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Optimization of Crop Cutting Experiments using Geospatial Technology for Shivamogga District, Karnataka, India

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***Abstract* - Accurate and reliable estimates of crop yield losses are crucial inputs for adjudicating the crop insurance and providing income security to the farmers. Notwithstanding several schemes in vogue to improve the crop estimates, there have been delays in settling the insurance claims. It is to improve this situation that the study presented here is focused on evaluating the use of geospatial techniques in assessing the impact of rainfall and drought occurrence on crop growth and condition and implication in crop insurance.**

The study is aimed at understanding the different parameters that affect crop yield and to relate their behaviour with the remotely sensed parameters such as Normalised Difference Vegetative Index, Normalised Difference Drought Index and Normalised Difference Moisture Index. The study was conducted in the Shivamogga district of Karnataka state. Rice crop was chosen for the study, which is principal crop identified under the crop insurance schemes in the district. Resourcesat-2 Advanced Wide Field Sensor (AWiFS) data was used. The data was acquired on 14th October 2015 which is one month before the crop was harvested. The methodology developed was tested and the Crop Cutting Experiments (CCEs) were identified for Biliki Gram Panchayat in Shivamogga taluk, Shivamogga district, Karnataka, India.

Keywords:* *CCE (Crop Cutting Experiments), Geospatial Technology, Crop Insurance

INTRODUCTION

Conventional method of yield estimation is through crop cutting experiments but due to drawbacks like incomplete framework, improper sample size, different type of selection of crop, area measurement variation and non-sampling errors (like measurement area inaccuracy, field reporting inaccuracy, etc.).Hence geospatial approach for yield estimation is done.

MATERIALS AND METHODOLOGY

Study area

The Study area is entire Shivamogga district. Shivamogga district lies in Malnad region of the Western Ghats in Karnataka State, India. It lies between 13^0 27'N to $14^0$39'N latitudes and 74^0 38'E to 76^0 04' E longitudes. It has an area of 846498.189 Hectares. It has 7 taluks Bhadravathi, Hosanagara, Sorab, Shikaripura, Sagara, Thirthahalli and Shivamogga. There are approximately 267 gram panchayats in Shivamogga.(39 GP's in Shivamogga,40 GP's in Bhadravathi, 30 GP's in Hosanagara,35 GP's in Sagara,40 GP's in Sorab,44 GP's in Shikaripura,and 39 GP's in Thirthahalli.)

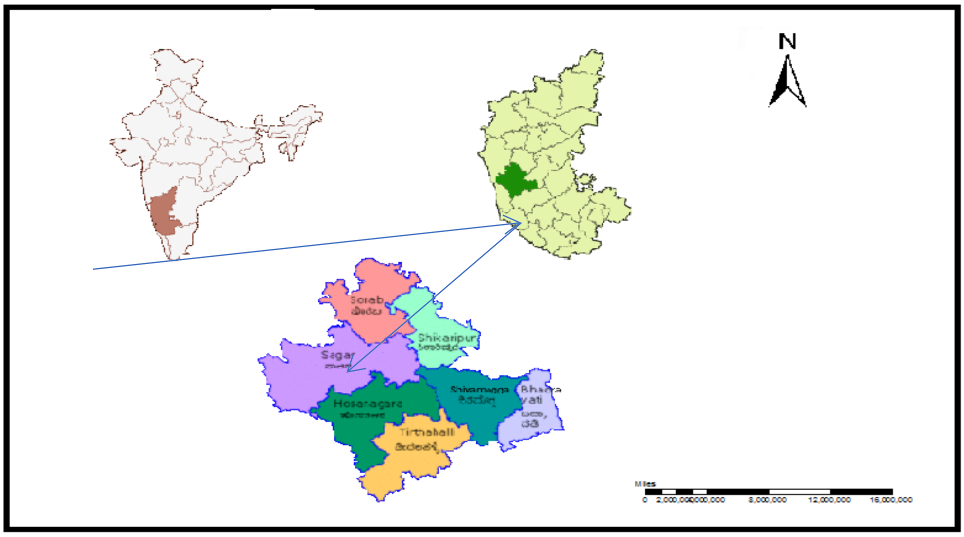

Fig.3.1 Location Map of Study Area

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Shivamogga lies in Tropical semi-arid region.

- Kodachadri hill is the highest point of this district with an altitude of 1343m.
- The four major rivers originate in this district are-River Kali, Sharavathi, Tadadi, Gangavathi. Tunga and Bhadra are the two rivers flow through the district and meets at Koodli to form Tungabhadra.
- Average annual rainfall is around 1800mm and average temperature is 26^{o}C.
- Major crops grown are cotton, maize, arecanut and paddy.
- Major minerals are Limestone, White quartz, Kaolin, Kainite and Manganese.
- Major soil forms are Lateritic clay and gravelly, red Clay and gravelly, medium deep black, non-saline and saline alluvo-colluvial and brown forest soil.

Materials Used:

- Multi-date RISAT-1 microwave data from 25th July to 15th Sep 2015
- IRS–Resourcesat2 AWiFS Sensor data passing along the path 98 and row 62 on 14/10/2015.With 4 bands-Green (G), Red (R),Near Infrared (NIR) and Shortwave Infrared(SWIR).
- Land use/land cover data: Land use/ land cover map of 2011-12 prepared by KSRAC, Bengaluru.
- Geo Spatial data Selection available with KSRSAC
    - i. Administrative layers
    - ii. LULC
    - iii. Cadastral Reference data base with Survey numbers

Methodology

The given satellite data is geo-referenced and subset of the Area of Interest (AOI) is generated in ERDAS Imagine (fig.1.1).Later the Agricultural mask was overlaid and agricultural area is obtained. For the obtained agricultural area supervised classification is done using given training sets. By creating a model using supervised classified image (as in fig.1.2) and LULC of Agricultural land, Paddy Crop Map is obtained (as in fig1.3).

From Subset of AOI, NDVI is generated (as in fig.1.4). By creating a model using Paddy Crop Map and NDVI of AOI, NDVI of Paddy Crop is obtained.

The obtained NDVI of Paddy Crop is stratified (as in fig.1.5) and gram panchayat boundaries are overlaid to obtain CCE location points (as in fig.1.6)
The detailed methodology is explained in table 1.1a and 1.1b.

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Table.1.1a Methodology followed in this Study

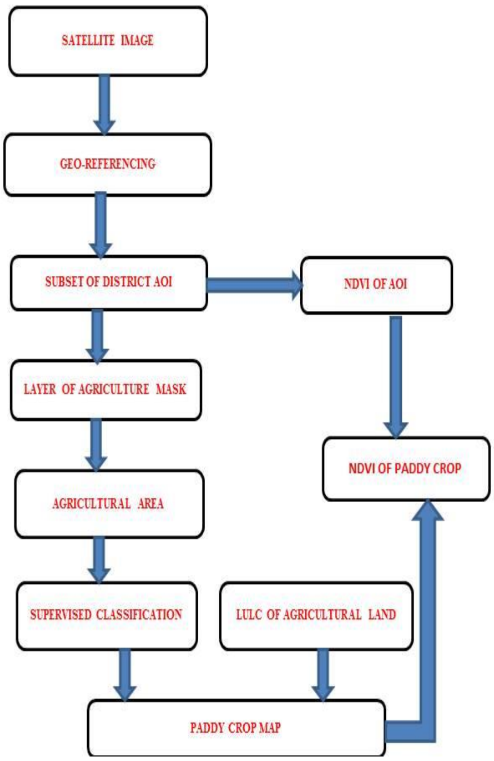
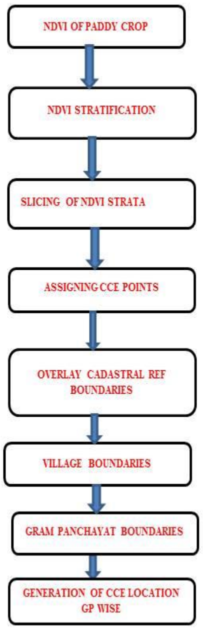


Table.1.1b Methodology followed in this Study



RESULTS AND DISCUSSIONS

From the IRS–Resourcesat2 AWiFS Sensor data on 14/10/2015 the subset was created (Fig.4.1) and later the subset image was classified using given training sets, supervised classification. (Fig.4.2) by intersecting classified image with the total agricultural area, paddy crop is obtained. (Fig.4.3). Using NDVI map (Fig.4.4) and paddy Crop map depending on their vegetation types they are stratified to TYPE-A, TYPE-B, TYPE-C, TYPE-D (Fig.4.5) In the stratified image CCE location for one Gram Panchayat is located. (Fig.4.6).

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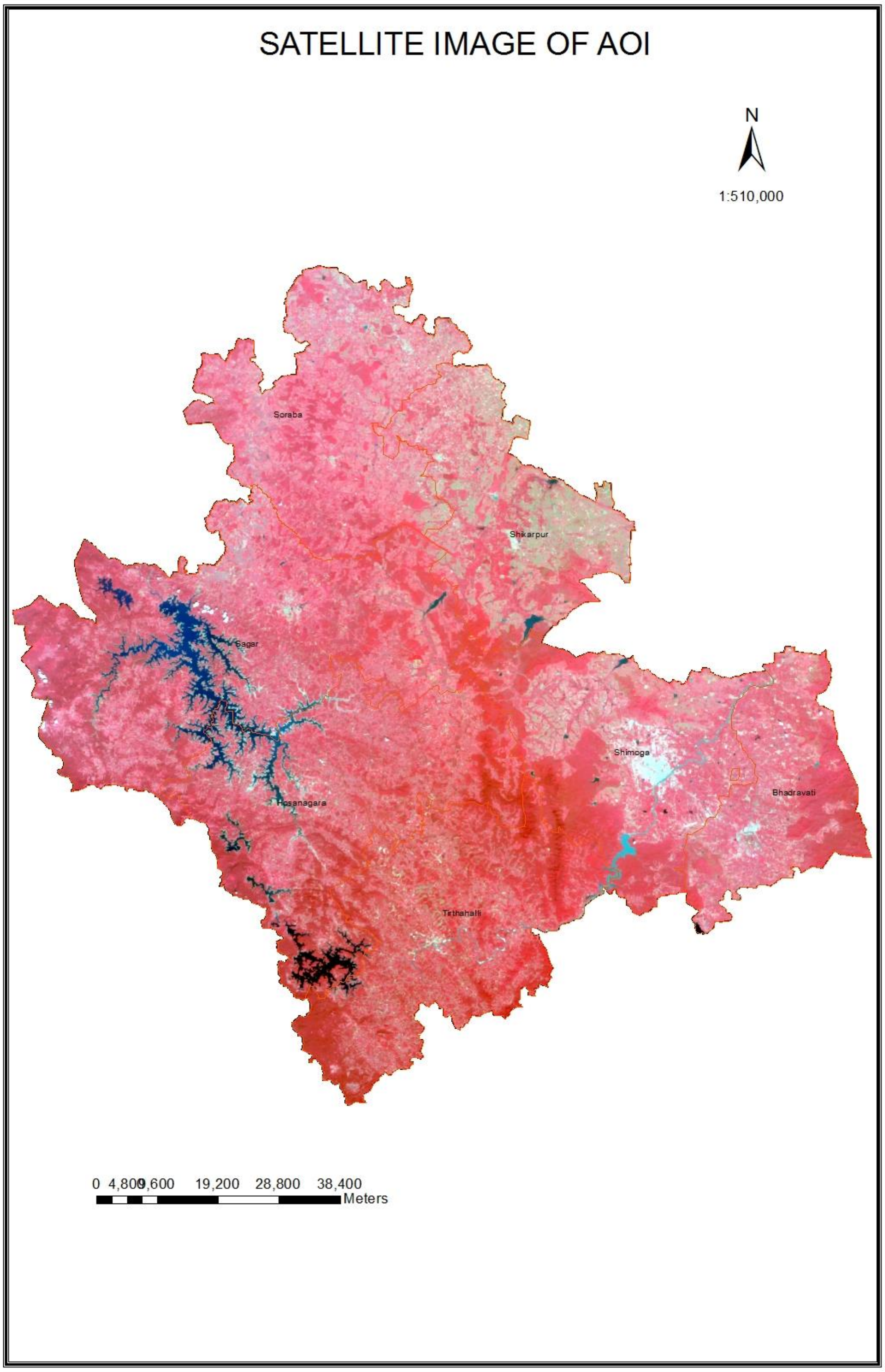

Fig.1.1 Satellite Image For AOI

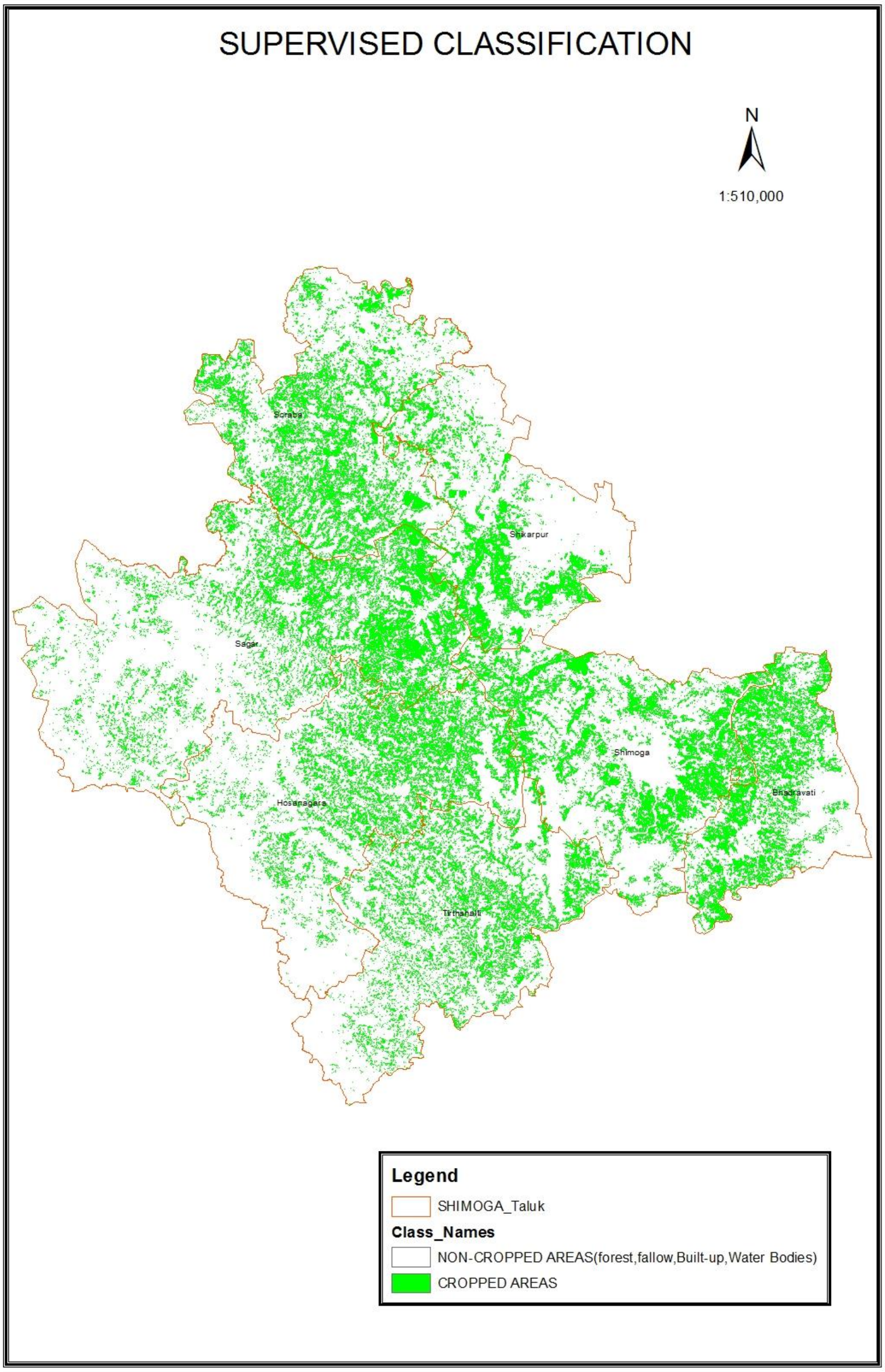

Fig.1.2 Supervised Classification

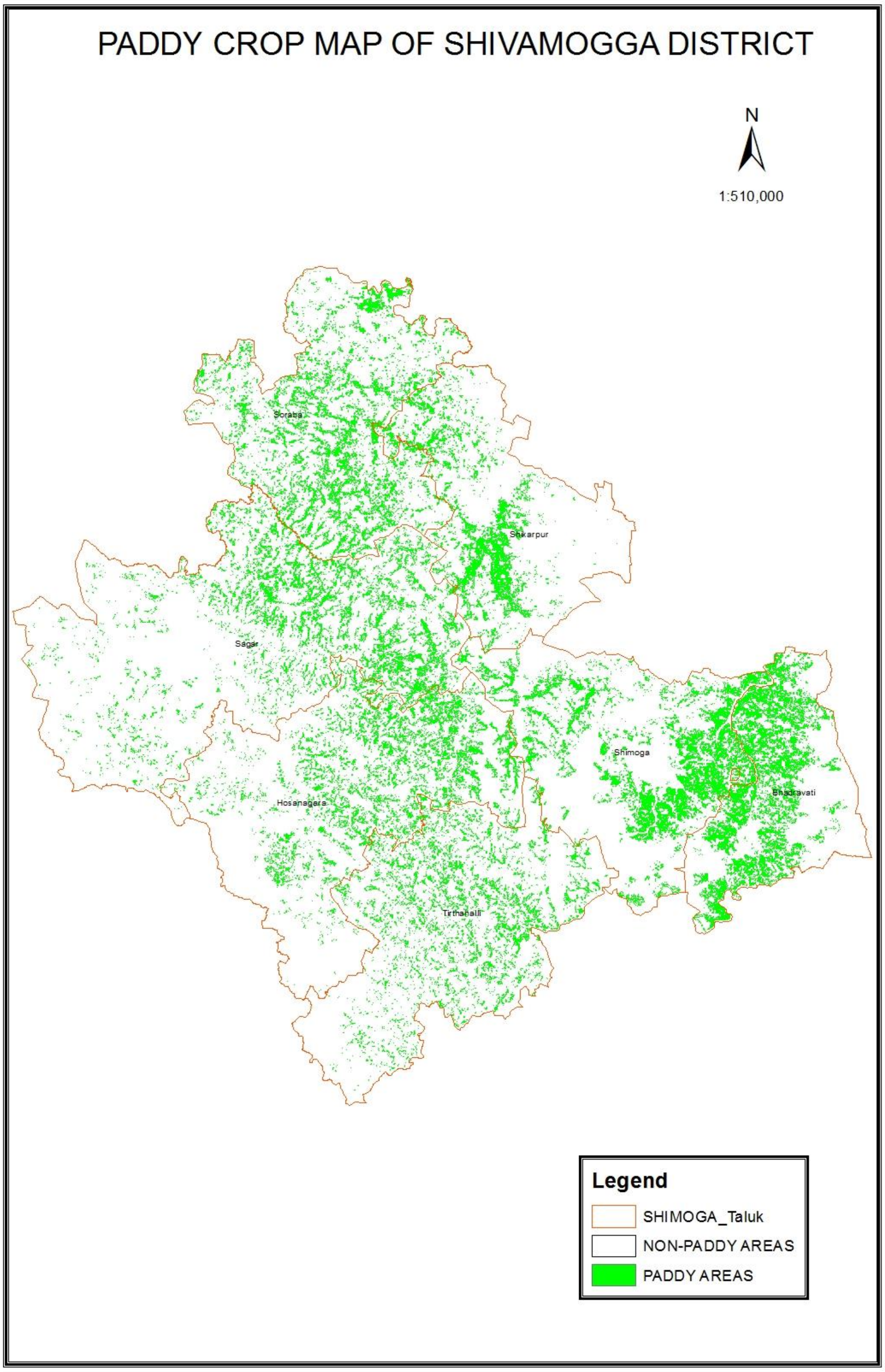

Fig.1.3 Paddy Crop Map

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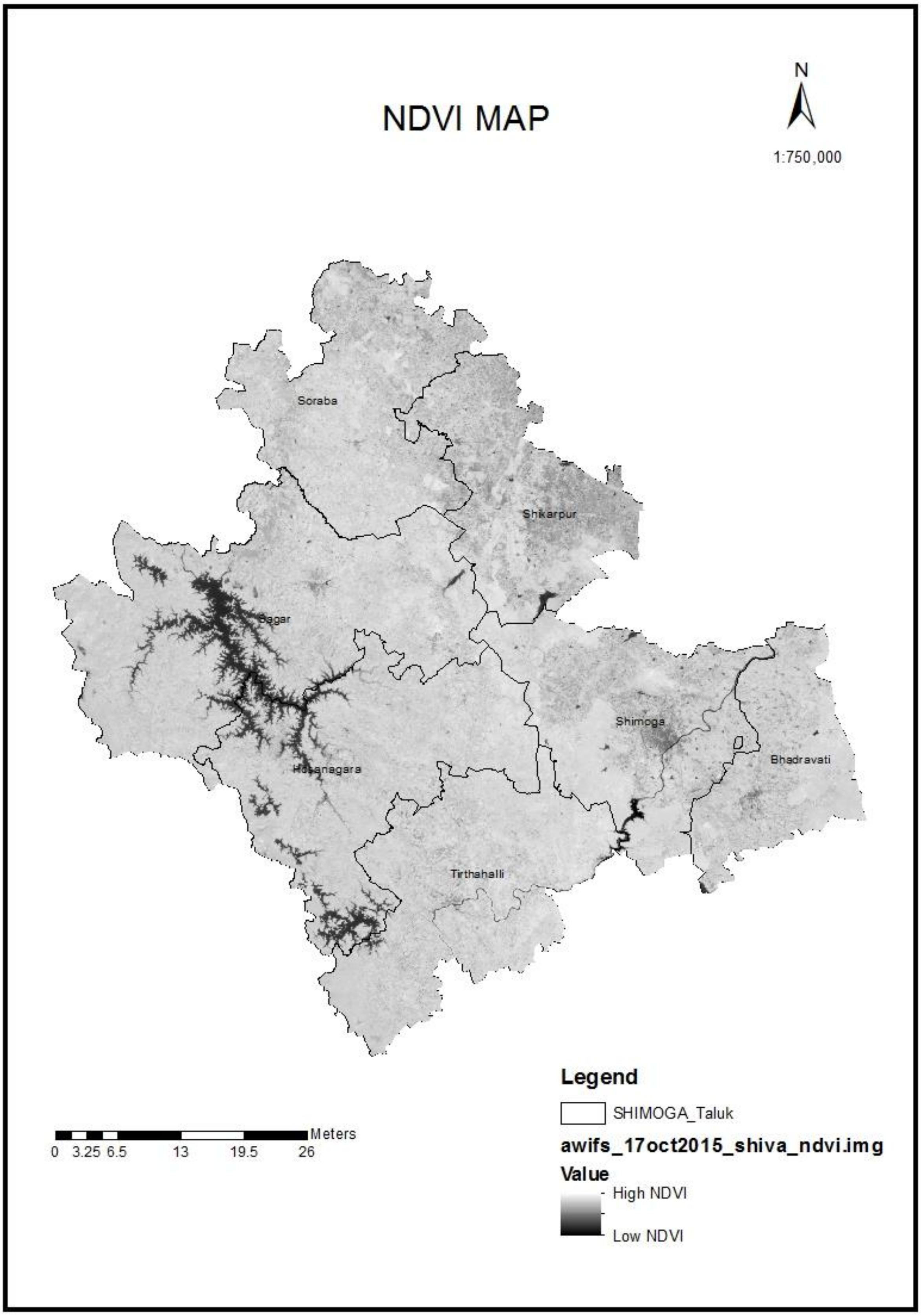

Fig.1.4 NDVI Map

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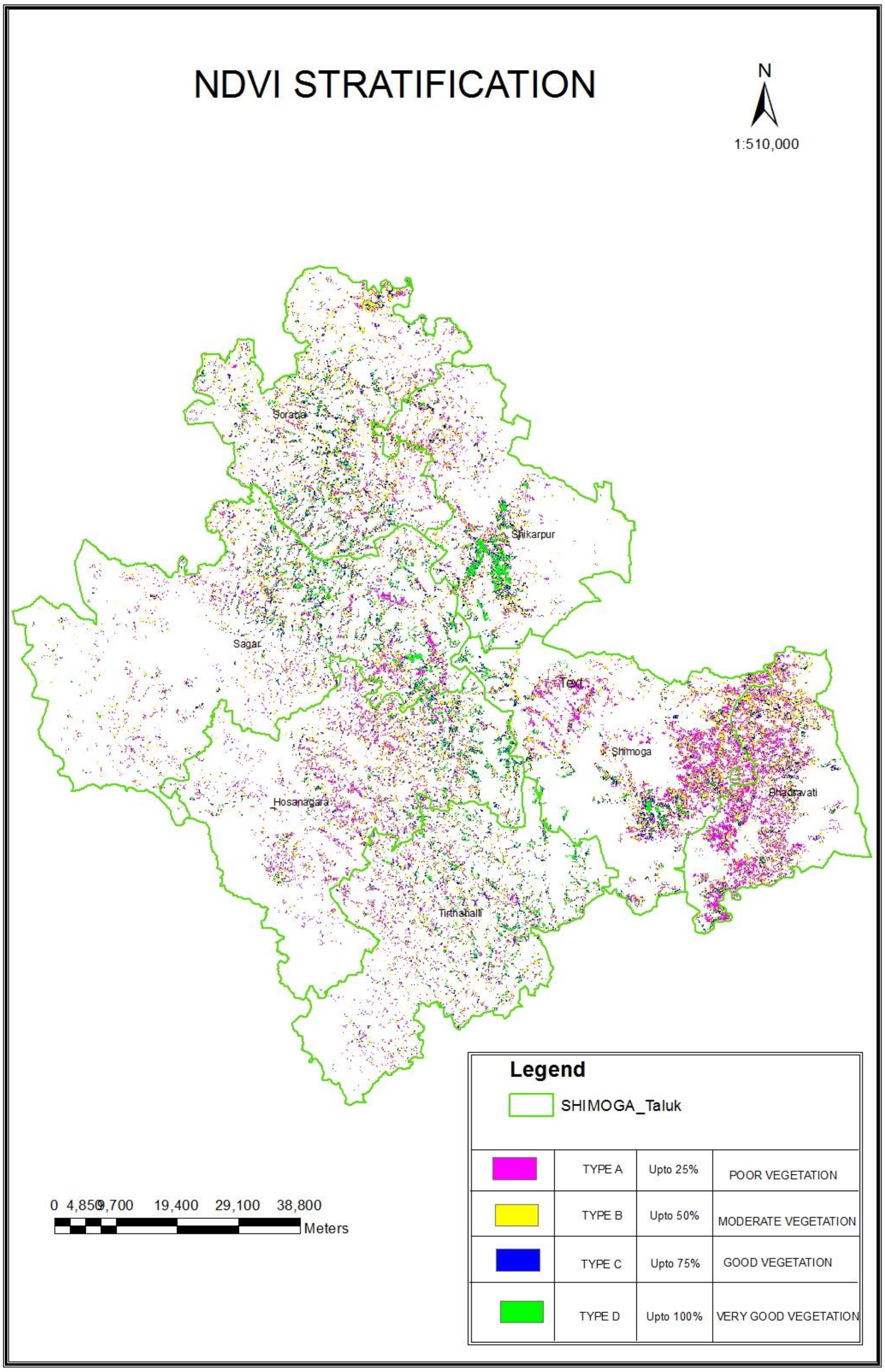

Fig 1.5 NDVI Stratification

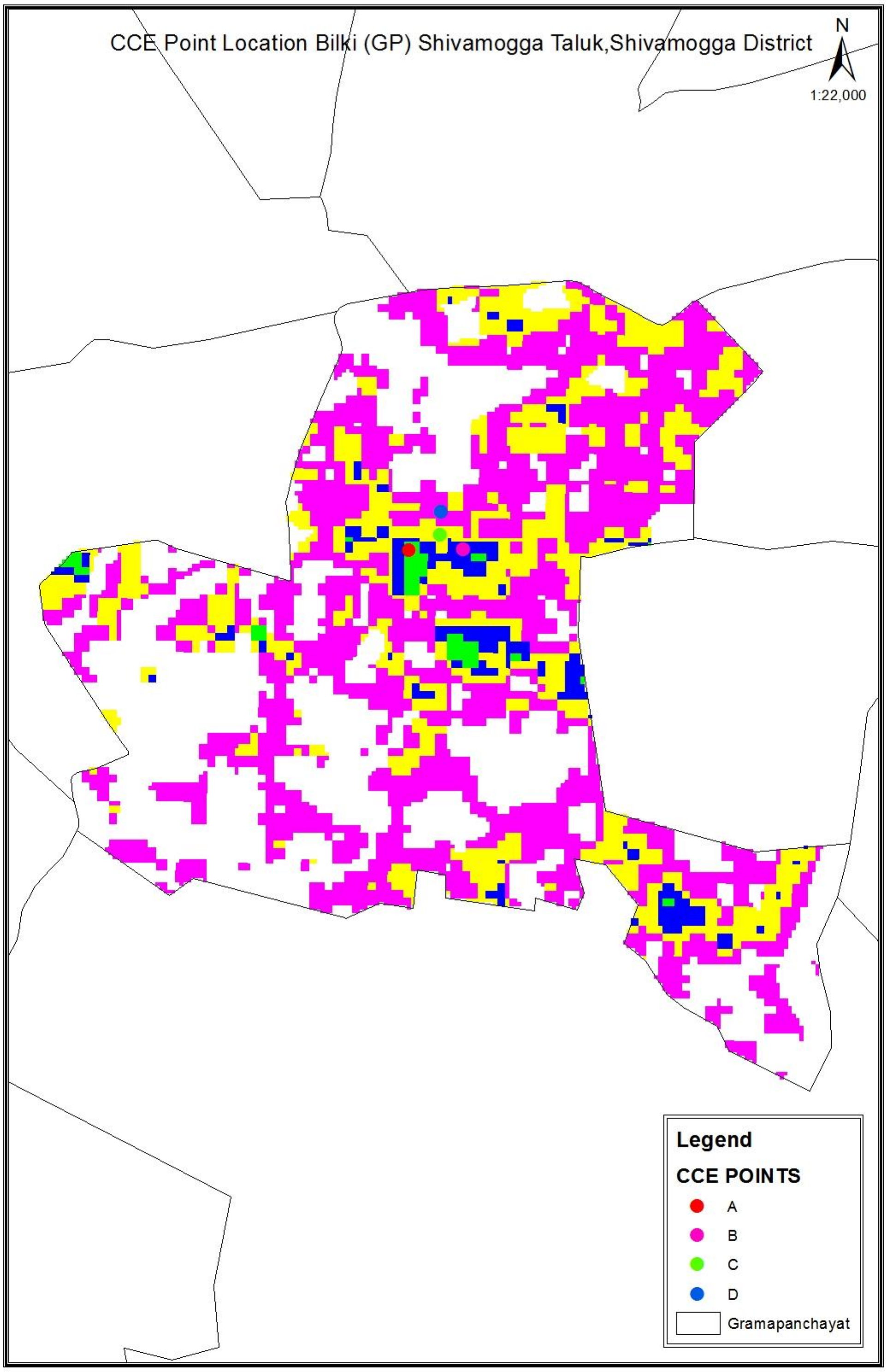

Fig.1.6 CCE point Location BILKI (GP)

SOFTWARES USED

- ERDAS IMAGINE 2014
- Arc Map 10.3.1
- Microsoft Excel

ERDAS IMAGINE 2014

Using ERDAS IMAGINE I was able to

- Layer Stack the given satellite image
- Geo-referencing
- Create Subset of AOI

- Create NDVI
- Supervised Classification of agricultural area
- Obtain Paddy Map, LU/LC Map, Agri mask and NDVI of Paddy Map
- Stratification was done for NDVI of Paddy Crop.

ARC Map 10.3.1

Using Arc Map

- CCE points were assigned on Stratified NDVI by overlaying GP boundaries or Village boundaries
- The obtained CCE points are categorised to TYPE-A, B, C and D.

CONCLUSIONS

Through this study it was confirmed that increase in NDVI value, rainfall and moderate temperature there will be an increase in yield value, hence decreasing drought.

The obtained yield model is verified through remote sensing method and Crop yield is further used for Crop insurance claim validation.

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