

GIS application for identifying the rice field area in supporting rice production in Lubuk Linggau city

Indrayani¹, Erika Buchari^{2,*}

Civil Engineering Department, Politeknik Negeri Sriwijaya, Palembang, Indonesia¹;
Civil Engineering Department, Faculty of Engineering, Universitas Sriwijaya, Palembang, Indonesia^{2,*}.



Abstract— The government is actively encouraging food and energy independence to achieve development targets. So, it is necessary to make an inventory of existing rice fields. Identification of rice field area can be done using geographic information system (GIS). By doing so, a comparison of rice field a comparison of rice fields between data and interpretation results can be obtained and rice production in each district in the city of Lubuk Linggau can be predicted. Interpretation was carried out to get the classification of rice fields in the study area by using Landsat 8 Image. The interpretation of the image was carried out on a combination of band 653. The level of accuracy of the results of interpretation of rice fields in Lubuk Linggau City is 98.34%. The interpreted rice fields are smaller than the existing rice fields in the data, which is 55%.

Keywords—GIS; identifying; rice field, rice production.

1. Introduction

Millions of people in the world consume rice as their main food, which is nearly 50% of the world's population. This local Indonesian main food actually has bright prospects, but this potential has not been well utilized. In fact, Indonesia still imports a lot of rice, even though the import should be suppressed, even eliminated by optimizing the potential of local food sources in Indonesia. The World Food Agency (FAO) states that 80% of the rice circulating on the world market is absorbed by Indonesia [5]. This data shows that Indonesia's food security continues to be problematic if the country remains rely on rice self-sufficiency use.

The increase in population also has an impact on the development of the agricultural sector which is increasingly developing so that rice consumption is also increasing. South Sumatra has many potential agricultural products, especially food crops, including rice. South Sumatra in 2010 was ranked as the 6th of all provinces in Indonesia, namely 4.92% of the total 66,411,469 tons of rice in 2010. The situation of food security in Indonesia is still weak. This was indicated among others from: (a) the population is food insecure (consumption rate < 90% of the recommendation of 2,000 kcal/cap/day) and very food insecure (consumption rate < 70% of recommendations 2,000 kcal/cap/day) still quite large, namely 36.85 million and 15.48 million respectively for 2002; (b) malnourished children under five are still quite large, namely 5.02 million and 5.12 million for 2002 and 2003 [1]. Rice fields continue to experience extensive changes due to changes in the function of rice fields, which continue to be converted for other activities such as plantations, settlements, even becoming an industrial area [6]. Concurrently, the government consistently encourages food and energy independence to achieve development targets. Population growth is also the main cause of the decrease in rice fields, where rice fields continue to be converted into settlements [8], for that it is necessary to carry out an inventory of the existence of rice fields which is a benchmark of rice

production in an area. Then, from these results rice production will be predicted in each sub-district in the city of Lubuk Linggau. Identification of land use or paddy rice was carried out using GIS can save time [3][7]. The purpose of an inventory of rice fields using a geographic information system (GIS) is (1) to obtain the area of rice fields by utilizing remote sensing technology, (2) to compare of the existing rice fields with the interpreted rice, (3) to identify the largest rice production in Lubuk Linggau.

2. Metodology

Identification of the existing rice fields area is done by comparing the results of interpretation with existing conditions so that the results of this study can be used in predicting the results of rice production in Lubuk Linggau City, South Sumatra Province.

2.1 Classification method

The image interpretation process was carried out to obtain the classification of rice fields in the study area by using Landat 8 Image that downloaded from the United States Geological Survey in the scene: path 125/row 062 [9]. Furthermore, the image processing is carried out by doing geometric corrections to position of the image so that it matches the coordinates of the reference system [4]. While the radiometric correction is to improve the visual quality of the image, then the image is cut in accordance with the study area. Finally, the composite band process was obtained in order to get the band combination in accordance with the review of land cover, which is the band combination 653. Furthermore, the interpretation of the image is carried out on a combination of band 653 and with the help of Google Earth maps exported to Arcgis and Online Map Viewer World Imagery in the ArcGIS 10.5 program. Field cross check is conducted to validate the results of the interpretation, whether it is in accordance with the existing conditions.

2.2 Study area

This research was conducted in the City of Lubuk Linggau, South Sumatra Province because this city has a strategic position, in trans-Sumatra transportation route, which can make Lubuk Linggau City as one of the chains of rice distribution in the South Sumatra region and beyond. The area of study can be seen in Figure 1.

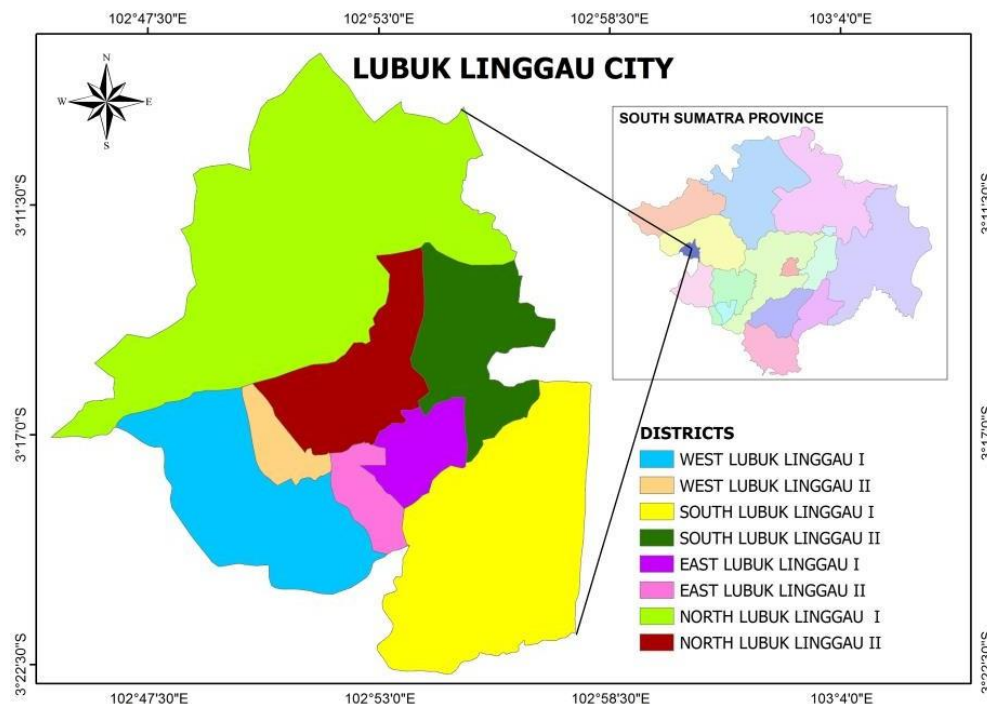


Figure 1. Map of the study area in the Lubuk Linggau city

3. Result

Landsat 8 image processing begins with the image cutting, arithmetic and geometry correction and the final result of image processing is obtained, in terms of composite band 653, which will be used in the introduction of rice fields in the study area. The results of the composite band 653 on image processing and maps from Google Earth will be used in interpreting as seen in Figure 2.

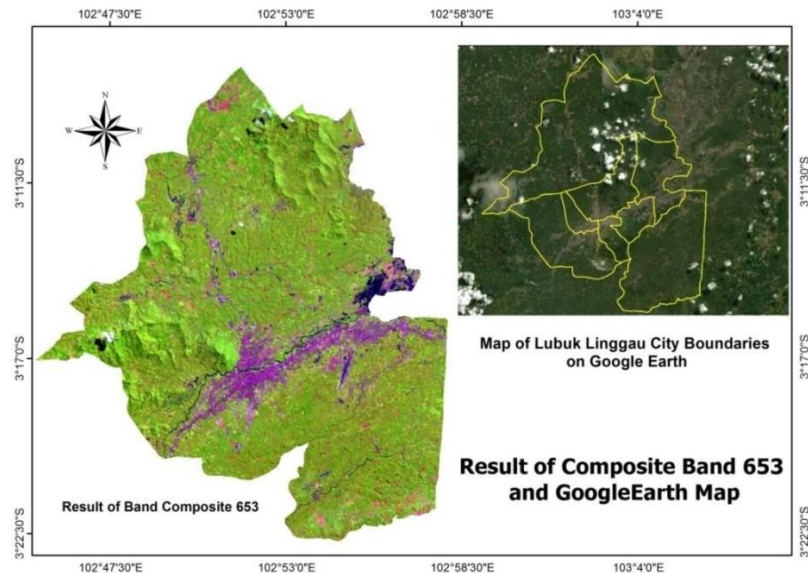
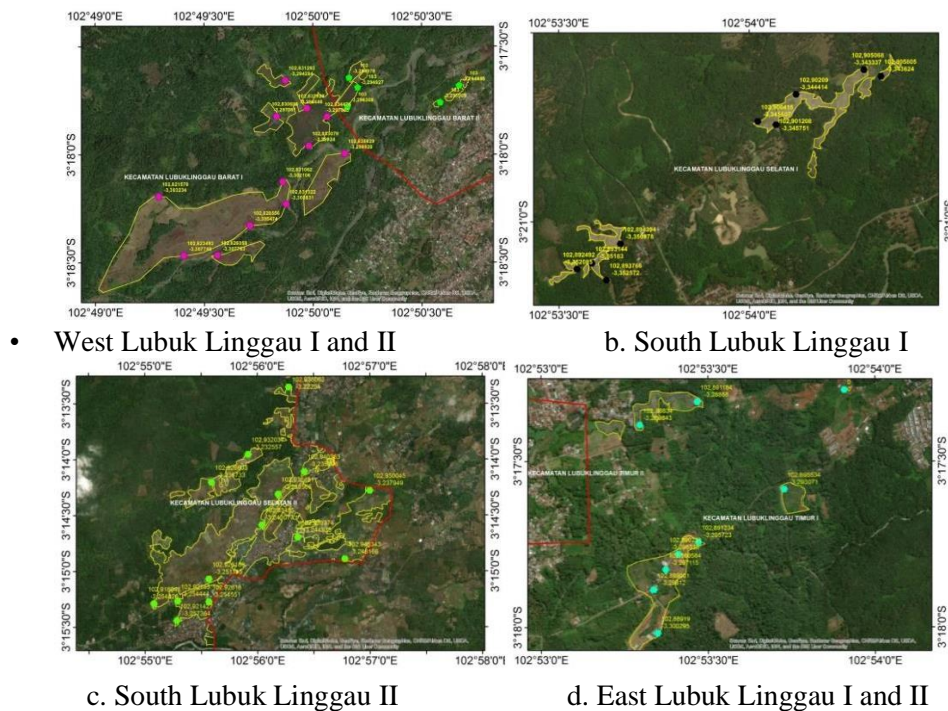


Figure 2. Maps of the results of the composite band 653 and the results of digitization from Google Earth

3.1 Image interpretation

Furthermore, an interpretation of the extent of rice fields in the City of Lubuk Linggau. Map of Interpretation Results per district can be seen in Figure 3.



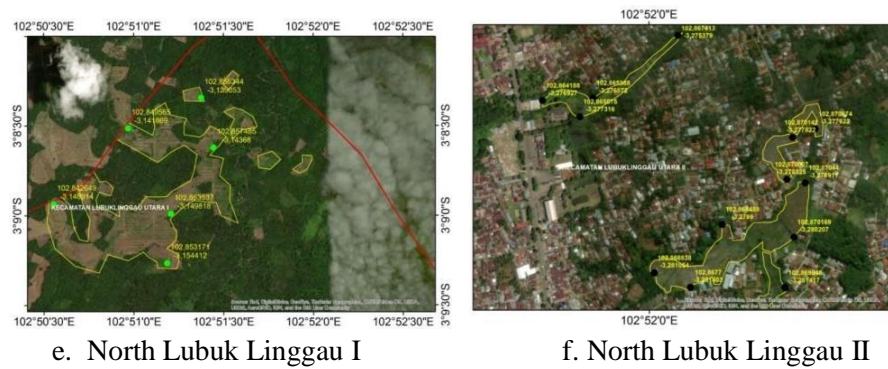


Figure 3. The rice field interpretation results in Lubuk Linggau city

3.2 Validation of interpretation result

Validation of interpretation results is done through cross-checking in the field. Confusion Matrix on the rice field classification from the interpretation results can be seen in Table 1.

Table 1. Confusion matrix on the rice field classification

Description	Object Classification		Quantity (Pixel)	Ommision (%)	Commision (%)	Mapping Accuracy (%)
	Rice field	Not rice field				
Rice field	2365	26	2392	0.01	1.46	97.76
Not rice field	33	4567	4600	0.01	0.56	98.72
Commision	35	26	6932			98.34

From table of confusion matrix on the rice field classification, it can be seen that the percentage of accuracy level is 98.34%. This shows that the results of interpretation can be used for comparing the results of identification of existing rice field with secondary data.

3.3 Comparison of rice fields area

Based on data released by the Central Statistics Agency of Lubuk Linggau City in 2018 that the rice fields area in Lubuk Linggau City in 2017 was 1959 Ha, which consist of 181 ha in South Lubuk Linggau I sub-district, 610 ha in South Lubuk Linggau II sub-district, 539 ha in North Lubuk Linggau I sub-district, 139 ha in North Lubuk Linggau II sub-district, 65 ha in East Lubuk Linggau I sub-district, 325 ha in West Lubuk Linggau I sub-district, 100 ha in West Lubuk Linggau II sub-district. On the other hand, there are no rice fields in East Lubuk Linggau II sub-district. From this data, it can be seen that the largest area of rice fields is in the District of South Lubuk Linggau II. The results of interpretation of rice fields in Lubuk Linggau City can be seen in Table 2.

Table 2. The results of the interpretation of rice fields in Lubuk Linggau City

No	Description	Total area (Ha)
1	Sub-district of South Lubuk Linggau 1	39
2	Sub-district of South Lubuk Linggau 2	402
3	Sub-district of North Lubuk Linggau 1	313
4	Sub-district of North Lubuk Linggau 2	6
5	Sub-district of East Lubuk Linggau 1	16
6	Sub-district of East Lubuk Linggau 2	0
7	Sub-district of West Lubuk Linggau 1	92
8	Sub-district of West Lubuk Linggau 2	6
Total Area		874 Ha

The results of the interpretation show that the largest rice field area in Lubuk Linggau Selatan II sub-district is 402 Ha. While the total area of rice fields is 874 Ha. Comparison of rice field area between data and interpretation results can be seen in Table 3.

Table 3. Comparison of the rice field area in Lubuk Linggau city

No	Description	Total area (Ha)		Comparison (%)
		Data 2017	Interpretation Result	
1	Sub-district of South Lubuk Linggau 1	325	39	88
2	Sub-district of South Lubuk Linggau 2	100	402	75
3	Sub-district of North Lubuk Linggau 1	181	313	42
4	Sub-district of North Lubuk Linggau 2	610	6	99
5	Sub-district of East Lubuk Linggau 1	65	16	75
6	Sub-district of East Lubuk Linggau 2	0	0	0
7	Sub-district of West Lubuk Linggau 1	539	92	83
8	Sub-district of West Lubuk Linggau 2	139	6	96
Total Area		1959	874	55

Table 3 shows that the interpretation result of rice fields is smaller than the rice fields in the data, except for South Lubuk Linggau II sub-district and North Lubuk Linggau I sub-district. The difference in interpretation results with data from the Central Statistics Agency of Lubuk Linggau City in 2018 is 55%. This difference can occur due to land use change from rice fields to settlements or plantations, which are carried out by the community due to an increasingly high population growth rate i.e. 2.29% per year [2]. Decrease in rice fields can cause a decrease in rice production, and care must be taken seriously by the government. The food security movement should be continued to be echoed by the government consistently.

3.4 Prediction of rice production result based on interpretation result of the rice field area

Rice production in 2018 in Lubuk Linggau City was 2.65 million tons after it was converted to rice or 5.16 tons/ha [1]. From these results, it can be predicted that rice production in each sub-district in the city of Lubuk Linggau is 202 tons/ha in South Lubuk Linggau I sub-district, 2075 tons/ha in South Lubuk Linggau II sub-district, 1617 tons/ha in North Lubuk Linggau I sub-district, 31 tons/ha in North Lubuk Linggau II sub-district, 83 ton/ha in East Lubuk Linggau I sub-district, 475 tons/ha in West Lubuk Linggau I sub-district, 31 tons/ha in West Lubuk Linggau II sub-district.

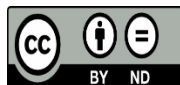
4. Conclusion

From the discussion it can be concluded that (1) The total area of interpreted rice fields in the City of Lubuk Linggau are 874 Ha, which the level of accuracy of the interpretation results is 98.34%, (2) The interpreted rice fields is smaller than the existing rice fields, which is 55%. (3) The largest rice production based on the results of interpretation is in the South Lubuk Linggau II sub-district which is 2075 tons/ha.

5. References

- [1] Badan Litbangtan. 2010. "Rencana Strategis Badan Penelitian dan Pengembangan Pertanian 2010- 2014". Badan Litbang Pertanian. Jakarta. Kementerian Pertanian.
- [2] BPS Kota Lubuk Linggau. 2018. "Lubuk Linggau Minicipality in Figure". Statistic of Lubuk Linggau Municipality.

- [3] Indrayani., Buchari, E., Putranto, D.D.A., Saleh, E. 2017. "Analysis of landuse in the Banyuasin district using the image Landsat 8 by NDVI method". AIP Conference Proceedings 1903, 030007, <https://doi.org/10.1063/1.5011514>.
- [4] Indrayani., Buchari, E., Putranto, D.D.A., Saleh, E. 2018. "Spatial analysis of soil texture and peat soil by NDSI method at swamp area of Banyuasin District, Indonesia". *Ecology, Environment and Conservation Journal*, Vol. 24 (2), 673-680.
- [5] Mohammadi, A., Rafiee, S., Jafari, A., Keyhani, A., Dalgaard, T., Knudsen, T., Thu Lan, T.N, Borek, R., Hermansen, J.E., 2015. "Joint Life Cycle Assessment and Data Envelopment Analysis for the benchmarking of environmental impacts in rice paddy production". *Journal of Cleaner Production*, Vol. 106, 521-532, <https://doi.org/10.1016/j.jclepro.2014.05.008>.
- [6] Rusdi, M., Sugianto, Fadhli, R., Fazlina, Y.D. 2018. "Mapping Of Existing Paddy Rice Field Using Spatial Technology Towards One Map Policy Case Study in Aceh Besar and Aceh Jaya Regencies". Seminar Nasional Geomatika, 143-148.
- [7] Shiu, Y., and Chuang, Y. 2019. "Yield Estimation of Paddy Rice Based on Satellite Imagery: Comparison of Global and Local Regression Models". *MDPI Remote Sens*, doi:10.3390/rs11020111, www.mdpi.com/journal/remotesensing.
- [8] Sihaloho, M., Dharmawan, Arya, H., Rusli, S. 2007. "Konversi Lahan Pertanian dan Perubahan Struktur Agraria (Studi kasus Di Kelurahan Mulyaharaja, Kecamatan Bogor Selatan, Kota Bogor, Jawa Barat". *Sodality, Jurnal Transdisiplin Sosiologi, Komunikasi, dan Ekologi Manusia*, 253-270.
- [9] USGS, 2019. "Landsat 8 (L8) Data Users Handbook". U.S. Geological Survey. South Dakota: Department of the Interior.



This work is licensed under a Creative Commons Attribution Non-Commercial 4.0 International License.

Technology Reports of Kansai University

Country	Japan -  SIR Ranking of Japan
Subject Area and Category	Engineering Engineering (miscellaneous)
Publisher	Kansai University
Publication type	Journals
ISSN	04532198
Coverage	1975, 1977-1988, 1997-2019
Scope	Information not localized
 Join the conversation about this journal	

3

H Index

ISI Thomson Reuters Indexing

