GEOBIA an (Geographic) Object-Based Image Analysis for coastal mapping in Indonesia: A Review

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Abstract. The traditionally human-visual or manual interpretation is generally chosen method for spatial feature extraction on map producing process in Indonesia, although the pixel-based feature extraction is used in particular step. The main problem of human-visual method is the dependency to operator capacity. Subjectivity may occur because each operator has different ability. In early 20th century, the image segmentation method was still developing and now Geographic Object-based Image Analysis (GEOBIA) method is introduced to mapping process. Researchers are still developing and applying GEOBIA for many mapping purposes. The advantage of GEOBIA is object-based segmentation which contextually influenced by spatial feature characteristics. GEOBIA provides more meaningful information than traditional pixel-based image analysis by allowing less well-defined edges or borders between different classes. On the resulting maps, there are divisions between different types of object classification, for example where some species of mangroves meet are not generally represented by a single object. The developing of remotely sensed imagery data quality requires the developing of extraction method as well. This article discusses the implementation of GEOBIA for coastal mapping in Indonesia. Some research combined pixel-based and GEOBIA method, and some get the overall accuracy > 70% of GEOBIA method. By developing a new segmentation accuracy measure, we evaluated that segmentation accuracies decrease with increasing segmentation scales and the negative impact of under-segmentation errors become significantly rise at large scale. The use of GEOBIA for coastal mapping in Indonesia are still lacking, locally applicable and still developing the transferability rule sets. The conclusion is that the innovation is needed to make GEOBIA method applicable for mass production of Indonesian coastal map.

1. Introduction
Visual interpretation and digital image processing is a kind of method to extract image information in remote sensing technique. The extraction of image information is a process to recognize objects of an aerial or satellite imagery, while the objects involve some man-made or natural objects such as land cover, buildings, roads, and others [1]. There are many advantages of image extraction such as object identification or object changes detection. The object changes detection is useful for monitoring as land cover, deforestation estimation, and others [2].

Visual or manual image interpretation still a common way that used in the mapping as well as in Indonesia, for example is topographic mapping. One of the advantages of visual interpretation is efficient at cost because that process is simpler rather than digital image processing, even though visual interpretation is limited to small mapping coverage relatively [3] [4]. Both visual interpretation and
Digital image processing have their advantages and disadvantages. The subjective process (matter) is one of disadvantages of visual interpretation, because it has multivarious results depending on the image interpreter [5].

In line with technological development, digital image processing also has been developed, for example in terms of image information extraction such as pixel-based and object-based (still going to be developing). In the 1970’s, the image processing concept that mostly developed is pixel-based. While in the earth modeling by computer-based usually has the problem because the representation of objects is very complex. Whereas the purpose of remote sensing technique is to obtain information as accurately as possible without override the quantitative approach. The concept of object-based information extraction is accommodating the concept of image segmentation. It using the homogeneity principle of the pixel group, and it being one of the methods of remote sensing that offers more information extraction accurately [6].

Object-Based Image Analysis (OBIA) is specifically intended to extract the imagery into image-objects and assess by its spatial characteristics that taken from spectral, temporal and other values [7] [8]. One of the main processes in OBIA is image segmentation into specific image [7] [1] [9]. As no longer new, the topic about image segmentation was developing in 1950’s (according to Scopus Database, the oldest research with keyword image segmentation identified in 1954). One of image-segmentation study is use a stepwise optimization approach that published in 1989 [10]. A review of image-segmentation applications using different algorithms has also been done in 1993 [11].

Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis of OBIA was formally presented at the first OBIA International Conference in 2006 [7]. In its development, the term of OBIA is devoted and determined into Geographic Object-Based Image Analysis (GEOBIA), and proposed to be a part of remote sensing discipline [12]. Several studies that apply GEOBIA use various types of the data, ranging from very low to very high resolution such as ASTER, JERS, Landsat ETM, RADARSAT, SPOT, Quickbird, IKONOS, Envisat, etc. [8]. The purpose of using the GEOBIA are multivarious, e.g. to extract the road objects, buildings, land cover, mangrove distribution and etc. [13] [14] [15] [16] [17].

One of the application of GEOBIA is for coastal studies. Based on the principles stated in the United Nations Convention on The Law of The Sea (UNCLOS) Indonesia is referred to as the archipelago country (Indonesia has ratified UNCLOS through The Indonesian Law No. 17 of 1985) [18] [19]. As the archipelagic country, Indonesia has coastline as along 99.093 KM, and it is the second longest of world [20] [21], the GEOBIA method should be used as an alternative to coastal mapping. The application of GEOBIA for coastal mapping is to be known whether the GEOBIA method can be used to mass production particularly for coastal mapping in Indonesia. This paper aims to review related on GEOBIA and its application for coastal mapping particularly in Indonesia. The result of this review is expected to know the role and position of Indonesia in the application and development of OBIA method.

2. GEOBIA today
GEOBIA is always associated to the several processes related with image processing. Some previous studies have developed digital image processing for various purposes such as health study, mapping and more. The paper summarizes some of the processes related to GEOBIA method, which sourced by some of previous studies (see Table 1.)

| Process related to GEOBIA | References |
|--------------------------|------------|
| Image segmentation       | [10] [11] [22] [1] [23] [9] |
| Feature extraction       | [24] [25] [26] [13] [14] [27] [28] |
| Object classification    | [29] [30] [15] |
| Developing automated method | [8] [12] [29] [16] [31] |


This paper tries to prove that the image segmentation has been existed before the emergence of OBIA term in 2006 and GEOBIA in 2008 by searching from references database i.e. Scopus database [32]. The first search, by using keywords "image segmentation" with categories of "document article" and set the year of search for "all year", results 53901 articles distributes from 1954 - 2017 (Figure 1).

The second search, by using keywords "object-based image analysis" or "object-based image analysis" or "object-based classification" or "OBIA" or "GEOBIA" and using categories of "documents article" and set the years for "all year", results 1176 articles distributed from 1954 to 2017 (Figure 2). Based on the results of the search, an article was identified with the title "Object-oriented image analysis published in 1987. In it article is written that “An image analysis workstation is described which supports the object-oriented representation and manipulation of grayscale sensed image objects” [33]. There are top of 20 journals related to Object-based Supervised Classification as shown as Figure 3 [34]. Further it proves that OBIA and GEOBIA is a basic to take into consideration in the development and application of image processing.

Formally, OBIA has a conference held every two years or biennial. The first OBIA international conference was held in 2006 at Salzburg University, Austria with the topic "Bridging Remote Sensing and GIS". Further, in its conference begin with appoint the sub-topic "automated", which is intended to develop automation trends in mapping [35]. The second conference was held in 2008 in Calgary, Alberta, Canada with the topic "GEOBIA - Pixels, Objects, Intelligence: GEOgraphic Object Based Image Analysis for the 21st Century". The sub-topic is consisted of such as "Comparative studies: object-based and pixel-based methods", "Evaluation and comparison of segmentation methods", "New classification methods", "Requirements for object-based accuracy assessment", etc. In 2008, it began to specified the scope of OBIA only into Geographical aspect, and it transform to term of GEOBIA [36]. The third conference was held in 2010 in Ghent, Belgium. Several articles discussed about the use of GEOBIA methods for the development of "Free and Open Source Geomatics solution for residential waste", "Classification of High Resolution Optical and SAR Fusion Image Using Fuzzy Knowledge and Object-Oriented Paradigm", and "OBIA for change detection of multi-temporal image"[37]. The fourth conference was held in 2012 in Rio de Janeiro, Brazil. The sub-topic is consisted of such as "Accuracy assessment, aquatic and coastal ecosystems, change detection, classification, feature extraction, LiDAR and SAR application", etc. [38]. The fifth conference was held in 2014 in Thessaloniki, Greece with the topic "Advancements, trends and challenges". This indicates that GEOBIA's development is being prepared to more advanced level with possible emerging issue is the Modifiable Area Unit Problem (MAUP) [39]. Sixth Conference was held in 2016 in Enschede, The Netherlands with the topic “Solutions and Synergies”. The sixth conference discuss about how to develop optimized, generic and transferable methods for solving standard problems in GEOBIA applications. Transferable is one of the keys of GEOBIA's success [40] The number of conference papers in each OBIA / GEOBIA conference presented in Figure 4.
Figure 1. Number of Articles related to “image segmentation” keywords in Scopus Database (1954 – 2017)
Figure 2. Number of Articles related to "object-based image analysis" OR "object-oriented image analysis" OR "geographic object-based image analysis" OR "object-based classification" OR "OBIA" OR "GEOBIA" keywords in Scopus Database (1954 – 2017)
Figure 3. Top 20 journals for articles related to object-based supervised classification [34]

Figure 4. OBIA to GEOBIA conference trends [35] [36] [37] [38] [39] [40]
3. GEOBIA for coastal mapping research

Coastal refers to regional mosaics of habitats including intertidal habitats (mangrove, marshes, rocky, etc.), semi-enclosed bodies of water (bays, estuaries, gulf, etc.), benthic habitats (coral reefs, sea-grass bed, etc.) [41]. Researches that utilize OBIA for coral reef ecosystem has been done in decades [42] [43] [44] [45]. The fundamental difference of OBIA is in analysis unit which based on image object not a single pixel. OBIA was used for geomorphology and coral reef ecosystem mapping in three different waters and get higher accuracy [42]. Based on various sources, authors have summarizes the example of GEOBIA application for coastal mapping researches (Table 2).

| Classification             | Title                                                                 | Result                                                                                                                                                                                                 | Reference |
|----------------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Benthic habitats           | Mapping coral reefs at reef to reef system scales, 10s–1000s km², using object-based image analysis | - Hierarchical levels: reef, reef type, geomorphic zone, and benthic community  
- The rule sets increased in complexity following the hierarchical level increasing  
- Overall accuracy ranging from 76% to 82% of ‘geomorphic zone’ hierarchical maps  
- Overall accuracy ranging from 52% to 75% of ‘benthic community’ hierarchical maps  
- These sets of hierarchical maps are an important outcome considering the differences that arise due to the extent and composition of a reef, satellite image quality, and environmental conditions. | [43]      |
|                           | The Application Of Object Based Analysis Of High Spatial Resolution Imagery For Mapping Large Coral Reef Systems In The West Pacific At Geomorphic And Benthic Community Spatial Scales | - Overall accuracy of ‘geomorphic zone’ spatial scales map 82.1%  
- Overall accuracy of ‘benthic community’ spatial scales map 66.6%  
- The rule sets developed for one site could be implemented on other reefs that had similar characteristics after adjusting the thresholds for some of the mapping categories  
- The study demonstrates that object based image analysis is robust approach that can be applied on a variety of reef systems to create habitat maps at different spatial scales: 1) reef, 2) reef type; 3), geomorphic zone, and 4) benthic community. | [46]      |
|                           | Semi-Automated Object-Based Classification of Coral Reef Habitat using Discrete Choice Models | - Using a multinomial logistic model to perform an initial automated pass at classifying coral reef habitat from satellite imagery was able to attain assignment accuracies exceeding 85%  
- Quantifying uncertainty is important to the end-user when developing marine spatial planning scenarios and populating spatial models from reef habitat maps | [47]      |
|                           | Multi-scale, object-based image analysis for mapping geomorphic and ecological zones on coral reefs | - Overall accuracies for ‘geomorphic zones’ of Heron (Great Barrier Reef), Ngderack (Palau), and Navakavu (Fiji) about ±80%, ±80% and ±80% respectively using GEOBIA  
- Overall accuracies for ‘benthic community’ of Heron (Great Barrier Reef), Ngderack (Palau), | [42]      |
| Classification          | Title                                                                 | Result                                                                 | Reference |
|------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------|-----------|
| Intertidal habitats    | The Influence of Polarimetric Parameters and an Object-Based Approach on Land Cover Classification in Coastal Wetlands | and Navakavu (Fiji) consecutively 77.9%, 51.6%, and 65.4% using GEOBIA | [48]      |
|                        |                                                                      | - Overall accuracy of Proposed method is 87.3%                           |           |
|                        |                                                                      | - Overall accuracy of Wishart supervised classification is 66.6%         |           |
|                        |                                                                      | - Overall accuracy of Proposed method without polarimetric parameters is 74.0% |           |
|                        |                                                                      | - Overall accuracy of Proposed method without an object-based analysis is 71.1% |           |
|                        |                                                                      | - Overall accuracy of Proposed method without textural and geometric information is 73.2 |           |
|                        |                                                                      | - Overall accuracy of Proposed method using the nearest-neighbor classifier is 80.5% |           |
| Mangrove Species       | Identification: Comparing WorldView-2 with Aerial Photographs        | PS-WV2-VIS (pan-sharpening, visible spectral i.e., blue, green, yellow red and red-edge bands) has 89% of overall accuracy | [17]      |
|                        |                                                                      | PS-WV2-R/NIR1 (pan-sharpening, red, red-edge and NIR1 bands) has 87% of overall accuracy |           |
|                        |                                                                      | AP0.14M (Aerial Photograph) has 68% of overall accuracy                 |           |
|                        |                                                                      | AP0.5M (Aerial Photograph) has 68% of overall accuracy                 |           |
|                        |                                                                      | WV2-VIS (without pan-sharpening, visible spectral i.e., blue, green, yellow red and red-edge bands) has 58% of overall accuracy |           |
|                        |                                                                      | WV2-R/NIR1 (red, red-edge and NIR1 bands) has 42% of overall accuracy   |           |
|                        |                                                                      | The combination of high spatial resolution remote sensing data using a relatively large number of spectral bands within the visible, NIR region and the SVM non-linear machine learning classification technique can be a powerful way for mixed environments such as mangroves. |           |
| An Object-Based        | Classification of Mangroves Using a Hybrid Decision Tree—Support      | - Using a hybrid decision-tree and SVM approach, true mangrove species and associate mangrove species were classified with an accuracy of 94% at the object level. | [49]      |
|                        | Vector Machine Approach                                             | - There is a necessity for greater spectral resolution to distinguish between the subtle differences between individual species while combine non-linear machine-learning classification techniques such as support vector machine with OBIA using very-high spatial resolution data in order to provide marked improvement in the classification of vegetation types |           |
| Classification | Title | Result | Reference |
|----------------|-------|--------|-----------|
| Characterizing the Spatial Structure of Mangrove Features for Optimizing Image-Based Mangrove Mapping | - While using original and resampled WorldView-2 images, the author found that a pixel size ≤2 m was suitable for mapping canopy and inter-canopy related features within mangrove objects;  
- Pixel size of ≥4 m was more appropriate for mangrove vegetation formation, communities and larger mangrove features mapping;  
- The green and red-edge bands were optimum for discriminating smaller sized mangrove features (<8 m);  
- The near infrared1 band was more suitable for identifying feature ≥8 m; and  
- The NDVI image was suitable for mapping all targeted features.  
- The study site limited in Moreton Bay, Australia, with sub-tropical mangroves. | [50] |
| Transferability of object-based rule sets for mapping coastal high marsh habitat among different regions in Georgian Bay, Canada | - To examine the trend (the accuracy associated with each scene was generally dependent on the origin of the training set): how accurate each rule set is with regard to one scene/region and how accurate one rule set is with regard to all scenes/regions.  
- Significant differences among rule sets existed at the scene level, but no single rule set emerged as being superior while applied to the other two scenes. | [51] |
| Coastline | Extraction of Coastline in Aquaculture Coast from Multispectral Remote Sensing Images: Object-Based Region Growing Integrating Edge Detection | - Proposed automated method (object-based region growing integrating edge detection, OBRGIE) for aquaculture coastline mapping using multispectral imagery data;  
- The method is robust to segmentation scale parameter; and  
- The method could derive coastlines with pixel level accuracy in an automated way from relatively fine-to-moderate spatial resolution imagery | [52] |
| Coastal Changes and Movements in the Wider Vlora (Albania) Area | - Change Vector Analysis (CVA) is more exact result than GEObIA approach while using images with 30m of spatial resolution;  
- The situation will be different when dealing with high-resolution data (10 m or higher spatial resolution). | [53] |

In remote sensing aspect, coastal mapping holds onto two basic structures, geomorphologic zone, and benthic habitat which both determine classification. Besides, the moderate resolution imagery is more appropriate for studying reef geomorphology than reef biology [54]. Landscape, form, spread, compactness, and depth are features that compromise the geomorphologic zones. As well the benthic habitat assigned by the percent coverage of each benthic habitat class [55]. Research combining much information comprehends geomorphologic and biotic profusion has been done by Green et al [56].
Also in another benthic habitat, OBIA also implemented on sea-grass mapping projects. Baumstark et al [45] processed IKONOS imagery using a combination of water column correction, pixel classification, and image segmentation techniques that yield a sea-grass density index map with high spatial detail and gain overall accuracy around 77% [57]. Thus, water column correction play an important role to gain more accuracy in mapping. However, for sea-grass mapping, depth and distance from shore became significant parameters for discriminating spectrally between sea-grass and colonized hard bottom. In this case, Baumstark et al [45] achieved 78% overall accuracy using OBIA for Sea-grass, colonized hard bottom and sediment compared to 71% overall accuracy using the photo-interpretation method. This study revealed that OBIA as an alternative technique for offshore mapping with capability of producing higher thematic and spatial resolution maps.

In OBIA, appropriate threshold values are a major step to provide better classification results. The feature attribute used in this research consists of two; features related to objects and features related to the class [58]. Object-related features are obtained by evaluating the segmentation image objects. The features used are layer/ spectral value (average and ratio), hierarchy, thematic attributes, NDVI (normalize different vegetation index). Functions that related to the object class generated and consider the proximity of inter-class existence. The feature is a relation with neighbour objects that refer to objects that already have classes at the same level into the image object hierarchy class. Another feature used is the distance (unit pixels) to indicate centre point distance of an object reviewed with another central point that is nearby. All features employed in OBIA greatly simplified classification process of each class based on its characteristics and yielded better accuracy. By developing a new segmentation accuracy measure, we evaluated that segmentation accuracies decrease with increasing segmentation scales and the negative impact of under-segmentation errors become significantly rise at large scale.

4. GEOBIA application in Indonesia
GEOBIA application in Indonesia is still limited on the scale of research, and this is possible because GEOBIA is a new paradigm in image classification [59]. The implementations of GEOBIA method in Indonesia are not only for the coastal area but also covers of land and another theme. The classifying process of this method uses a hierarchical process of segmentation at the pre-processing stage so that the characteristics of the object can be added with some additional information such as text, texture, context, and other information related to the object [9].

The reef level and geomorphological zone level mapping using WorldView-2 with object-based classification method (OBIA) located in Pari Island able to gain accuracy respectively 97% and 87% [44]. For benthic habitat mapping study, GEOBIA usage is produced higher accuracy (73.3% while using sun glint corrected image) compared to the per-pixel classification (64.3%) and is comparable to the result of the original image [60]. Wahidin et al [61] had tried classified Landsat 8 OLI image coral reef benthic habitat mapping employing OBIA within seven classes (sand-rubble, rubble, coral, sand, sand-algae, sea-grass, and rubble-sand). The object-based classification was executed using several hybrid classification algorithms of the learning machine. The highest overall accuracy and Kappa on coral reef habitat mapping were produced by Support Vector Machine (SVM) algorithm (73% and 0.64). Then it is followed by Random Tree (RT), Decision Tree (DT), Bayesian, and k-Nearest Neighbour (KNN) algorithms of 68% & 0.59, 67% & 0.56, 66% & 0.53, and 56% & 0.46, respectively. It claimed the classification methods based OBIA approach within > 6 classes produced better accuracy than the pixel based classification technique. The other research compares the suitability of high (QuickBird 2, IKONOS, GeoEye-1, WorldView-1) and moderate (Landsat 7 ETM+, Landsat TM, ALOS) spatial resolution imagerys for coral reef mapping in Indonesia. It concludes that both moderate and high spatial resolution imagerys are suitable for benthic community and geomorphic zone mapping with an area more than 6.39 km² [62]. Kamal et al [63] focused on mangrove mapping research using GEOBIA and compare various imagerys such as Landsat TM, ALOS AVNIR-2, WorldView-2, WorldView-2+LiDAR to get multi-scale mangrove composition. The locations are different while develop the classification rule sets and test the applicability of the rule sets. Moreton Bay in Australia as the primary site to develop the classification rule sets and Karimunjawa Island in Indonesia to test the
developed classification rule sets. The use of Landsat TM, AVNIR-2, WorldView-2, WorldView-2+LiDAR data provided overall accuracies of 82%, 82%, 85%, 94% respectively for mangrove and non-mangrove mapping.

Out of coastal topics, several studies are shown OBIA for inland mapping. Thouret et al [64] applied OBIA for disaster, risk, and hazard. Object-oriented classification (OOC) and normalized difference spectral indices of vegetation, moisture and soil redness (NDVI, NDWI, and NDRSI) to identify and map pyroclastic and lahar deposits from the 2010 eruption of Merapi Volcano, Indonesia. This study shows that OBIA is ready to be embedded in GIS platform which can contribute to hazard and risk assessment in the area after a disaster. As well Zylshal et al [65] use a stereo using an object-based classification method. ESP tool was then used to determine the optimal segmentation parameter values. For further classification, decision tree algorithms were then performed to derive 11 land use/land cover classes. This gives GEOBIA an opportunity and challenges in the mapping and monitoring of land use. In the other location, Darmawan et al [66] use object-based approaches for land use/land cover changes identification. The process is Landsat imagery pre-processing, field survey, classification. To get an optimal segmentation, Darmawan et al [66] use trial and error process. That study indicates that cover type of artificial surface such as urban area, industrial and bare areas are increasing. Alrassi et al [67] tried to assess the GEOBIA classification method for generating the classification of land use in coastal areas of Banyuwangi, and also validated by field data. It yielded that Banyuwangi Regency is dominated by mangrove, agricultural fields, mixed farms, settlements, and ponds. Nonetheless, Puturuhu et al [68] compared the accuracy of interpretation methods and determine the location of landslide events using Landsat 8, QuickBird, and SRTM images. Landslide candidates determined by several methods, i.e., layered visual interpretations, digital transformation with NDVI, OBIA, Toposhape, and NDVI-OBIA combinations, and NDVI-OBIA-Toposhape. The various accuracy achieved such as 47% using digital transformation with NDVI, 45% using OBIA, 47% using Toposhape, and 53% for the combination of NDVI, and the combination of NDVI-OBIA-Toposhape 53%. Landslide type found from the layered visual interpretation combined with field observations, i.e., soil rotational slide types found in 7 points (38.9%), soil creep, debris flow, earth slide, and multiple rotational slides. In this case, the best interpretation method of landslide occurrence is layered visual interpretation with 90% of accuracy.

5. GEOBIA for national map production

National coastal map producer is refers to the custodianship regulation. Based on the existing regulation [69], mangrove ecosystem, sea-grass, and coral reef map custodian in Indonesia respectively are Ministry of Environment and Forestry, Indonesian Institute of Sciences and Indonesian Institute of Sciences. There are several regulations for mapping procedure of national coastal mapping. First regulation is Head of Geospatial Information Agency Regulation No 3/2014, about the technical guidance of mangrove geospatial data collecting and processing [70]. Then Head of Geospatial Information Agency Regulation No 8/2014, about the technical guidance of collecting and processing of shallow waters habitat geospatial data [71]. On 2014, Indonesian Institute of Sciences (LIPI) has published the manual book “Technical Guidance for Sallow Waters Habitat Mapping” of which references are National Standard of Indonesia documents (SNI) and Head of Geospatial Information Agency Regulation [72]. Both of Head of Geospatial Information Agency Regulation and manual book allowed the use of OBIA/GEOBIA method for mangrove and shallow water habitat mapping.

Even OBIA/GEOBIA usage has been allowed, Indonesian Institute of Sciences (LIPI) did not use it for massive or national coastal map production. Authors argue that one of the reasons is rule sets transferability problem. For national map of coral reef and sea-grass, LIPI use the unsupervised classification on Landsat ETM+, Landsat 8 OLI, SPOT-5 and through ground truth for validation [73] [74]. The result of coral reef and sea-grass mapping using that method are displayed in figure 5 to figure 8.
Figure 5. Seagrass distribution in Indonesia [73]

Figure 6. Seagrass status in Indonesia, 2017 [73]
Figure 7. Coral reefs distribution in Indonesia [74]

Figure 8. Coral reefs status in Indonesia, 2017 [74]
Many aspects are needed to make GEOBIA could be used operationally for national map production. Authors argue that even GEOBIA have many advantages e.g., GEOBIA could significantly contribute through raster images to vector products conversion [75], GEOBIA is still ‘new paradigm’ which is needs more innovative ideas and efforts to make it applicable for general conditions [59]. In addition, segmentation, sampling, feature selection, classification and accuracy assessment are kind of uncertainty factors [34]. Moreover, limited access of suitable software is become the other problems. Then the fully transferability become the main question while applying GEOBIA for massive production.

6. Conclusion
In remote sensing especially for feature extraction, manual interpretation has some weakness e.g. subjectivity. OBIA and GEOBIA is a basic to take into consideration in the development and application of image processing. GEOBIA has been developed for automation process and increase geometry detail. One of GEOBIA development target is mapping problem which is related to inefficiencies could be solved. Generally, GEOBIA applications in the whole of the world are still limited on the scale of research. The number use of GEOBIA for coastal mapping studies in Indonesia are still lacking, locally applicable and still developing the transferability rule sets.

National coastal map producer in Indonesia is refers to the custodianship regulation. The producer means legal institutions did not use GEOBIA for massive or national coastal map production. Authors argue that one of the reasons is rule sets transferability problem. Many aspects are needed to make GEOBIA could be used operationally for national map production. Segmentation, sampling, feature selection, classification and accuracy assessment are kind of uncertainty factors. Moreover, limited access of suitable software is become the other problems. Then the fully transferability become the main question. The innovation and effort are needed to make GEOBIA method applicable for massive production of Indonesian coastal map. The richness of Indonesian coastal resources should be the main factors why Indonesia must be involved in developing GEOBIA method.

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