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THE MODELING OF TSUNAMI EFFECT TO THE AGRICULTURE SECTOR IN PADANG, WEST SUMATRA PROVINCE

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ABSTRACT: If a tsunami comes there are several impacts i.e the most material loss and fatalities especially in the coastal area of densely populated such as Padang, West Sumatra. The research about the modeling of tsunami damage and effect is needed as the government references in the policy-making about the city layout. In this modeling, the tsunami has the sea level as much as 11 meters in the shoreline. Then we will calculate the decreasing water level which is blocked by the areas used. To know the land effected is used Cost-distance analysis. The indicator of area damage calculated in the agriculture sectors are the rice fields, farms, and fields. The modeling results showed that the rice fields have impact as wide as 2. 090,36 ha or 38% from the total area of rice fields, while the fields have impact as wide as 663,86 ha or 23,10% from the fields total area and the farms have impact as wide as 829,73 ha or 8,15% from the total area.

Keywords: The Modeling, Agriculture, and Tsunami

1. INTRODUCTION

Indonesia is the Southeast Asia countries and the archipelago in the equator. Besides, Indonesia has so many volcano mountains from the west to the east, hence Indonesia is called the ring of fire country. That thing is one of the reasons why Indonesia has frequent earthquakes and mountain eruptions[5] [6] [7] [8]. We could see that Indonesia is located surrounded by 3 active tectonic plates. It is Indo-Australian Plate in the southern, Pacific plate in the eastern and Eurasia Plate in the northern [9] [14] [15] [16]. West Sumatra has a dangerous geographic condition because that place is located in the west coast Sumatra Island where there is Indo-Australian Plate in there[3].

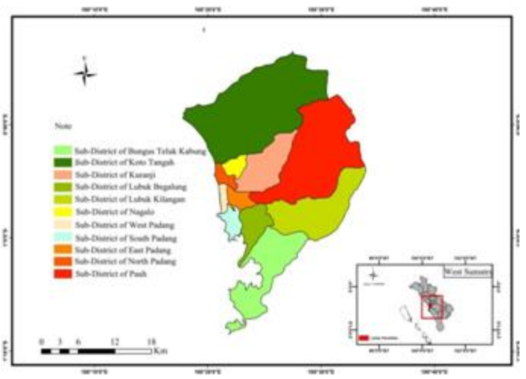

Fig 1 The research location

In history, West Sumatra has encountered a tsunami for several times. The tsunami had been occurred in 1797 because of the underwater landslide after the earthquakes, with the water level around as high as 5 to 11 meters or 1 km to the land. And then, in 1833 tsunami had been occurred because the sea trough crack as long as 1000 km and the earthquakes are 8,8 to 9,3 Mw [7] [8] [9] [10]. Base on the Ina-Geoportal data in 2019, Padang has 20.001,64 ha the agriculture areas. The areas are divided into the rice fields 6. 949,90 ha, the fields 2.837,95 ha and the farm as wide as 10.177,79 ha. [2] [11] [12] [13]. said in 2017 the citizen of Padang has a profession in the agriculture sector is as much as 22.330 people. If the tsunami has happened in Padang so, the economy of Padang, especially in the agriculture sector, will be hampered because the citizen of Padang is the mostly agriculturists.

Base on that problem, we researched to study the agriculture sector with the affected land explanation of the rice fields, fields and farms. And the research title is the modeling of tsunami effect to the agriculture sector in Padang, West Sumatra Province. The aim research is to count the wide areas of the agriculture sector affected in the tsunami modeling

2. METHODS

2.1 The research location and research times

The research location is conducted in the administration areas of Padang, West Sumatra. The calculation of affected agricultural land potential. Types of agriculture are rice fields, farm, and fields. The wide affected land made in the modeling is divided into the projection of increased water level of the tsunami in the shoreline 11 meters. To determine the increased water level had been in the attachment of the Tsunami Risk Assessment book, the regulatory

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chief of National Disaster Management Authority no 4/2012, is 11 meters. In that book, explained the potential of increased water level of the tsunami in Padang is 11 meters.

Table 1. Type and the source data

No	Data	Source
1	*DEM GDAM*	ASTER
2	userland map	Ina-Geoportal
3	administration map	Regional Development Planning Agency of Padang

Source: the research 2019

Table 2. The research variable

No	Variable	Indicator
1	The Tsunami Potential	The increased waters level 11 meters.
2	The destructive potential of the agriculture sector	a. Rice fields b. Fields c. Farms

Source: the research, 2019

2.2 The research method

In the data processing, the first step is to counting decreased the sea level by using H-loss. The second step is using a cost-distance tool on ArcGIS to get the wide seawater or the affected wide fields of the tsunami. The next step is to show all of the counting indicators on all variables in a table or the statistic data so, we could get the affected wide fields table with the explanation of wide rice fields, fields and farm affected tsunami in Padang

2.3 Data processing techniques

Tsunami is the sea wave height reaching the shoreline to the land and usually, it is the destructive wave. That is the decrease in water level formula:

$$Hloss = \left(\frac{167n^2}{H_0^{1/3}}\right) + 5\sin S$$

source: National Disaster Management Authority 2016

H-loss : the value of the decreased waters when it comes to the land
N : the surface roughness coefficient
H0 : the sea wave height in the shoreline
S : slope

The surface roughness that means is the roughness value of the used areas. The surface roughness is the power of every used area to hold up the sea wave to reach the land. The every used area have a different value of the surface roughness coefficient. In the surface roughness classification, the jungle has a high value to hold up a tsunami. In Padang, there is no jungle in the shoreline, so the high value of the surface roughness coefficient is the settlements.

Table 3. The surface roughness coefficient value

No	Type of the used areas	The Surface Roughness Coefficient Value
1	Waterbody	0,007
2	Bush	0,040
3	Jungle	0,070
4	Farms	0,035
5	Agriculture areas	0,025
6	Empty land	0,015
7	Settlement	0,045
8	Mangrove	0,025
9	Fishpond	0,010

Source: Berryman in Santius, 2015

To count the destructive wide potential in the agriculture sector is conducted by counting every area of an affected tsunami as the following formula:

$$T=n1+n2+n3\ldots$$

Note:
T :The increased water level
N : The agriculture sector-wide per polygon

Because the agriculture sector is too wide to study, we have the limitation of the research. We only count the affected rice fields, fields, and farms of the tsunami in this research.

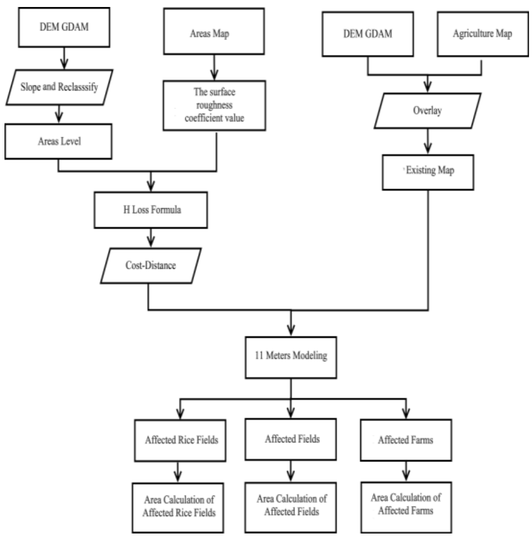

Fig 2. The flow diagram

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2.3 The data analysis technique

Table 4: the data analysis technique

No	The research aim	Method	Result
1	To know the affected tsunami areas in 11 meters water level in the shoreline	*Cost-Distance*	The area map of affected tsunami
2	To know the destructive potential of the agriculture sector	*Overlay*	the destructiv e potential data of the agricultur e sector

Source: the research, 2019

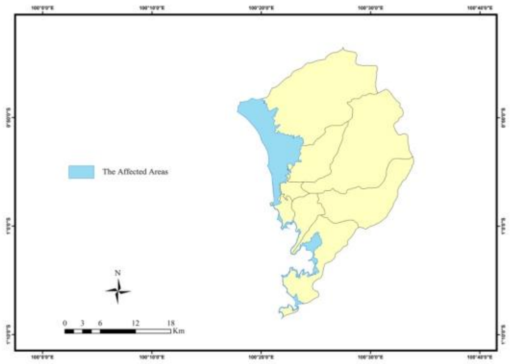

Fig 3 The modeling map of the seawater level 11 meters.

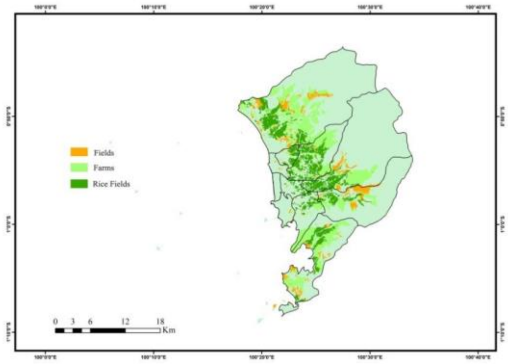

Fig 4. The Padang Agriculture Map

3. RESULTS AND DISCUSSION

3.1 The rice fields

The modeling map of the seawater level 11 meters is affected by the rice fields as wide as 2.108,92 hectares or 30.08% from all of the rice fields areas in Padang. The widest affected of rice fields is in sub-district of Koto Tangah, 1.229,30 hectares or 66,81% from all of the rice fields in that sub-district.

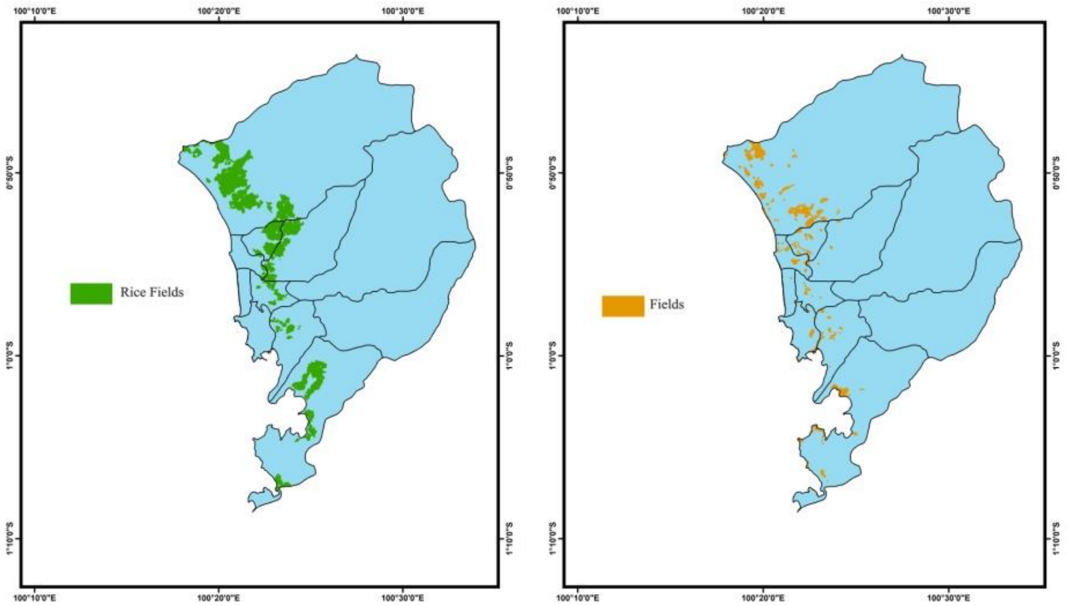

Fig 5: The Rice Field and the fields map

3.2 Fields

The modeling map of the seawater level 11 meters on the fields as wide as 645,82 hectares or 32,10% from all of the fields in Padang. The widest affected fields are in sub-district Koto Tangah as wide as 454,12 hectares or 23,10% from all of the fields in that area.

3.3 Farms

The Modeling Map Of The Seawater Level 11 Meter The Farms As Wide As 828,73 Hectares Or 8,15% From All Of The Farms In Padang. The Widest Affected Farms Are In Sub-District Koto Tangah As Wide As 595,05 Hectares Or 14,47% From All Of The Fields In That Area.

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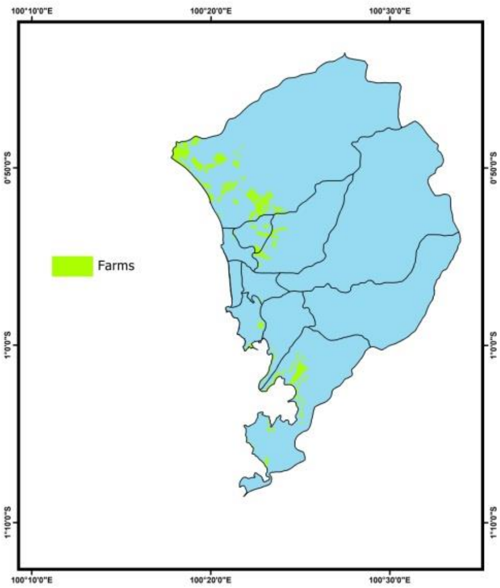

Fig 6 the affected farms

4 CONCLUSIO

That modeling results showed that have been affected as much as 11,87% from all of the Padang Areas and have an impact as much as 17,90% from all of the agriculture sector in Padang, where the rice fields have impact as wide as 2. 090,36 hectares or 38% from the total area of rice fields, while the fields have impact as wide as 663,86 hectares or 23,10% from the fields total area and the farms have impact as wide as 829,73 hectares or 8,15% from the total area.

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