

Spatial Dynamics of Rice Plant Health in Kerinci District Using Remote Sensing Data

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ABSTRACT

One of many districts that sustain the enhancement production of rice in Jambi Province is Regency Kerinci. However, if seen from the amount of production paddy, the Regency Kerinci experiences a decline, based on data from Regency BPS Kerinci seen that the amount of production rice is unstable. Therefore, it needs to be done monitoring to plant rice. Monitoring plant paddy can be done through image remote sensing. The objective of this research, namely detect and analyze the level of health of plant paddy quickly by using NDVI and NDRE parameter indices as well as showing the connection between healthy plant rice in quantity production rice in the Regency Kerinci. The NDVI calculation it states that in 2018 the plant's rice was in very good condition with an area of 11409.8 ha, in 2019 plant's rice was in condition well with an area of 10028.59, in 2020 plant rice was in condition well with an area of 8382.77 ha, while in 2021 plants rice in condition both with an area of 9536.74 ha. Based on the results of NDRE calculation in 2018 crops paddy declared unhealthy or planted immature rice with an area of 8212.22, in 2019 plants unhealthy rice with an area of 7430.7 ha, in 2020 plants paddy declared healthy with an area of 6746.78 while in 2021 plants paddy declared unhealthy with an area of 13,392 ha. Multiple linear regression results show a coefficient determination of 0.814, that is the NDVI variable and NDRE variable simultaneously influence to variable amount production paddy amounting to 81.4%.

Keywords: Sensing, NDVI, NDRE, Quantity production paddy

1. Introduction

State the objectives of the work and provide an adequate background, relevant literature review but avoiding a detailed literature survey or a summary of the results.

Plant Rice (*Oryza sativa*, sp) is one type of plant food is one of them that needs principal part of the world community is cultivated through plain low. Indonesia also relies on it sector agriculture as a source eye livelihood for its inhabitants. However, the amount production of rice in Indonesia is still relatively low compared to with level of consumption in society. Besides that, there is Another problem is changing functions resulting in land reduced results agriculture [1].

Jambi Province has enough potential in the field of agriculture Because its commodity superior can increase the growth economic area and provide donations to GRDP [2]. One of the many districts that sustain the enhanced production of rice in Jambi Province is Regency Kerinci. Regency Kerinci includes in the Land Agriculture Food Sustainable (LP2B). LP2B in principle is part of field land established agriculture for and protected only for agriculture food to maintain resilience food and sovereignty food. The objective main Land program Agriculture Food Sustainable is to avoid rate switch function land agriculture, especially rice fields in Indonesia.

With Regional Regulation Regency Kerinci No. 8 of 2019 concerning the protection of Land Agriculture Food sustainability, yes help prevent switch function land in the Regency Detailed and capable of becoming base strong law for increase wide land agriculture and production of rice in the Regency Kerinci. However, in the implementation application of regional regulations the Not yet fully can walk with God by expected aims and objectives. This thing can be seen from the amount of production rice in the Regency Kerinci experienced its decline. Based on data from BPS Jambi Province, the number production of rice in the Regency Kerinci in 2018 was as many as 110339.23, in 2019 as much as 98685.68, in 2020 as much as 100061.29 while in 2021 the number production paddy as much as 91260.58. Happen decline in 2019 and 2021, based on data from Regency BPS Kerinci saw that the amount of production paddy No stable.

Based on the description above, it should be with the existence of LP2B, land agriculture No will change and the amount of production not even rice will decrease. Therefore, that needs to be monitored to plant rice. Monitoring plant paddy does not need to be surveyed directly but it can be done through image sensing from far away [3][4]. In the era of globalization, technology sensing Far develops quickly and is implemented in a way for observing and mapping plant rice. Sensing Far is knowledge accessing data about something object or area that uses radiation electromagnetic (light) without contact directly with the object or study area [5].

In knowing your health condition plant paddy through image satellite can use NDVI and NDRE algorithms. Principle NDVI algorithm is based on the plant's reflective green radiation infrared close and absorbing radiation in the light looks, so obtained ribbon combination of NDVI algorithm that can show greenish plant as size health relative plants. The density of a plant can influence the tall low NDVI value, which is a low value that shows that a plant is seldom or not dense and vice versa. As with NDVI, NDRE will deliver Let's go to the problematic plant so that it can investigate further the reason low content of chlorophyll in it [6].

Objectives from this research are to detect and analyze level health plant paddy quickly by using NDVI and NDRE parameter indices on technology remote sensing with sentinel-2 imagery data in the Regency Kerinci as well as Detect and analyze level health plant paddy quickly by using NDVI and NDRE parameter indices on technology remote sensing with sentinel-2 imagery data in the Regency Kerinci.

2. Research methodology

This research is research conducted to find out the health of plant rice and the relationships between plant health rice in quantity production rice in the Regency Detailed using remote sensing data. This research uses NDVI (Normalized Difference Vegetation Index) and NDRE (Normalized Difference Red Edge) indices. This type of research is research with an approach quantitative.

This research was conducted in the Regency Kerinci. The data used in this research is Sentinel-2 Satellite Image data obtained from Sentinel Hub EO Browser, Administrative Boundaries data Regency Kerinci obtained from Ina-Geoportal and quantity data production paddy from 2018-2021 from the District BPS Kerinci. In the Regency Kerinci, there are two period plants every year that is April-September period and the period October-March. NDVI processing is performed from 2018-2021, so there are 7 periods of plant rice to do the calculation.

NDVI calculations were carried out using ArcGIS software on the raster calculator tool. In processing NDVI, Sentinel 2 image data is used, and NDVI calculations are carried out using the formula:

$$NDVI = (NIR - RED) / (NIR + RED) \quad (1)$$

Where NIR is radiation infrared near pixels. On Sentinel-2 NIR is band 8 in length wave 0.842. While RED is radiation light red from pixels. On Sentinel-2 RED is band 4 in length wave 0.665. The NDVI value has a range between -1 to +1. Representative value vegetation is in the range of 0.1 to 0.7, if the NDVI value above this value shows the level of health from cover better vegetation.

NDRE calculations were carried out using ArcGIS software on the raster calculator tool. In processing NDRE, Sentinel-2 image data is used, and NDRE calculations are carried out using the formula:

$$NDRE = (NIR - Red Edge) / (NIR + Red Edge) \quad (2)$$

Where NIR is band 8 in length wave 0.842. Meanwhile, Red Edge is band 5 in length wave 0.705. The scale used for the NDRE index value is 1 to 1. Total low chlorophyll can indicate plant problems or plant diseases,

infected plant pests, deficient plant nutrients, and damaged plants. NDRE will direct it to problematic plants, so it can investigate further. The reason low content of chlorophyll in it [4].

3. Results and discussion

3.1. Plant health level paddy through NDVI and NDRE parameter

3.1.1. NDVI calculation

From the results NDVI calculation can be done done classify healthy plant rice, classification used based on Table 1 following:

| Plant Health | NDVI value |
|--------------|--------------|
| Very Low | -0.10 – 0.12 |
| Low | 0.12 - 0.22 |
| Normal | 0.22 - 0.42 |
| Good | 0.42 - 0.72 |
| Very good | 0.72 - 1 |

Following map classification health plant rice in the Regency Kerinci. From the results NDVI processing follows the map classification health plant rice in the Regency Kerinci from 2018-2021 period 1 to period 7.

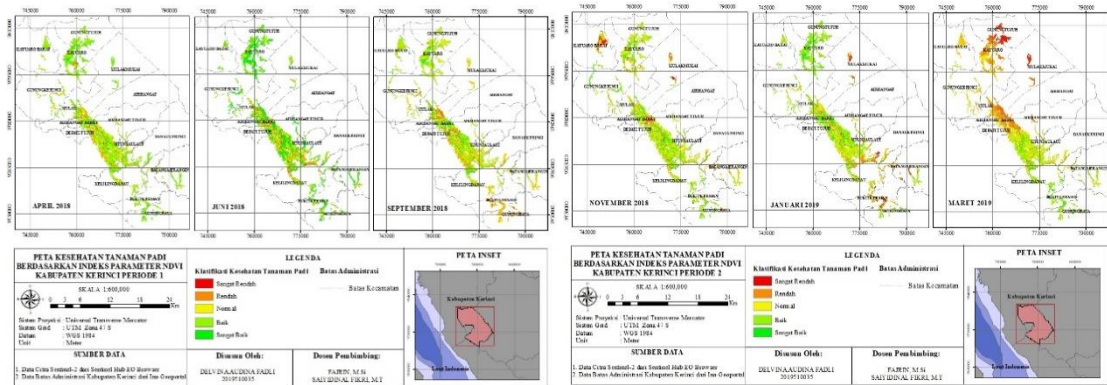


Figure 1. Rice plant health map based on NDVI calculation periods 1 and 2

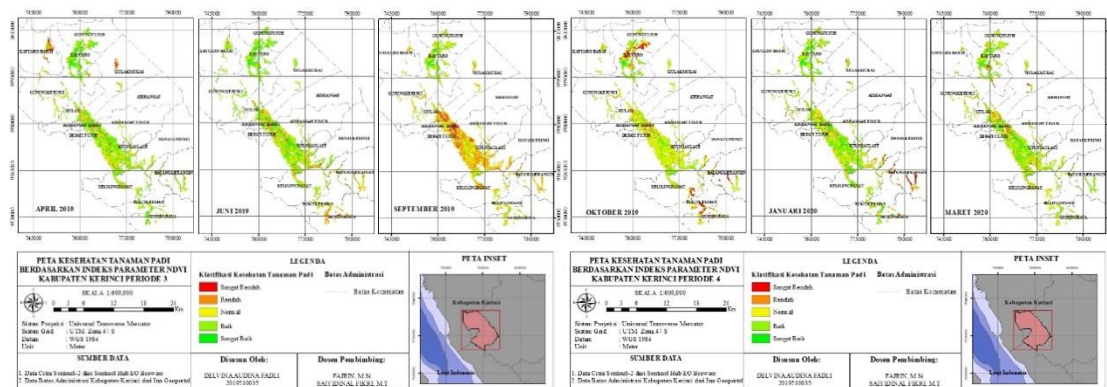


Figure 2. Rice plant health map based on NDVI calculation periods 3 and 4

Based on map results health plant paddy, in period 1 if seen from phase maturation namely in September 2018 classification health plant paddy color red state plant rice in very low health with extensive area is 116.58 ha. On classification health low on colour orange wide the area is 307.05 ha. Classification normal health covering an area of 4151.01 ha expressed in the colour yellow. Meanwhile, regarding classification health Good wide the area is 11409.8 ha and is classified as very good health the area is 3125.03 ha. This shows that the study area is the most numerous rice with health good. In period 2 plant rice has very low health wide the area is 889.83 ha, health low with an area of 726.25 ha, normal health covering an area of 3788.55 ha. Meanwhile, regarding classification health the area is 9128.15 ha and is classified as very good health the area is 3842.62 ha. This shows that the study area is the most numerous rice with health good.

In period 3 plants rice had very low health wide area is 49.19 ha, health low with an area of 774.17 ha, and normal health covering an area of 6465.59 ha. Meanwhile, regarding the classification health Good the area is 10028.59 ha and, in the classification, very good health, the area is 942.46 ha. This shows that the study area is the most numerous rice with health good. In period 4 plant rice has a very low health wide area is 103.3 ha, health with an area of 163.28 ha, and normal health covering an area of 2333.14 ha. Meanwhile, regarding classification health Good wide the area is 9564.23 ha and it is classified as very good health the area is 6012.17 ha. This shows that the study area is the most numerous rice with health good.

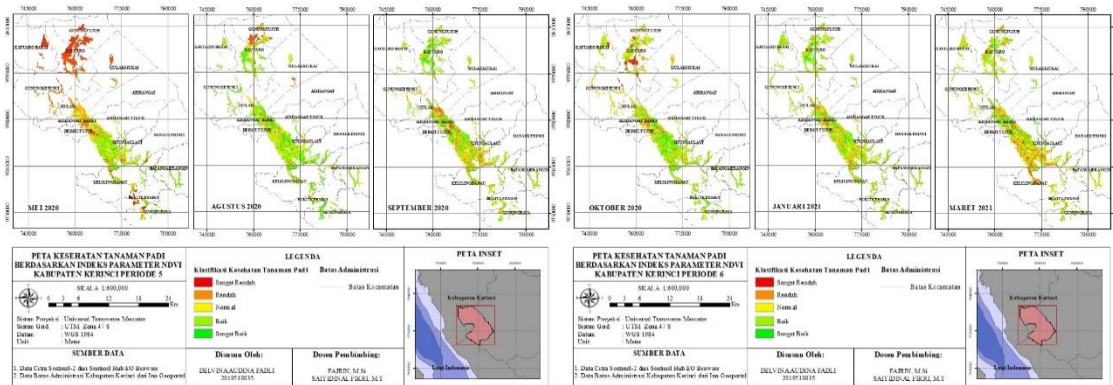


Figure 3. Rice plant health map based on NDVI calculation periods 5 and 6

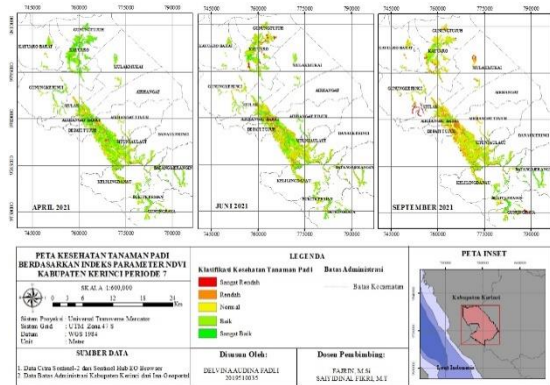


Figure 4. Rice plant health map based on NDVI calculation period 7

In the period of 5 plants rice has very low health wide the area is 805.99 ha, health low with an area of 471.26 ha, normal health covering an area of 2815.94 ha. Meanwhile, regarding classification health the area is 8382.77 ha and is classified as very good health the area is 5889.78 ha. This shows that the study area is the most numerous rice with health good. In the period of 6 plants rice that has very low health wide area is 144.02 ha, health low with an area of 283.42 ha, normal health covering an area of 3881.26 ha. Meanwhile, regarding classification health the area is 9663.47 ha and is classified as very good health the area is 5169.42 ha. This shows that the study area is the most numerous rice with health good. In the period of 7 plants rice has very low Health the area is 308.26 ha, Low health has an area of 517.93 ha, and normal health has an area of 3992.73 ha. Meanwhile, the Health classification is good the area is 9536.74 ha and the health classification is very good wide the area is 3940.97 ha. This shows that the study area has the most numerous rice with good health.

3.1.2. NDRE calculation

Based on the results of NDRE calculation, in period 1 if seen from phase maturation namely in September 2018 classification health plant paddy colour red state plant Rice is in very poor health, you know widely bald _ the area is 4479.96 ha. Colour beige states that plant rice is in unhealthy or immature condition with an area of 8212.22 ha. Whereas color green states that rice is in condition healthy and mature plants with an area of 6410.77 ha. This shows that the study area is the most numerous rice with unhealthy health or immature plants. In period 2 plants rice are in very poor health or plant widely bald _ the area is 3696.57 ha. Plant rice is in unhealthy or immature condition with an area of 14451.76 ha. Whereas plant rice is in condition healthy and mature plants with an area of 278.82 ha. This shows that the study area is the most numerous rice with unhealthy health or immature plants.

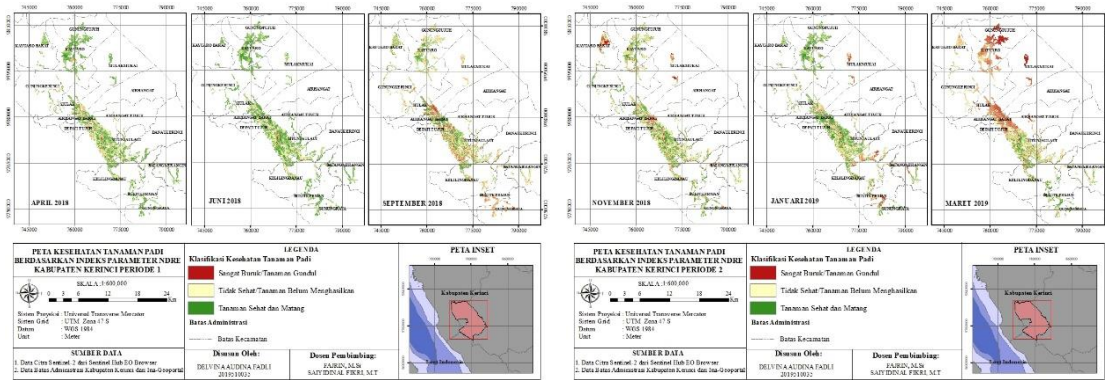


Figure 5. Rice plant health map based on NDRE calculation periods 1 and 2

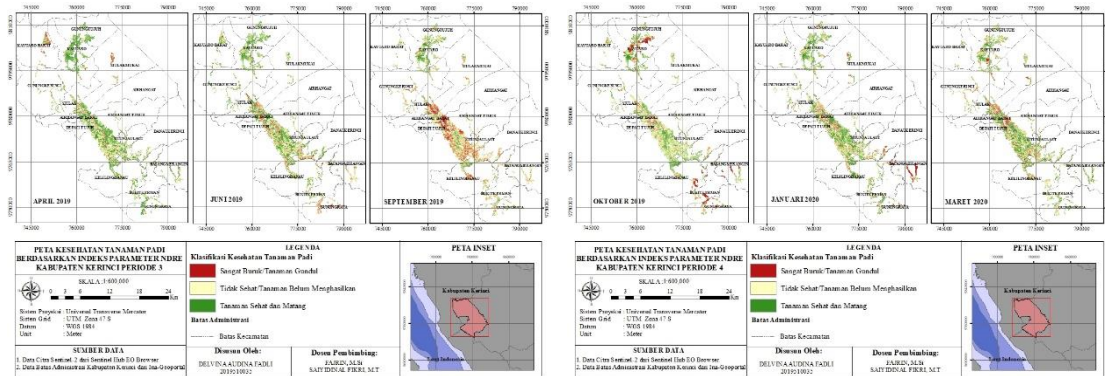


Figure 6. Rice plant health map based on NDRE calculation periods 3 and 4

In period 3 plants rice are in very poor health or plant widely bald _ the area is 5303.55 ha. Plant rice is in unhealthy or immature condition with an area of 7430.7 ha. Whereas plant rice is in condition healthy and mature plants with an area of 5514.93 ha. This shows that the study area has the most numerous rice with poor health. In period 4 plant rice is in very poor health or plant widely bald _ the area is 3957.32 ha, plant rice is in unhealthy or immature condition with an area of 6957.41 ha. Whereas plant rice is in condition healthy and mature plants with an area of 7261.76 ha. This shows that the study area has the most numerous rice with healthy and mature plants.

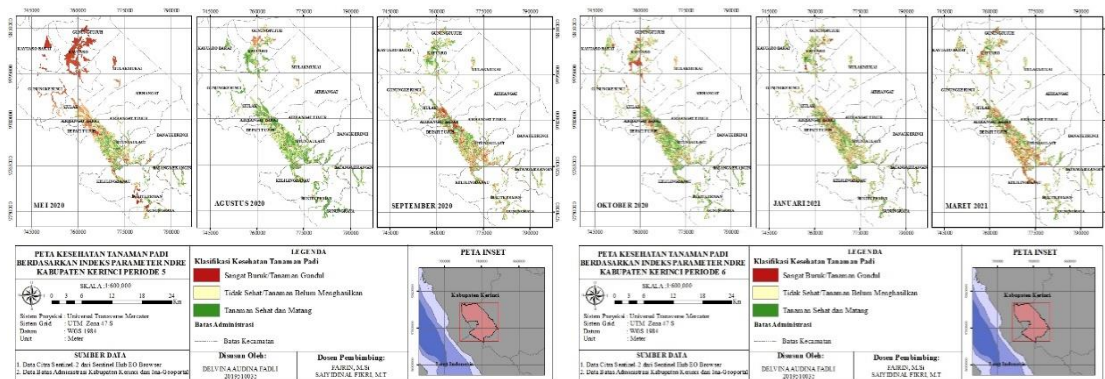


Figure 7. Rice plant health map based on NDRE calculation periods 5 and 6

In the period of 5 plants rice is in very poor health or plant widely bald the area is 4797.29 ha, plant rice is in unhealthy or immature condition with an area of 6722.74 ha. Whereas plant rice is in condition healthy and mature plants with an area of 6746.78 ha. This shows that the study area has the most numerous rice with healthy and mature plants. In the period of 6 plants Rice is in very poor health, you know widely bald the area is 4938.31 ha, plants rice is in unhealthy or immature condition with an area of 14043.77 ha. Whereas plant rice is in condition healthy and mature plants with an area of 196.24 ha. This shows that the study area is the most numerous rice with unhealthy health or immature plants.

In the period of 7 plants rice is in very poor health or plant widely bald _ the area is 4749 ha, plants rice is in unhealthy or immature condition with an area of 13392 ha. Whereas plant rice is in condition healthy and mature

plants with an area of 193 ha. This shows that the study area is the most numerous rice with unhealthy health or immature plants. With the results of this NDRE, you can confirm if plants are growing healthy or not. The amount of low chlorophyll can indicate plant problems or plant diseases, infected plant pests, deficient plants and damaged nutrients and plants.

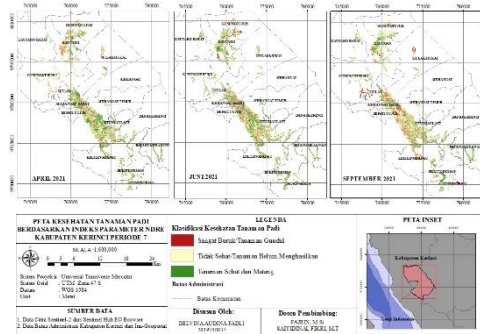


Figure 8. Rice plant health map based on NDRE calculation period 8

3.2. Plant health relationships by quantity production paddy

To find out the connection health of plant rice in quantity production paddy done using analysis multiple linear regression. Amount production paddy as variable bound, NDVI and NDRE as variable free. In this research to find out the connection both did calculations using the device SPSS (*Statistical Package for the Social Sciences*) software. Following results calculation from SPSS:

| Model Summary | | | | | |
|-------------------------------------------------|--------|----------|-------------------|----------------------------|---------------|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
| 1 | 0.902a | 0.814 | 0.441 | 5870.25956 | 2.802 |
| a. Predictors: (Constant), NDRE (X2), NDVI (X1) | | | | | |
| b. Dependent Variable: PRODUKSI (Y) | | | | | |

Figure 9. SPSS calculation results

Based on The SPSS "model summary" the output table above is known as mark coefficient determination or R Square of 0.814. This R Square value comes from the squaring mark coefficient "R" correlation. The size number coefficient determination (R Square) is 0.814 or 81.4%, meaning that the NDVI variable (X1) and NDRE variable (X2) respectively simultaneous (together) influence to variable amount production rice (Y) of 81.4%. Whereas the rest 18.6 % is influenced by other outside variables equality this regression or unexamined variables.

4. Conclusions

Based on the results NDVI and NDRE calculations are obtained classification-level health plant rice in the Regency Kerinci from 2018-2021. From NDVI calculations in 2018 plants' rice was in very good condition with an area of 11409.8 ha, in 2019 plants' rice in the Regency Kerinci was in good condition well with an area of 10028.59, in 2020 plants' rice in the Regency Kerinci is in good condition well with an area of 8382.77 ha, while in 2021 plants rice in the Regency Detailed in condition both with an area of 9536.74 ha. Based on the results of NDRE calculation in 2018 crops paddy declared unhealthy or planted immature rice with an area of 8212.22, in 2019 plants unhealthy rice with an area of 7430.7 ha, in 2020 plants paddy declared healthy with an area of 6746.78 while in 2021 plants paddy declared unhealthy with an area of 13,392 ha. Based on the results of multiple linear regression with coefficients his determination of 0.814, that is the NDVI variable (X1) and NDRE variable (X2) respectively simultaneous (together) influence to variable amount production rice (Y) of 81.4%.

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