(Vegetation Dense monitoring) Agriculture Season in Al Rajhi Agriculture Field in Barber Sudan (2019_2020)

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1. INTRODUCTION

Monitoring large agricultural areas became a challenging task for agronomists, especially in large agricultural investments with different varieties. Remote sensing techniques (specifically, Vegetation Indices) were created because they can speed up the process and provide information that the human eye cannot detect it.

The Normalized Difference Vegetation Index (NDVI) was calculated for two separate months September, December in the seasons (2019 and 2020) for a project in Barber, River Nile state in Sudan, using Sentinel-2 multispectral satellite imagery. These index indicate the vegetation.

A temporal analysis was used to highlight changes in vegetation between the beginning of the season (September) and the end of the season (December).

Images for both months were analysed, and difference maps were constructed to show where the vegetation varied.

2. MATERIALS AND METHODS

For the purpose of this project, Sentinel-2 satellite images were obtained using the EO Browser web application. The EO Browser web site interface allowed for interactive browsing, selection, and downloading of the Sentinel-2 data based on specific criteria such as cloud cover, acquisition date, processing level, spectral resolution, and bands.

Spesefication of satellite Misssion:

- **Temporal resolution:** Temporal resolution is the time it takes for a satellite to complete an orbit and revisit the same observation area. This resolution depends on the orbit, the sensor's characteristics, and the swath width. Because geostationary satellites match the rate at which Earth is rotating, the temporal resolution is much finer. In the case of the Sentinel_2, it is equal to 5 days at the equator with 2 satellites under cloud-free conditions, which result in 2-3 days at midlatitudes.

- **Spatial resolution**: Spatial resolution is defined by the size of each pixel within a digital image and the area on Earth's surface represented by that pixel, Sentinel-2 bands have a spatial resolution of 10-20m/px for most bands.

- **Spectral resolution**: Spectral resolution is the ability of a sensor to discern finer wavelengths, that is, having more and narrower bands. Many sensors are considered to be multispectral, meaning they have 3-10 bands. Some sensors have hundreds to even thousands of bands and are considered to be hyperspectral, Sentinel-2 has 13 spectral bands.

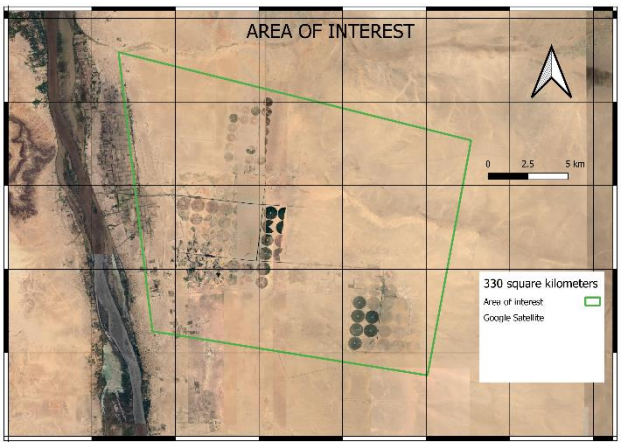
- **Radiometric resolution**: the number of brightness levels in an image pixel. Depends on the number of bits used in representing the energy recorded by the sensor, The radiometric resolution of Sentinel-2 is 12bit. This gives a potential range of brightness levels from 0 - 4095.

- From the Eo browser web site, separate acquisition dates images for area of interest have been downloaded.

Acquisition dates:

2019	2020
09 September	19 September
24 December	28 December

Table 1: Acquisition dates



Figuer:1 Area of interest

The properties of analyzed field:

The total area of the project which is in (Barber_River Nile state in Sudan) is about 81545 acers, but the planted area until the 2019's season was separate to two areas in west side 16061.8 acers and in the south-east of the project area 6548 acers.

Qgis software used to perform analysis.
Band Algebra using Raster Calculator in QGIS is the main operator in the calculation of classification maps, RED and NIR are the two needed band to calculate the NDVI index also Quick Map Services tool has been used to obtain Base-maps for Visualization.
NDVI Index: The value range of the NDVI is -1 to 1. Negative values of NDVI (values approaching -1) correspond to water. Values close to zero (-0.1 to 0.1) generally correspond to barren areas of rock, sand, or snow. Low, positive values represent shrub and grassland (approximately 0.2 to 0.4), while high values

indicate temperate and tropical rainforests (values approaching 1). It is a good proxy for live green vegetation. (Sentinel hub)
Eo browser allows you to download specific bands according to your needed sentinel-2 l2A, Red (band 4) NIR (band 8). A virtual raster was created for virtualization and clipping purposes.
NDVI vegetation maps were calculated using Raster calculation tool and the NDVI equation.
The normalized difference vegetation index defined as:

NDVI = (NIR - R) / (NIR + R)

Where: NIR = Near Infra-Red band (band 8)
Red = Red band (band 4)
After generated NDVI maps for each month (September and December) in two separate years (2019-2020) the classification maps have been calculated to highlight the Vegetation dense, barren areas (I assumed it as sand based on my knowledge) and water as following properties:

- Sand in range -0.1 _ 0.1
- Vegetation any value over 0.2
- Water any value less than -0.2

After creating NDVI maps the classification maps have been generated to highlight mainly the differ in vegetation dense between months and seasons as it shown in figures below

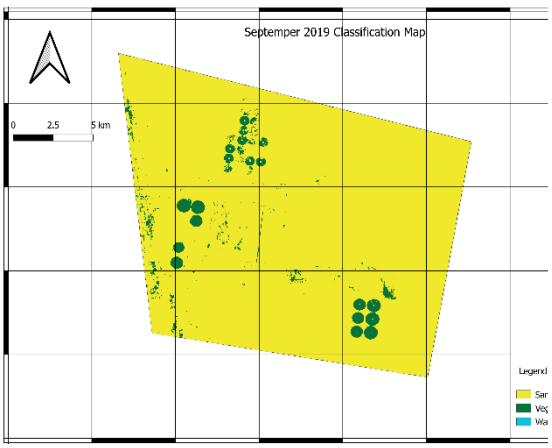


Figure 2: Classification Map of September 2019

Month	Area (m^2)	Area (Acres)
September	**11849466.8**	**2928**

Table 2: Cultivated Area in September 2019

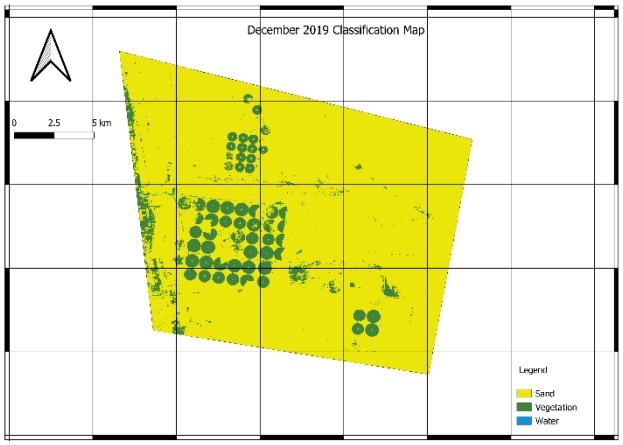


Figure 3: Classification Map of December 2019

Month	Area (m^2)	Area (Acres)
December	**34237396.5**	**8460**

Table 3: Cultivated Area in December 2019

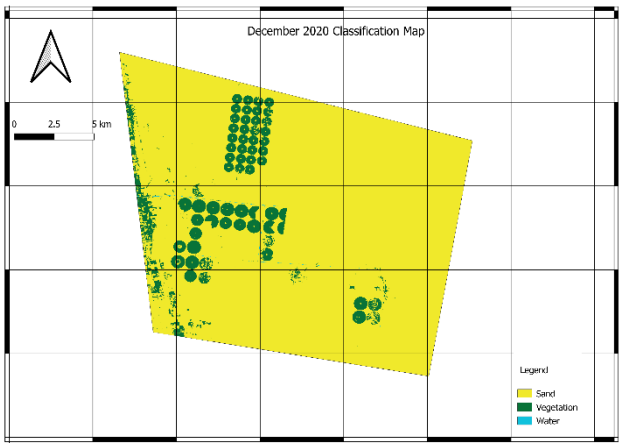


Figure 4: Classification Map of December 2020

Month	Area (m^2)	Area (Acres)
December	**29290718.5**	**7237.8941**

Table 4: Cultivated Area in December 2020

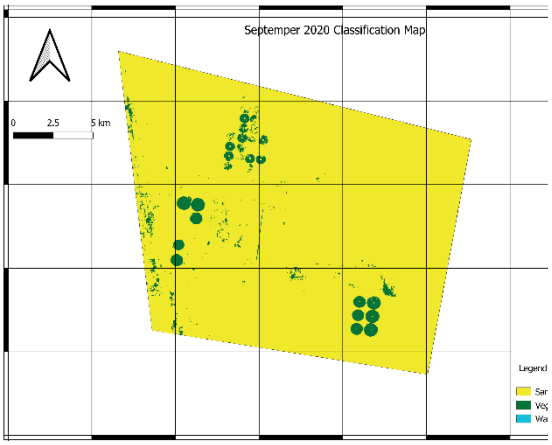


Figure 5: Classification Map of September 2020

Month	Area (m^2)	Area (Acres)
September	**11850073.84**	**2928.217**

Table 5: Cultivated Area in September 2020

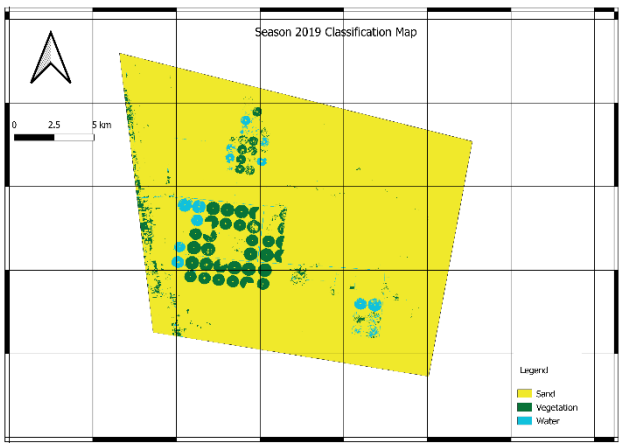


Figure 6: Represent differ in vegetation dense in season 2019

Season	Area (m^2)	Area (Acers)
2019	**21129406.69**	**5221.19**

Table 6: total difference in planted area between beginning and the end of the season 2019

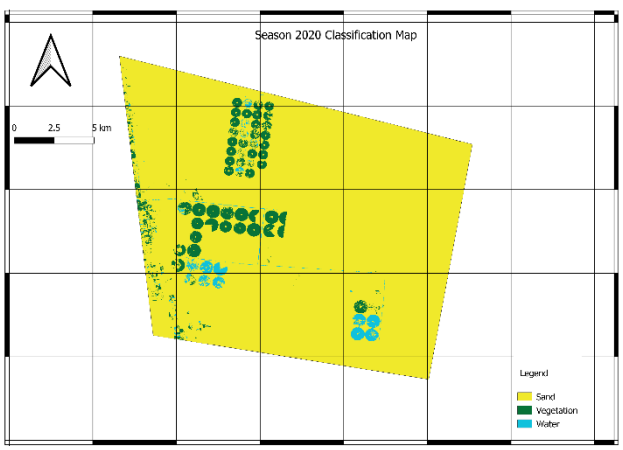


Figure 7: Represent differ in vegetation dense in season 2020

Season	Area (m^2)	Area (Acers)
2020	**17938589.16**	**4432.72**

Table 7: total difference in planted area between beginning and the end of the season 2020

3. RESULTS DISCUSSION

The obtained results clarify that the vegetation density always increased in December with respect to the beginning of the season in September in both studied seasons (the main crop planted in this field is wheat). Due to the delay in the agricultural process in the cultivate area, the difference in vegetation density between the beginning of the season and the end of December for seasons 2019 and 2020 has been calculated and represented by tables 6, 7, respectively.

On the process:

The process takes a long time, mainly due to the heaviness of the downloaded images, but if I download only the needed bands, this decreases the download time by more than 50%. The analyses take more time than expected due to some unexpected technical issues.

REFERENCES

-Dermanis, A., Biagi. L., & Venuti, G. (2023). Band Algebra - Lecture Notes.
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