"Supplementary Data Availability"

Sentinel-2A level 1C analysis

Satellite imagery which in this study uses mapping of the distribution of kulong on Bangka Island with Sentinel-2A level 1C satellite imagery acquired on April 9, 2021. This Sentinel-2A satellite image is free data that can be obtained by downloading it on the website: https://scihub.copernicus.eu. The Sentinel-2A satellite is a new generation satellite designed by the European Space Agency (ESA) for earth observation where all data can be accessed free of charge with a temporal resolution of 10 days (single satellite) 5 days (combined constellation), as well as 12-bit radiometric resolution. In addition, the RGB band resolution is relatively good for land cover mapping. The characteristics of the Sentinel-2A satellite sensor are presented in Table 1.

Table 1. Characteristics of the Sentinel-2A image

Band name	Wavelength (µm)	Resolution (m)
Band 1 Coastal Aerosol	0,443	60
Band 2 Blue	0,443	10
Band 3 Green	0,560	10
Band 4 Red	0,665	10
Band 5 Vegetation Red Edge	0,705	20
Band 6 Vegetation Red Edge	0,740	20
Band 7 Vegetation Red Edge	0,783	20
Band 8 NIR	0,842	10
Band 8b Vegetation Red Edge	0,865	20
Band 9 Water Vapour	0,945	60
Band 10 SWIR-Cirrus	1,380	20
Band 11 SWIR	1,610	20
Band 12 SWIR	2,190	20

The software used for processing satellite imagery is the SeNtinel Applications Platform (SNAP) software from ESA, while for the process of classifying map layouts using Arc Map 10.5 software. The initial stage of processing Sentinel 2A level 1c satellite imagery is to use software that is a plugin on ESA SNAP, namely Sen2Cor. This software is used to make corrections to the atmosphere, terrain, and cirrus clouds on the Sentinel-2 Level 1C imagery. After that, it is continued with an analysis of the level of change in the built-up land around the Yogyakarta international airport.

Factor Analysis Sustainability

The MDS-Rapfish method is an approach and tools used to determine the level of sustainability of the management of an object of study including IKH. MDS-Rapfish was first developed by Pitcher (1999). This approach is based more on the principle of Multi Criteria

Analysis (MCA) by relying on an algorithm known as the MDS algorithm (Fauzi and Anna 2005). Multi Dimensional Scaling (MDS) is a statistical analysis technique that performs multidimensional transformations (Kavanagh and Pitcher 2004).

The assessment or scoring given to each attribute is analyzed multidimensionally to determine the position of the sustainability studied relative to two reference points, namely; good and bad. To facilitate visualization, ordinate analysis is used. The coordination process uses Rapfish software (Kavanagh and Pitcher, 2004). Furthermore, it is stated that MDS can present an effective ordinating method. The observed object or point is mapped into 2 or 3 dimensional space, so that the object or point is tried to be as close as possible to the point of origin. In other words, two points or the same object are mapped in one point that are close to each other. Instead objects or points that are not the same are described with points that are far apart (Fauzi and Anna 2005). Furthermore, it is also stated that the ordination technique is by configuring the distance between points in the t-dimensional which refers to the Euclidean distance between points. The position of the sustainability points visually will be very difficult to imagine considering the many dimensions. Therefore, to facilitate the visualization of this position, ordinate analysis is used with the multi-dimensional scaling (MDS) method. Before MDS was implemented, all data was standardized, i.e. normalized on all attributes. Through this ordination system, the position of the effectiveness point can be visualized in two axes (vertical and horizontal). Through the axis rotation method, the position of these points can be projected on a horizontal line where the extreme point "bad" is given a score of 0% and the extreme point "good" is given a score of 100%. The position or position of the sustainability to be studied is between these two extreme points and the sustainability index can be analyzed by looking at the percentage value on the horizontal line, with reference to the sustainability value set by Pitcher (1999).

The MDS-Rapfish analysis in this study is intended to obtain an overview of the level of sustainability of settlements around the Yogyakarta international airport. Following are the operational stages of sustainability analysis using the Rapfish software, with modifications to the Rapfish stages according to Yusuf (2016) as follows:

- Determine the theme/topic of the study, namely the sustainability of settlements around the Yogyakarta international airport (YIA).

- Determine aspects of the study, including 5 dimensions of sustainable management namely; ecological dimension, economic dimension, social dimension, technological dimension and institutional dimension.
- Determine the attributes of each dimension of the study, which are attributes that have a relationship or influence on the sustainability of settlements around the Yogyakarta international airport (YIA), including; ecological dimension (13 attributes), economic dimension (10 attributes), and social dimension (10 attributes).
- Make scoring (bad-good) and criteria on each attribute.
- Inputting the value/score of the assessment results of each attribute into the Rapfish software
- Arranging anchors with formulas (nx2)-4.
- Run Rapfish software.
- Bringing up rap analysis (sustainability coordination). Rap analysis is intended to determine the percentage of sustainability from each study dimension.
- Me-run leveraging to obtain leverage of attribute, which is the determination of the lever attribute of each management dimension. Leverage attribute is an attribute whose existence is sensitive to increasing or decreasing sustainability status, the greater the RMS value, the greater the role of this attribute in sustainability sensitivity (Kavanagh and Pitcher, 2004). Determination of lever attributes refers to Yusuf (2018) that lever attributes are attributes that have a dominant value (extreme bar) or a value of more than half of the highest value.
- Run a Monte Carlo with a 95% confidence interval. Monte Carlo analysis is intended to see the effect of errors (errors), in an effort to increase confidence in the output/results of the analysis. The difference or difference between the Monte Carlo score and the ordinate score (sustainability percentage), indicates that the impact of scoring errors is relatively small. If the value of the difference between the two analyzes (Monte Carlo Analysis and Rap Analysis > 5%) then the results of the analysis are not sufficient as an estimator of the value of the sustainability index.
- Generates the value of the squared correlation (R2) as an assessment of the goodness of fit. The squared correlation (R2) is the square of the correlation coefficient which indicates the proportion of the variance of the optimally scaled data, which is contributed by the multidimensional scaling procedure which is a goodness of fit measure. The R2 value indicates the amount/amount of data variance that can be explained in the model. The

squared correlation value is used to determine the closeness between the data and the perceptual map whether the data is well mapped or not. The closer the R2 value is to 1, the better the data is mapped or in other words, the higher the R2 value, the better the model is in explaining the variance of the data. Kavanagh (2001) states that the value of R2 > 80% indicates that the sustainability index estimation model is good and sufficient.

- Displays a stress value to indicate a lack of fit measure. The stress value is the opposite of the R2 value. The stress value is used to see whether the results/output are close to the actual situation or not. The closer to zero (0), the resulting output is more similar to the actual situation. The lower the stress value, the better/fit the model is. Conversely, the higher the stress value, the less suitable the model is. The stress value that can be tolerated is <20% (Kavanagh and Pitcher 2004).
- Displays the Root Mean Square (RMS) value of each dimension. The greater the RMS value, the greater the role of this attribute in sustainability sensitivity (Kavanagh and Pitcher 2004).
- Making a kite-diagram of the value of each dimension of settlement studies around Yogyakarta international airport (YIA). Kite-diagrams are useful as a visualization of sustainability trade-offs.

Assessment of the sustainability of the management of settlements around the Yogyakarta international airport is carried out using a management dimension approach which includes; ecological dimension, economic dimension, and social dimension. These three dimensions are expected to show the level/status of settlement sustainability around Yogyakarta International Airport (YIA) so far, so that various further management steps can be formulated. A description of the dimensions and attributes of the sustainability of settlements around the Yogyakarta international airport (YIA), is detailed as follows:

Table 2. Dimensions/Attributes of Settlement Sustainability around YIA

No	Sustainability Attributes	Skor	Good	Bad	Criteria
A	**Ecological Dimension**				
1	Contour/Topography	0;1;2;3	0	3	[0] Bad (> 80% is on the contour 25-45%

No	Sustainability Attributes	Skor	Good	Bad	Criteria
					[1] enough (>50-80% is on the contour 25-45% [2] Good (>50% is on the contour 25-45%
2	Layout of settlements (distance from airport)	0;1;2	0	2	[0] Bad (0-100m from the airport) [1] Enough (100-300m from the airport) [2] Good (>300m from the airport
3	Built Up	0;1;2	0	2	[0] pretty good (<50%) [1] moderate (51-80%) [2] relatively high (>80%)
4	Drainage conditions (flood control)	0;1;2	2	0	[0] Bad (>50% badly damaged) [1] Enough (30-50% damaged) [2] baik (<30% lightly damaged)
5	Availability of clean water (quality and quantity)	0;1;2;3	0	3	[0] Low (<30% served) [1] Not enough (<30-50% served) [2] Enough (<50-80% served) [3] High >80% served)
6	Waste/garbage management	0;1;2	2	0	[0] there is no waste treatment [1] there is waste treatment, but not optimal [2] there is waste treatment and optimal
7	Availability of open and green open space (area)	0;1;2;3	3	0	[0] relatively low, if the land is open <10% [1] moderate (11-30%) [2] quite high (31-50%) [3] is very high >51%

No	Sustainability Attributes	Skor	Good	Bad	Criteria
8	Environmental pollution and sanitation	0;1;2	0	2	[0] low pollution [1] moderate pollution [2] high pollution
B	**Economic Dimension**				
1	Resident income	0;1;2	2	0	[0] Low [1] Moderate [2] High
2	The economic value of the area	0;1;2	2	0	[0] Low economic value of the area [1] Lack of regional economic value [2] High economic value of the region
3	Mastery and ownership of assets	0;1;2	2	0	[0] Asset ownership is reduced [1] Fixed asset ownership [2] Asset ownership increases
4	Land economic value	0;1;2	2	0	[0] Low land economic value (<NJOP) [1] The economic value of the land is sufficient (=NJOP) [2] The economic value of the land is high (>NJOP)
5	Resident comfort level	0;1;2	2	0	[0] low (poor population >30%) [1] moderate (poor population 10-30%) [2] high (poor population <10%)
6	Availability of funds for settlement improvement	0;1;2	0	2	[0] poor (there is no availability of settlement improvement funds [1] less (there are funds <5% of APBD)

No	Sustainability Attributes	Skor	Good	Bad	Criteria
					[2] high (there are funds > 5% of APBD)
7	Savings rate	0;1;2	2	0	[0] Less than loan interest [1] the same as the loan interest [2] more than interest on loan credit
8	*Marketable right*	0;1;2;3	3	0	[0] *open access property* [1] *communal/ common property* [2] *state property* [3] *private property*
C	**Social Dimension**				
1	Population density	0;1;2;3	0	3	[0] Not densely populated: 0-50 people/km^2 [1] Less crowded: 51-250 people/km^2 [2] Quite dense: 251-400 people/km^2 [3] Very dense:>400 people/km^2
2	Employment (Labor Application)	0;1;2	2	0	[0] Low (0-25% of the cumulative population) [1] Moderate (26-50% of the cumulative population) [2] High (>50% of the cumulative population)
3	Number of poor people	0;1;2	0	2	[0] Low (0-5% of the cumulative population) [1] Moderate (5-10% of the cumulative population) [2] High (>10% of the cumulative population)
4	Education	0;1;2;3	3	0	[0] Low (>30% did not finish school) [1] Less (a few 15-30% do not finish

No	Sustainability Attributes	Skor	Good	Bad	Criteria
					school) [2] Moderate (6-15% did not finish school) [3] High (<5% did not finish high school)
5	Public opinion of existance YIA airport	0;1;2	0	2	[0] Not useful [1] Less useful [2] Quite useful
6	Public Services (Health)	0;1;2;3	0	3	[0] classified as low/poor (<10 served population) [1] classified as underserved (10-30% of the population served) [2] moderate (30-50% of the population served) [3] relatively high (> 50% of the served population)
7	Land Ownership	0;1;2	0	2	[0] own (certificate, girik) [1] Contract [2] illegal
8	Social participation level	0;1;2;3	0	3	[0] classified as low/poor (<5 residents participate) [1] classified as less (5-10% of the population participates) [2] moderate (10-30% of the population participates) [3] relatively high (>30% of the population participates)
9	Social conflicts/land disputes	0;1;2	0	2	[0] Nothing/didn't happen [1] It happens sometimes

No	Sustainability Attributes	Skor	Good	Bad	Criteria
					[2] Often occur
10	Social relationship pattern	0;1;2	2	0	[0] Bad (Pattern of kinship) [1] Moderate (Patron-client) [2] Good (Democratic)

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