GIS BASED INCENTIVISED CROP YIELD MONITORING SYSTEM

Dr. (Mrs.) GovindarajuVeena Rao[1],Ms.Kornika Chakraborty[2], Ms. Rajkamal N.Goundi[3]

[1] Associate Professor in Geology, Hon. Director, Centre For Remote Sensing and GIS(CRSGIS), 6th Floor, New Engineering Building, Somaiya Vidyavihar Campus, Vidyavihar, Mumbai 400077. .docgvr@gmail.com

[2]Lecturer in RST & GIS, Centre For Remote Sensing and GIS(CRSGIS), 6th Floor, New Engineering Building, Somaiya Vidyavihar Campus, Vidyavihar, Mumbai 400077. kornika_c@rediffmail.com

[2] System Analyst, IT Department, Godavari Bio refineries Limited, At Post Sameerwadi, Mudhol Taluka, Bagalkot District, Karnataka 587316. .rajkamal@somaiya.co

ABSTRACT

Where farmers have been provided with an incentive to produce yield of a certain quality and variety it is essential to monitor this method to ensure equitable distribution of loyalty privileges. In the current case study a GIS based method has been developed to maintain a database containing required parameters. The area of study is Sameerwadi, Karnataka, India. The primary crop is sugarcane.

A map with associated spatial parameters collected primarily by ground surveys is created. Stage of production, acreage, variety of sugarcane crop are duly recorded. Projected yield at the end of the harvest season is estimated, and post harvest data compared with the original to compute a graded mechanism of farmer loyalty. This when compared to historical data provides a further basis for computing loyalty rewards.

Thus the use of GIS technology for devising a suitable process to ensure mutual benefits for producer and the consumer is demonstrated.

1.0 INTRODUCTION

In an agrarian economy one of the best methods of improving productivity is by usage of various technologies. These are usually aimed at minimising cost of production, increasing efficiencies in improving crop yield. Many case studies exist of micro farming, sensor based monitoring, micro climate control etc. All of these in essence are variants of geographic information systems. They strive to exploit the enormous potential of geospatial based analytical techniques.

This paper presents such an analysis carried out in the sugarcane belt of Karnataka India. An important characteristic of this area is that the farmers work on contract basis and supply the cane to neighbouring sugar mills. It is therefore in the interest of the sugar mill owners to establish a symbiotic relation with the farmers. This is often achieved by devising a loyalty program and an incentivising scheme. These may take many forms such as supply of subsidised fertiliser, easy financing etc. However, one important requirement is to ensure equity and judicial implementation of the scheme. This can best be achieved by use of GIS technology.

The objective of this paper is to present a method of using GIS in the development of an incentivised scheme. The parameters measured are crop yield and to infer its causative effects. The causes may depend on quality of fertiliser, availability of water, stage of harvesting and other parameters. A detailed analysis is done to arrive at Farmer Loyalty Factor (FLF).

2.0 LOCATION OF STUDY AREA

Bagalkot district (Figure No.2.1), is located in the northern part of Karnataka state, India. The district lies between 15º46¹ and 16º46¹ north latitude and 74º59¹ and 76º20¹ east longitude. The district has boundaries with Bijapur district in north and Belgaum district in the west; Raichur & Koppal in east and Gadag in the south directions. Bagalkot district has an area of 6593 sq.km. and a total Population of 1.65 million

The average rainfall in the district is 562 mm (Figure No 2.2). The district receives 40% of the total rainfall in the south west monsoon period from June to September.

In Bagalkot district three major rivers flow viz., Krishna, Ghataprabha and Malaprabha. The Ghataprabha and Malaprabha are tributary to Krishna river. The deep black soils of mixed geological origin are found in the area lying in between Krishna, Ghataprabha and Malaprabha rivers. This type of soil is found in Bagalkot, Hunagund, Badami, Mudhol, Bilagi and part of Jamakhandi talukas.

Only two talukas namely Mudhol and Jamakhandi (Figure No. 2.3) were selected as case studies. The village boundaries falling within these two talukas is shown in (Figure No. 2.4).

Within a buffer of 10 kms radius from the factory point, two villages - Bisanal, Budni from Mudhol Taluka, and Yaragatti, Golbhavi from Jamakhandi Taluka (Figure No.2.5), were identified for the analysis.

This paper describes the analysis for Bisanal village (Figure No.2.6) of Mudhol taluka only.

A survey number may have many farmers and therefore the yield per famer per hissa per survey number is calculated. Alternatively one farmer may own many parcels / survey numbers. The yield produced from many parcels by one farmer is calculated.

Each survey number/parcel is subdivided into hissas /sub parcel. These hissas /sub parcel are spatially referenced by a point and colour coded based on areal extent. The total

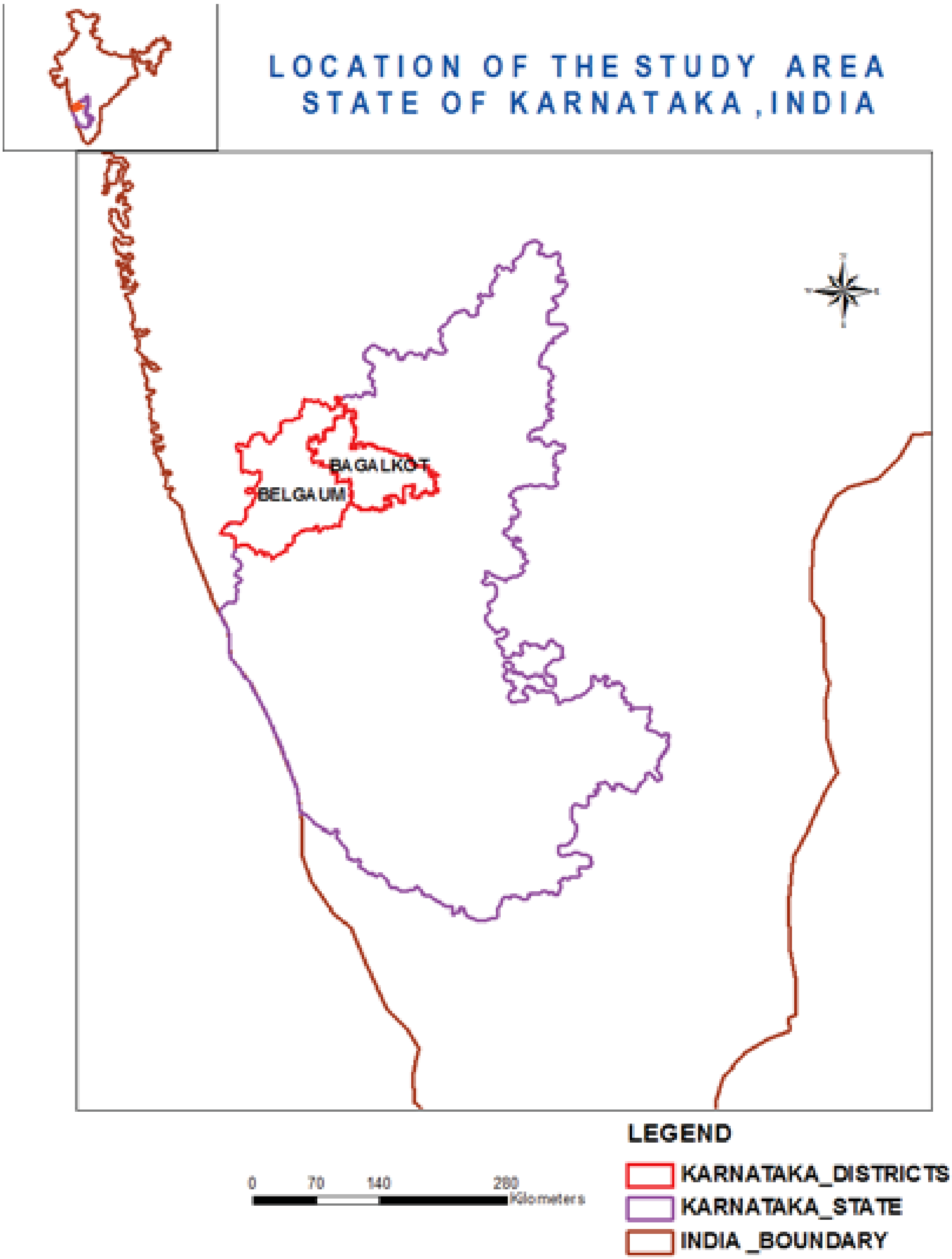

FIGURE NO. 2.1 Location of the Study Area – Bagalkot District, Karnataka

sub parcel area per survey number for each farmer is known. These points are then used to generate Farmer Loyalty thematic map.

The parcels in Bisanal have soil of medium texture. The soil permits certain high yielding varieties of cane crop to be cultivated. The soil type is loamy black soil. This soil type favours cane cultivation.

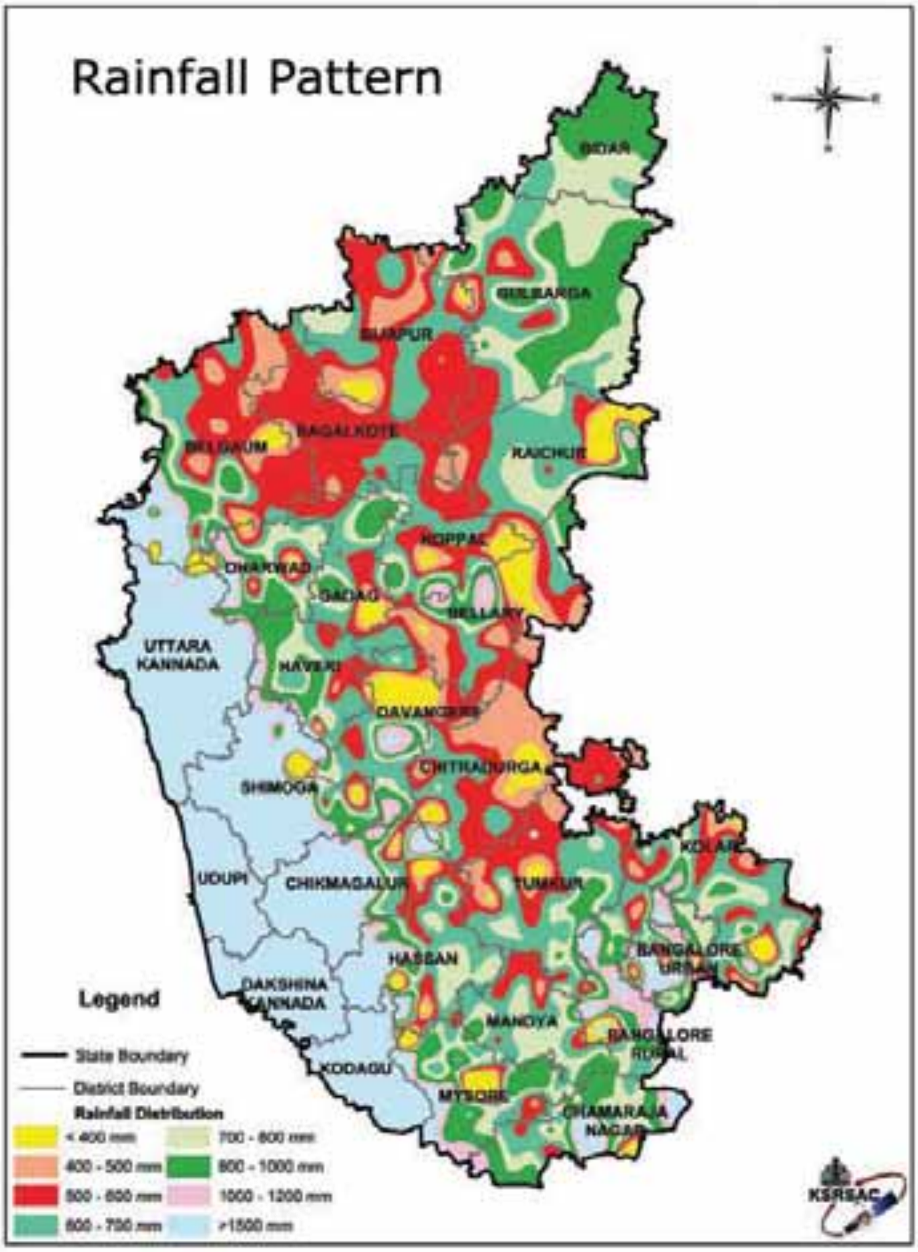

FIGURE NO.2.2 : Rainfall distribution map for Karnataka

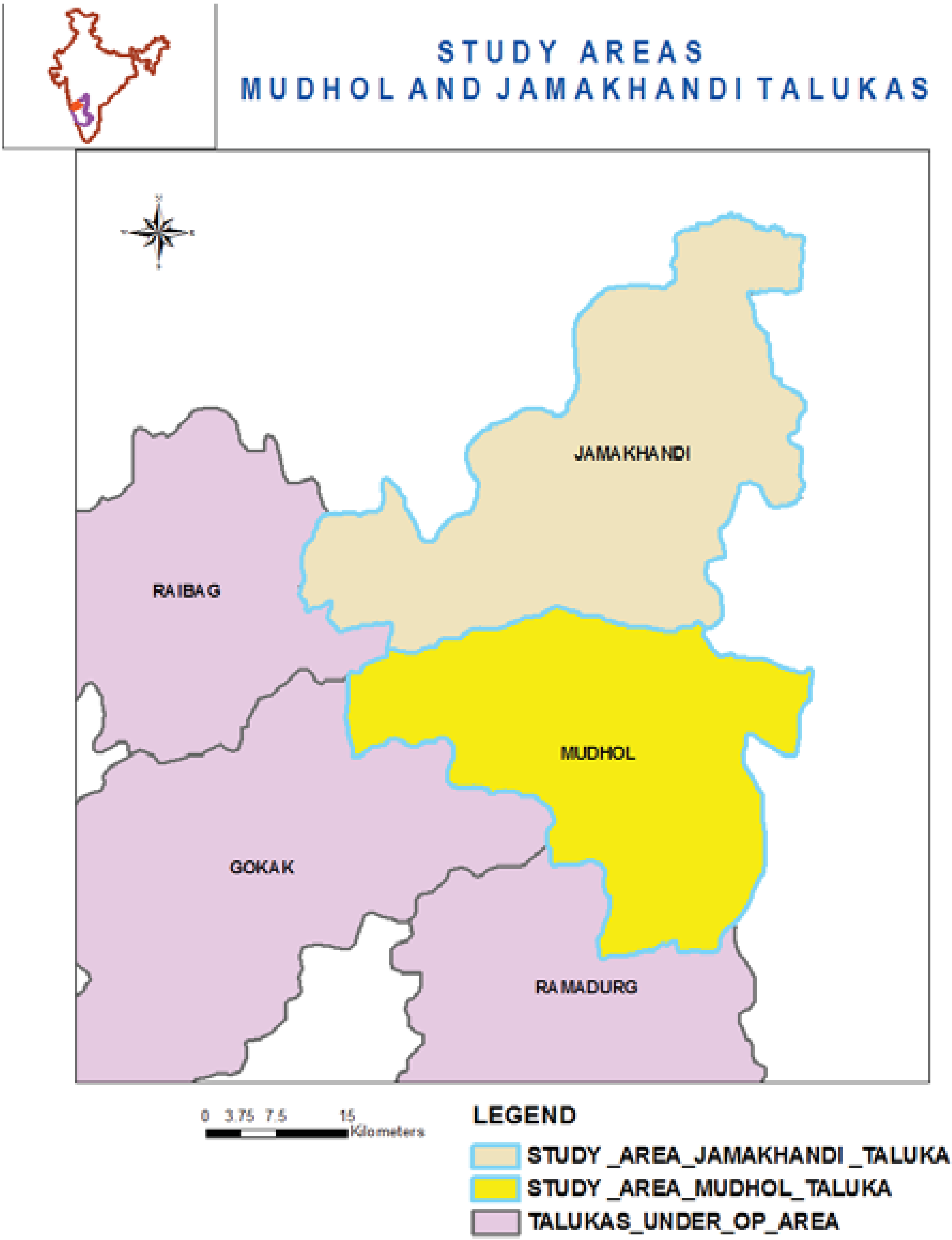

FIGURE 2.3: Talukas Mudhol and Jamakhandi under study

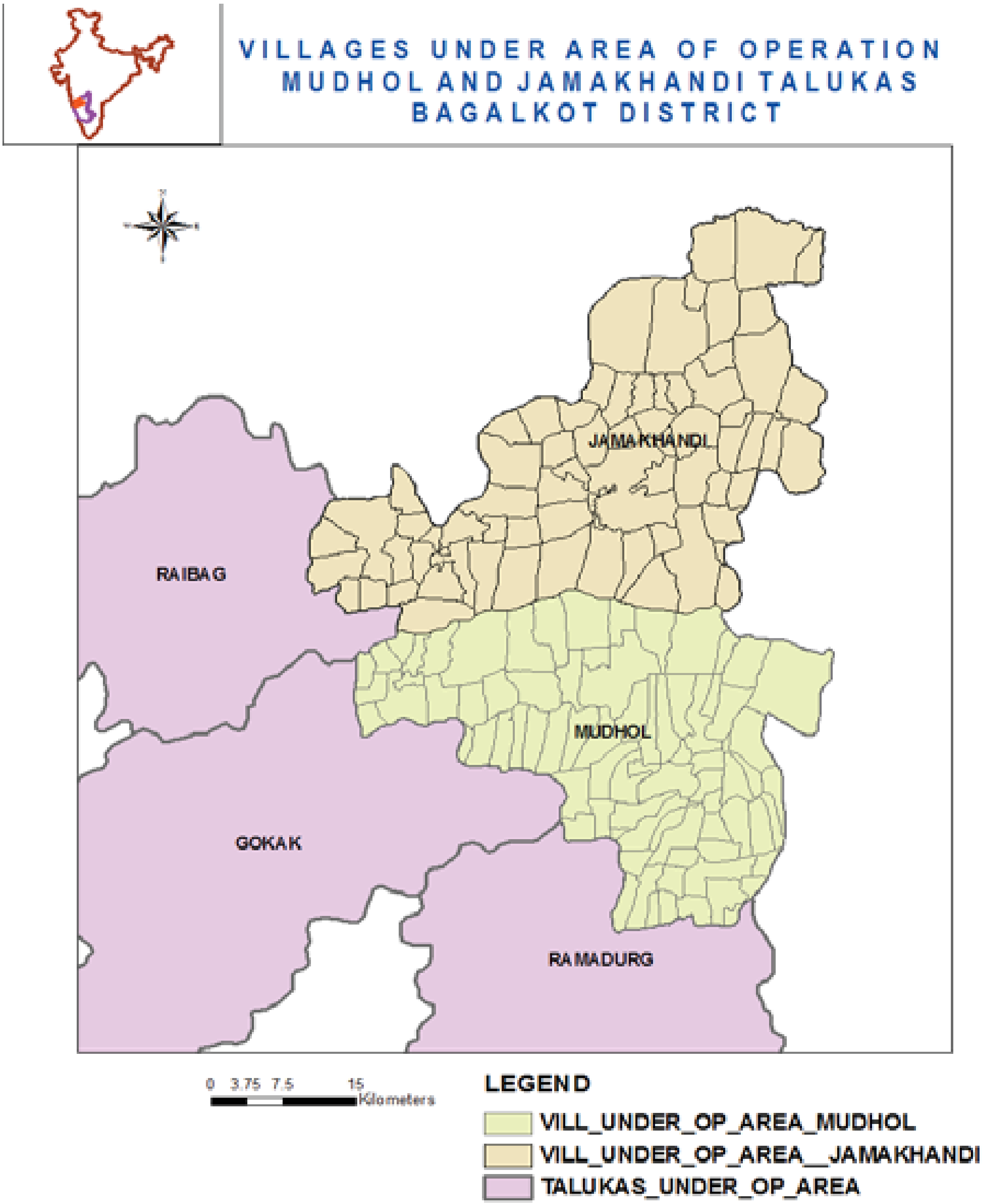

FIGURE NO. 2.4 : Villages under Operational areas of Talukas Mudhol and Jamakhandi

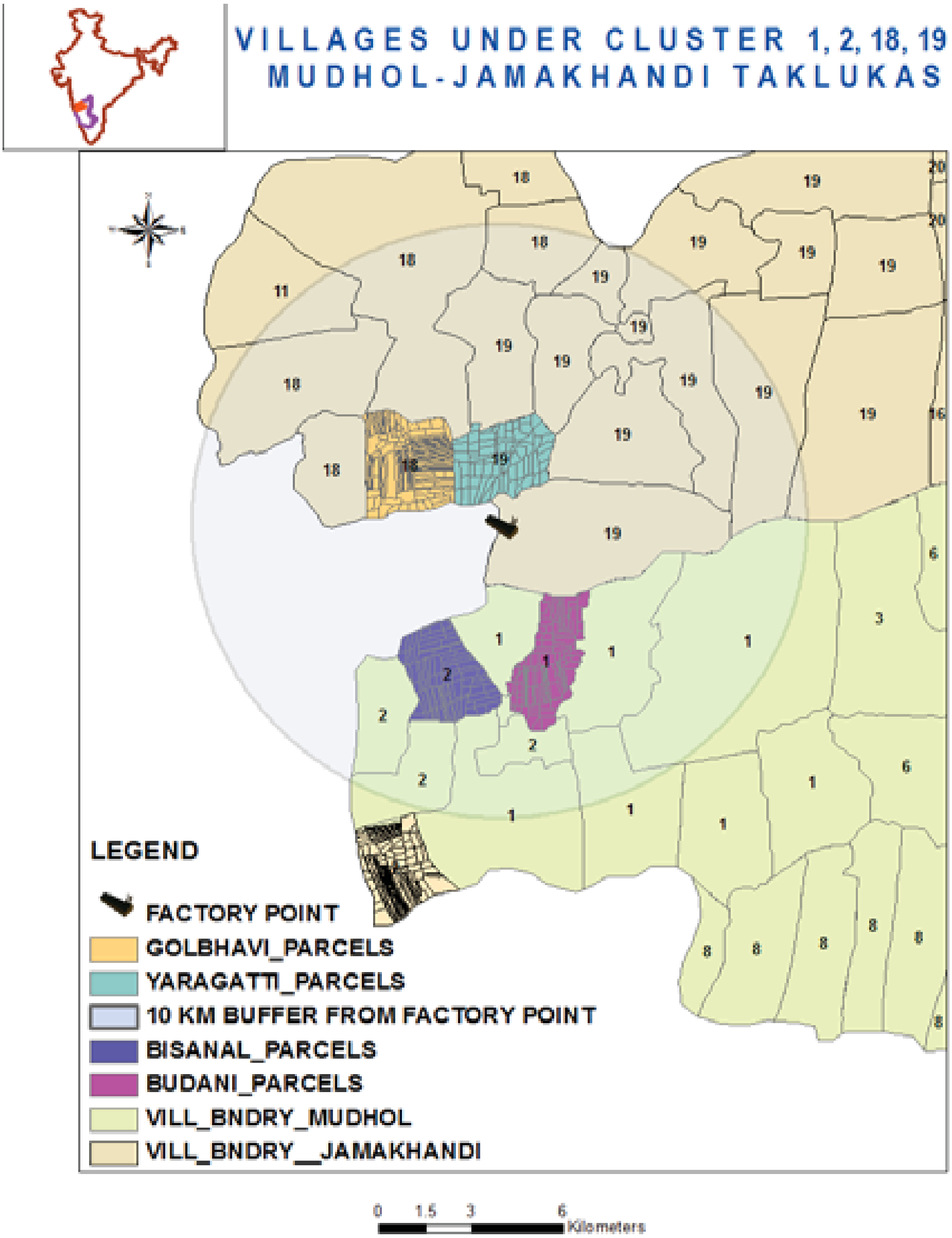

FIGURE NO. 2.5 : Parcels within the 10km radius buffer from factory Point - Mudhol and Jamakhandi Talukas

FIGURE NO. 2.6: Total Survey Area per Parcel,Village Bisanal, Mudhol District

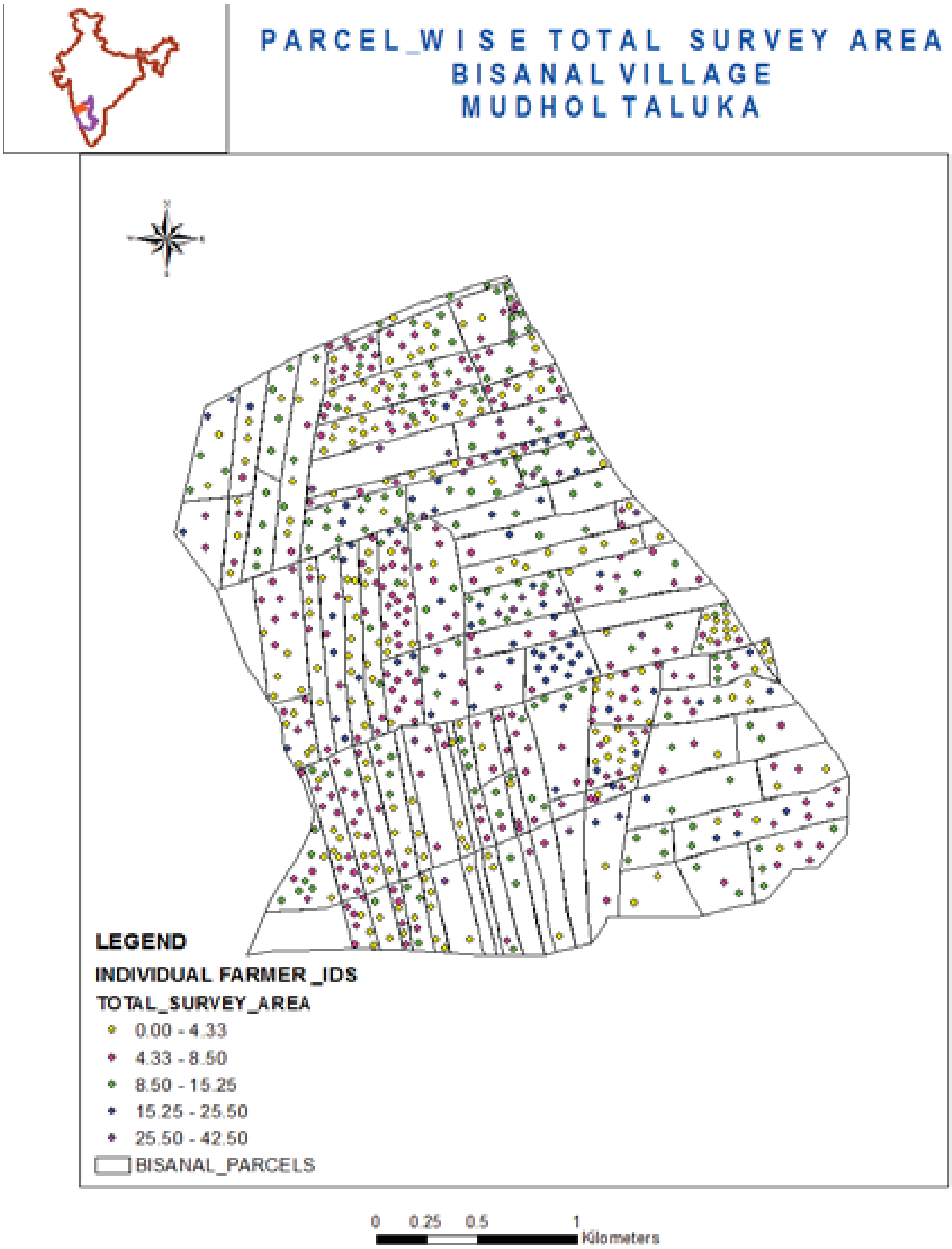

FIGURE NO.. 2.6: Total Survey Area per Parcel,Village Bisanal, Mudhol District

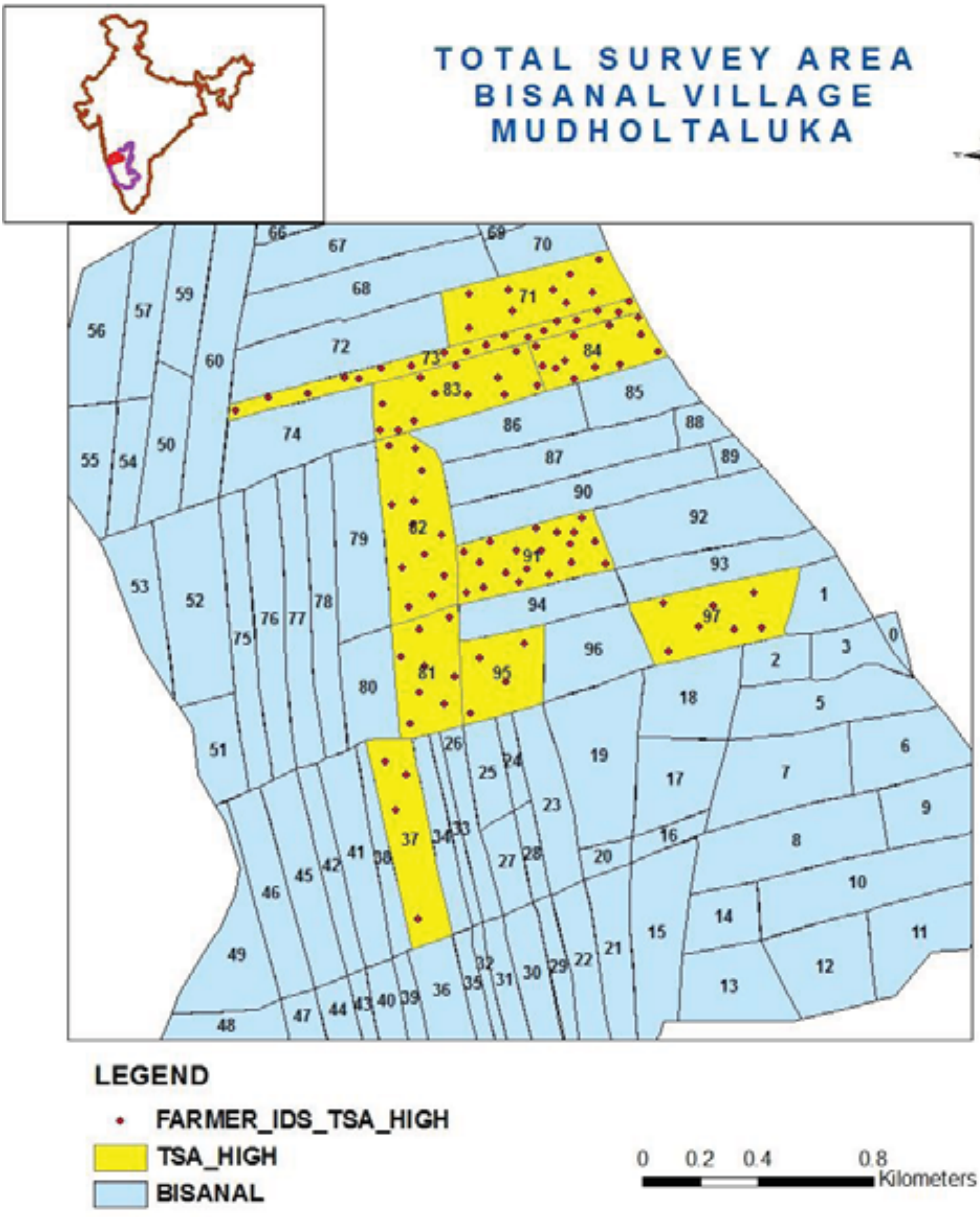

FIGURE NO.2.6.1

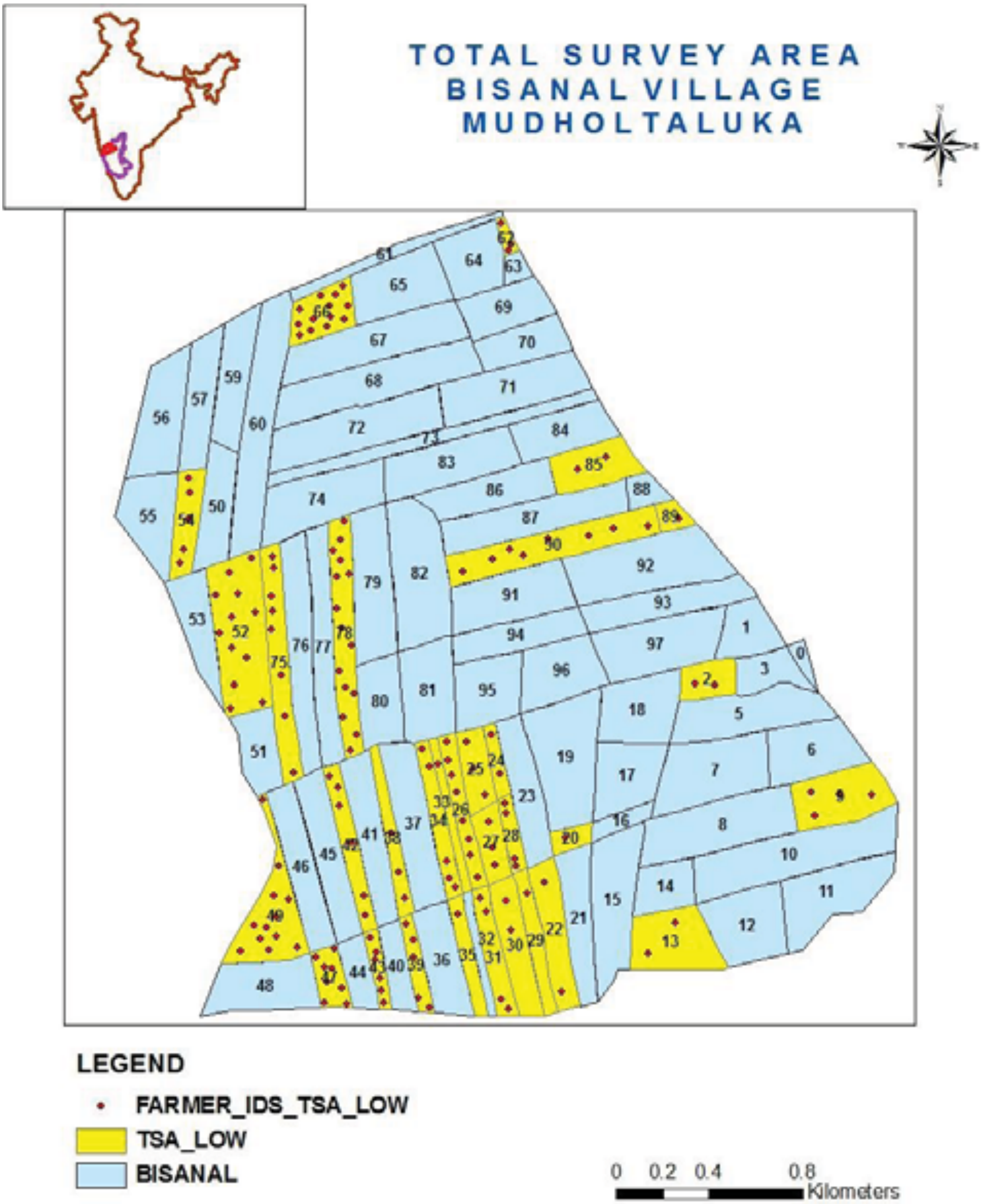

FIGURE NO.2.6.2

3.0 METHODOLOGY

The methodology broadly consists of preparing a geospatial database of the individual villages containing parcel boundaries and land holdings. These are linked to the farmer database in which each farmer is assigned a unique identification code. It is important to note that a farmers land holding may be geographically disparate but the link is maintained by using a one- is – to – many relationship. This enables quantitative data of the crop yield to be credited to the appropriate farmer. One peculiar aspect that has to be taken into account is that the farmer may not devote his entire land holding to a single sugar mill. In the database these subdivisions are referred to as Cane area, Harvest area and Disposal area. Cane area is the total area under cultivation, Harvest area is the area from which the yield is supplied to a particular sugar mill and Disposal area is usually reserved for the cultivation of some other rotational crop.

3.1 SOFTWARE USED

ArcGis9.3.1 was used in the analysis.

3.2 PARAMETER CALCULATION

The crop yield per farmer *(YPF), (*Figure No.3.1, Figure No.3.1.1, Figure No. 3.1.2) is calculated taking into account all three types of subdivisions within the land holding f

$$\textbf{Crop Yield per Farmer (YPF)}\ \textit{(tons/acre)} = \frac{\textit{Total Tons of Cane Area}}{\textit{Cane Area + Disposal Area + Harvest Area}}$$

Farmer Loyalty Factor *(FLF), (*Figure No. 3.2, Figure No.3.2.1,Figure No. 3.2.2) is calculated using the following formula:

$$\textbf{Farmer Loyalty Factor (FLF)} = \frac{\textit{Yield + (Disposal Areax40)+(Harvest Areax40)}}{\textit{(Disposal Areax40)+(Harvest Areax40)}}$$

The maximum crop yield is approximately 122 tons and the maximum FLF is 2.5. It now becomes possible to generate a geospatial thematic map showing the relationship between crop yield and Farmer Loyalty.

If a farmer supplies entire yield to the factory, he gets a farmer loyalty factor of 2.5.

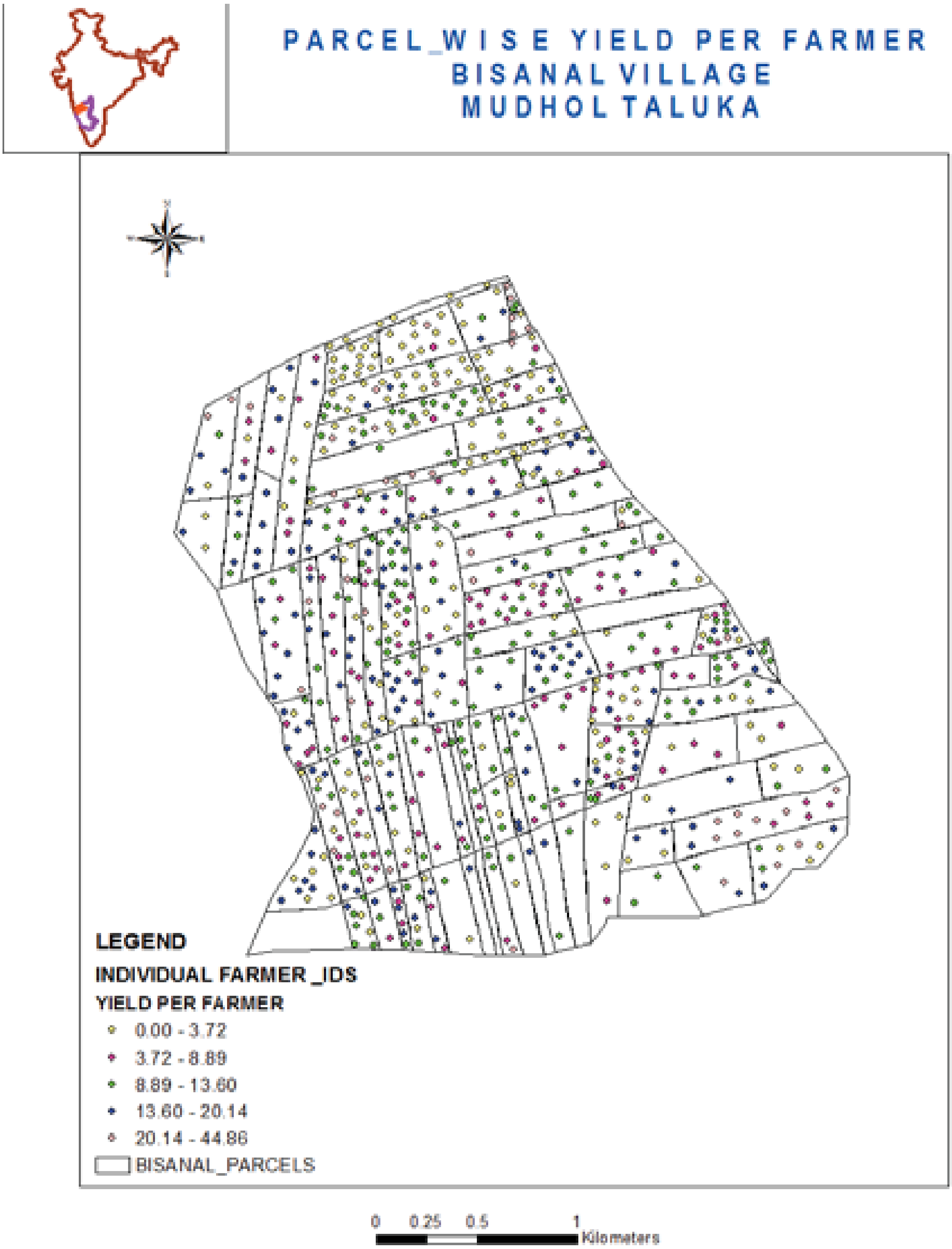

FIGURE NO. 3.1: Yield Calculations Per Farmer, Bisanal Village, Mudhol Taluka

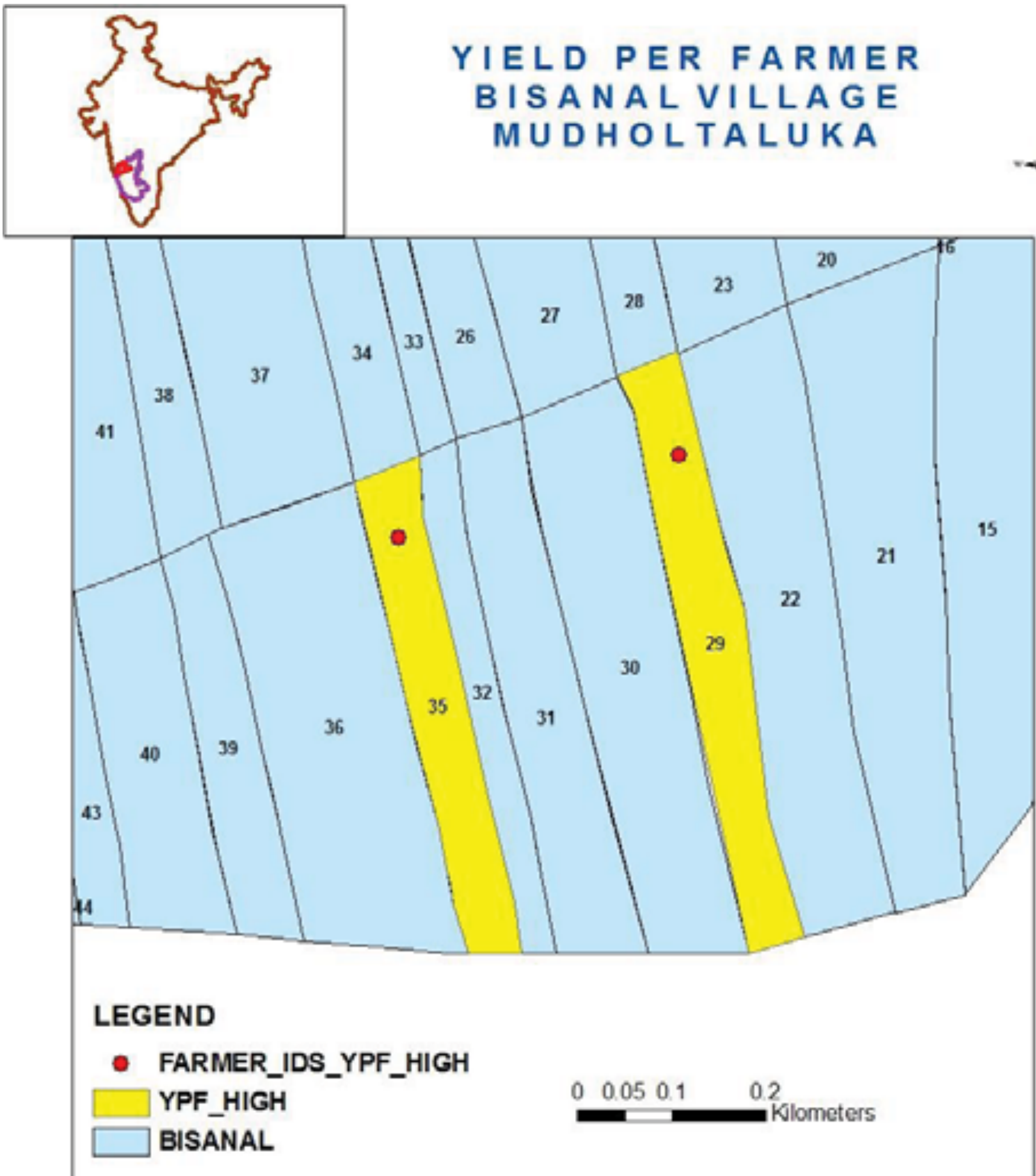

FIGURE NO.3.1.1

Fname	UID	Sy_Area	TSA	Tonnage	YPF	FLF	cane_Area	Har_Area	Disposal_A
MANG BASAPPA LAXMAPPA	1235	2	3	18.8	18.8	1.94	0.5	0.5	0
HOSUR SANGAPPA MADIWALA	1229	0.75	4.5	55.106	15.75	1.79	1.75	1.75	0

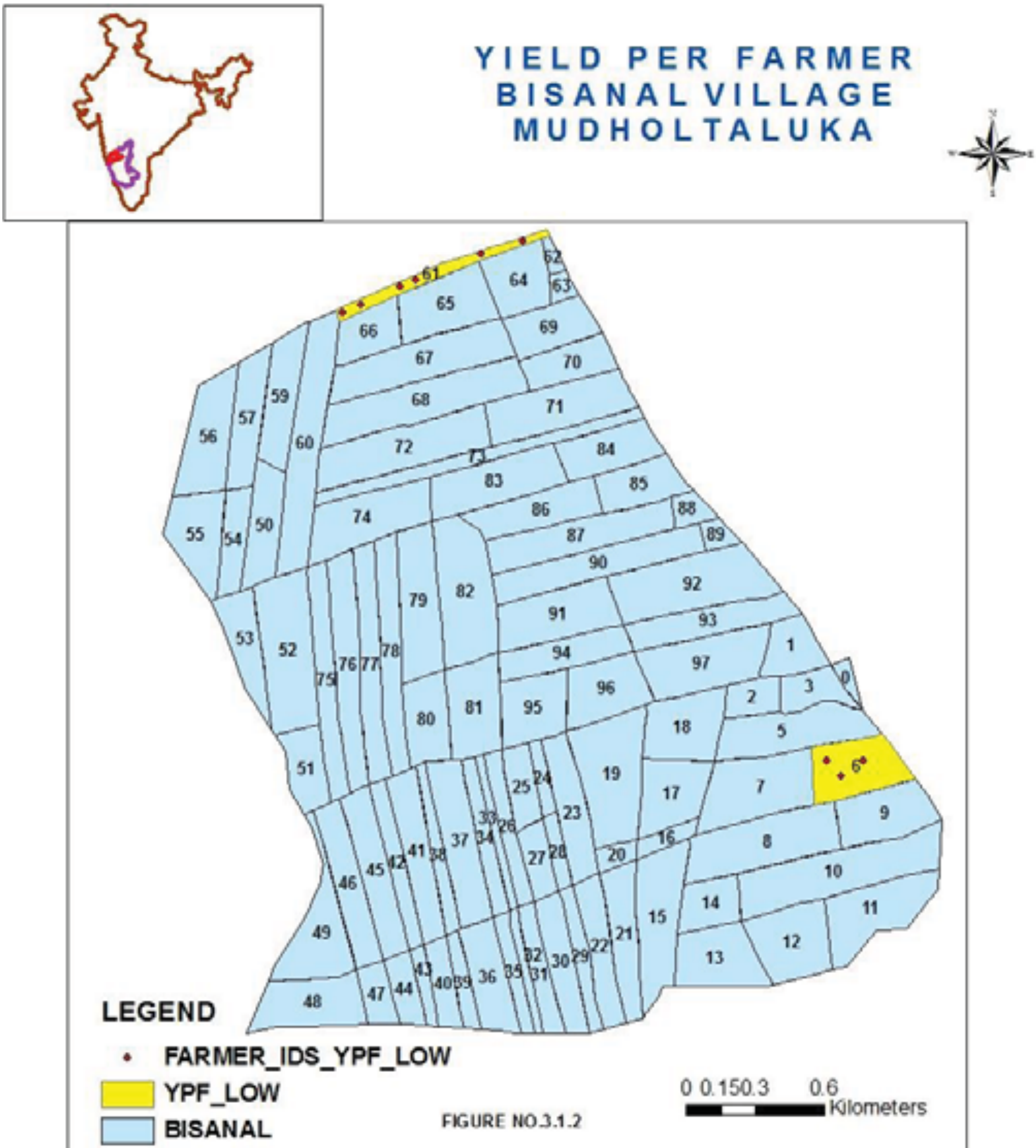

FIGURE NO.3.1.2

Frame	UID	Sy_Area	TSA	Tonnage	YPF	FLF	cane_Area	Har_Area
VAJJARAMATTI MAHALINGAPPA	126/3	1.5	10	0	0	1	1.5	0
CHANNAL GANGAPPA BASAPPA	1226/2	0.75	5	34.001	5.67	1.28	3	1
VAJJARAMATTI MAHALINGAPPA	126	2.5	10	0	0	1	1.5	0
ULLAGADDI BASAPPA SHIDARAYAP	1261	4.75	6.75	0	0	1	0.75	0
ULLAGADDI MAHADEV SATYAPPA	1261	1.13	5.88	16.241	2.09	1.1	3.88	1.5
ULLAGADDI SIDARAYAPPA MALLAP	1261	0.75	12	0	0	1	4.75	0
ULLAGADDI RAMAPPA MALLAPPA	1261/1	1	1	0	0	1	1	0
ULLAGADDI SIDARAYAPPA MALLAP	1261	6.5	12	0	0	1	4.75	0
ULLAGADDI SIDARAYAPPA MALLAP	1261	1.75	12	0	0	1	4.75	0

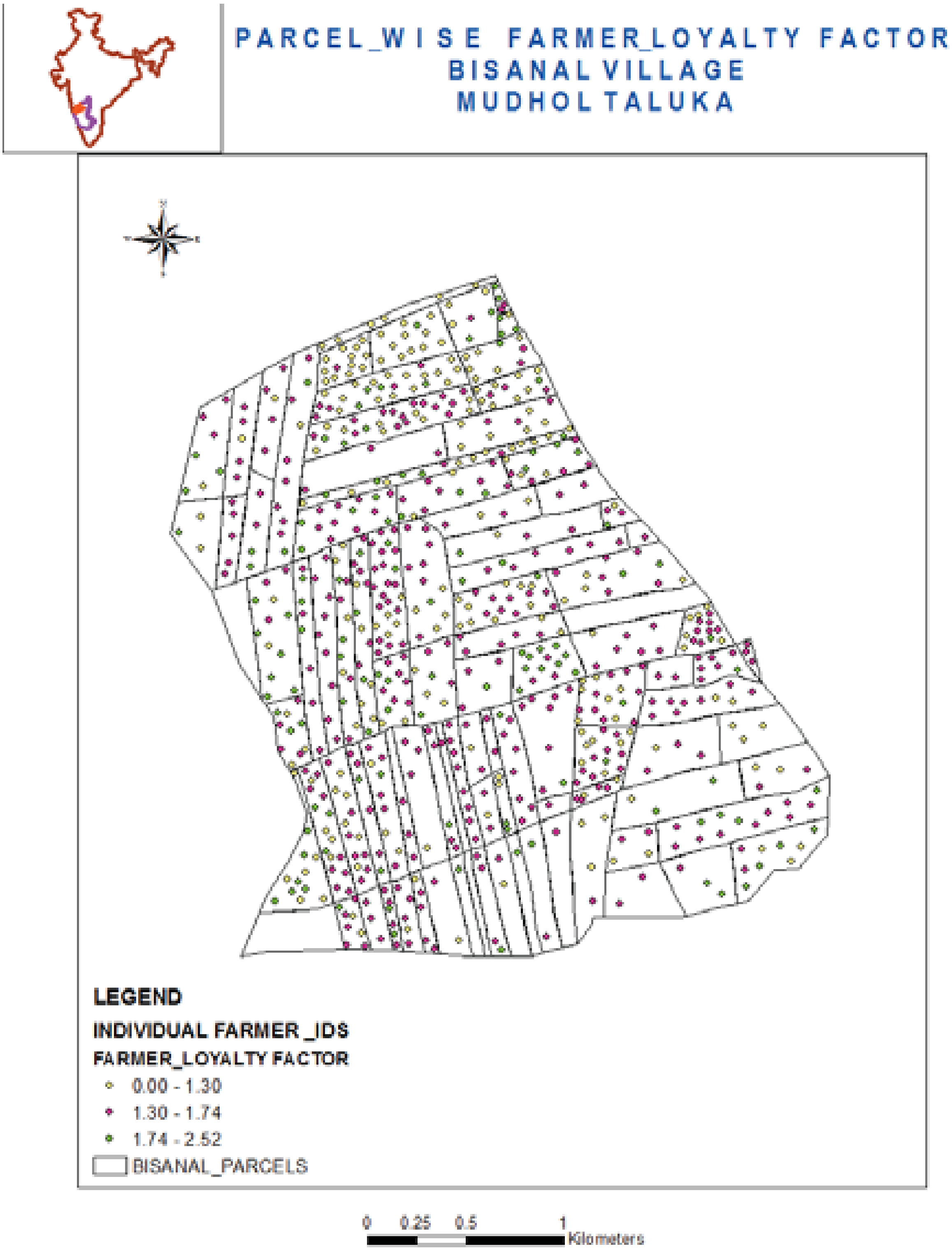

FIGURE NO.3.2: Farmer_Loyalty Factor, Village Bisanal, Mudhol Taluka

FARMER LOYALTY FACTOR
BISANAL VILLAGE
MUDHOL TALUKA

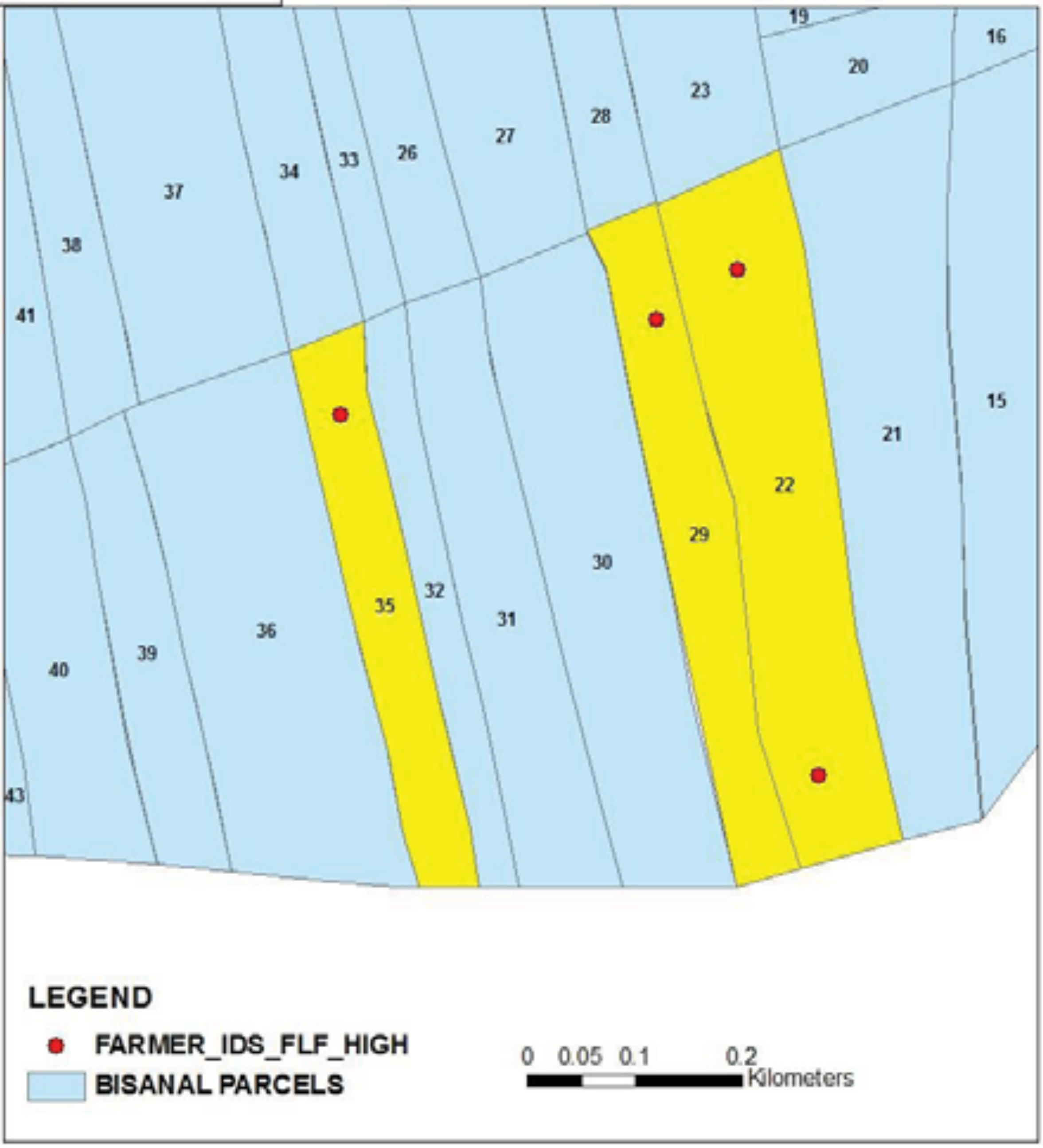

FIGURE NO. 3.2.1

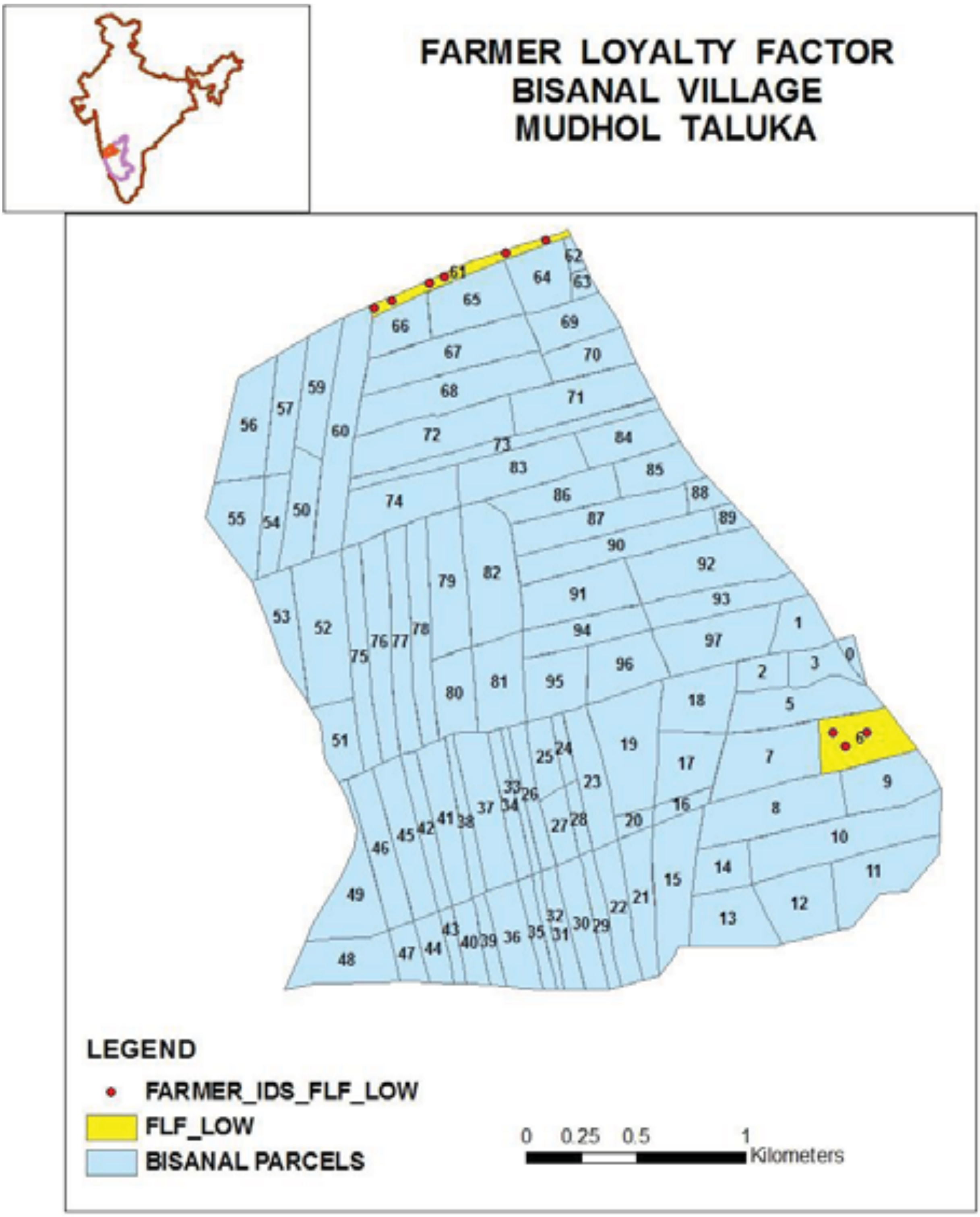

FIGURE NO. 3.2.2

4.0 CONCLUSION

Using geospatial analytical techniques we have been able to identify farmers who have produced high yield of the cane crop and have therefore been awarded high loyalty factor. The rewards accorded according to two categories (A) & (B) :

Award Category (A)

- Fertiliser at subsidised rates
- High quality seeds at subsidised rates
- Financial assistance
- Enrolment in Kisan Khazana (farmer reward scheme)

Award Category (B)

- Same as in (A) but with lower subsidies.

As a future extended study it is proposed to geographically map various generations of crop. These are referred to as Ratoon1, Ratoon 2 and Ratoon 3. These generations although of an inferior sugar content are also important because they help the factory in catering to fluctuating market needs. For instance when the price of sugar per quintal is high it can be earmarked for exports thereby generating high revenue.

In conclusion this paper demonstrates the enormous computational power of GIS and its application in enhancing the economic status of the farmers.

ACKNOWLEDGEMENTS

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