CHAPTER I
INTRODUCTION

1.1. Background

An urbanization issue that tends toward the global coastal cities is the primary concern of this research. This issue has been occurring globally and its movement direction is caused by the strategic aspects of the coastal area in the field of navigation and natural resources (Baser & Biyik, 2016; Kesgin & Nurlu, 2009; Liu *et al*., 2013). This issue accompanied by the intensification of human activities in living and fulfilling their economic needs has increased the land demand in the coastal cities (Bulleri & Chapman, 2010; Lotze, 2006; Wang, Liu, Li, & Su, 2014). The global scope of this urbanization issue is evidenced by the dynamics of coastal cities in both developed and developing countries, such as in the Netherlands (Hoeksema, 2007), Japan (Elgamal, Zeghal, & Parra, 1996), and Korea (Cho, Son, Park, & Chung, 2009; Kim, Kim, Ryu, & Chang, 2006). The urbanization issue has a physical impact on the world's coastal cities in the form of rapid land dynamics (Bulleri & Chapman, 2010; Lotze, 2006).

A rapid land dynamics have significant consequences in the form of damage to the coastal ecosystems (Balaguer *et al*., 2008; Bin *et al*., 2009; Forst, 2009; Primavera, 2006). Bulleri & Chapman's theory (2010) stated that coastal land dynamics narrow the area of the land cover type, which plays a role in environmental conservation. This research interprets the theory that the damage of the coastal ecosystems can be in the form of decreasing of green open spaces such as forest and paddy field, as well as land cover types that have conservation value. Another damage to the ecosystem also in the form of pollutants such as urban drainage waste, inorganic waste, and industrial chemical waste (Lakshmi & Rajagopalan, 2000). The land dynamics which are not regulated by the government policy will result in a deficit of green open space and pollution of inorganic substances in the coastal cities.

The damage of coastal ecosystems can be overcome by one of the solutions stated by Belfiore (2003) called the effectiveness of the government policies. The regional spatial plan *(Rencana Tata Ruang Wilayah/RTRW)* is one form of government policies, which regulates the land use, so it balances between the cultivation and protection functions.

Regional spatial plan, which is far from the current land dynamics trend, will result in an ineffective implementation in maintaining the balance of the coastal ecosystems.

This research focuses on evaluating the effectiveness of spatial pattern plan (the part of the regional spatial plan) and selects the Semarang Metropolitan coastal area as the study area. The location was chosen by considering the population aspect and its strategic role. The Semarang Metropolitan has the fourth largest population in Indonesia and acts as the main structure (capital city) in the Central Java Province. Those strategic conditions of the study area are in line with the opinion that the tendency of urbanization leads to the Semarang Metropolitan coastal area due to the availability of access to the sea and air navigation (seaport and airport) and marine resources (Baser & Biyik, 2016; Kesgin & Nurlu, 2009; Liu *et al*., 2013). Those considerations indicate that the Semarang Metropolitan coastal area experiences rapid land dynamics in line with the urbanization theory.

This research focuses on three factors influencing the land dynamics in the Semarang Metropolitan coastal area, namely facilities agglomeration (Bulleri & Chapman, 2010), the existence of toll gates (Lakshmi & Rajagopalan, 2000), and the reclamation activities (Cho *et al*., 2009; Elgamal *et al*., 1996; Hoeksema, 2007; Kim *et al*., 2006; Marques & Khakhim, 2016). This research does not discuss some other aspects such as political and social aspects, so this can be the limitation of this research. The land dynamics in the Semarang Metropolitan coastal area are technically measured by the Object-Based Image Analysis (OBIA) method.

The current land dynamics monitoring process generally uses a pixel-based image analysis method. This traditional method and has the disadvantage of a “salt-and-pepper effect,” meaning that the distribution of scattered pixels that are not suitable with its correct classification. The problem is visible if it is applied in the higher spatial resolution of satellite imagery. Therefore, an object-based image analysis (OBIA) method is developed to overcome such an issue (Yu *et al*., 2006). The object-based image analysis method answers the problem of “salt-and-pepper effect” by delineating objects detected in the satellite imagery and eliminating objects with a size less than a particular area.

The implementation of object-based image analysis (OBIA) results in a relatively higher accuracy level compared to the pixel-based image analysis, especially in a higher resolution imagery. The pixel-based image analysis method produces accuracies of 82.8%

to 86.2% on low-resolution satellite imagery such as Landsat (Zhou, Ning, & Bai, 2018). While the OBIA method produces an accuracy of around 84.83% using the same resolution (Landsat) (An, Zhang, & Xiao, 2007). The OBIA method has a relatively similar accuracy compared to the pixel-based method, but the OBIA has an advantage of overcoming the "salt-and-pepper effect." The advantages of the OBIA method will be more visible if it is applied to higher resolution imagery such as IKONOS and QuickBird, to produce an accuracy of 90% (Lackner & Conway, 2008) or up to 92.73% (Kong, Xu, & Wu, 2006).

The OBIA usage has terms and conditions related to the software and the satellite imagery. This method can only be applied if there is software capable of executing the OBIA method (such as eCognition or Orfeo ToolBox (QGIS)) along with multispectral imagery with any level of spatial resolution. This method would be more useful if it is applied with a higher resolution imagery as it addresses the "salt-and-pepper effect" as in the traditional method (pixel-based image analysis) (An *et al*., 2007; Chen *et al*., 2007; Kong *et al*., 2006; Lackner & Conway, 2008; Zhou *et al*., 2018).

The object-based image analysis method has been used globally in a variety of research locations on five continents: America (Aguirre-Gutiérrez, Seijmonsbergen, & Duivenvoorden, 2012; Lackner & Conway, 2008; Platt & Rapoza, 2008; Yan & Mas, 2008; Yu *et al*., 2006), Europe (Belgiu & Drăguţ, 2014; Bock, Xofis, Mitchley, Rossner, & Wissen, 2005; Castillejo-González *et al*., 2009), Africa (Duveiller, Defourny, Desclée, & Mayaux, 2008; Gamanya, De Maeyer, & De Dapper, 2009), Asia (An *et al*., 2007; Chen *et al*., 2007; Kong *et al.*, 2006; Yan, Mas, Maathuis, Xiangmin, & Van Dijk, 2006), and Australia (Whiteside, Boggs, & Maier, 2011). However, all research conducted on those five continents did not use the results of the OBIA method into the context of the regional spatial plan assessment. This research, therefore, contributes to the discipline of urban and regional planning in the form of further implementation of the OBIA method into the context of the regional spatial plan assessment.

1.2. Research Issue

Research issue raised in this research is the rapid land dynamics in Semarang Metropolitan coastal area. The land dynamics has consequences to the area in the form of coastal ecological hazard. Hence, the regional spatial plan *(Rencana Tata Ruang Wilayah/RTRW)* exists to minimize the disadvantages from the land dynamics. However, the rapid land dynamics in the coastal cities could not be controlled effectively by the regional spatial plan. The suitability of the regional spatial plan needs to be examined to determine the effectiveness of its implementation.

The evaluation of the regional spatial plan's effectiveness requires a method for analyzing satellite imagery to produce land cover models. The method commonly used in this topic is the pixel-based image analysis (or maximum likelihood classification). This method has a disadvantage of posing a "salt-and-pepper effect." The object-based image analysis (OBIA) method offers an advantage to solve such a problem. However, this object-based image analysis method is rarely used in research on regional spatial plan assessment. Therefore, this research employs the OBIA method to add the number of research that employs this method in the regional spatial plan context. The urgency of evaluating the regional spatial plan and the scarcity of the OBIA implementation in the topic raises a question: "How is the regional spatial plan of the Semarang Metropolitan coastal area is assessed based on land dynamics model resulted from the OBIA method?"

1.3. Research Purpose and Objectives

This research aims to analyze the land dynamics rate of the Semarang Metropolitan coastal area and to conduct assessment of the regional spatial plan through OBIA method's application. The objectives of this research are realized as follows:

a. Identification of the study area profile and data compilation;
b. Object-based image analysis;
c. Land dynamics prediction; and
d. Spatial plan assessment.

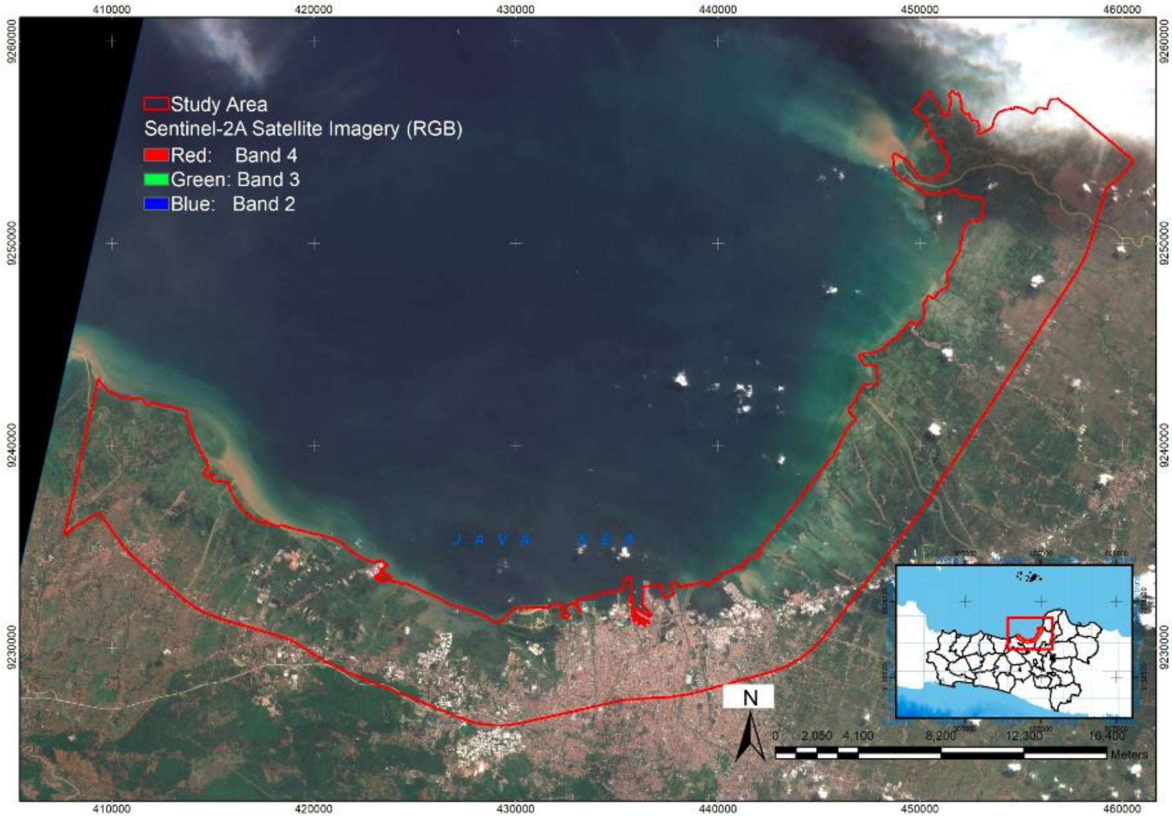
1.4. Benefits of Research

This research is useful in the long-term for the discipline of urban and regional planning and the local government. This research contributes to the novelty of the object-based image analysis (OBIA) implementation related to the regional spatial plan assessment in the discipline of urban and regional planning. The benefit for the local government is available in the form of the regional spatial plan assessment's result as an input or suggestion for creating a more effective regional plan accommodating existing land dynamics.

1.5. Research Scope

1.5.1. Regional Scope

The observation area in this research is limited to the coastal areas of Kendal District, Semarang City, and Demak District, available in the Sentinel-2A satellite imagery with tile number T49MCN. The study area in this research is within a radius of 8 kilometers to the south of the coastline. The study area is 37,793 ha (or 377.93 km^2) and located between coordinates 410000 mE 9260000 mS and 460000 mE 9230000 mS (see **Figure 1.1**).



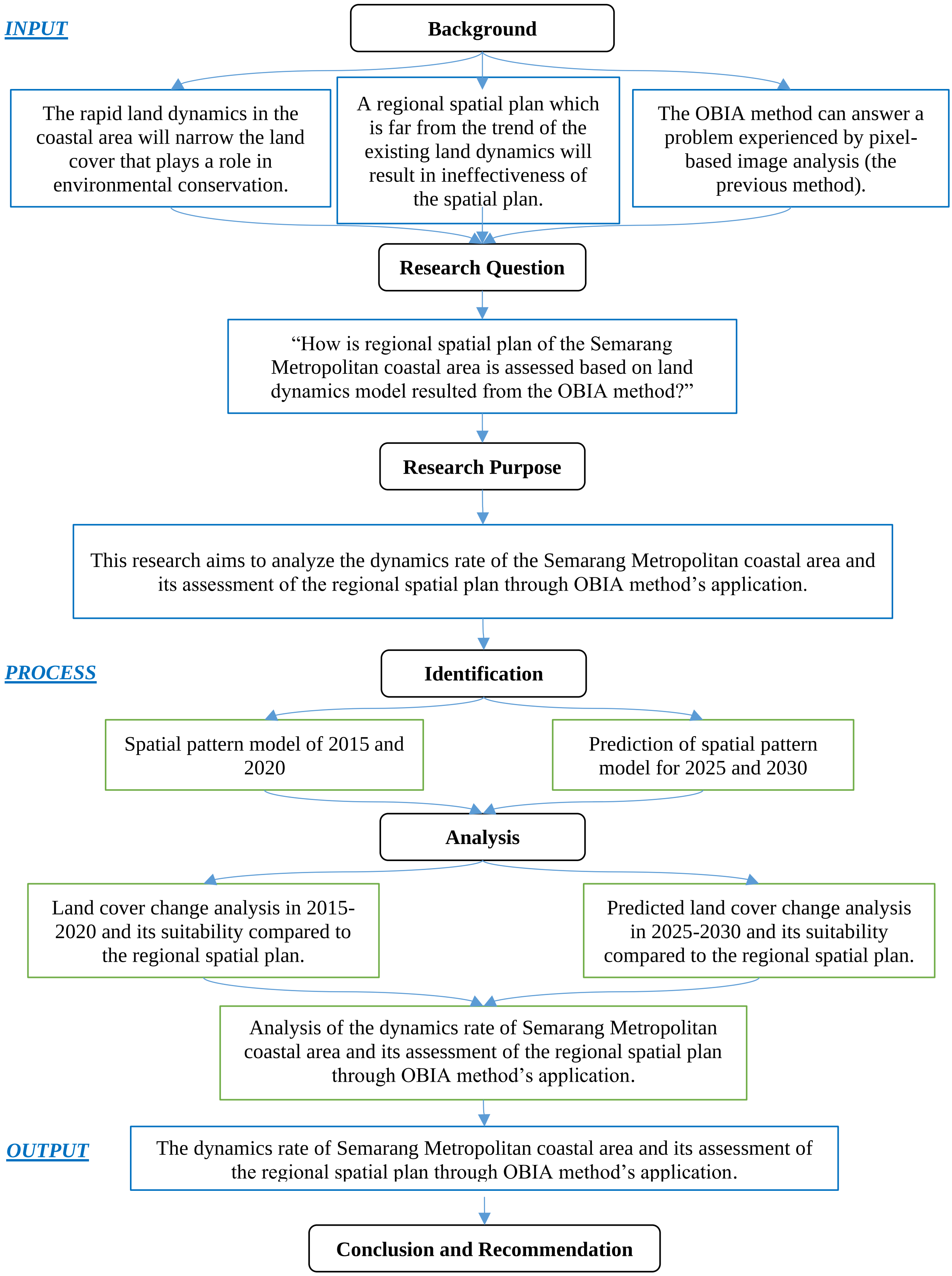
Source: ESA (European Space Agency), 2020.

Figure 1.1. Administrative Map of Semarang Metropolitan Coastal Area

1.5.2. Substance Scope

This research focuses on how the land dynamics rate in the Semarang Metropolitan coastal area and its assessment of regional spatial pattern plan through the object-based image analysis (OBIA) method application will be conducted. The primary substance of this research addresses the urbanization issue in the study area, the result of OBIA modeling, and the assessment of spatial pattern plan.

1.6. Research Framework



Source: Author's analysis, 2020.

Figure 1.2. Research Framework

1.7. Research Method

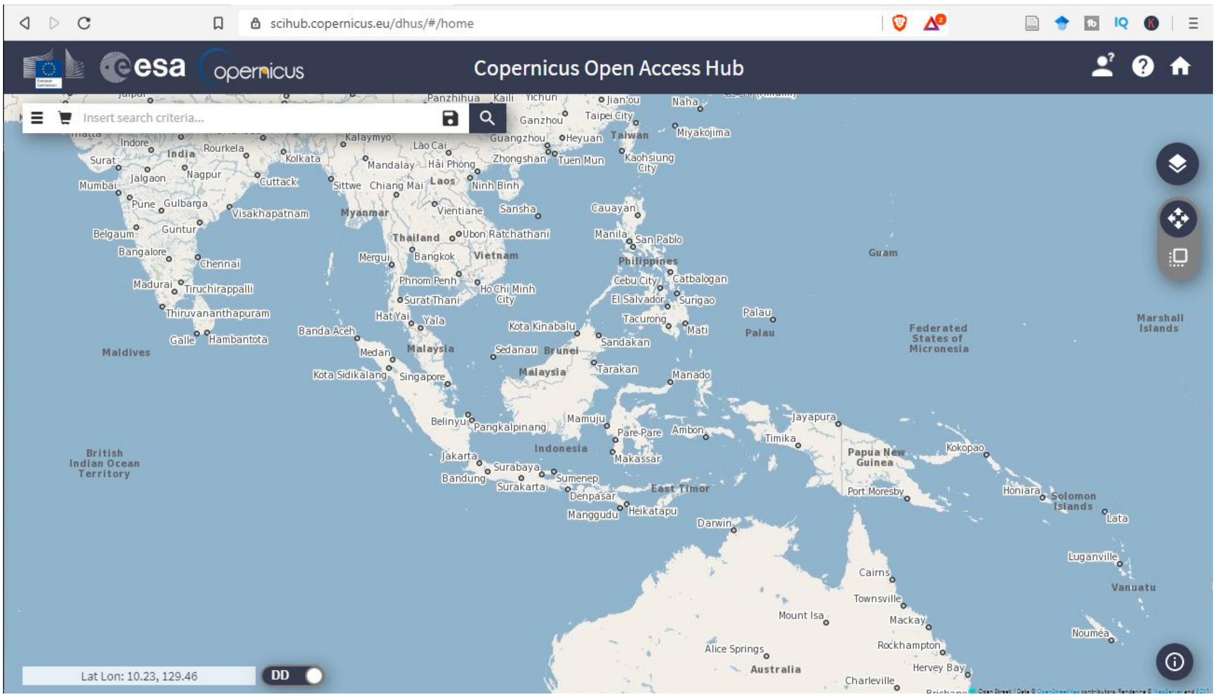
This research uses quantitative and experimental methods. The quantitative method represents the value of mean (average value of pixels), var (variance), and nbpixels (number of pixels) as variables in the object segmentation process. The experimental method is then conducted using trial and error method to find the best modeling results. These research methods are applied in QGIS 3.10.6 and QGIS 2.18.20 software, also in Orfeo ToolBox (OTB) 7.1.0 and MOLUSCE plugin.

1.8. Data Collection and Analysis Methods

This subchapter details the data collection and analysis techniques used in this research. The data collection techniques explain the data acquisition stages, whilst the analysis techniques describe the object-based image analysis (OBIA) method application. The specific analysis techniques include data preparation, object segmentation, train set preparation, object classification, land cover prediction, and spatial plan assessment.

1.8.1. Data Collection Techniques

This research uses two secondary data and supported by one primary data. The secondary data used is Sentinel-2A satellite imagery downloaded freely from the European Space Agency's official website (**Figure 1.3**). The other secondary data is the spatial plan maps of each administrative region within the study area. The primary data used in this research is photographs of existing land cover conditions. This research uses the photographs as supporting data for validating the train sets. Characteristics of each data are clarified as in **Table I. 1.**



Source: ESA (European Space Agency, 2020.

Figure 1.3. The ESA Page for Sentinel-2A Satellite Imagery Acquisiton

Table I. 1. Research Data

Objective	Variable	Data Name	Year	Type of Data	Form of Data	Collection Technique	Source
Object-based image analysis	Low-resolution satellite imagery covering the study area	Sentinel-2A Tile Number T49MCN	October 7 2015, at 02:59:46	Secondary	Satellite Imagery	Online Downloading	ESA
			September 6 2019, at 02:35:51				
			April 23 2020, at 02:35:51				
	High-resolution satellite imagery	Google Satellite Imagery	2020	Secondary	Satellite Imagery	Online Connection via QGIS Software	Google Earth
	Existing land cover condition	Tutupan lahan	2020	Primary	Photo	Observation	Existing Land Condition
Land cover prediction; Spatial plan assessment	Map of spatial pattern plan	Spatial pattern plan of Kendal District	2011-2031	Secondary	Shapefile	Data Request	_Bappeda_* of Kendal District
		Spatial pattern plan of Semarang City				Data Request	_Bappeda_* of Semarang City
		Spatial pattern plan of Demak District				Unsupervised Classification and On-Screen Digitization	Appendix of Regional Spatial Plan of Demak District

Source: Author's analysis, 2020.

Note: _*Bappeda_ is development planning agency at sub-national level.

1.8.2. Analysis Techniques

This research consists of seven stages of the analysis techniques. These techniques included data preparation, object segmentation, training/test set preparation, object classification, accuracy assessment, land cover prediction, and spatial plan assessment. The seven analytical techniques are described in this section.

a. Data Preparation

This research referred to Osgouei, Kaya, Sertel, & Alganci (2019) in determining the image composition of Sentinel-2A satellite imagery. Osgouei *et al*. (2019) proved that MNDWI-NDTI-NDVIre multi-index imagery can improve separating land cover classes (mainly built-up and bare land) than a 10-20 meter resolution of Sentinel-2A band combination. The multi-index imagery is arranged by each formula stated below and is processed with a "Raster Calculator" function in QGIS software. The following three indexes are then compiled with a "Build Virtual Raster" function and cropped according to the study area delineation through a "Clip Raster by Mask Layer" function. The multi-index imagery produced at this stage has a spatial resolution of 20 meters.

$$MNDWI = \frac{((Green - SWIR1))}{((Green + SWIR1))} \quad \text{(1.1)}$$

$$NDTI = \frac{((SWIR1 - SWIR2))}{((SWIR1 + SWIR2))} \quad \text{(1.2)}$$

$$NDVIre = \frac{((RedEdge1 - Red))}{((RedEdge1 + Red))} \quad \text{(1.3)}$$

b. Object Segmentation

A segmentation process aims to automatically delineate objects detected to have similarity criteria in the satellite imagery (Thomas, Hendrix, & Congalton, 2003; L. Wang, Sousa, & Gong, 2004). This analysis technique is applied with a "LargeScaleMeanShift" function in the Orfeo ToolBox 7.1.0 plugin. This object segmentation uses parameters as described in **Table I.2** and only applied to MNDWI-NDTI-NDVIre multi-index imagery. The object segmentation result is shown in **Figure 1.4**.

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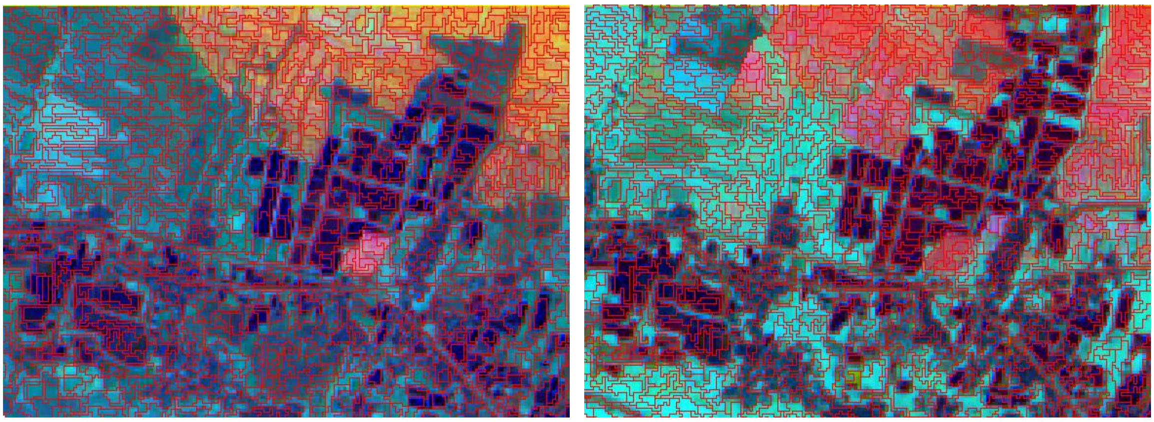
Table I.2. Segmentation Parameters for MNDWI-NDTI-NDVIre Multi-Index Imagery

Segmentation Parameters in QGIS	Value
Spatial radius	1
Range radius	0,001
Minimum segment size	10

Source: Author's analysis, 2020.



Source: Author's analysis, 2020.

Figure 1.4. Segmentation Results on MNDWI-NDTI-NDVIre Multi-Index Sentinel-2A Imagery in (Randu Garut, Kendal) 2015 (Left) and 2020 (Right)

c. Preparation of Train Set and Test Set

Train set is a group of samples of selected object segments as a reference in classifying land cover classes. Whereas, a test set is a group of samples as a reference in assessing the accuracy of the modeled land cover map. The train set and test set are prepared based on the Author's interpretation, are chosen randomly. They are supported by observation photo data (**Appendix A** and **Appendix B**) and high-resolution satellite imagery (Google Earth Imagery). The number of object segments in the prepared train set, and the test set listed in detail in **Table I.3**.

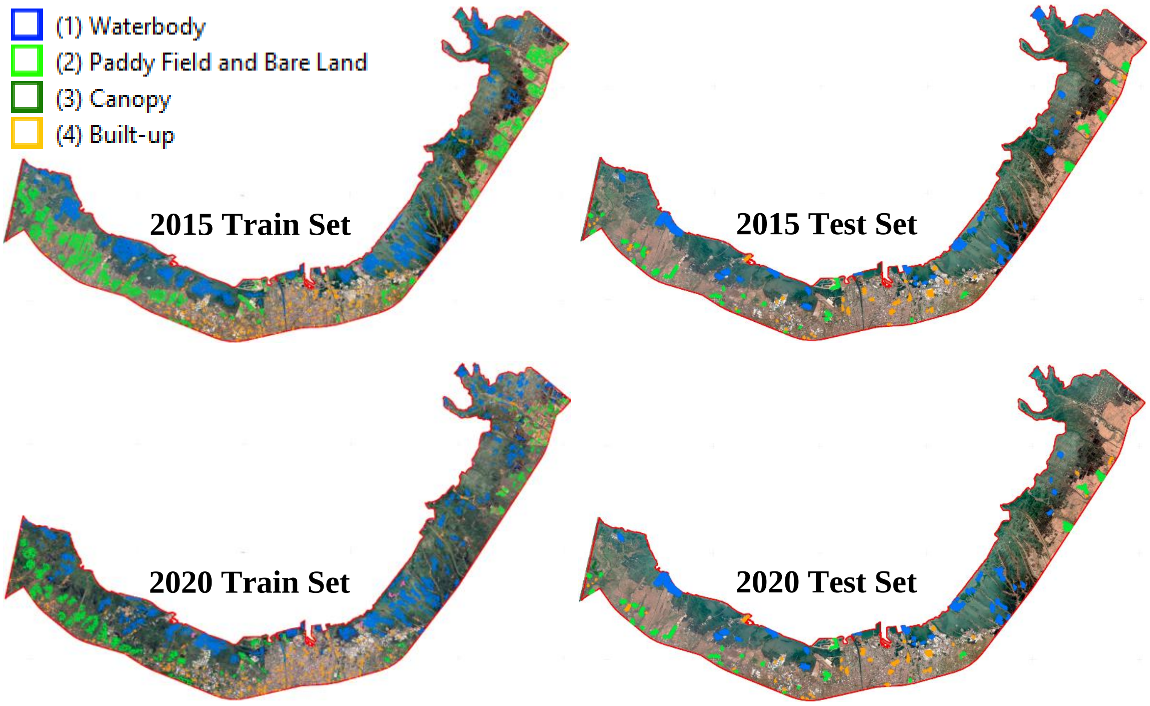
Table I.3. Train Set and Test Set of 2015 and 2019/2020 Data

	Number of Segments as Train Set			Number of Segments as Test Set	
	2015	2019	2020	2015	2019-2020
(1) Waterbody	2,576	556	2,008	1,528	1,210
(2) Paddy field and bare land	2,706	236	1,148	788	706
(3) Canopy	67	24	66	12	14
(4) Non-industrial built-up	634	34	530	377	366
Number of segments of train/test set	5,983	850	3,752	2,705	2,296
Area of segments of train/test set (ha)	4,493.28	655.92	2,829.28	2,063.12	1,731.88
% area of train/test set compared to the processed imagery	11.89 %	10.24 %	9.01 %	5.46%	4.58%

Source: Author's analysis, 2020.

Notes:
Area of 2015 processed imagery data is 37,793.48 ha
Area of 2019 processed imagery data is 6,406.80 ha
Area of 2020 processed imagery data is 31,386.68 ha (or 37,793.48 ha for 2019-2020 mosaicked result)

Noi & Kappas (2018) recommended that the train set area need to be at least 0.25% of the total classified area. The train set used in this research exceeds 9% of the classified area each year, so it meets the recommendation. This research uses the imbalanced train set as one of the methods tested by Noi & Kappas (2018). The definition of imbalanced train set means there are a different number of pixels in each referenced land cover class. The distribution of train set and test set used in this research are shown in **Figure 1.5**.



Source: Author's analysis, 2020.

Figure 1.5. The Distribution of 2015 and 2020 Train Set and Test Set

Noi & Kappas (2018) ensured that the distance between the train set and the test set must be separated more than 15 meters. If not, it will produce an invalid accuracy. This research has already accommodated such distance limitation by eliminating test set located within the 15-meters buffered radius from the train set. The technical challenge in this stage is in line with the opinion of Belgiu & Drăguţ (2014) and Ma *et al.* (2015, 2017) that choosing the train set and assessing the accuracy of the modeled maps are the crucial challenges in this OBIA method.

d. Object Segment Classification

The SVM (Support Vector Machine) algorithm is chosen based on the results of two previous studies (Laban, Abdellatif, Ebeid, Shedeed, & Tolba, 2019; Thanh Noi & Kappas, 2018). Those two studies tested that the SVM algorithm with the RBF (Radial Basis Function) kernel type produced the best accuracy. This type of algorithm requires an optimal "Cost parameter C" value, so this research refers to the results of Laban *et al.* (2019) that the optimal C parameter is 4000. The gamma (γ) parameter does not applied in this research due to the absence of such a parameter in the Orfeo ToolBox 7.1.0 plugin. This analysis technique produces land cover models of 2015 and 2020. This stage sequentially uses the "TrainVectorClassifier" and "VectorClassifier" functions with parameters summarized as in **Table IV.4** and **Table IV.5.**

Table I.4. "TrainVectorClasifier" Parameter

Parameter	Value	Format
Input Vector Data	(Train set shapefile)	.shp
Output model	(Classifier output name)	.txt
Field names for training features	meanB0 meanB1 meanB2	-
Field containing the class integer label for supervision	(A column contains land cover codes in the train set shapefile)	Integer
Classifier to use for the training	LibSVM classifier	-
SVM Kernel Type	Gaussian radial basis function	-
SVM Model Type	C support vector classification	-
Cost parameter C	4000	

Source: Author's analysis, 2020.

Table I.5. "VectorClasifier" Parameter

Parameter	Value	Format
Name of the input vector data	(A shapefile of object segmentation result)	.shp
Model file	(Output file from TrainVectorClassifier function)	.txt
Output field	predicted	-
Field names to be calculated	meanB0 meanB1 meanB2	-
Output vector data file	(Output of modeled land cover)	.shp

Source: Author's analysis, 2020.

e. Accuracy Assessment

This analysis technique assesses the accuracy of the classified land cover map based on the test set produced in the previous step. This accuracy assessment uses the “r.kappa” function in QGIS 3.10.6 (with GRASS) software. Parameters used in that function are classified land cover map as “Raster layer containing classification result” and the test set as “Raster layer containing reference classes.” This function results in a “txt” file format containing a kappa index and an observed correct value. This analysis technique is applied to measure the accuracy of 2015 and 2020 land cover models.

f. Land Cover Prediction

A land cover prediction in this research is done through the QGIS 2.18.20 software and MOLUSCE plugin. The technique requires several spatial variables as a driver of land cover change. The ArcGIS 10.4.1 in this research is used just as a tool to prepare the spatial input variables. This research refers to one of the previous studies (Kusniawati, Subiyanto, & Amarrohman, 2020) and develops six variables shown in **Table I.6.**

Furthermore, this analysis technique results in a “Transition Potential Modeling” table with the respective parameters shown in **Table I.7**. This technique also produces Pearson’s correlation value between spatial variables and “Current Validation Kappa” value as depicted in **Table I.8** and **Table I.9**. At last, the “Cellular Automata Simulation” in this part uses parameters of “1” to predicts 2025 land cover model and of “2” to predict 2030 land cover model for the “Number of simulation iterations” value.

Table I.6. Spatial Variables in Land Cover Prediction

Spatial Variables	Source of Data	Analysis Method
(A) Distance from the River	*Bappeda** of Central Java Province, 2015	Euclidean Distance, Clip
(B) Land Value	http://peta.bpn.go.id/, 2020 (website of *Badan Pertanahan Nasional***)	Georeferencing, Iso Cluster Unsupervised Classification, Reclassify, Union, Clip
(C) Distance from the Built-up	Object based image analysis result, 2015.	Euclidean Distance, Clip
(D) Slope Level (Degree)	http://tides.big.go.id/, 2020 (website of *Badan Informasi Geospasial****)	Slope, Clip
(E) Population Density	*BPS***** of Kendal District, Semarang City, and Demak District, 2019.	Feature To Point, Kernel Density, Clip
(F) Distance from the Road	*Bappeda** of Central Java Province, 2015	Euclidean Distance, Clip

Source: Author's analysis, 2020.
Notes:
**Bappeda* is a development planning agency at sub-national level;
***Badan Pertanahan Nasional* is a national land agency;
****Badan Informasi Geospasial* is a geospatial information agency; and
*****BPS* is a central bureau of statistics.

Table I.7. Parameter of Transition Potential Modeling

Define Samples	
Mode:	Random
Number of samples:	10,000

Method:	**Artificial Neural Network (Multi-layer Perceptron)**
Neighbourhood:	1 px
Learning rate:	0.1
Maximum iterations:	1,000
Hidden Layers:	10
Momentum:	0.05

Source: Author's analysis, 2020.

Table I.8. Interpretation of Pearson's Correlation

Pearson's Correlation	Interpretation
0.00 to 0.30 (-0.00 to -0.30)	Negligible correlation
0.30 to 0.50 (-0.30 to -0.50)	Low positive (negative) correlation
0.50 to 0.70 (-0.50 to -0.70)	Moderate positive (negative) correlation
0.70 to 0.90 (-0.70 to -0.90)	High positive (negative) correlation
0.90 to 1.00 (-0.90 to -1.00)	Very high positive (negative) correlation

Source: Yadav, 2018.

Table I.9. Interpretation of Kappa Index

Kappa Index	Interpretation
< 0	No agreement
0.00 – 0.20	Slight agreement
0.21 – 0.40	Fair agreement
0.41 – 0.60	Moderate agreement
0.61 – 0.80	Substantial agreement
0.81 – 1.00	Almost perfect agreement

Source: Eyoh et al., 2012.

This research has a weakness of methods used in this research related to the validation technique toward the predicted land cover model. This research uses only the "r.kappa" function in QGIS software to validate the 2015 and 2020 land covers. The validity of the predicted land dynamics rate is not measured in this research due to limited time for processing data with OBIA method. This method requires an extensive processing time for trial and error in finding the best model which suits the human interpretation (Johnson & Jozdani, 2018). The untolerated processing time in this method is also influenced by the challenge in preparing the train set and test set, as argued by Belgiu & Drăguţ (2014) and Ma *et al.* (2015, 2017).

The validation for predicted land cover of 2025 and 2030 can only be finished if the 2010 data is provided and processed along with the 2015 data in the MOLUSCE plugin. This process will produce a 2020 predicted land cover, which is then compared with the 2020 OBIA result (the existing model). The difference between the MOLUSCE-based predicted result and the existing land cover model indicates the error level of the MOLUSCE prediction. This research recommends future research for accommodating the validation process of future land dynamics, as done by Kusniawati *et al*. (2020) and Rahman *et al*. (2017).

g. Spatial Plan Assessment

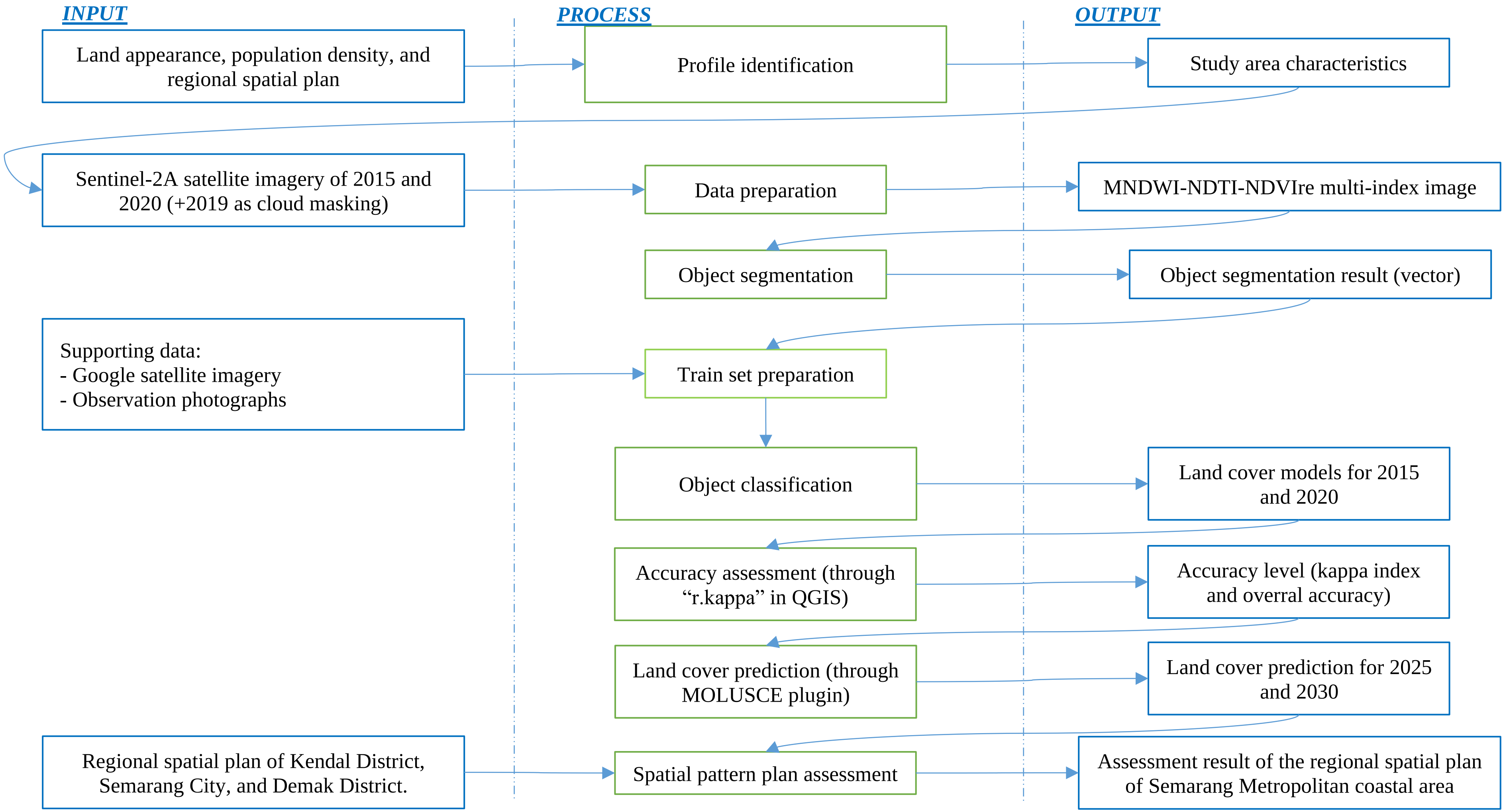
This research conducts the analysis technique by comparing 2020 (existing model) and 2030 (predicted model) to the 2011-2031 regional spatial plan. However, each administrative region included in the study area has a different spatial pattern term, so it is reclassified the different spatial pattern into the more contextual term. The reclassified spatial pattern plan is shown in (**Appendix C**) and the land cover model is assessed according to **Table I.10**.

Table I.10. Land Cover Suitability Compared to the Reclassified Spatial Pattern Plan

No.	Land Cover Model	Rencana Pola Ruang (Reklasifikasi)	Suitability
1	Waterbody	Waterbody	Suitable
2	Paddy field and bare land	Waterbody	Not Suitable
3	Canopy	Waterbody	Not Suitable
4	Built-up	Waterbody	Not Suitable
5	Waterbody	Paddy field and bare land	Not Suitable
6	Paddy field and bare land	Paddy field and bare land	Suitable
7	Canopy	Paddy field and bare land	Not Suitable
8	Built-up	Paddy field and bare land	Not Suitable
9	Waterbody	Canopy	Not Suitable
10	Paddy field and bare land	Canopy	Suitable
11	Canopy	Canopy	Suitable
12	Built-up	Canopy	Not Suitable
13	Waterbody	Built-up	Not Suitable
14	Paddy field and bare land	Built-up	Suitable
15	Canopy	Built-up	Suitable
16	Built-up	Built-up	Suitable

Source: Author's analysis, 2020.

1.9. Analytical Framework



Source: Author's analysis, 2020.

Figure 1.6. Analytical Framework

1.10. Writing Systematics

This thesis consists of five chapters. The first part contains a research problem, research methods, literature review, and an overview of the study area. The primary substance of the thesis contains a discussion of the analysis result. This thesis ends with conclusions and recommendations. The details of each chapter in this thesis are detailed as follows.

CHAPTER I INTRODUCTION

The first chapter discusses the background, the research problem, the purpose and objectives of this research, the scope of research, and the writing systematics. This chapter is also completed with a review of data collection and analysis techniques as well as analytical framework used in this research.

CHAPTER II LITERATURE REVIEW ON COASTAL SPATIAL PATTERN MODELING

The second chapter contains references to previous studies that are strictly related to the definition of coastal areas, coastal city activities, coastal land dynamics, spatial structure and patterns, spatial modeling, and object-based image analysis (OBIA). This chapter ends with a literature synthesis.

CHAPTER III OVERVIEW OF SEMARANG METROPOLITAN COASTAL AREA

The third chapter provides an overview of Semarang Metropolitan coastal area as a research location. This chapter reviews the land appearance, demographics, and spatial plan in coastal areas of Kendal District, Semarang City, and Demak District.

CHAPTER IV ASSESSMENT OF SPATIAL PLAN OF SEMARANG METROPOLITAN COASTAL AREA THROUGH OBIA-BASED SPATIAL PATTERN MODELING

The fourth chapter sequentially discusses the impact of urbanization and the symptoms of land dynamics, the result of object-based modeling, and the result of the 2011-2031 regional spatial plan (*Rencana Tata Ruang Wilayah*/RTRW) assessment.

CHAPTER V CONCLUSIONS AND RECOMMENDATIONS

The fifth chapter concludes the discussion of research results and provides recommendations for further research.