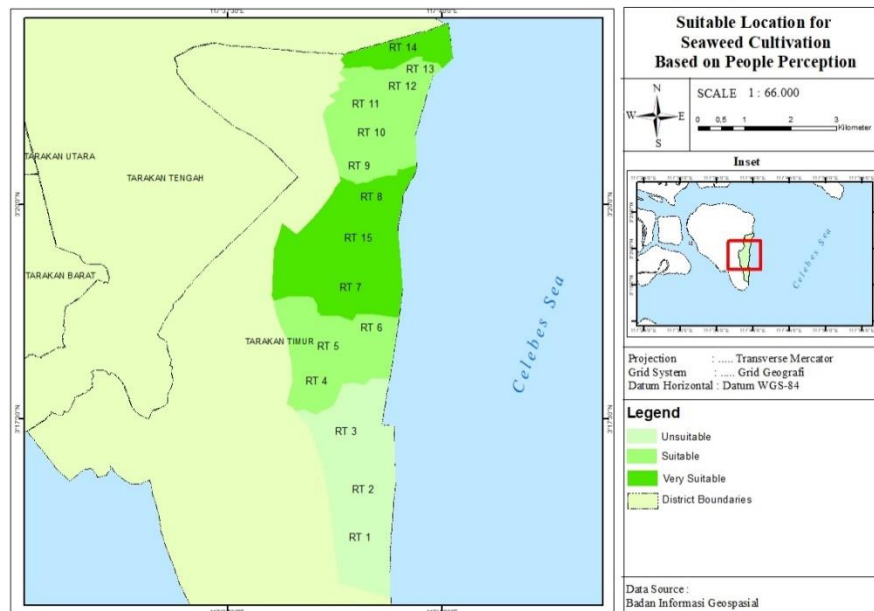


Figure 6. Suitable location for seaweed cultivation based on people perception.

Characteristic of seaweed cultivation based on people perception is locations with high family income, as well as large seaweed production, and also calm waters are not too choppy. In the other words, RT 7 is a RT with good location characteristics for seaweed cultivation and continued with RT 14. while RT 1 until RT 3 is no longer good if continued for seaweed cultivation. These, makes many residents of the area turn into trawlers.

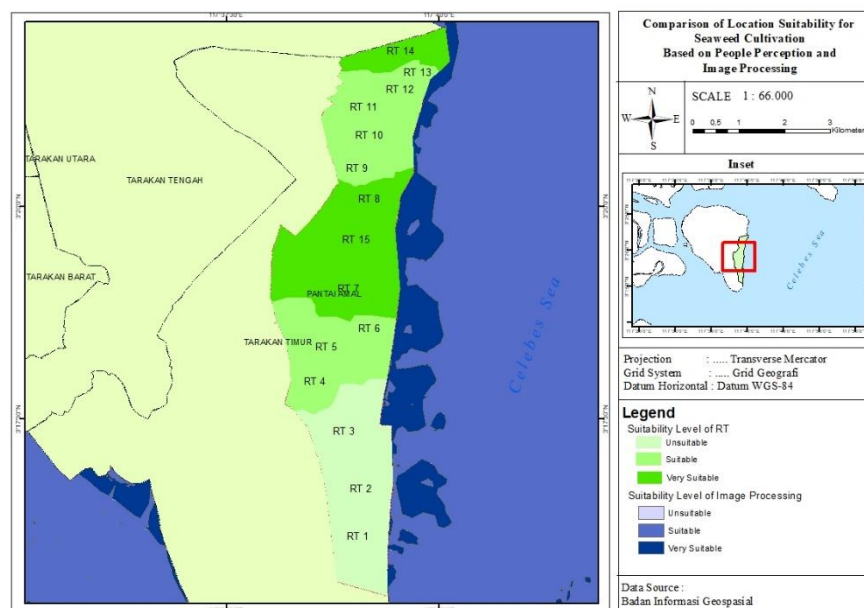


Figure 7. Comparison of suitable location for seaweed cultivation based on people perception and image processing.

Based on comparison, appears that RT 7, 15, and 8 have very suitable level for seaweed cultivation. Which explains that the household has relatively high family income. This condition can also be seen that the environment in the household is still maintained and can be promising for long-term business. Meanwhile, at RT 1 until 3 relatively has low family income, due to the condition of the waters which are also not good for seaweed cultivation.

4. Acknowledgement

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5. Conclusion

Location characteristic from people perception in Amal Coast almost same as image process result. Image processing result mentioned that in middle of Amal coast is the suitable area for seaweed cultivation. From people perception, the best cultivation location which have characteristic with family income more than Rp 400.000,- per day, increased condition for seaweed yield, and water condition that still quite good. In the other words, the best area for cultivation that increasing family income, and more long-term business, and also sufficient resources of seaweed. Based on image processing, southern region is unsuitable area that showed in RT 1, 2, and 3 in administrative area.

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