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EXPLORING IMAGE PROCESSING TECHNIQUES FOR THE CONSERVATION OF CULTIVATED CROPS USING TEMPORAL DATA

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Abstract
Mapping cultivated land using remotely sensed images requires a variety of possibilities, procedures, and strategies. The increased availability of remotely sensed images as a result of significant advancements in remote sensing technology broadens our options for imagery sources. Different sources of images are known to differ in spectral, spatial, radioactive, and temporal features, making them suited for diverse uses of vegetation mapping. In general, a vegetation classification must be developed first before categorizing and mapping vegetation cover from distant sensed photos, either at the community or species level. Then, relationships between types of crops (communities or species) in this categorization system and detectable spectral properties of remote sensing pictures must be established. These spectral classifications of the images are eventually translated into the vegetation.
This research work is about Exploring Image Processing Techniques and prediction for the Conservation of Cultivated Crops using Temporal Data in the upcoming years.
Key Words :*Cultivated Crops, Temporal Data, Remote sensed imagery, Image processing techniques, Conservation.*

INTRODUCTION:

Urbanization is beneficial to society because it facilitates individuals to live in a more organized manner. However, it can also be a destructive if not planned and managed properly [1](Mohan et al. 2011; Rimba et al. 2021). In 2008, urban areas became home to 50% of the world's population, marking a significant historical milestone.
Rapid urbanization [2](Sun et al. 2013, 2016; Bharath et al. 2021). has significantly altered the natural resources of that area, affecting both the ecology and civilization [3](Berling-Wolff and Wu 2004; Mundia and Aniya 2006; Bhat et al. 2017). Sudden rise in the development of Industries and cities has sparked an increased interest in knowing more about its environmental implications. This is due to several causes that have been recognized as potential threats to the growth of new urban areas, such as the loss of arable land and a decline in natural vegetation cover.
In this work an attempt is made to pick up one district and examine the variations in the cultivation of Principal crops through 2001 to 2021. Digital Maps are obtained from secondary data[4] (Ref https://karnataka.census.gov.in/DCHB-PART- A/583.Bangalore%20Rural.pdf) and [5] (Bharath Ashwathappa et al. 2022), the digital images and maps are acquired by Remote Sensing Data Centers. The data is assessed for every 10 years and the prediction is presented for the year 2030. The outcome of this study is useful for the government to devise measures to efficiently manage the Land Use/ Land cover and devise strategies to save the earth from the wrath of urbanization. This study sensitizes the importance of conservation of natural resources in general and cultivated crops in particular.
The area of study is Bangalore Rural District. Agriculture is the district's primary economic activity. According to the 2011 Census of India, 27.78 percent of the district's population is cultivators, while18.29 percent are agricultural laborers. The production of principal crops in the year 2010/11 substantiates the crops grown. [4] (Ref. https://karnataka.census.gov.in/BangaloreRural)

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LITERATURE SURVEY:

Table 1:

Principal Crops	Irrigated			Unirrigated			Total		
	Area in hectare	Production in tonnes	Yield in kg. per hectare	Area in hectare	Production in tonnes	Yield in kg. per hectare	Area in hectare	Production in tonnes	Yield in kg. per hectare
1	2	3	4	5	6	7	8	9	10
Paddy	1564	10463	7042	103	314	3210	1667	10777	6805
Rice	1564	6980	4698	103	209	2141	1667	7189	4540
Jowar	0	0	0	0	0	0	0	0	0
Bajra	0	0	0	4	2	413	4	2	413
Maize	4554	26134	6041	6381	24278	4005	10935	50412	4853
Ragi	973	3115	3370	40782	89380	2307	41755	92495	2332
Wheat	0	0	0	0	0	0	0	0	0
Total small Millets	-	-	-	-	-	-	8	4	526
Total cereals and Millets	-	-	-	-	-	-	**54369**	**150102**	**2906**
Total Pulses	-	-	-	-	-	-	**8891**	**6413**	**759**

[4] Obtained from Karnataka Census website

The main crops farmed in the district are ragi, rice, and maize. Ragi is the district's most important rain-fed crop, occupying 41,755 hectares, followed by maize, which occupies 10,935 hectares. Ragi farming yields 3,370kg per hectare when irrigated, and 2,307kg when not watered. The district's next biggest crop is paddy, which yields 6,805 kg per hectare. [4](.Ref. https://karnataka.census.gov.in/DCHB-PART- A/583.Bangalore%20Rural.pdf)

Geographic information systems (GIS) and remote sensing are crucial instruments for researching land-use patterns and their dynamics. The creation and use of plans for sustainable development benefit from these technologies. A methodical tool for studying geographical data, geographic information systems (GIS) can be used to forecast and assess changes that have an impact on the environment. Remote Sensing(RS) is a kind of technology that gathers data about an object without physical touch by using sensors carried by aircraft and spacecraft [6](Jin et al. 2019; Mahmoud et al. 2019).

With this type of data collecting, future scenarios can be anticipated and environmental changes can be investigated. Scientists can use GIS and RS technology to gain deeper insight into how urbanization impacts LULC change.[7](Wang etal.2018). Land use change analysis frequently uses RS approaches because of its temporal frequency and cost-effectiveness. Planners and environmentalists can also benefit from this technology by better understanding the different elements influencing LULC evolution. Additionally, it can give them significant deep applicable knowledge about the urban areas they aspire to progress. [8](Hashim et al. 2020).

Additionally, they can assist environmentalists and planners in accurately and economically identifying the different factors that influence LULC changes [6][8](Jin et al. 2019; Hashim et al. 2020). Natural resource mining is always linked to changes in land usage. Comparing time- sequential data serves as the foundation for researching changes in land- use patterns utilizing remotely sensed data. In addition to the simplicity of capturing data into a GIS, change detection utilizing satellite data can provide timely and consistent assessments of changes in land-use trends across broad areas [9](Prakash & Gupta, 1998).In order to help users organize, store, edit, analyze, and display positional and attribute information regarding geographical data, the Geographic Information System introduced spatial data management and analysis tools [10](Burrough, 1986).

Based on the application, a satellite remote sensing program may be roughly split into two groups, one of which is Earth observation systems for the management of any region and inventory of renewable and non- renewable resources. Satellite remote sensing programs have been used in a variety of fields, including agriculture, geology, and climatology.

In addition to monitoring danger zones like flood plains and volcanoes, this also entails monitoring the local flora, deforestation, soil, minerals, inland water bodies, snow and ice cover, urban growth, and coastlines.

LANDSAT, SPOT, MOS, and JERS are all examples of missions that fall within this category of remote sensing. The second type of mission is known as an environmental mission [11](Du S, Shi P, Van Rompaey A (2013), and its purpose is to research the dynamics of the land-ocean-atmospheric interacting system in order to get relevant information that can be used to make predictions regarding the future of the Earth's environment, climate trends, and other related topics.

This makes it necessary to conduct extensive, all-encompassing monitoring of a broad range of geophysical, chemical, and biological components of the earth's system over an extended period of time. This category could contain remote sensing programmes like UARS/NOAA, POES/NOAA and ERS/ESA and any other meteorological satellite programmes that are currently in operation.

OBJECTIVES:

The purpose of this study is to examine how urban sprawl affects the crops that are grown in the study area. Additionally, it offers suggestions for enhancing the guidelines and practices pertaining to the creation of new metropolitan regions.

AREA OF STUDY:

[14](Jagadeesha Menappa et al.)The southern region of the Indian state of Karnataka is home to the Bangalore Rural District. According to the 2011 Census, it has a population of 9,90,923 and a geographical area of 2305 sqkm. The district is situated between 600 and 900 meters above sea level on average. Because of the presence of many Hills, it is regarded as an outlier of the Eastern Ghats. These regions' rock formations are thought to belong to the Gneiss category. Captivating vistas have also been shaped by the granite gneisses located in the Taluks of Nelamangala and Devanahalli. The Kanva, Arkavati, and Dakshina Pinakini are the district's three main tributaries.

The region is rich in red soil and is made up of granite with a variety of textures and colors. Bangalore Rural District has seen significant urbanization in recent years, which has led to a significant shift in the area's vegetation, the removal of trees for road widening, and significant investments from builders and developers. The goal of this study is to use remote sensing data to examine the district's numerous thematic levels.

METHODOLOGY:

The study is supervised using various data sets to analyze the cultivated crops using the temporal data in the area. To effectively manage this region's growth, it is imperative to comprehend the dynamic

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phenomena of urban sprawl. Jupyter Notebook and MATLAB 18 are the two software tools used in this investigation.

PROPOSED ALGORITHM:

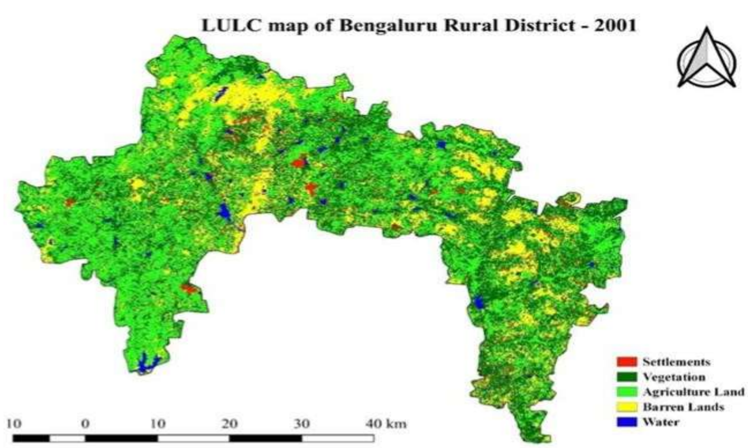
- Obtain Image of the study area from Remote sensing Data Programme
- Data Acquisition
- Build ML Models (Data Preprocessing and classification)
- Performance comparison with existing models
- Final LULC classification map; Extraction of cultivation land(details)
- Analysis of cultivation area of different crops in the given study area
- Forecasting of the area of cultivation of different crops

[19](Pallavi M; A Thesis)

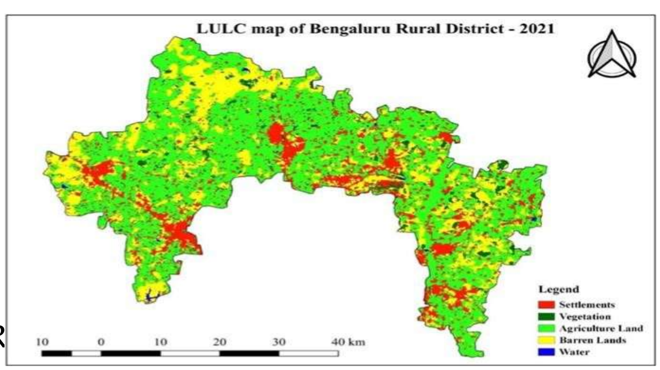
- **Data Acquisition from Google Search Engine of LANDSAT**
- **Data Preprocessing using appropriate software**
- **Data Mapping**
- **Data Validation**
- **Conveying opinion on predicted data**

Table 2. Details about the study area[5](Bharath Ashwatappa et al)

Data	Source	Satellite	Date of acquisition	Properties
Satellite images	USGS-Earth Explorer	Landsat 7	03/2001	30m resolution
	(earthexplorer.usgs.gov)	Landsat 8	04/2021	



Obtained from [5](Bharath Ashwatappa et al.)



DATA ACQUISITION IMAGE ACQUISITION:
Imaging sensors that can digitize the signal captured by the sensor in its video and digital camera measure the energy that is reflected acquired from the surface of the Earth. Sensors are fixed to platforms of spacecraft or airplanes. The practice of looking at photos to extract information that is buried in their form is known as digital image processing.
With this we can examine the LULC variations in the region by using the multi-spectral satellite photos. They were provided by the United States Geological Survey (USGS) Earth Explorer, which was acquired through the use of Landsat data. The photos taken over two seasons are analyzed for small seasonal variations. Many types of data that were used in this study.

IMAGE PRE-PROCESSING & IMAGE CLASSIFICATION:
Histogram equalization is a technique used to enhance satellite data before picture classification in order to improve image interpretation accuracy by modifying contrast [15](Mallupattu and Sreenivasula Reddy, 2013). A Supervised classification technique is applied for image classification, wherein the user defines the training sites as told by Mallupattu and Sreenivasula Reddy 2013; [16](Chowdhury et al. 2020). MATLAB 18 is the software used for image processing and classification. The rural district of Bangalore is used as the study area for crops. This is accomplished using Google Earth Pro [17](Das Kangabam et al. 2019; Tsai et al. 2019). Ultimately, a final categorized image is created using the maximum probability method.

CULTIVATED CROPS CHANGE ASSESSMENT:
An exhaustive understanding of the distribution of Cultivated Crops in the stipulated area of study at two timelines is anticipated to be provided by the study results. In order to ascertain the degree of changes in cultivated crops, the categorized photos from two different time periods are compared.

DISCUSSION :
To effectively design methods to enhance the agricultural growth of this region, it is imperative to obtain a full understanding of the fluctuations in the cultivated crops throughout time in the area. The complexity of the procedure makes classifying and mapping the land cover pattern extremely difficult. The same operation may now be carried out on satellite photos thanks to the growing variety of image processing techniques and algorithms. After downloading the 2001 and 2021 satellite photos from the USGS, MATLAB 18 software is used to classify the images using a supervised image classification method. The parts that follow go over the scenarios for the cultivated crops for each of the two eras.
LULC scenario for the year 2001 [5](Bharath Ashwathappa et al, 2022)
The study area in 2001 is represented thematically in Table 3 provides specifics regarding several data for 2001. It is evident that the study area in 2001 was 838.88 km2 (36.38%).
LULC SCENARIO FOR THE YEAR 2021
The research area's grown crops in 2021 are depicted thematically in Table 3 provides information on various LULC data for 2021. Observations reveal that in 2021, the research area of 1254.25 km2 (54.40%)
Land Use Land Cover from 2001 TO 2021
A comparison of categorized photos from 2001 and 2021 will show the evolution of cultivated crops. The amount of agricultural land increased significantly throughout this period. There has been an significant alterations in the LULC and in that agricultural land i.e it has sprawled from from 838.88

km2 to 1254.25 km2, and a rise in barren land from
465.25 km2 to 584.96 km2. Figures 5.3 and 5.4 illustrate the coverage of each LULC class in 2001 and 2021, respectively, and the percentage change in LULC classes between 2001 and 2021.

Table 3. Land use land cover from 2001 to 2021
[5](Bharath Ashwathappa et al, 2022)

Year/ land cover class	Land cover area in km^2			Changes in %
	2001	2021	Changes from 2001 to 2021	
Settlement	63.29	346.12	282.83	446.91%
Vegetation	891.87	104.04	-787.83	-87.77%
Agriculture land	838.88	1254.25	415.37	49.51%
Barren land	465.25	584.96	119.71	25.73%
Water	46.39	11.12	-35.27	-75.93%

Table 4. Taluk wise LULC Data from 2001 and 2021
[5](Bharath Ashwathappa et al, 2022)

ACCURACY CHECK:
A random sample technique was used to select 250 locations at random from the gathered images in order to measure accuracy. The total accuracy was 87.31% and 85.86%, respectively, according to the results, while the corresponding Kappa coefficients for the identified photos from 2001 and 2021 were 0.869 and 0.847. The findings show that the classified photos' accuracy is adequate. [5](Bharath Ashwathappa et al, 2022)

CONCLUSION:
After the completion of this work the percentage increase in the area of cultivation of each principal crops (Ragi, Rice, Maize etc.) will be understood and forecasted.

Taluk Name	Particular	Settlement	Vegetation	Agriculture	Barren	Water
Nelamangala	Area in 2001 (km^2)	27.70	171.16	268.07	56.44	11.52
	Area in 2021 (km^2)	97.99	18.15	268.67	145.39	4.70
	% Change	253.68%	-89.40%	0.22%	157.60%	-59.19%
Doddaballapura	Area in 2001 (km^2)	24.98	269.13	258.76	201.02	17.66
	Area in 2021 (km^2)	69.42	36.88	454.46	206.94	3.87
	% Change	177.89%	-86.30%	75.63%	2.95%	-78.06%
Devanahalli	Area in 2001 (km^2)	22.21	178.66	156.89	91.40	7.55
	Area in 2021 (km^2)	94.65	22.09	246.88	91.20	1.90
	% Change	326.11%	-87.64%	57.36%	-0.22%	-74.88%
Hosakote	Area in 2001 (km^2)	28.38	252.90	134.96	116.32	9.65
	Area in 2021 (km^2)	98.28	27.86	288.09	126.41	1.59
	% Change	246.36%	-88.98%	113.47%	8.67%	-83.51%

Accuracy assessment

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