A simplified approach to identifying seawater intrusion by the fraction of seawater in the coastal area of Jember Regency

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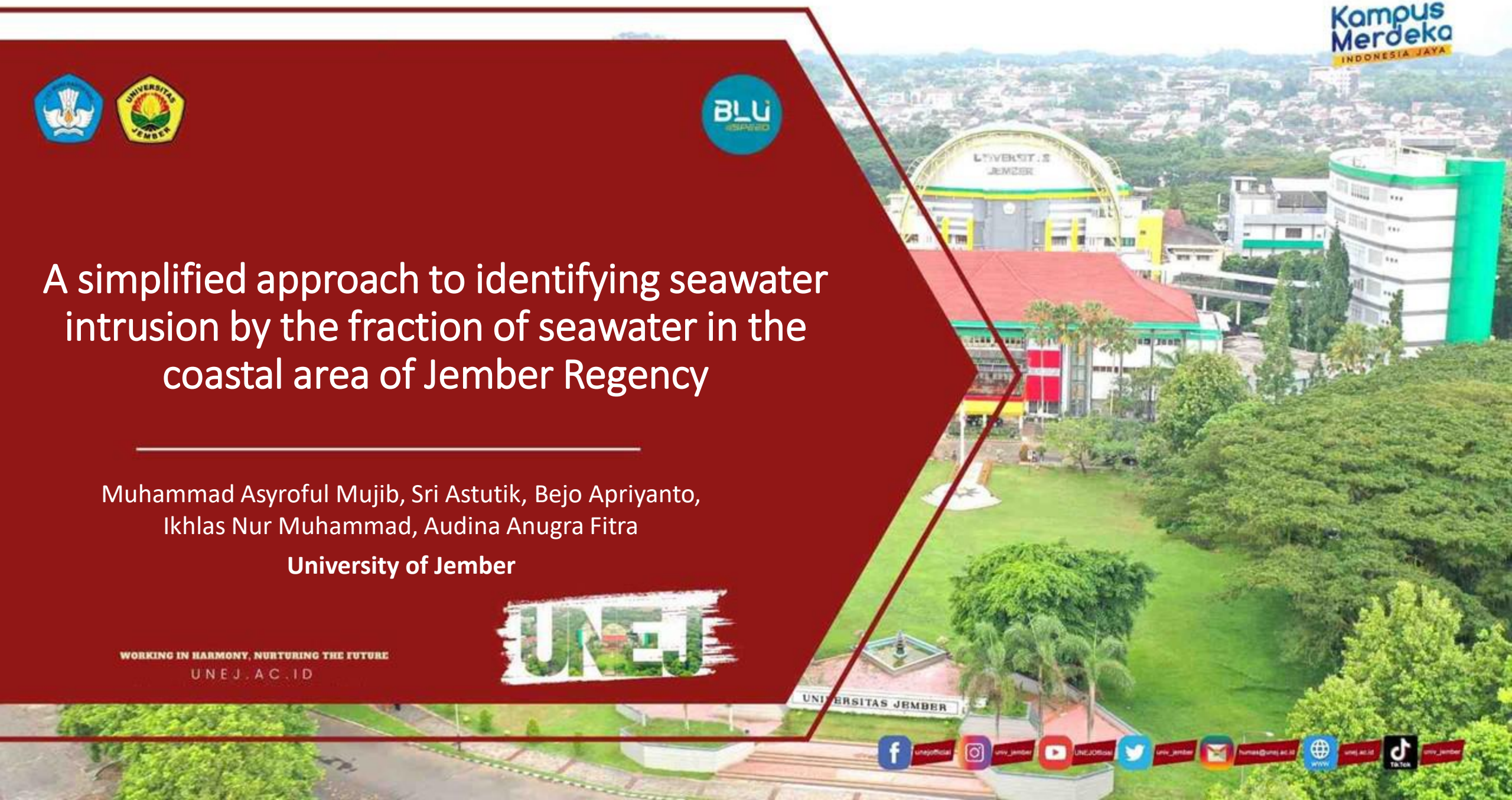

INTRODUCTION

Coastal areas vulnerable to seawater intrusion

Factors influencing seawater intrusion in coastal areas consist of natural and anthropogenic factors. The main anthropogenic factors is groundwater exploitation in coastal areas.

Based on previous research with geophysical analysis, in Payangan Beach and Paseban Beach, as well as Hydrogeochemical analysis (EC) in Puger Beach, it is indicated that seawater intrusion occurs in the coastal area of Jember Regency

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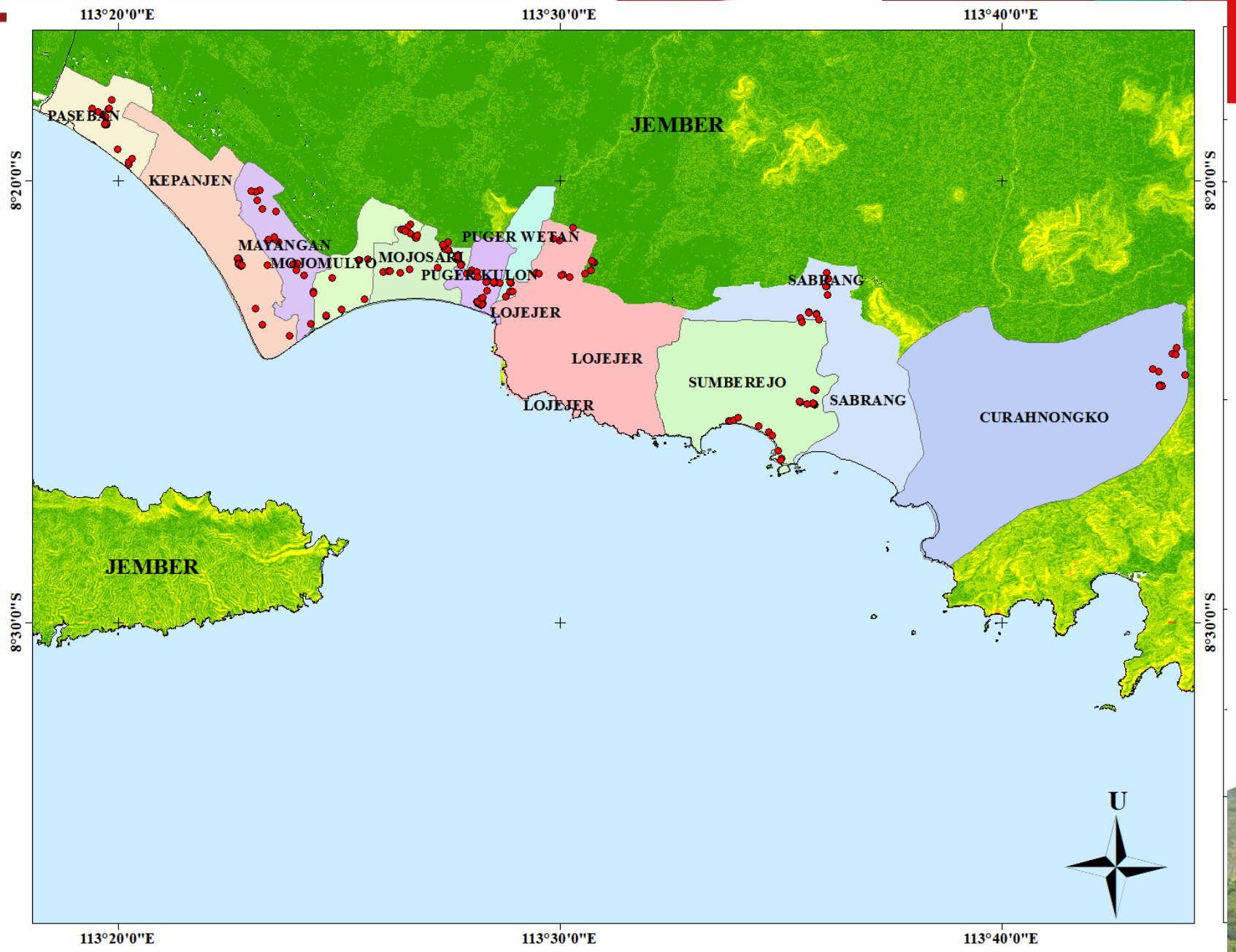
STUDY AREA

10 villages in the coastal area of Jember Regency

Paseban, Kepanjen, Mayangan, Mojomulyo, Mojosari, Puger Kulon, Lojejer, Sumberejo, Sabrang, and Curahnongko Village

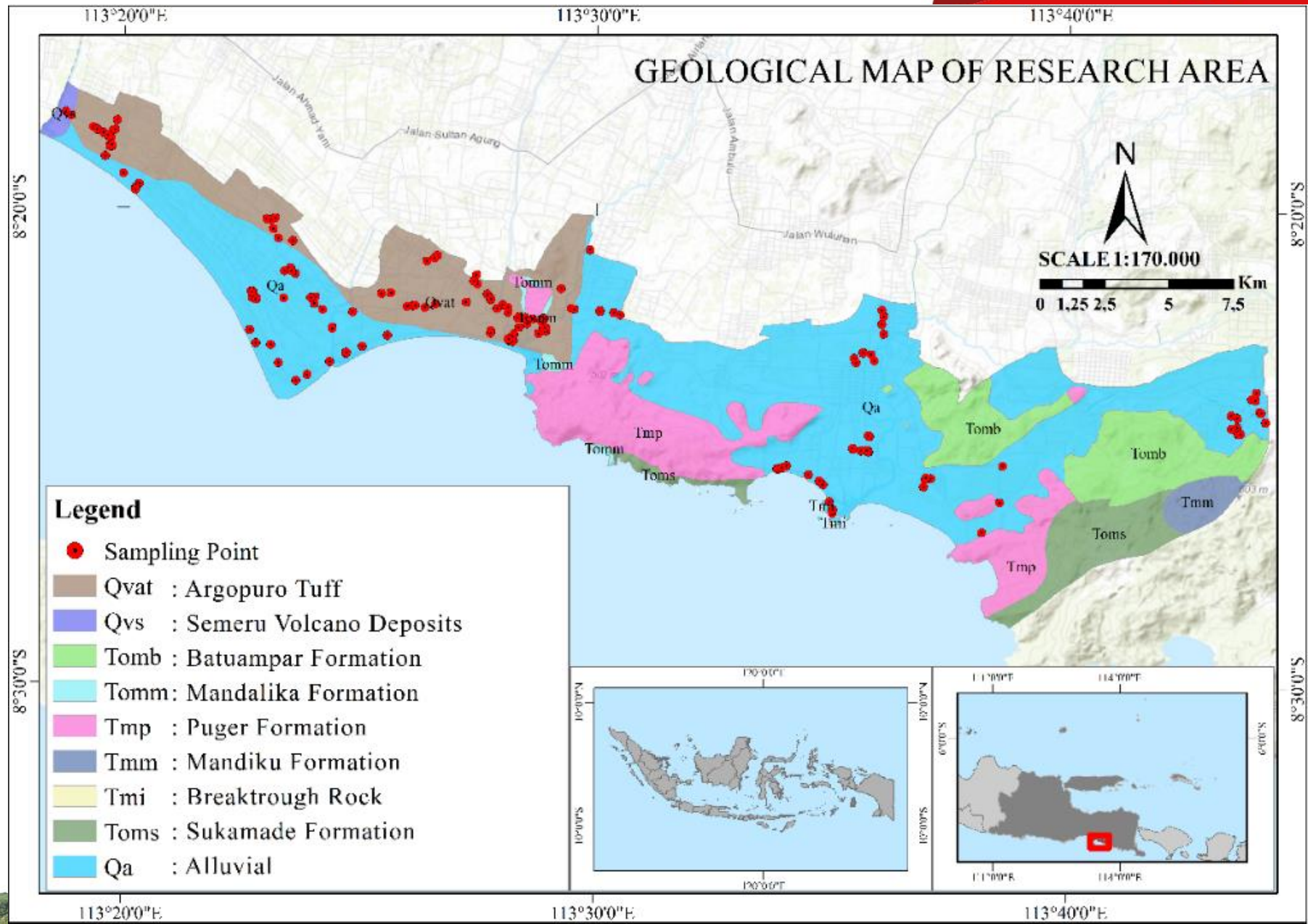
Groundwater samples were obtained from 211 wells, consisted of :

202 dug wells used for domestic purposes, and 9 bore wells used for irrigating agricultural land



Geologically, the research location is divided into 3 formations:

- alluvium and coastal deposits formation (Qa=Alluvium)
- Sedimentary rock formation (Puger and Sukamade Formation)
- Volcanic rock formation (Merubetiri Formation)



METHODOLOGY

Groundwater levels were measured from the 211 dug wells at the research site to map the Piezometric map

Based on the Piezometric map data, the position of the sea-freshwater interface can be predicted using the **Ghyben-Herzberg formula**

$$h_s = \frac{\rho_f}{\rho_s - \rho_f} h_f$$

In Situ Monitoring for Temperature, pH, EC, TDS and Chloride.
Choride for Seawater is obtained by taking a sample of seawater and testing it in the laboratory.

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METHODOLOGY

Classification of water based on total dissolved solids (TDS), electrical conductivity (EC), and chloride (Cl)

Class	TDS (ppm)	EC (µS/cm)	Cl (meq/l)
Fresh groundwater	0-500	<700	<2.8
Slightly saline groundwater	500-1500	700-2000	2.8-7.1
Moderately saline groundwater	1500-7000	2000-10000	7.1-14.1
Highly saline groundwater	7000-15000	10000-25000	14.1-28.2
Very Highly saline groundwater	15000-35000	25000-45000	28.2-282.2
Seawater	>35000	>45000	>282.2

The Fraction of Seawater equation (fsea)

$$f_{sea} = \frac{Cl_{sample} - Cl_{freshwater}}{Cl_{seawater} - Cl_{freshwater}}$$

The spatial distribution mapping of each hydrochemical parameter is analyzed using geostatistics Analysis (**Ordinary Kriging)**

$$Z = \sum_{i=1}^{n} \lambda_i Z(x_i)$$

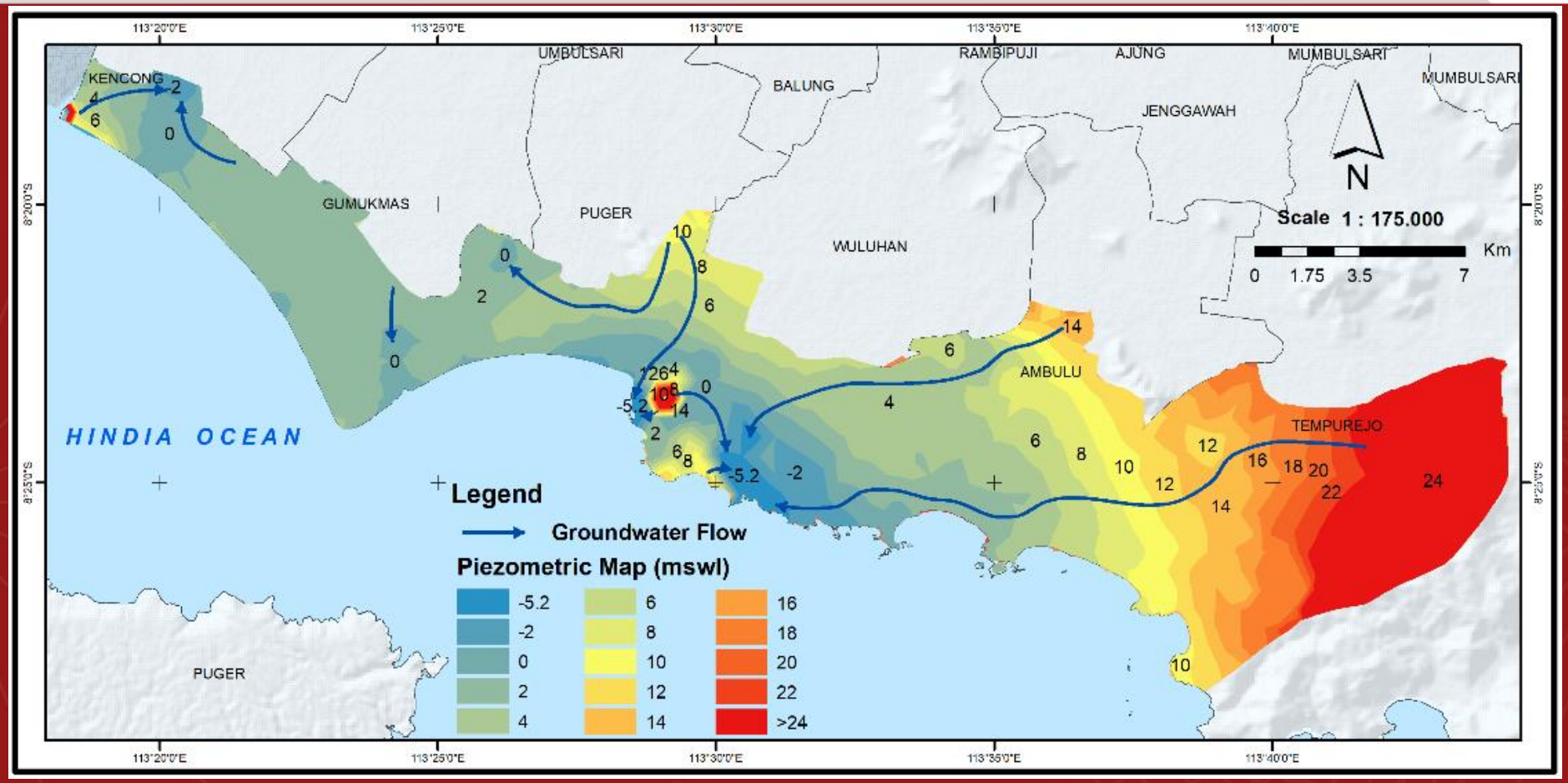
RESULT AND DISCUSSION

Piezometric Map

The groundwater level at the research site ranges from -5.20 mswl to 41.87 mswl.

The groundwater level below the sea level (-5 to 0 msl) accounts for 13% of the total sampeles (29 sample points)

These 29 samples are distributed in karst aquifer areas with hilly topography, alluvial sediment areas in the estuary of the Bedadung River and the estuary of the Kalimalang River. Most of the locations with groundwater levels below the sea level are found in Lojejer Village, which is a karst hilly area



The groundwater level above sea level (0-4 msl) is predominantly found in sandy aquifers with coastal deposits and alluvium

The high groundwater level is found in the hilly area of Tempurejo District or Meru Betiri National Park. This affects the direction of groundwater flow, which moves from the hills in Meru Betiri National Park towards the west in Wuluhan District, specifically in Lojejer Village.

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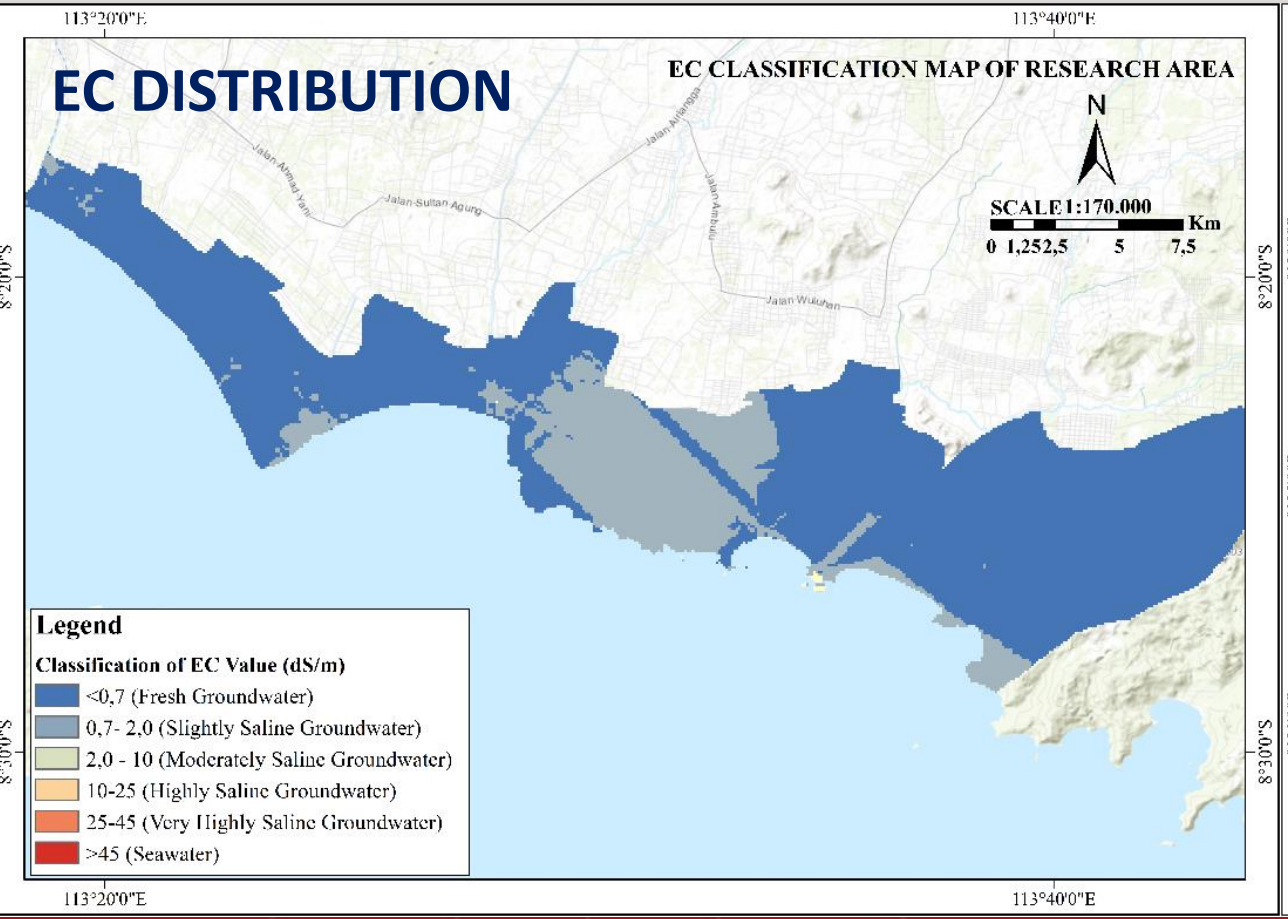
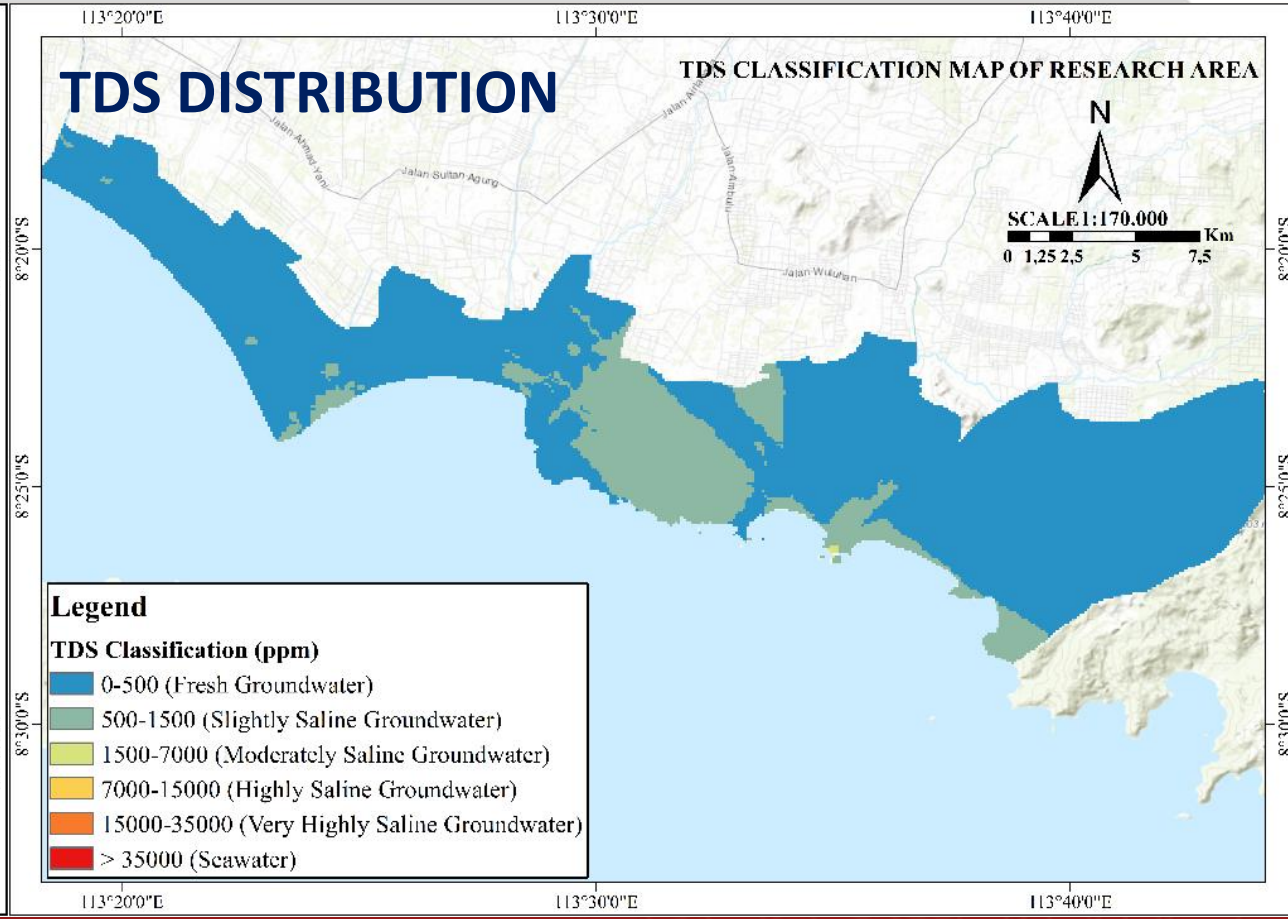
RESULT AND DISCUSSION

Physco chemical analysis





Electrical Conductivity (EC) in the research area ranges from 120 µS/cm to 6800 µS/cm with an average value of 550 µS/cm.
EC is divided into fresh groundwater (<700 µS/cm) accounting for 83%, slightly saline groundwater (700-2000 µS/cm) accounting for 16%, and moderately saline groundwater (2000-10000 µS/cm). accounting for 1%

Total Dissolved Solids (TDS) has a strong correlation with EC, with the same class categories: fresh groundwater (0-500 ppm) accounting for 83%, slightly saline groundwater (500-1500 ppm) accounting for 16%, and moderately saline groundwater (1500-7000 ppm) accounting for 1%

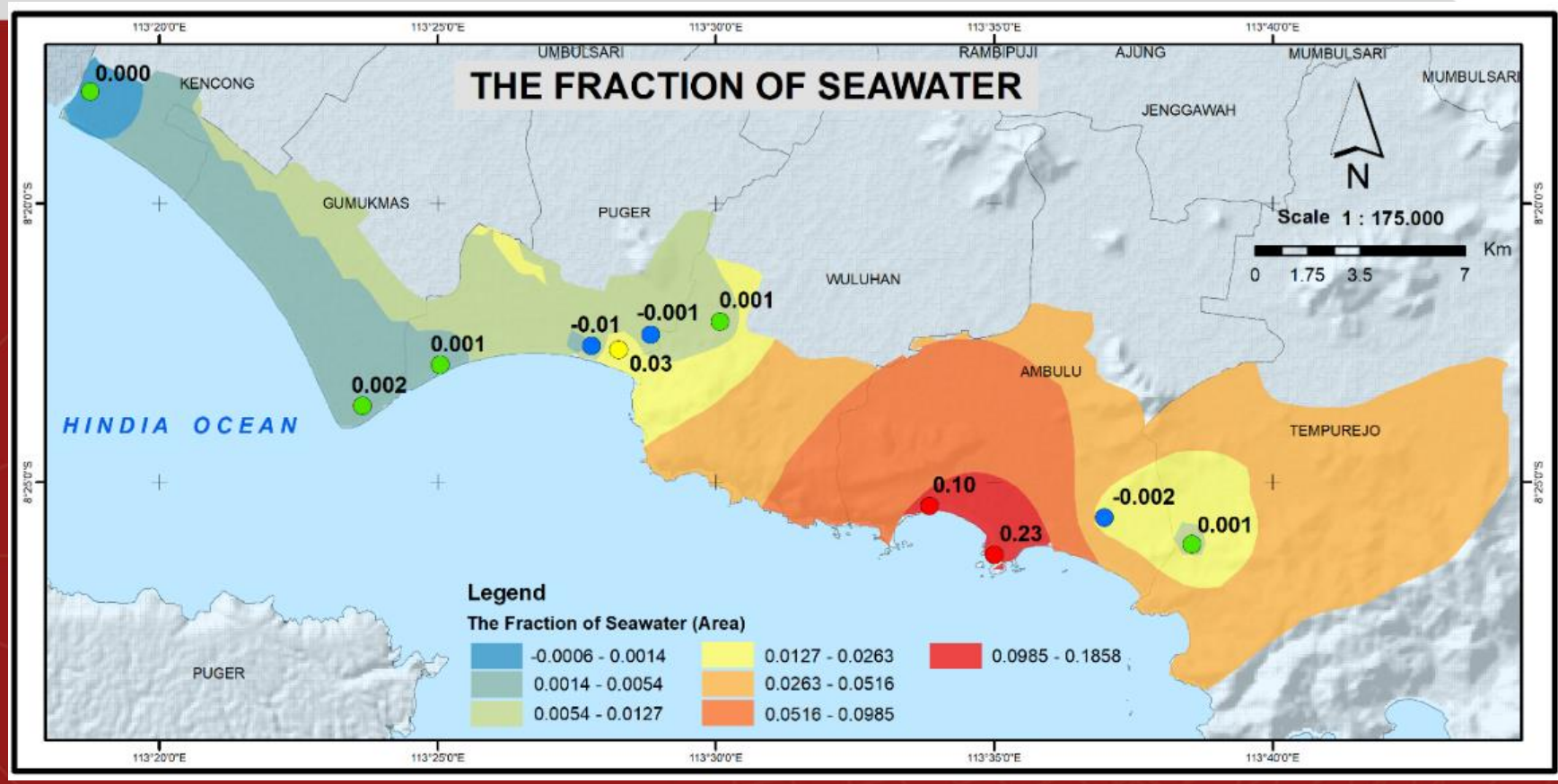
RESULT AND DISCUSSION

The Fraction of Seawater

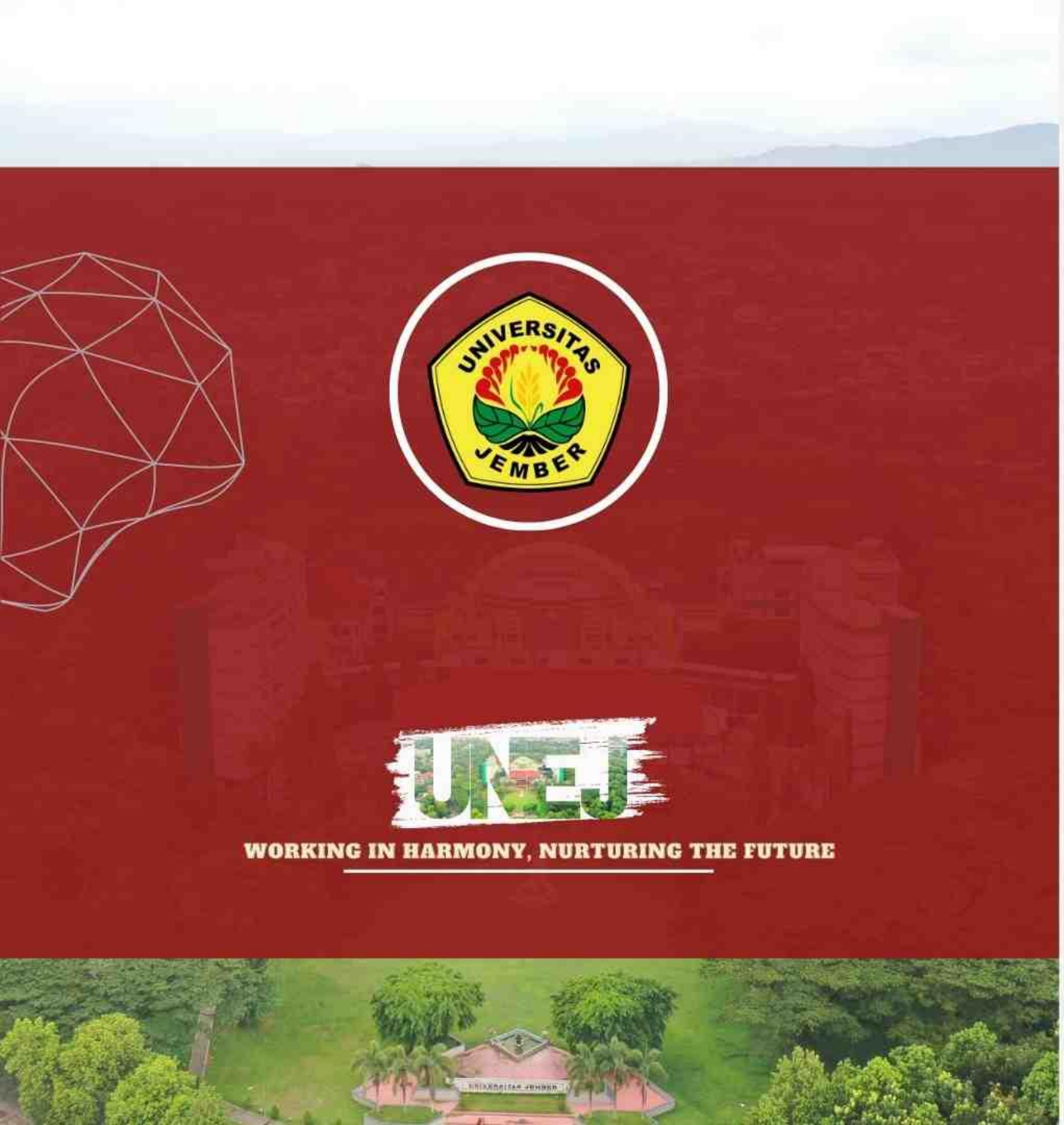
The value of seawater fraction, if in percentage form, ranges from 0 to 100.

A higher value of fsea indicates a higher level of mixing between seawater and groundwater, while a lower value of fsea indicates a lower level of mixing or a more freshwater groundwater.

The lowest value of fsea with negative values (-0.001 and -0.002) is found at sample points 6, 10, and 11, indicating no mixing of seawater.



The highest fsea value in the research area is at sample point 8 (Watu Ulo Beach) with a value of 0.10, and at sample point 2 (Payangan Beach) with a value of 0.23. The proportion of seawater mixed with groundwater at sample points 8 and 2 is estimated to be 10% and 23%, respectively.



Thank You

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