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"RABI CROP ACREAGE ESTIMATION IN DUMKA DISTRICT, JHARKHAND USING SATELLITE REMOTE SENSING".

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1. ABSTRACT

Using Sentinel-2 satellite data, this research attempts to map and analyze the average distribution of Rabi crops in Jharkhand's Dumka district. The study evaluates the quantity and quality of Rabi crops throughout the winter cropping season by utilizing Sentinel-2's multispectral capabilities. The investigation will offer insightful information about crop productivity and agricultural practices in the area. Rabi crops are a crucial component of the agricultural operations in the area, and accurate data on their extent is necessary for efficient resource allocation, agricultural planning, and yield prediction. The utilization of Sentinel-2 imagery, which provides high spatial resolution multispectral data and facilitates enhanced crop categorization, is part of the methodology employed in this study. The work demonstrates how to categorize satellite photos and recognize rabi crops present in the region.To verify the classification results derived from satellite imaging, the study also takes into account ground truth data obtained from field surveys.The study's conclusions show how well Sentinel-2 satellite data and cutting-edge remote sensing technologies can map the area of rabi crops in Dumka District.The produced crop maps give farmers, policymakers, and local government officials useful information that helps them decide on crop management, resource allocation, and agricultural planning.

Keywords- Sentinel-2, Rabi crop, Multispectral data.

2. INTRODUCTION

The great majority of people in India work in the agriculture industry.India's economic progress relies on the agriculture sector expanding. It makes up roughly 16% of India's GDP and 13% of its export revenues [(1)]. There is a state in India called Jharkhand where the vast majority of the population is employed in agriculture. This report refers to the "Dumka" area of the Jharkhand district's rabi crops, which is rich in an assortment of crops. In the Indian subcontinent, rabi crops refer to those that are sown in the winter and harvested in the spring. Major crops produced in the area include rice and pulses including moong, black gram, pigeon pea, and horse gram.

Wheat cultivation is also prominent during the Rabi season in Dumka. ArcGIS software is been used to analyze data and map. By utilizing ArcGIS, farmers, and researchers can identify suitable land for Rabi crop cultivation based on factors such as soil type, climate, and topography. This helps in optimizing crop yield and resource allocation. Sentinel-2 satellite data is being used to analyze the rabi crops area of the study area which plays a crucial role in crop mapping and monitoring. The data has been analyzed using the unsupervised classification of the following months; December, January, February, March, and April from different software of Remote Sensing. Unsupervised classification is particularly useful when dealing with large datasets or when the classes are not well-defined or known beforehand.

It involves data acquisition, layer stacking, selection of bands, determining the number of classes, and visualization. Using the power of ArcGIS, these maps will yield insightful information about the spatial distribution and health status of Rabi crops throughout the study area. We will be able to produce thorough maps that provide insightful information about the Rabi crops throughout the research region by merging these databases. The rabi crop map, which analyses the crop area in hectares for several months, is displayed on the study area map. Additionally, contrasting them and explaining why one location has greater.

3. OBJECTIVE

1) Assess the spatial distribution of Rabi crops in Dumka district, Jharkhand, during the winter cropping season using Sentinel-2 satellite data.
2) Analyse the area of Rabi crops in different blocks of the Dumka district

4. STUDY AREA

The northeastern region of the Indian state of Jharkhand is home to the Dumka district. It is roughly located between latitudes 23°47'20" and 24°38'57" North and longitudes 86°28'25" and 86°42'16" East. East: Pakur (Jharkhand) and Burdwan (West Bengal); North: Sahibganj, Godda (Jharkhand), and Banka Bihar. South: Burdwan (West Bengal) and Jamtara (Jharkhand) Deoghar is in the west. The entire area is 33716.02 square kilometres. The total amount of forest cover in Dumka town is around 120763 acres or 48305.2 hectares. Geographically, the geography of this district is varied. The area is made up of plains and valleys dotted with plateaus and steep terrain with varying elevations. Dumka district's position in the northeastern region of Jharkhand has an impact on its climate.

The region has a subtropical climate with significant seasonal variations. While winters are often cold, with occasional lows below 10°C (50°F), summers are typically hot, with highs exceeding 30°C (86°F).Significant rainfall is brought about by the monsoon season, which runs from June to September and is essential for the region's agricultural activity. Because of the various topography, the Dumka district has a variety of soil types. Fertile alluvial soil can be found in valleys and plains, while red and laterite soil can be found on rocky slopes and plateaus. Due to its suitability for agricultural agriculture, the district's alluvial soil is crucial for crop production. 1,321,442 people are living in the Dumka district as per the 2011 census.

Based on this, it is ranked 370th out of 640 in India. 300 people are living in the district per square kilometer (780/sq. mi.). From 2001 to 2011, the population grew at a pace of 19.39%. Dumka has a 62.54% literacy rate and a sex ratio of 974 females for every 1000 males. The population's urban density is 6.82%. Scheduled Tribes account for 43.22% of the population, while Scheduled Castes make up 6.02%. 39.71% of Indians spoke Santali as their first language at the time of the 2011 Census, followed by 34.44% Khortha, 9.59% Bengali, 6.64% Hindi, 2.40% Malto, and 1.86% Urdu. 3.02% of respondents listed Hindi as their language of communication [(2)].

Overall, the subtropical temperature, hilly topography, and numerous soil types of the Dumka district in Jharkhand combine to create an environment that supports a range of agricultural practices and adds to the region's cultural andeconomic significance.

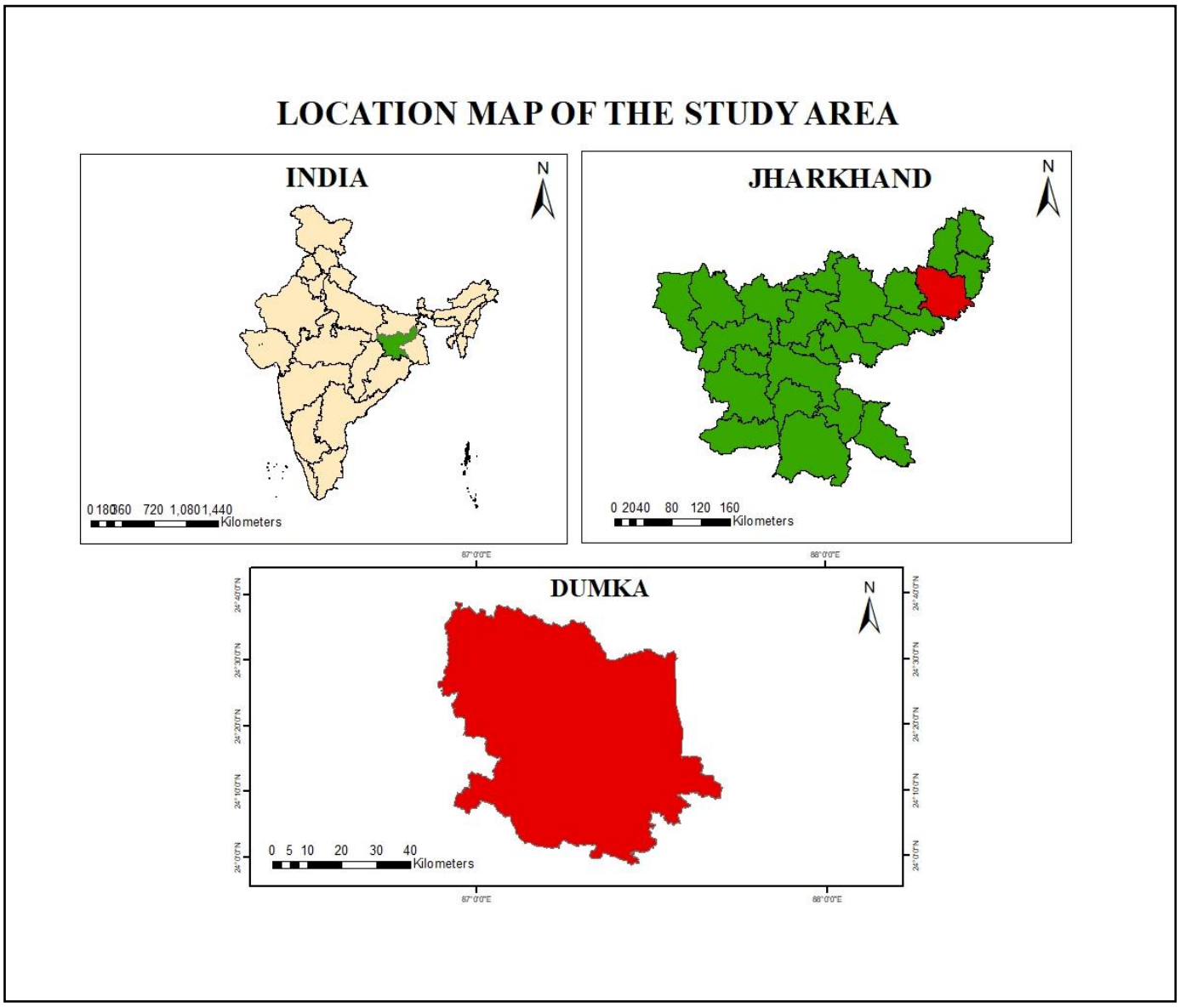

Fig.1: *Location map of Dumka, Jharkhand*

5. <u>METHODOLOGY</u>

Data Acquisition: Sentinel-2 satellite pictures, preferably from the European Space Agency (ESA) database or other trustworthy sources, were used in this study to capture the winter cropping season over the previous four months.

SENTINEL-2:A constellation of two similar satellites in the same orbit serves as the foundation for Sentinel-2. For a fresh look at our landscape and plants, each satellite is equipped with a cutting-edge, wide-swath, high-resolution multispectral imager with 13 spectral bands.

Table 1: Specification of Sentinel-2 with the interpretation used to analyze satellite data.

SENTINEL-2 Specification	
Resolution(m)	*10*
Spectral Bands(µm)	*B5: 0.705*
	B6: 0.740
	B7: 0.783
Swath(km)	*290*
Repeat Cycle(days)	*5*

Table 2: Software used to analyze the sentinel-2 satellite data

SL.NO	SOFTWARE	VERSION
1	*ArcGIS*	*10.8*
2	*QGIS*	*3.22.5*

5.1 METHOD

5.1.1 ***Unsupervised Classification***: Using this method, pixels with comparable spectral characteristics are automatically grouped into clusters by the classification algorithm in remote sensing.

Step1: Add data

Step2: Open the search window search 'composite bands' and run it.

Step3: To clip the image;In Arc toolbox > Go to 'Data management tools' > 'Raster' > 'Raster processing' > 'Clip'.

Step4: To divide into classes: Open Arc toolbox > Go to 'Spatial analyst tools' > Train ISO cluster classifier' > 'Classify raster'.

Step5: - Then reclassify into two classes; Open Arc toolbox > 'Reclass' > 'Reclassify'.

5.1.2 ***Using Raster Calculator:***

Step1: Ensure that all the crop maps you want to combine are in the same coordinate system and have the same cell size and extent.

Step 2: Open ArcGIS and load all the crop maps into the map document.

Step 3: Go to the "Spatial Analyst" extension (if not already enabled) by navigating to Customize > Extensions and checking "Spatial Analyst. "From the main menu, select "Raster" > "Raster Calculator."

Step 4: In the Raster Calculator window, you can use mathematical expressions to combine the crop maps.

Step 5: Choose the output raster location and name and specify the output data type, if necessary.

Step 6: Click "OK" to run the Raster Calculator, and the resulting combined crop map will be generated.

6. RESULT AND DISCUSSION

Table 3:*Table of Rabi crop area in the months of December 2022, January 2023, February 2023, March 2023, and April 2023.*

RABI CROP AREA (ha) 2022-23					
BLOCK NAME	**DEC**	**JAN**	**FEB**	**MAR**	**APR**
SARAIYAHAT	921.04	1711.04	1098.84	349.08	162.96
JARMUNDI	628.64	778.44	794.12	353.88	73.40
RAMGARH	1412.08	751.68	416.80	151.64	14.00
GOPIKANDAR	81.72	28.92	36.00	3.52	0.76
KATHIKUND	199.48	155.24	44.24	26.36	0.16
SHIKARIPARA	339.04	590.48	109.00	43.80	7.44
RANISHWAR	454.92	1226.36	298.88	1899.16	1170.56
DUMKA	168.16	264.92	103.52	478.60	142.20
JAMA	534.88	712.88	299.68	180.16	32.60
MASALIYA	215.40	528.56	158.80	130.08	5.80

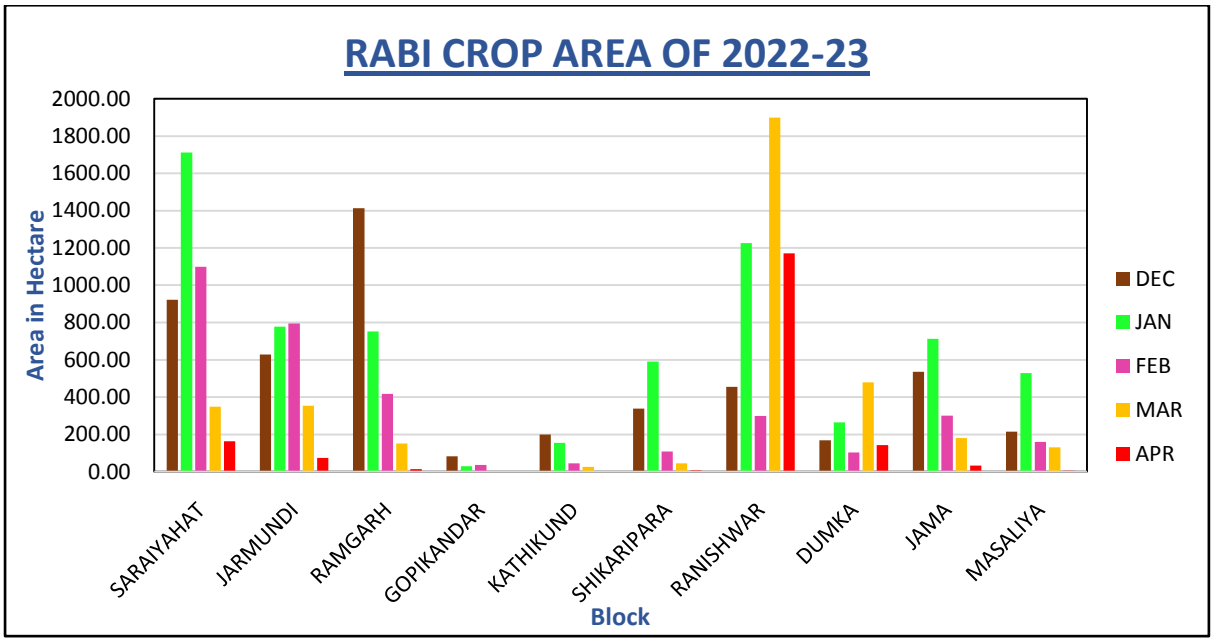

Fig.2: *Bar graph of Rabi crop area in the months of December 2022, January 2023, February 2023, March 2023, and April 2023.*

Ramgarh block has the most rabi crop cultivation in December 2022, while Gopikandar block has the lowest. Saraiyahat block has the most rabi crop

cultivation in January 2023, while Gopikandar block has the lowest. The cultivation of the rabi crop is highest in the Saraiyahat block and lowest in the Gopikandar block in February 2023. The cultivation of the rabi crop is highest in the Ranishwar block and lowest in the Gopikandar block in March 2023. The cultivation of rabi crops in April 2023 is highest in the Ranishwar block and lowest in the Kathikund block.

The water bodies over the Gopikandar block are comparatively smaller than those over the other blocks in the Dumka district, as shown in Fig. 3. This means that there is less water available and less irrigation capacity, which has an impact on the cultivation of rabi crops in the months of December, January, February, and March. Compared to other blocks in the Dumka district, the blocks of Saraiyahat and Ranishwar have more water, which leads to a higher cultivation of rabi crops in the months of January, February, March, and April, respectively.

Water conservation techniques, including rainwater harvesting, can be used in areas with limited water availability to collect and store rainfall for use in agriculture. Encourage the planting of crops that are more adapted to the local climate and soil types, or that require less water. In regions where water is scarce, treated wastewater can be an invaluable resource for irrigation. Farmers can also benefit from training sessions and workshops that educate them regarding effective irrigation practices and water management.

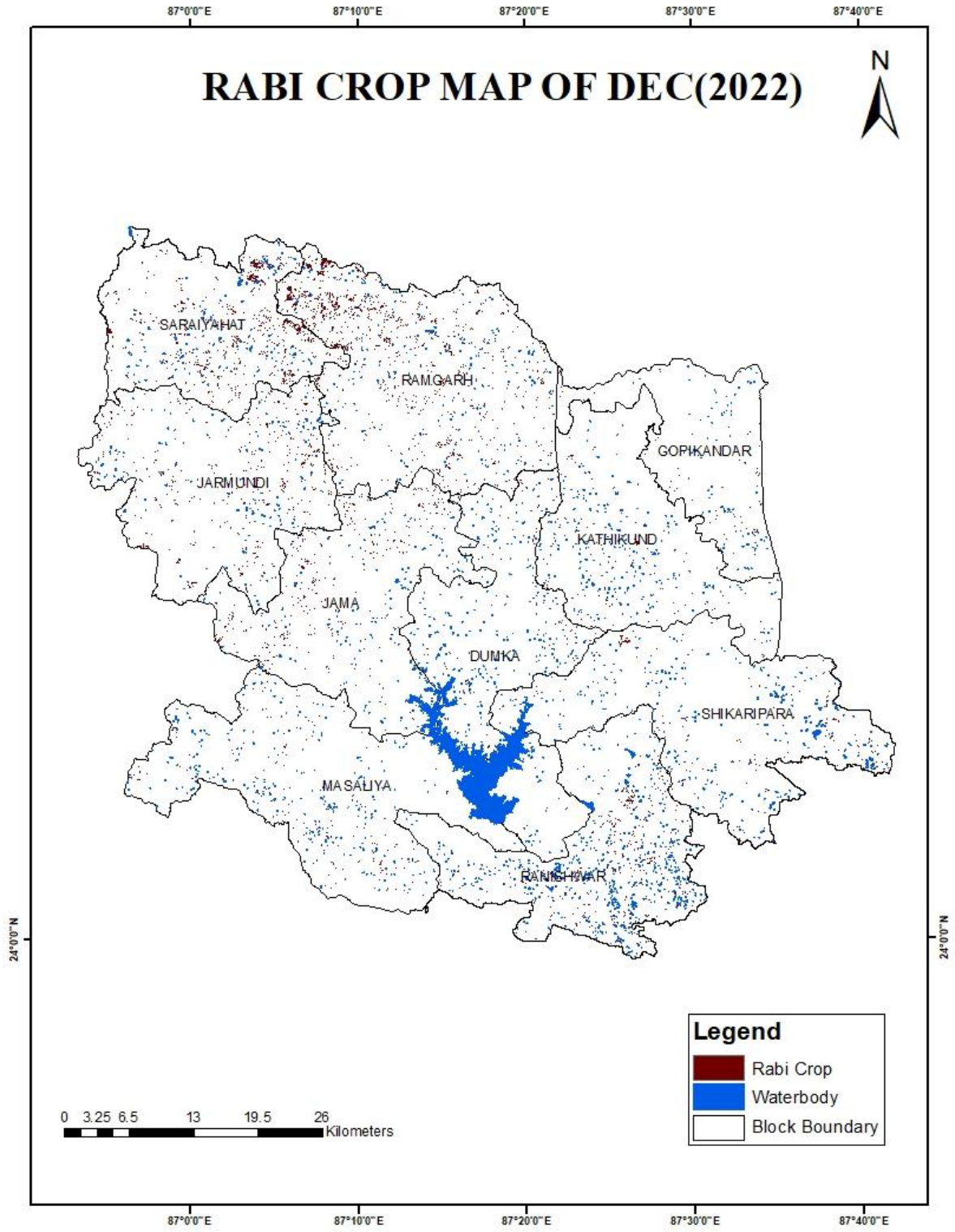

Fig.3

The total geographical area of the Dumka district is 3716.02 Sq. km and in**49.55 Sq.km** of the total area, rabi cropsare sown in the month of December 2022, as shown in *Fig.3*.

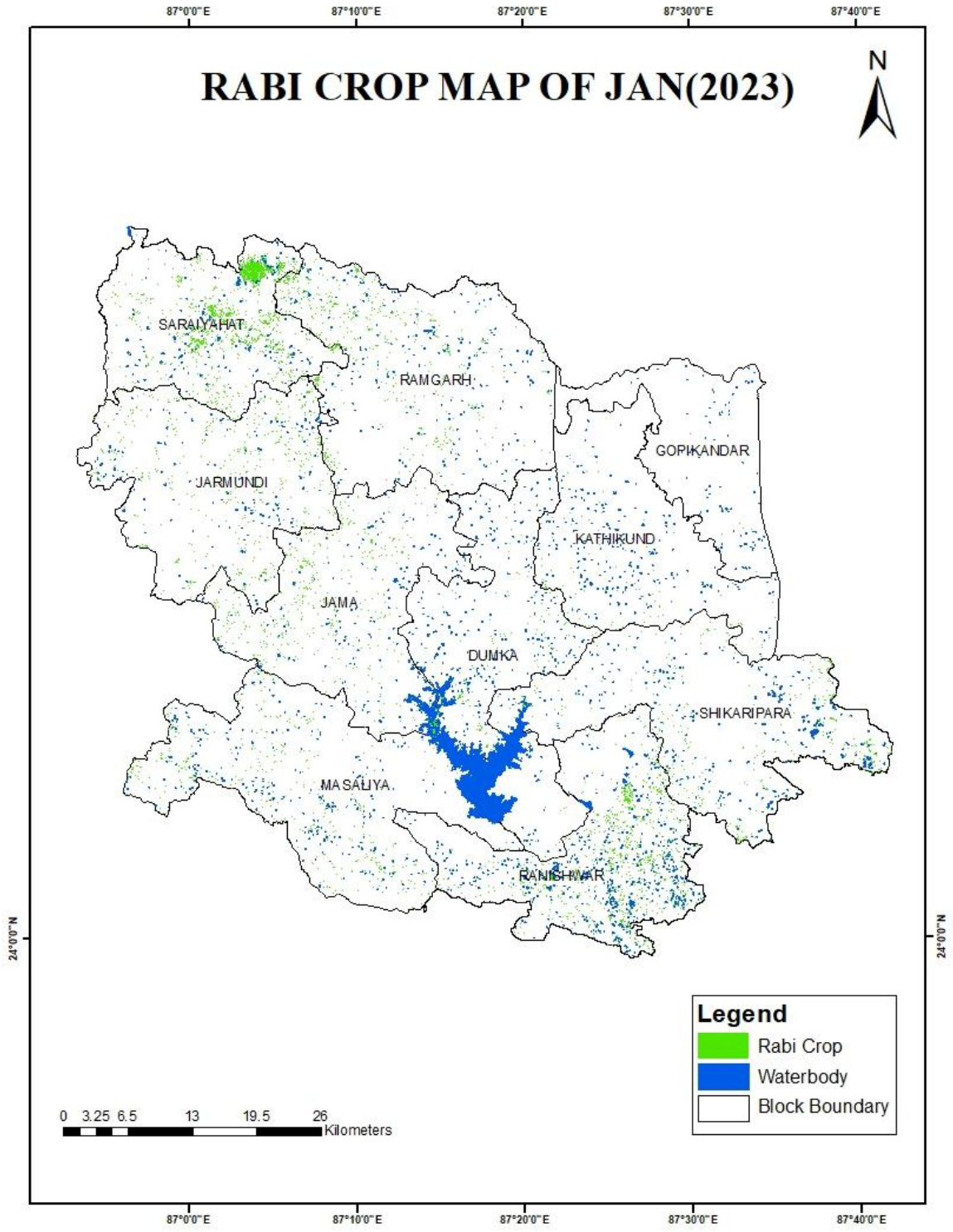

Fig.4

The total geographical area of the Dumka district is 3716.02Sq. km and in**67.48 Sq.km** of the total area, rabi cropsare sown in the month of January 2023, as shown in *Fig.4*.

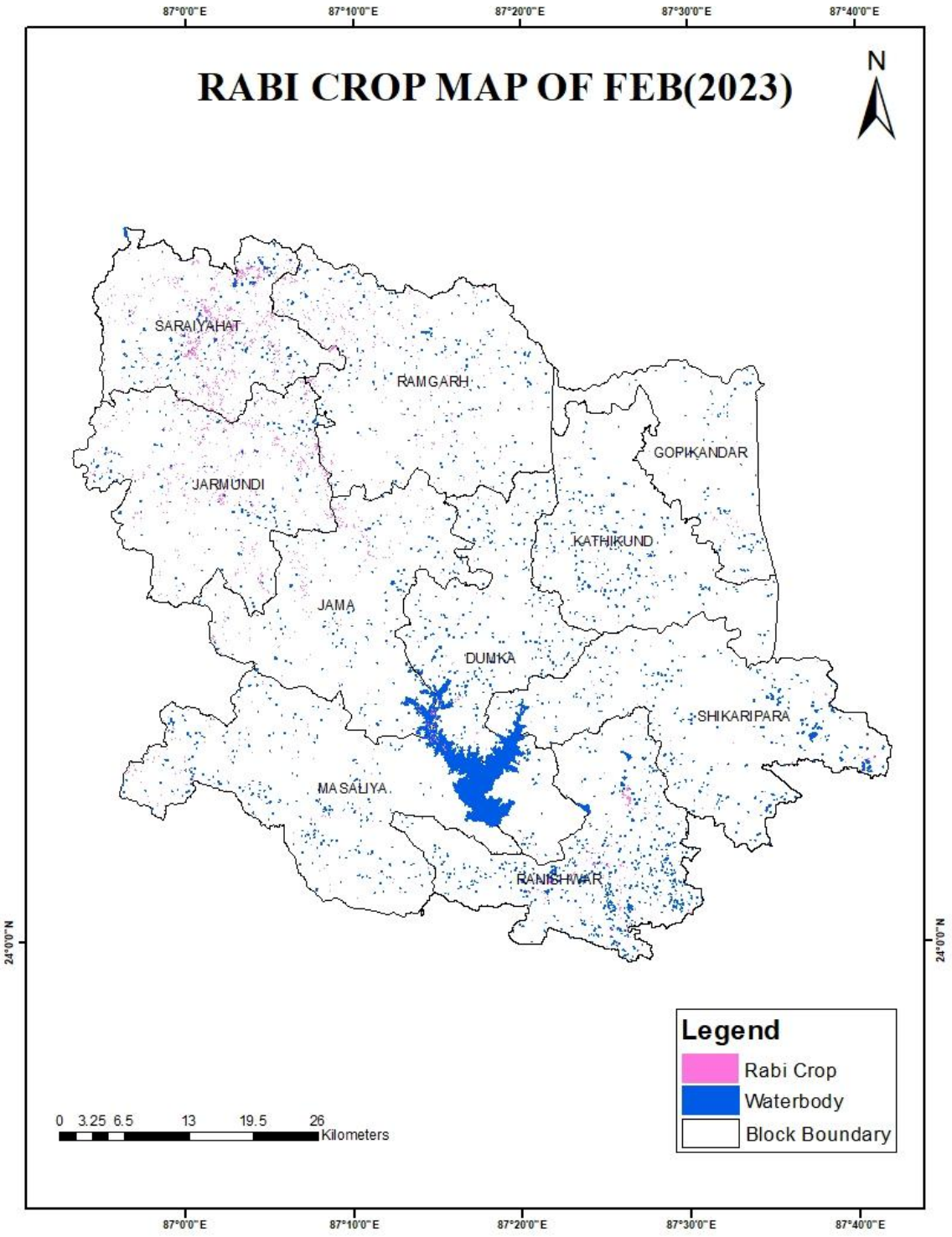

Fig.5

The total geographical area of the Dumka district is 3716.02 Sq. km and in**33.59 Sq.km**of the total area, rabi cropsare sown in the month of February 2023, as shown in *Fig.5*.

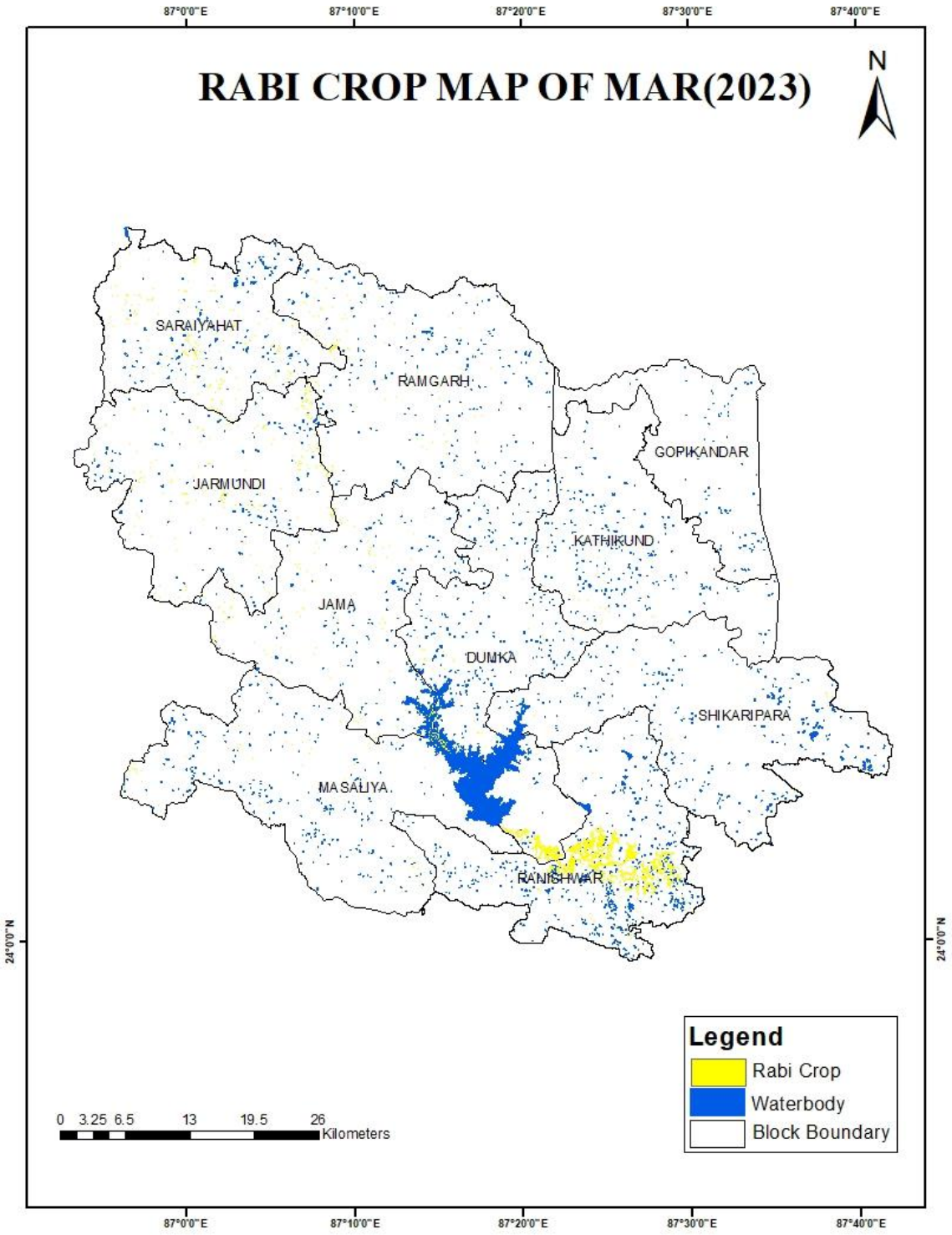

Fig.6

The total geographical area of the Dumka district is 3716.02 Sq. km and in**36.16 Sq.km** of the total area rabi cropsare sown in the month of March 2023, as shown in *Fig.6*.

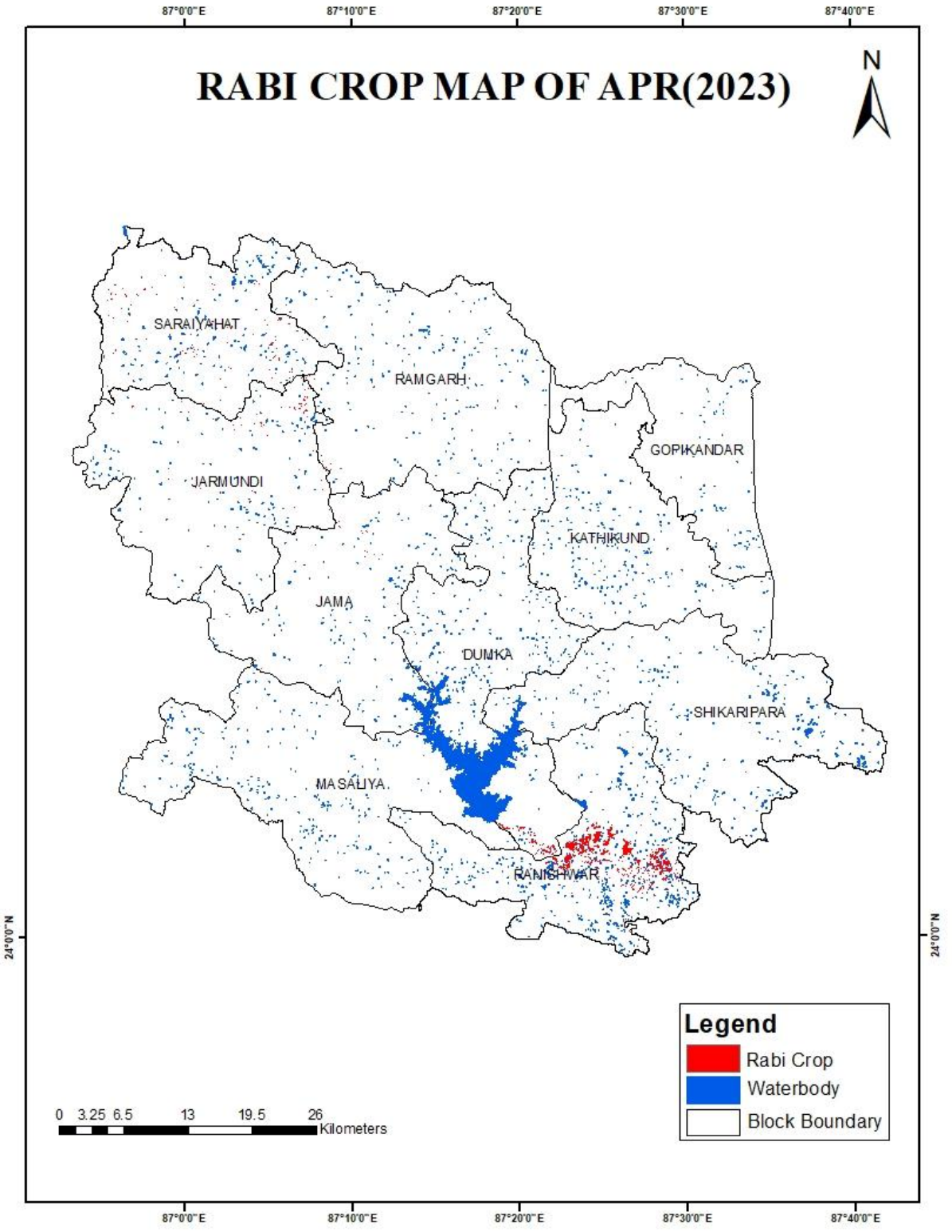

Fig.7

The total geographical area of the Dumka district is 3716.02 Sq. km and in**16.09 Sq.km** of the total area, rabi cropsare sown in the month of April 2023, as shown in *Fig.7*.

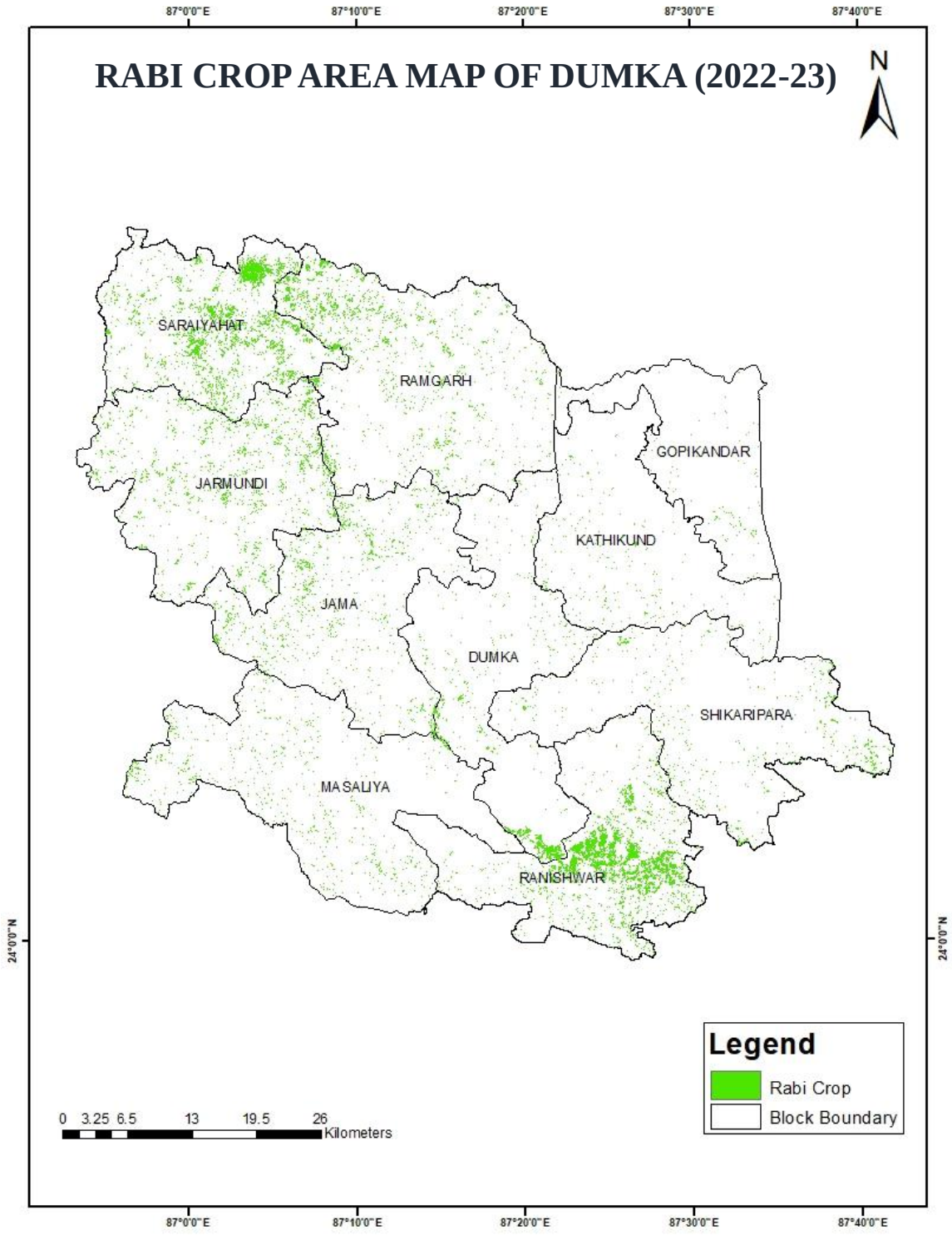

Fig.8

The total geographical area of the Dumka district is 3716.02 Sq. km. and in the month of December, January, February, March, and April in the year 2022-23, **202.87 Sq.km** the rabi crop is sown in the above-mentioned time period as shown in *Fig.8*.

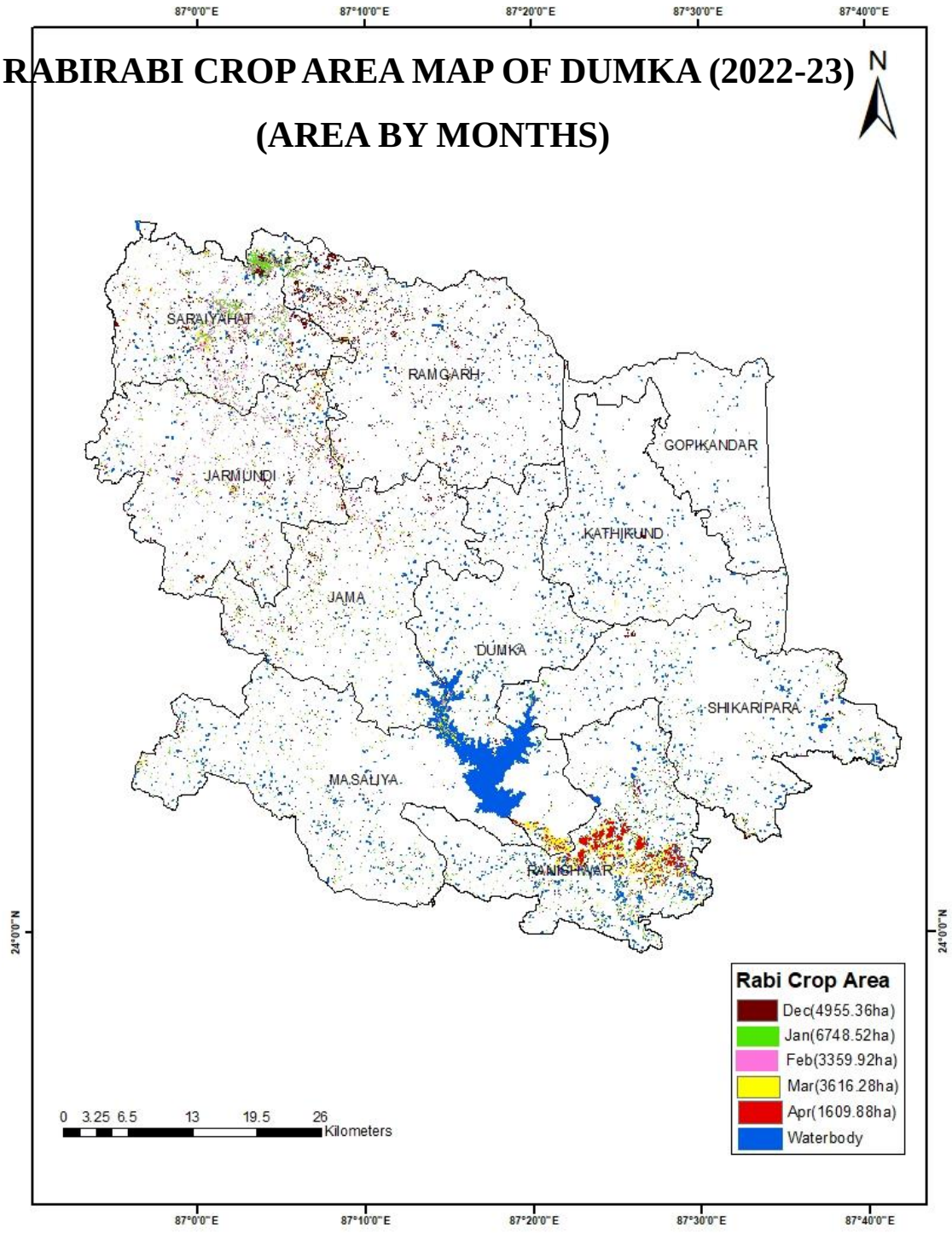

Fig.9

The spatial distribution of the rabi crop area of Dumka district of Jharkhand as shown in Fig.8 and with distinct rabi crop classes based on rabi crops cultivated are shown in Fig.9. Based on the result **20287 ha** of the total geographical area (**371602 ha**) of Dumka was under rabi crops. Most of the rabi crops were grown in the month of January (6748.52ha) followed by December (4955.36ha), March month (3616.28ha), February (3359.92ha), and April month (1609.88ha) respectively.

7. CONCLUSION

The entire land area in the Dumka that is planted with winter crops during the Rabi season is known as the Rabi crop acreage. For food security, agricultural sustainability, and economic stability in India and other areas with comparable agricultural methods, these crops are essential. A thorough grasp of the study's conclusions and their relevance to rural development and agriculture can be gained from the discussion of the Rabi crop map. It also draws attention to the possible effects of precise crop mapping on food security and sustainable agricultural methods.

To maximize the production and yield of Rabi crops, proper management techniques—such as crop rotation and water management—are crucial.This study intends to give policymakers, agricultural professionals, and farmers useful information for making informed decisions about Rabi crop planning, and management. Sustainably developing the area will depend on increased agricultural output and food security, which will be facilitated by accurate assessment of Rabi crop acreage and health status.

The results of this study will also serve as a basis for further research on the efficient monitoring and management of agriculture through the use of GIS and remote sensing technology. The Dumka District's effective use of satellite data and remote sensing for crop monitoring shows how this strategy could be expanded to other areas dealing with comparable agricultural difficulties. By encouraging the use of satellite-based methods for sustainable and effective agricultural practices, this research advances precision agriculture.

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