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Lockdown turned farm to fork – dream or reality - Agricultural Situation in Thanjavur, India before, during and after COVID-19

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Abstract
Thanjavur, being the southernmost district of the Cauvery delta, plays a critical part in Tamil Nadu's agricultural landscape, since 70% of the population is employed in agriculture and related activities. As usual, the "Rice Bowl of Tamil Nadu" grew paddy vegetation between 2019 and 2020, but farmers were unable to pay for COVID lockdowns. This resulted in a condition that was worse than a drought scenario. In this respect, we intend to combine early evidence of the COVID-19 influence on the Indian agriculture system, including production, marketing, and consumption, as evidenced via the use of a set of ability approaches to recover and thrive post-pandemic. The 2020 NDVI picture was compared to the similar images from 2019 and 2021. A change picture was created, and state-degree NDVI values were calculated. Additionally, the district-level cropped area share was mapped via the NDVI thresholding technique. Additionally, the location of the crop sowed, the crop condition, and the amount of vegetation that was unable to grow due to pandemic conditions were compared for each year. The epidemic caused havoc on all players in the Indian agricultural equipment industry on a major physical, social, financial, and emotional level. Seizing the opportunity presented by the accident, the examination suggests a slew of actions and long-overdue reforms.

***Keywords*:** *Normalized Difference, Remote sensing, COVID-19, Lockdown, Vegetation Index (NDVI), Multi Criteria Analysis.*

Introduction
A complementary investigation on vegetation phenology was undertaken using the NDVI (Normalized Difference Vegetation Index) at adjacent scales. Understanding the climatological and environmental consequences of inter- and intra-annual changes in plant cover is crucial for competency (Ahmadi H, Nusrath A,2012). We employed multispectral Landsat 8 data to characterise plant life in this study. Multispectral Remote Sensing photos are highly successful at enhancing our understanding of the earth's climate (Ahmadi H, Nusrath A,2012). It is the Science and Art of acquiring information and extracting supplies in the Spectral, Spatial, and Temporal dimensions about specific objects, areas, or marvels, such as plant life, land cover order, metropolitan region, horticulture land, and water assets, without actually touching such products. (Karaburun A. A. K. Bhandari,2010). Remote sensing data has a variety of applications, including land cover classification, soil moisture estimate, woodlands type characterisation, estimation of plant life's fluid water content material, snow planning, ocean ice type classification, and oceanography (Karaburun A. A. K. Bhandari,2010).. The multispectral far-off detecting images provide critical coordination of the items' phantom and spatial elements (Chouhan R, Rao N,2012). The multispectral image of Thanjavur is used in this article to determine the area of agricultural land before to, during, and after Lockdown. The NDVI method is used to differentiate the unique additives included within the Vellore region's three-band satellite image. Vegetation cover is the only really extensive biophysical indicator of soil degradation that can be quantified using flower lists extracted from satellite images [1-5]. Exposed soil is assigned NDVI values that are as close to zero as possible, whereas water in our bodies is assigned a low NDVI value [4-7]. Advanced image processing of satellite data enables the picture to be analysed using a variety of computations and numerical lists. Provisions rely on reflectance characteristics, and papers were written to work as hobby supplements at the camera (Shikhar Deep , AkanshaSaklani,2014). There are various publications recommending flower-bearing places on a far-flung detecting scene. NDVI is a standard and often used file format (A.K. Bhandari, A. Kumar,2012). It is a massive floral database that is generally used in research on worldwide botanical and climatic change (A.K. Bhandari, A. Kumar,2012), (Nageswara PPR., et.al,2005). The article discusses how the differences between the visible purple and near infrared (NIR) components of an INSAT picture may be used to distinguish places with enormous flowers and varied vegetation. Numerous experts have advocated for the use of NDVI to monitor vegetation [10]. In semi-arid regions, the relationship between precipitation and the annual NDVI has been proven to be highly correlated, particularly during the developing season. Thus, precipitation is considered to be the primary factor decreasing NDVI, as frequent droughts and weather unpredictability have resulted in a yearly discount in NDVI, particularly in shrublands and croplands. Although precipitation is critical, temperature changes can have an immediate influence on flowers, since substantial negative connections between temperature and NDVI were discovered in those types of regions throughout the development season (Yang Y, Zhu J, Zhao C, Liu S, Tong,2010).

Materials and Methods
Study Area
The research region is contained between the latitude range of 10.766oN and longitude range of 79.023o E, encompassing an area of 878.982Km2. Thanjavur Taluk's geological formation is composed of Cretaceous, Tertiary, and Alluvial deposits, with the Alluvial and Tertiary deposits occupying the primary location. Four critical tributaries of the Cauvery River run through this territory, deriving significant advantages from rural activities. Annual rainfall is 945 millimetres. The yearly mean temperature is greater than 22oC. The soils of the newly created deltaic area are suitable for a diverse range of plants, including coconut, mango, groundnut, and paddy. Summer crops such as pulses, cotton, ginseng, soyabean, and groundnut are produced in this area without irrigation. Paddy is the primary crop farmed in three distinct seasons: Kuruvai, Samba, and Thaladi.

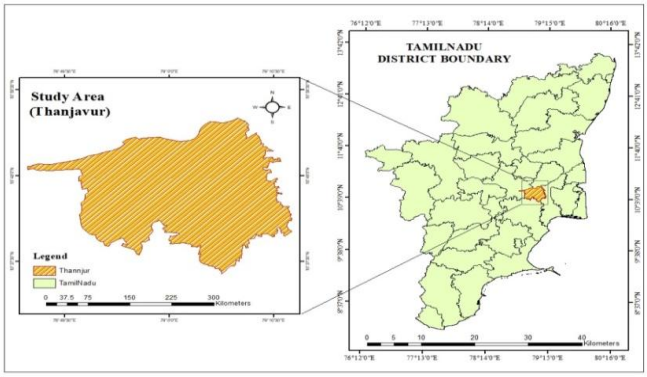

Figure 1 Study Area Methodology

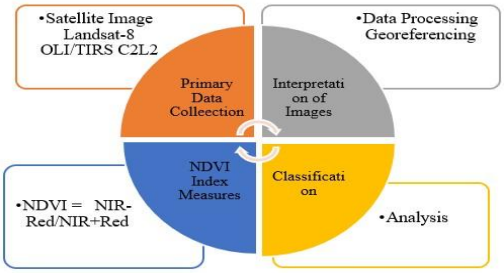

Figure 2 Methodology Layout

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The NDVI approach is used to remove the horticultural highlights included within the band 4 and band 5 satellite images of Thanjavur. The documentation of vegetation enables us to depict the dispersion of flowers and soil based on the distinctive reflectance of inexperienced blooms. The NDVI is a basic mathematical indicator that can be used to watch distant detecting estimates from a great distance and determine whether or not the target or object being observed contains remain inexperienced blooms.

Equation (1) : NDVI= NIR -RED /NIR + RED

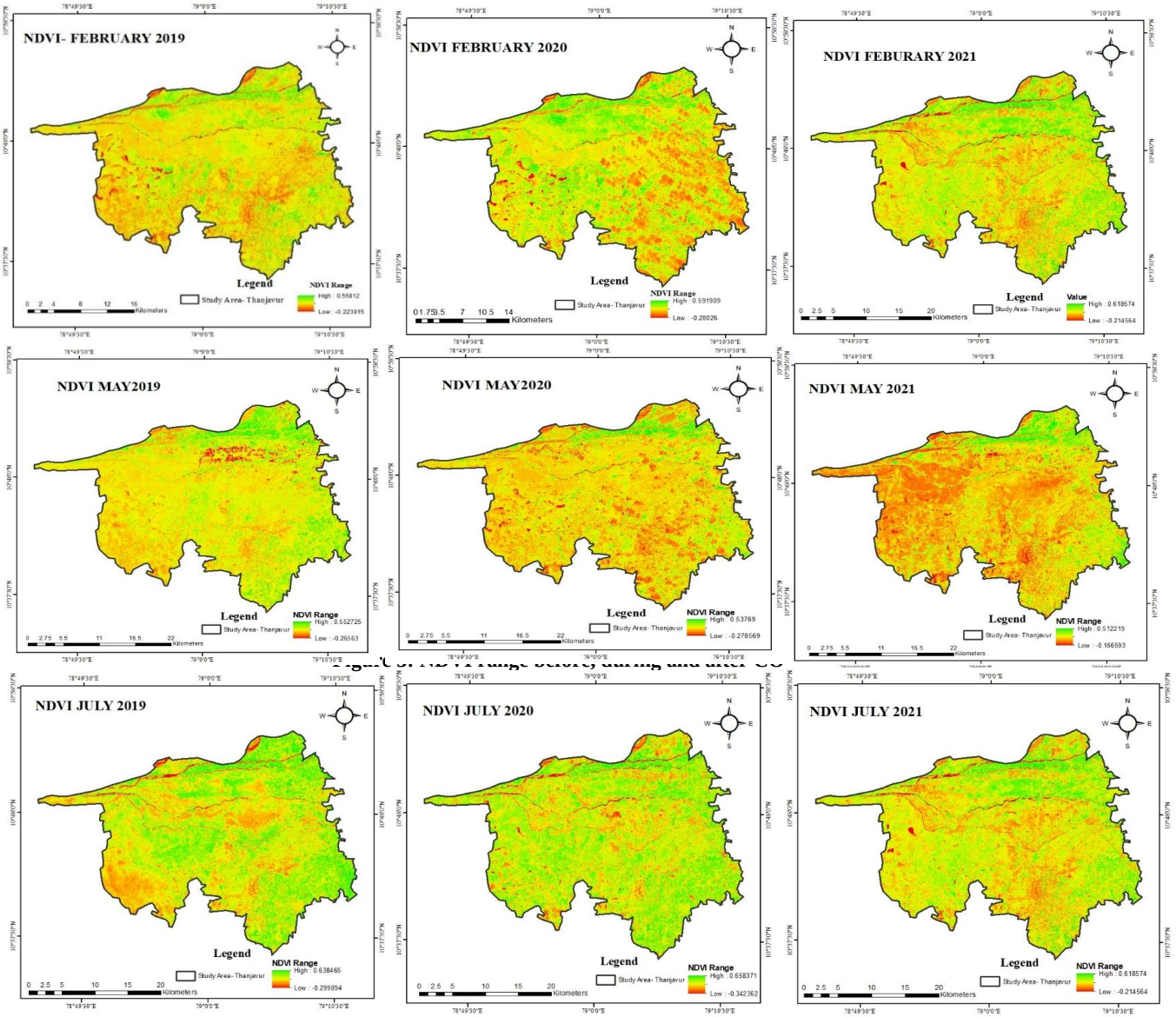
The NDVI value must separate each band in order to recognise the vegetation file in a multi-spectral remote sensing image that is provided in the satellite image. After isolating the distinct bands, the NDVI approach is applied on their trademarks, such as vegetation, at various NDVI edge values, for example, - 0.214 to 0.618.

Results and Discussions

Table 1 NDVI Range

		NDVI Value	
		Minimum	Maximum
February	2019	-0.224	0.568
	2020	-0.280	0.592
	2021	-0.215	0.618
May	2019	-0.266	0.553
	2020	-0.278	0.537
	2021	-0.157	0.512
July	2019	-0.299	0.638
	2020	-0.342	0.658
	2021	-0.214	0.618

The range of NDVI value for vegetation index should be within -1 to +1. All NDVI values for the month of February, May and July 2019, 2020 and 2021 are within the limit. The purpose of this study is to use Landsat-8 sensor data to assess the effect of COVID-19 lockout on agricultural sowing and harvesting activities from 1 February to 31 July 2021. Satellite data was utilised to determine the lockout length prior to (February), during (May), and after (July). The data were compared to the previous year, namely 2019, which became an additional agriculturally attractive year. Crop sown region and crop status (as determined by NDVI statistics) were compared.



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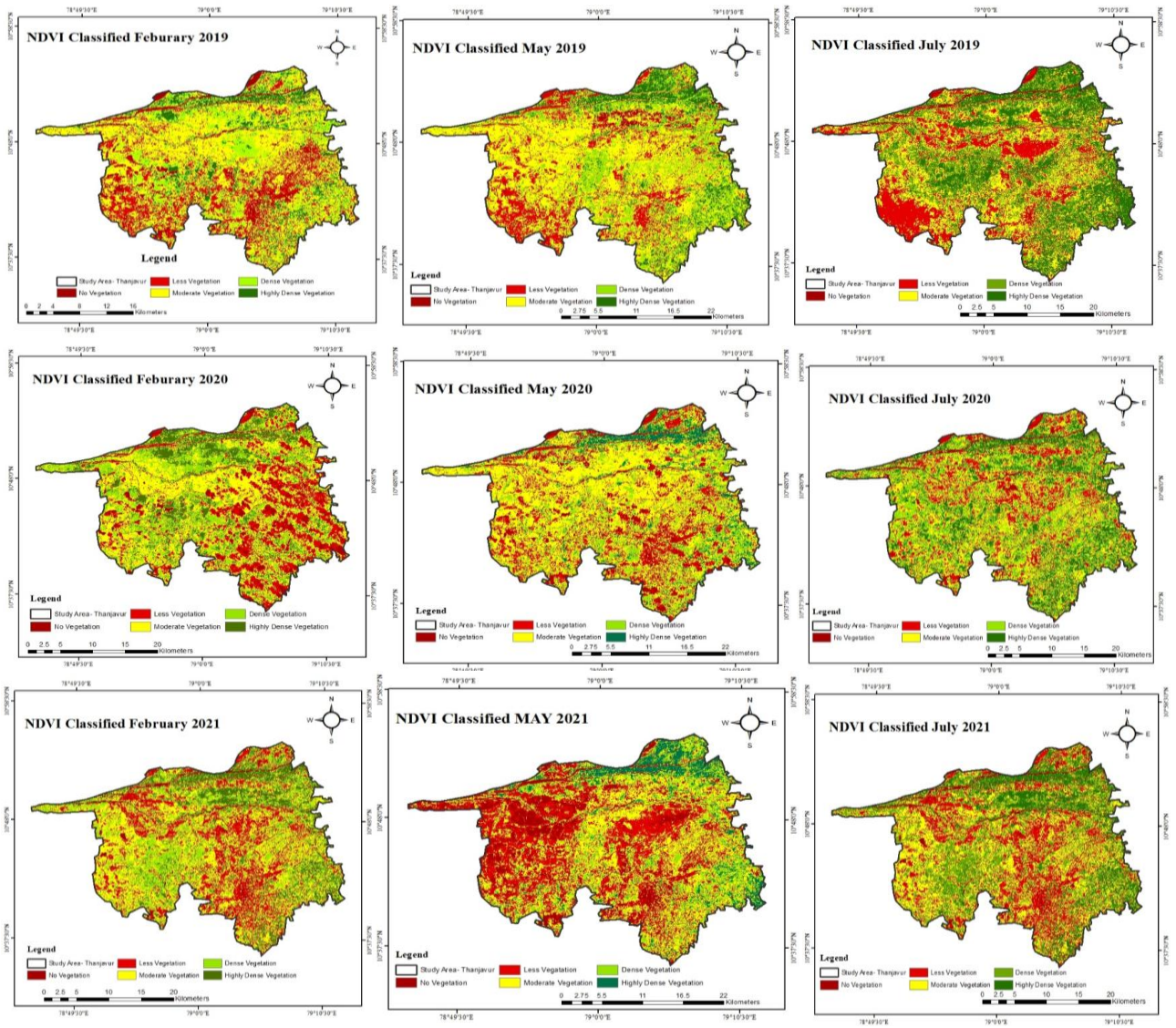

Figure 4: NDVI Classification before, during and after COVID

The minimum and maximum NDVI readings for February 2019 were - 0.224 and 0.568, respectively. The minimum and maximum NDVI readings for 2020 were − 0.280 and 0.592, respectively. Similarly, the minimum and maximum NDVI readings for 2021 were - 0.215 and 0.618, respectively. From Figures 3 and 4, as well as in Table 1, the NDVI values for February 2019 are significantly lower than those for February 2020 and 2021. The area of thick vegetation rose by 31.11 percent in February 2020 compared to February 2019 and by just 4.2 percent in February 2021. The NDVI values for May 2019 are significantly lower than those for May 2020, and the NDVI price for May 2021 remains extremely low. The minimum and maximum NDVI readings for May 2019 were - 0.266 and 0.553, respectively. The minimum and maximum NDVI readings for 2020 were − 0.278 and 0.537, respectively. Similarly, the NDVI readings for 2021 were - 0.157 and 0.512, respectively. The NDVI values for July 2019 are much lower than those for July 2020, while the NDVI value for July 2021 remains extremely low. The minimum and highest NDVI readings for July 2019 were - 0.299 and 0.638, respectively. The 2020 NDVI readings were – 0.342 and 0.658, respectively. Similarly, the minimum and highest NDVI readings for 2021 were - 0.214 and 0.618.

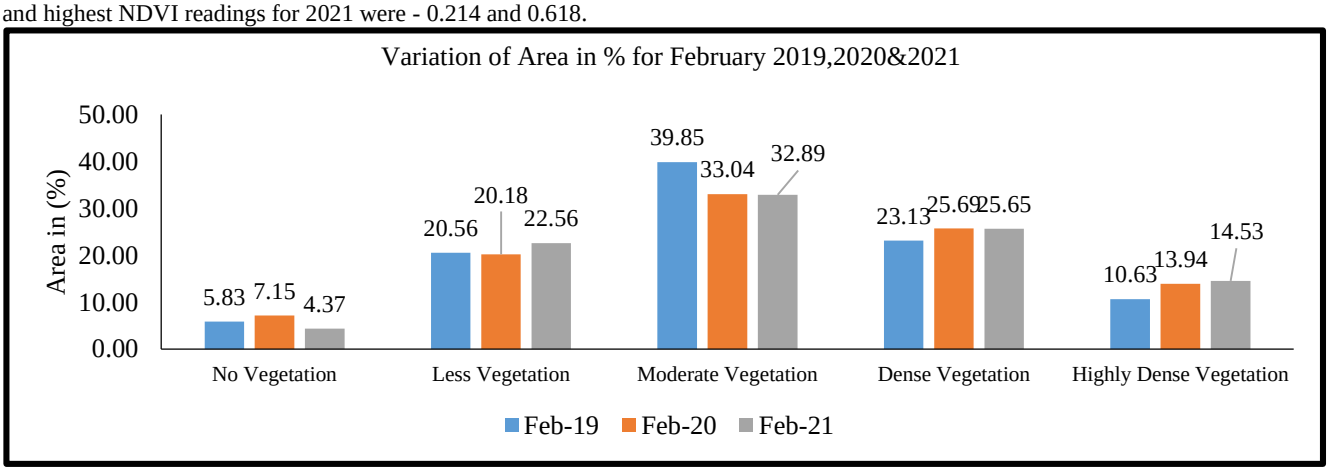

Figure 5 Variation of Area in Percentage for February 2019, 20120 & 2021

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The area of thick vegetation fell by 8.82 percent in July 2020 compared to July 2019 and rose by just 34.06 percent in July 2021 and it is highlighted in Figure 5.

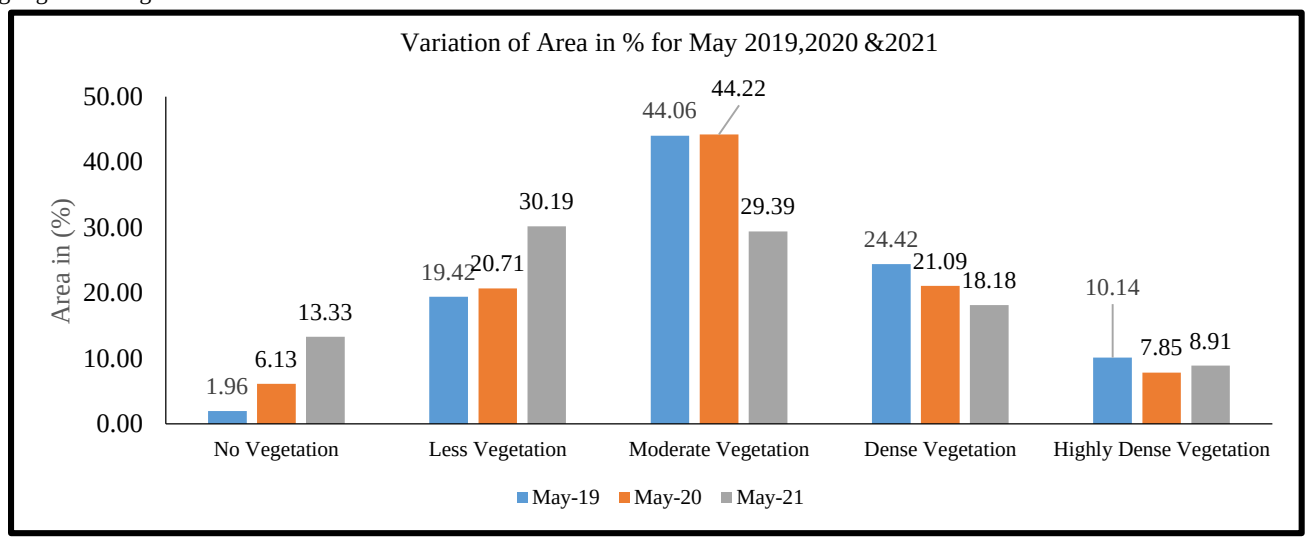

Figure 6 Variation of Area in Percentage for May 2019, 20120 & 2021

The area of thick vegetation fell by 22.62 percent in May 2020 compared to May 2019 and grew by 13.52 percent in May 2021 which is emphasized in Figure 6.

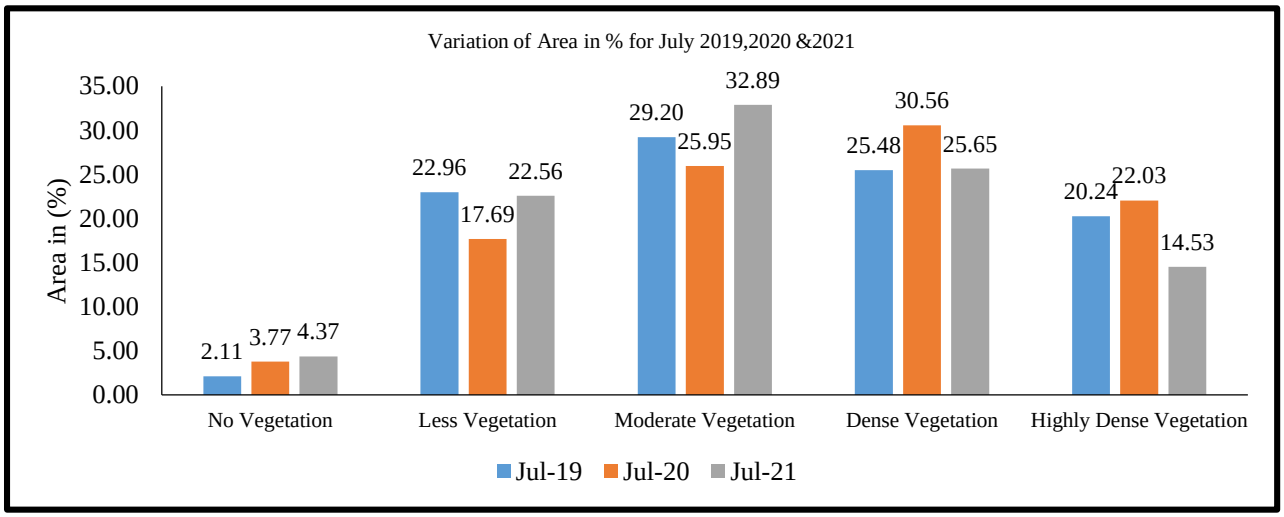

Figure 7 Variation of Area in Percentage for July 2019, 20120 & 2021

The area of thick vegetation fell by 22.62 percent in May 2020 compared to May 2019 and grew by 13.52 percent in May 2021 underscored in Figure 7.

Conclusion

End of March and April is the time for harvesting the Rabi crops. The length of harvesting for Kuruvai is from June- July. When the lockdown changed into first imposed, wheat crop changed into equipped to be harvested in. Since the authorities took weeks to awaken to the want for integrate harvesters in Thanjavur district, maximum of the crop changed into harvested manually via way of means of farmers themselves or via way of means of the use of anything labour changed into domestically available. Even whilst the crop is harvested manually, threshing machines are had to separate the grain. Harvesting and post-harvest paintings together with threshing, winnowing, loading and garage additionally require some of people to gather together. With the lockdown in place, maximum farmers may want to perform hose responsibilities best at a snail's pace. Implementing lockdown changed into additionally maximum draconian with inside the first few weeks, and not using readability approximately exemption to agricultural paintings, and neighbourhood police disrupting the works.

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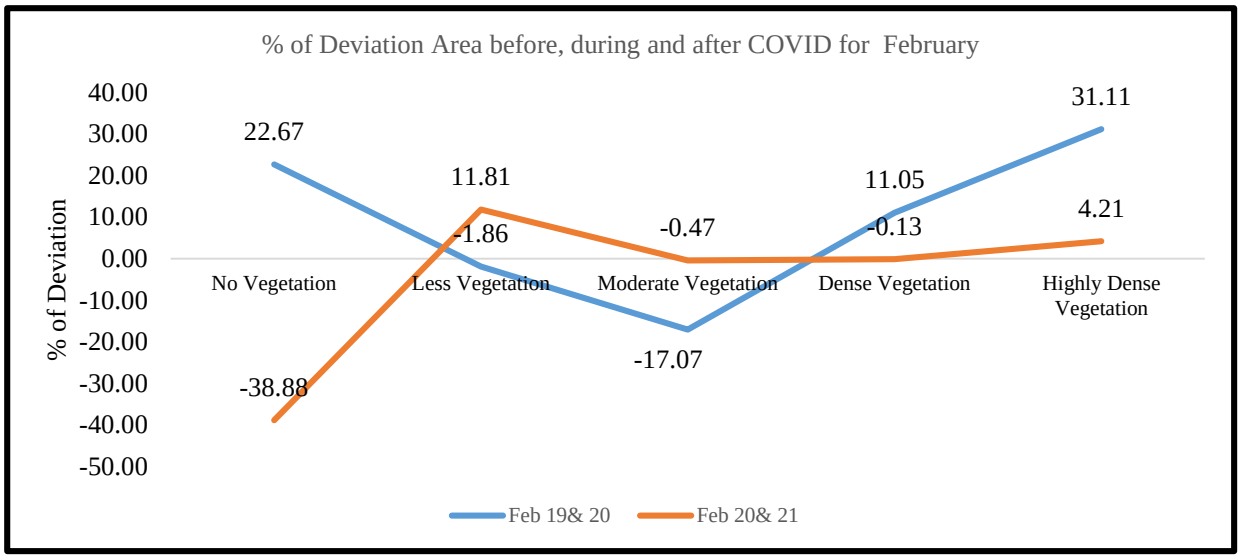

Figure 8 Percentage of Deviation in Vegetation in February

The percentage of deviation in the month of February 2019 & 2020 is compared with February 2020 & 2021 which means before, during and after lock down were compared. Its seems that the percentage of no vegetation have reduced 38.88% is emphasized in figure 8 and Less vegetation zone have increased to 11.81%, moderate vegetation zone have decreased to 0.47%, dense vegetation zone have decreased to 0.13% and the highly dense vegetation have increased to 4.21%.

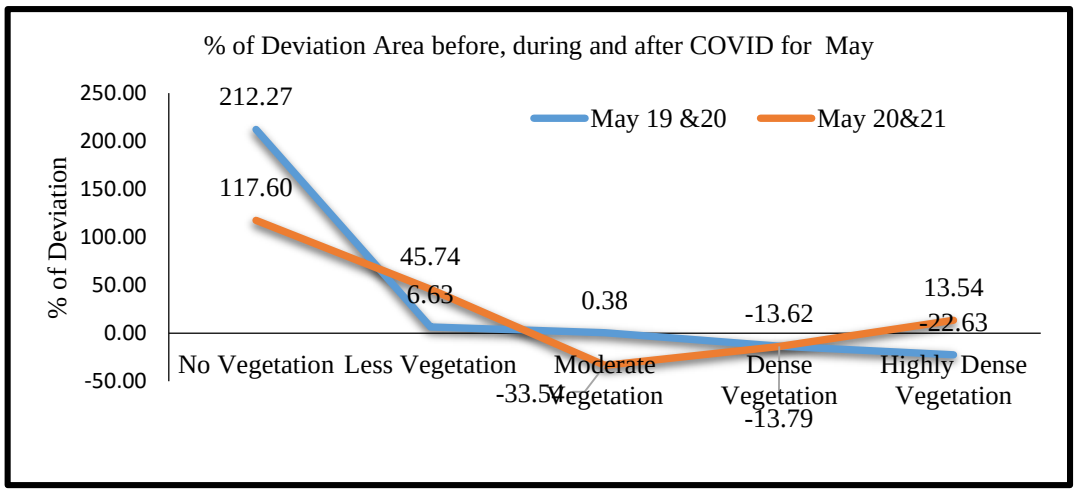

Figure 9 Percentage of Deviation in Vegetation in May

The percentage of deviation in the month of May 2019 & 2020 is compared with May 2020 & 2021 which means before, during and after lock down were compared which is shown as line diagram in figure 9. Its seems that the percentage of no vegetation have increased to 117.60%, Less vegetation zone have increased to 45.74%, moderate vegetation zone have decreased to 33.54%, dense vegetation zone have decreased to 13.79% and the highly dense vegetation have increased to 13.54%.

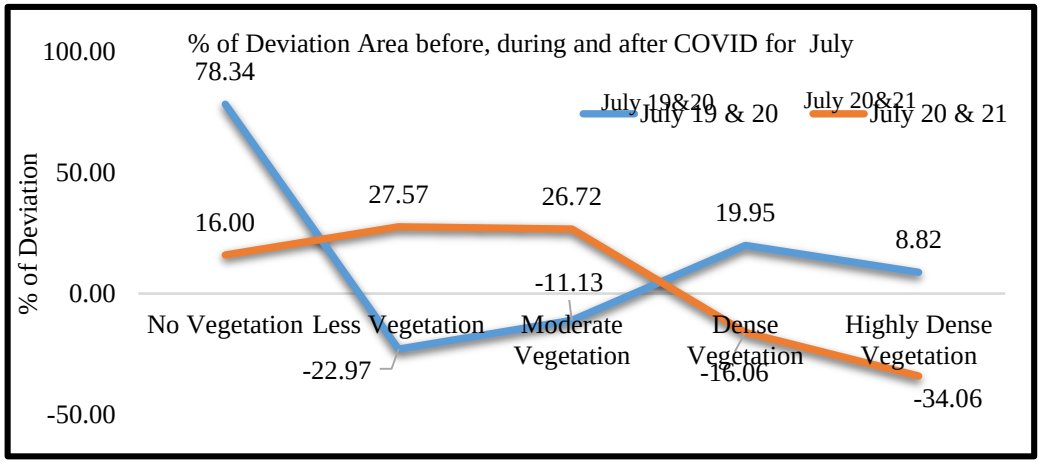

Figure 10 Percentage of Deviation in Vegetation in February

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The percentage of deviation in the month of July 2019 & 2020 is compared with July 2020 & 2021 which means before, during and after lock down were compared. Its seems that the percentage of no vegetation have increased 16.00%, is emphasized in figure 10. Less vegetation zone have increased to 27.57%, moderate vegetation zone have increased to 26.72%, dense vegetation zone have decreased to 16.06% and the highly dense vegetation have decreased to 34.06%.

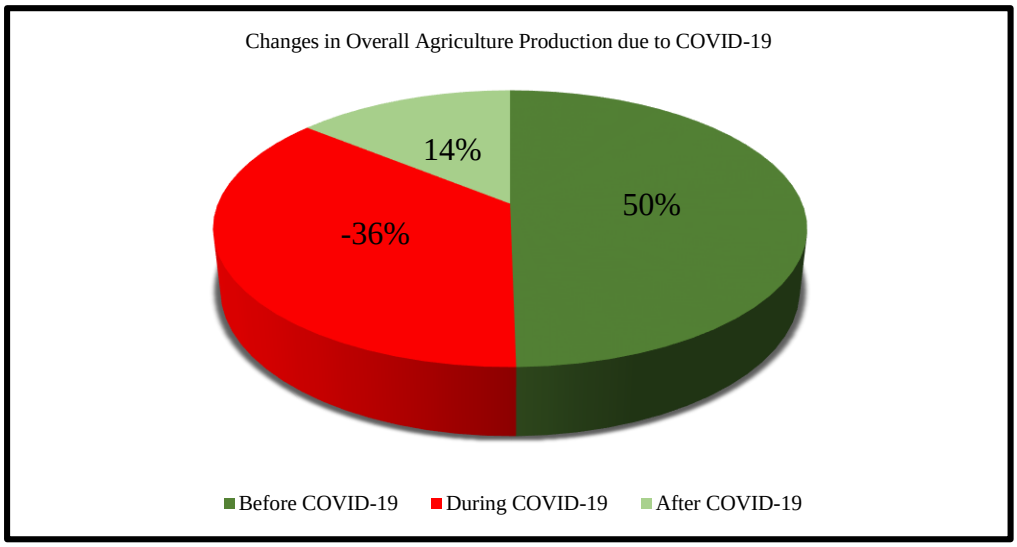

Figure 11: Changes in Overall Agriculture Production due to COVID-19

It is noted that during the year 2020 and 2021 there is a dip in the percent of fairly dense plant life from the Chart 11. Disruptions in deliver of fertilisers have been mainly acute with inside the preliminary segment of the lockdown. The fees of seeds had expanded throughout all states with inside the use of a. The availability of fertilizers became additionally drastically impacted because of the COVID-19 pandemic main to a growth in fees of fertilizers throughout all states. The rate of insecticides additionally expanded throughout all states with inside the use of a because of the dearth in availability. The scarcity in availability of agricultural equipment because of decreased availability of manpower managing such machines as a result of the lockdown additionally caused a growth with inside the lease on agricultural equipment throughout all states. The NDVI values display modifications in step with the years. The predominant motives of those modifications are the variations in plant life periods, the plant boom and the modifications in plant life because of vicinity pressure. The integration of remote sensing, AI-driven analytics, precision agriculture, and smart mechanization offers a sustainable pathway to stabilize vegetation health and agricultural productivity, even under unprecedented disruptions such as global pandemics. This approach ensures long-term resilience in food production systems and supports sustainable land and vegetation management.

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