

CHANGE ANALYSIS OF GRAPE AREA FOR MAVADI VILLAGE OF NASHIK REGION USING SATELLITE DATA

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Abstract

Grape (Vitis vinifera L.) is a significant fruit crop of India. The area under grape cultivation in Nashik region of Maharashtra is increasing very fastly in last some decades to calculate the actual change in area we select a village Mavadi from Dindori tehsil of Nashik district and analysis the change in area for year 2015 and 2019. Sentinel 2-A data of December, 2015 and November, 2019 were acquired from USGS earth explorer (<http://earthexplorer.usgs.gov/>) for analysis. This research assessed the capability of 10-m Sentinel-2A satellite imagery for grape territory identification through interactive supervised classification. The satellite data interpretation and classification were undertaken in ArcGIS 10.4.1 software. Village study area were divided into seven classes i.e. Grapes, degraded land, fallow land, water bodies, built-up, other crop and forest. During 2015 in Mavadi village there was about 141.61 ha of grape area which was increased up to 178.76 ha in 2019, there is about 26.21 % increase in grape area in four years. Same trend were obtained for build-up land, water bodies and forest while area under degraded land, fallow land and other crop were decreased in 4 consecutive years and which might be converted in grape area.

Key words- Grape, area mapping, Sentinel-2A, ArcGIS, Remote Sensing, Nashik

Introduction

Environmental change influences the worldwide farming and nourishment security in complex manners (Schmidhuber and Tubiello, 2007). It also leads in changing the cropping pattern, crop cultivation practices and shifting crop lands. Climate change also influences outbreak of several pest and diseases and occurrence some physiological disorders which renders in low yield with inferior quality with results into low income to farmers. This outcomes into shifting of land cultivation to monocropping which is most suitable for that region and having a high returns capacity. Grape is cultivated all across the world with an estimated production of 75.7 million tons over an area of 7.5 mha (Anonymous, 2016). It is also an important fruit crop of India cultivated over an area of 137 thousand hectares accounting around 1.7 % of total area (Anonymous, 2018). India has exported 2,46,133 tons of fresh grapes worth Rs. 2,335.24 crore (\$334.79 million) in 2018-19. Major grape growing states are Maharashtra, Karnataka, Telangana, Andhra Pradesh, Tamil Nadu and the North-West Region covering Punjab, Haryana, Western Uttar Pradesh and Rajasthan, besides Madhya Pradesh. Maharashtra ranks first in terms of production, value addition, innovative packaging and exports accounting for more than 81% of the total output. Traditionally ground surveying is the only method for crop area estimation but it was time consuming and laborious. Early and/or in-season information on spatiotemporal extent of grapes is useful from policy and decision makers standpoint. Information on total acreage of grapes would be helpful to the agencies like Agricultural and Processed Food Products Export Development Authority (APEDA) to plan the export related activities Further It also be helpful to the various stakeholders such as chemical and pesticide companies to plan their input supply and marketing activities. In addition to this, early season crop mapping provides an input to get the temporal information on crop stress which can be disseminated to the farmers throughout the crop growing season (Mohite *et al.*, 2017).

Traditional methods of manual surveying and field data collection to get crop samples are time and labour consuming and may involves errors resulting from incomplete field observations. Remote sensing based methods of crop mapping are cheaper and easily scalable because of large spatio-temporal coverage of region by number of satellites. Many earth observation satellites are

providing huge amount of remote sensing data which can be used for various applications such as crop mapping, yield prediction, drought monitoring etc. Research in the areas of crop area mapping/crop acreage estimation has been carried out over the years using both optical and microwave remote sensing data. Various single date and/or time series remote sensing datasets with varying spatial and temporal resolution have been used by the researchers to map the crop areas in a region (Sertel *et al.*, 2012; Karale *et al.*, 2014; Qin *et al.*, 2015; Hao *et al.*, 2015; Karakizi *et al.*, 2016; Zhang *et al.*, 2016). Sertel E. *et al.*, 2012 examined the usage and impact of different satellites with varying spatial resolution such as SPOT 5 (2.5m pan sharpened), IKONOS (1m pan sharpened) and World-view (50cm pan sharpened) for vineyard mapping. Karakizi *et al.*, 2016 proposed an object based classification framework using high spatial resolution imagery for vine detection, vine canopy extraction and the vine variety discrimination. Karale. *et al.*, 2014 carried out field level crop classification using multi-temporal Landsat 8 data. The VI's such as NDVI, Simple Ratio (SR) and DVI have been used for binary classification using feed forward neural network algorithm. Although time series data based crop mapping/classification approaches are providing better accuracies, we have attempted to use in-season two different years (2015 and 2019) single date image for land classification and grape area identification with aim to study the grape area change detection of Mavadi Village, Dindori tehsil of Nashik district, Maharashtra, India.

Materials And Methods**A. Study area**

The present study was performed for Mavadi village in Dindori tehsil of Nashik district, Maharashtra, India. It is located between 20° 18' 43.3296" N and 73° 55' 57.6336" E covers a geographical area of 678.97 ha. The climatic zone of the investigation territory is 'semi-arid' with a mean yearly precipitation of 621 mm. Agriculture is a main occupation of this area and grape is a main fruit grown in this region.

B. Data used in the study

Sentinel 2-A data were acquired from USGS earth explorer (<http://earthexplorer.usgs.gov/>), The Sentinel-2A satellite is operated by the European Space Agency (ESA). The Sentinel Multispectral Instrument (MSI) acquires 13 spectral bands ranging from Visible and Near-Infrared (VNIR) to Shortwave Infrared

(SWIR) wavelengths along a 290-km orbital swath. The Sentinel-2A satellite is operated by the European Space Agency (ESA). It provides an accuracy of 10 m. Sentinel 2-A image captured on 07 December 2015 and 26 November 2019 over the study area were downloaded from USGS earth explorer and used for further study.

C. Data processing

The satellite data interpretation and classification were undertaken in ArcGIS 10.4.1 software. Village study area were divided into seven classes i.e. Grapes, degraded land, fallow land, water bodies, built-up, other crop and forest. The same classification and processing were followed for both the years i.e 2015 and 2019 and through interactive supervised classification by using statistical calculators area under each class were measured. Maps were prepared with proper colour compositions and legends for understanding, Statistical data was used for graphical representation and area comparison for both the years.

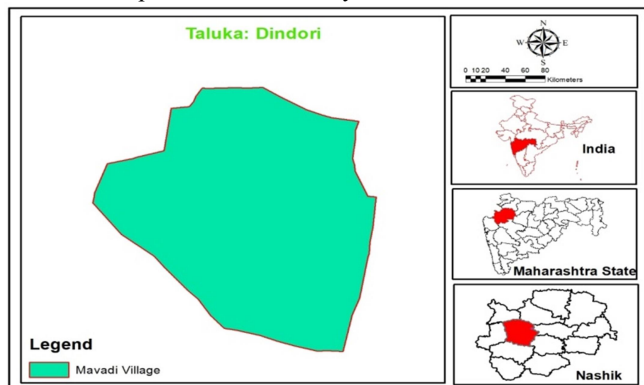
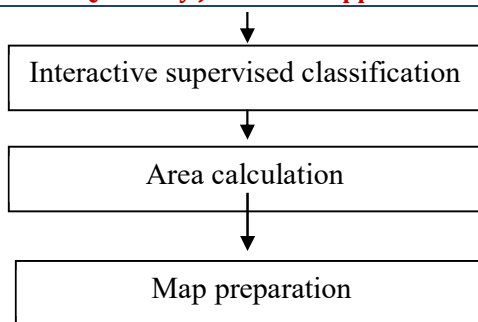
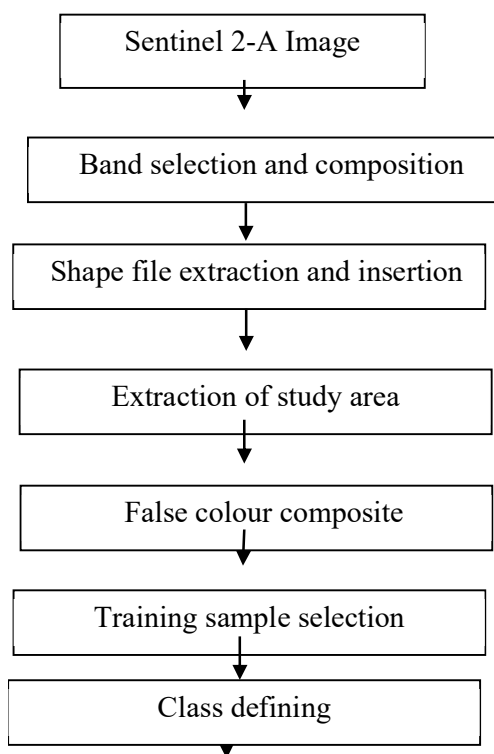


Figure: 1- Study area of Mavadi village (Nashik region, Maharashtra, India.)

Methodology

The all data processing and map preparation process were performed in ArcGIS 10.4.1 software. The various processes performed for this study are mention in following flow chart

Flow chart:



Results And Discussion

Grape (*Vitis vinifera* L.) is an important fruit crop of India. The area under grape cultivation in Nashik region of Maharashtra is increasing very fastly in last some decades to calculate the actual change in area we select a village Mavadi from Dindori tehsil of Nashik district and analysis the change in area for year 2015 and 2019 by using remote sensing technology. The results obtained from study clearly indicated that there is increase in grape area in subsequent four years and it is presented in Table 1.

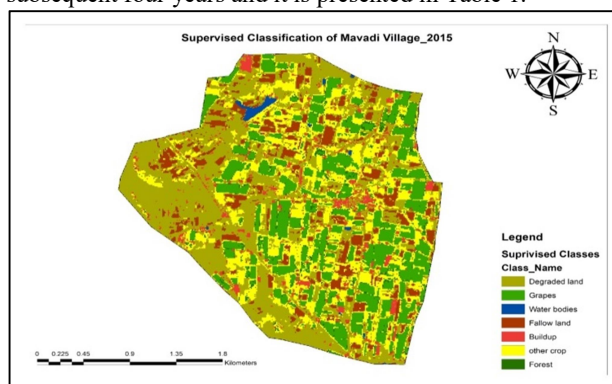


Figure 1: Supervised classification map of Mavadi village in 2015

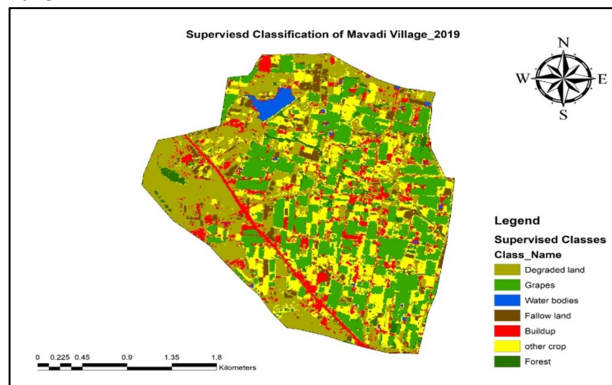


Figure 2: Supervised classification map of Mavadi village in 2019

Table 1: Mavadi village area for different classes in 2015 and 2019

S.N.	Classes	Area (ha)	
		2015	2019
1	Degraded land	258.93	220.65
2	Grapes	141.64	178.76
3	Water bodies	4.22	9.67
4	Fallow land	66.4	32.31
5	Build up	29.6	72.76
6	Other crop	161.14	142.18
7	Forest	17	22.6
	Total Area (ha)=	678.93	678.93

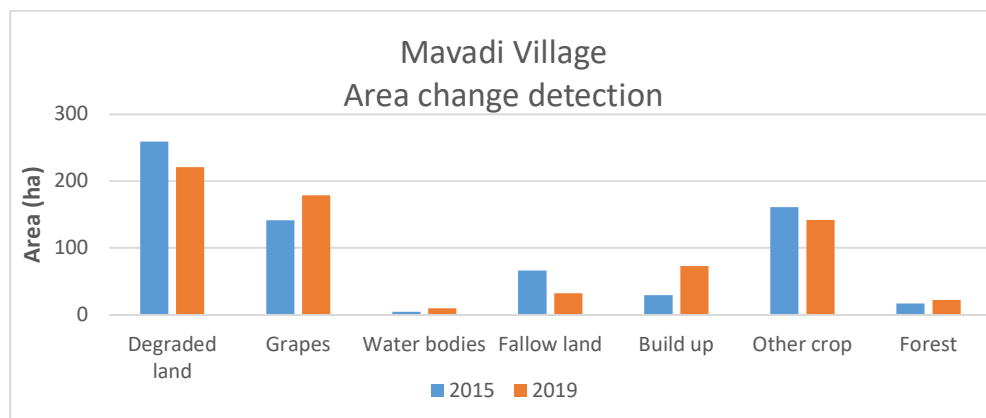


Figure 1: Mavadi village area for different classes in 2015 and 2019

In Mavadi village for the year 2015 the area under different classes are degraded land (258.92 ha), grapes (141.64 ha), water bodies (4.22 ha), fallow land (66.4 ha), build up (29.6 ha), other crops (161.14 ha) and forest (17 ha) While in 2019 the area under different classes are degraded land (220.65 ha), grapes (178.76 ha), water bodies (9.67 ha), fallow land (32.31 ha), build up (72.76 ha), other crops (142.18 ha) and forest (22.6 ha). The data obtained from sentinel-2 were processed in ArcGIS 10.4.1 software and analysed data was cross verified with the local Agricultural Department of Mavadi village, Teh.- Dindori, Dist.- Nashik of Maharashtra state after cross verifying, we acquired good amount of similarities in crop area for both (2014 and 2019) the years.

The results of study clearly indicates that there is increase in area of grapes from 141.64 ha to 178.76 ha in four years simultaneously area under water bodies (4.22 ha to 9.67 ha), build up (29.6 ha to 72.76 ha) and forests (17 ha to 22.6 ha) also increase significantly. While area under degraded land (258.92 ha to 220.65 ha), fallow land (66.4 to 32.31 ha) and other crops (161.14 ha to 142.18 ha) were decrease from 2015 to 2019. There is about 26.21 % increase in grape area in four years.

There are many reasons for increasing grape area which mainly includes environmental, economical and social. Environmental reasons includes the climate suitability of that village for grape cultivation. For economical reasons grape gives high and assured returns than other crops, availability of marketing facilities for grapes in that region also results for increased area. The knowledge and technology required for cultivation of grapes are readily available in that area and grape is a socially important crop in that region. This all factors might be contributed to the increased grape area of Mavadi village. In 2019 monsoon withdrawal was delayed for 1 month which results in increased water bodies and forest area of Mavadi village. The increase in number of farm ponds in village also results increased in water bodies. A decreased area of degraded land, fallow and other crops were converted into build up land and grape area. Bhosale and Sale (2016) noticed that the annual growth rate of Maharashtra grapes was 6.68 per cent they also reported that climate of Maharashtra state is appropriate for fruit production and the different horticultural schemes were very well adopted in Maharashtra from

1990s which has helped in the conversion of the dry and rainfed areas. Dhatrik (2018) found that there is diversification from subsistence crop to more commercial crops in selected tehsils of Nashik districts. Bose (2020) observed that some of the new seedless grape varieties showed the enormous potential for export and which was the measure concern for increasing the area of grapes in this pockets.

Similar results were recorded by Gadakh and Jaybhaye (2014) and Karale *et al.*, (2014).

Conclusion

NAAS Rating 2021- 4.51

During 2015 in Mavadi village there was about 141.61 ha area of grape area which was increased up to 178.76 ha in 2019, there is about 26.21 % increase in grape area in four years. Same trend were obtained for build-up land, water bodies and forest while area under degraded land, fallow land and other crop were decreased in 4 consecutive years and which might be converted in grape area. Sentinel-2 has great potential in vegetation mapping domain in remote sensing. Classification of crops provides essential information that is useful in a various decision making process for managing agricultural resources. Satellite image processing can provide timely and accurate information on crop type and reliable estimation of crop production using advance classification techniques.

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