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Role of GIS in Land Consolidation

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Abstract: ***The agricultural structure existing in Haryana for centuries has contributed to highly scattered agricultural parcels and improper land registration. Land records existing in Haryana are very old and unreadable, they are even not updated. Distribution of land resources has resulted in the situation, when almost 50% of farms are not involved in market production; this means that significant part of agricultural production do not reach the market in the existing agricultural structure. One way for solving those problems is land consolidation. Land consolidation will result in reduction of land parcels in farms and shape modification. This in turn will improve effectiveness of farming, through decrease in cost of transport and facilitate mechanization of farming. The aim of the study is to support the decision making process related to land consolidation work, by providing re-allotment design of plots by the use of GIS techniques. Base maps are prepared with appropriate measurements which work as a skeleton to do measurements of re-allotment design plan on field for land consolidation of the study area. They are used for easy demarcation of village boundary, give reference points on ground and dividing the area into equal parcels known as killas and murabbas according to new plot design***.

Keyword: Land consolidation, killa, Murabba, sajra, GIS

1. Introduction

Land is a finite, non-reproducible consumption resource held as a source of livelihood and a financial security transferred as wealth across generations [1]. In India we have right to property and inheritances thus the property of predecessors are inherited by successors. Consequently, land has to be sub-divided among the successors after the death of the predecessor. Population growth, dysfunctional land, credit and commodity markets in rural areas, inheritance law are major causes of this land fragmentation [2][3]. Thus the lands were divided into small patches and scattered over a larger area. Poor farmers lose considerable amount of bullock and human energy moving from one plot of land to another. Further, it is impossible to adopt modern scientific cultivation in tiny pieces of land. Modern machinery like tractors, pump sets cannot be applied to those small pieces of lands. On the other hand agricultural house hold also increases the cost of cultivation as each of the households has to maintain bullocks, equipments and spend more times for supervision of scattered plots. All these have adversely affected the agricultural productivity. Keeping this in mind Government has tried to consolidate the holing through laws. Consolidation of land aims at bringing together the small scattered pieces of land into compact units. At farm level, effective implementation of land consolidation policies can increase labor productivity and lower transportation cost for inputs and outputs [4] reduce cost of irrigation and land conserving investments, soil erosion as well as potential land disputes and negative externalities [5][6]. Consolidation of land will help in saving bullock and human energy and lowering operational cost of cultivation. At house hold level, land use consolidation drives to large scale crop production when combined with appropriate crop rotation, which in turn, allow farmer to produce both for food subsistence and for markets [7]. Furthermore, plot consolidation reduces income inequalities [8]. Cognizant of the fragmentation of agricultural land as a problem, earlier studies have documented the importance of land use consolidation to alleviate poverty and encourage efficient agricultural production [9]. Development researchers such as [10]; [11]; [12] observed that fragmented, scattered and depleting landholdings have led to rapid competition for land and land disputes, creating social tensions. Some State Governments have started consolidation work since long.

Land Consolidation process consists of the following steps:

1) Adjudication
2) Awareness campaigns-initiation
3) Interview with the owners
4) Inventory of cadastral maps and land registry map
5) Valuation
6) Elaboration of plan
7) Survey of the new boundaries
8) Decision making.

The main objective of the study is to make the process of land consolidation easy, fast and accurate with the help of GIS techniques. Land consolidation will further help in easy access to cadastral register and maps, land register and to keep this information up-to-date. Calculation of the values of stands properties and land owners shall be easier. GIS will help in the elaboration of the re-allotment design and the analysis of alternative designs at a much faster rate than manual survey method for land consolidation of the concerned village.

Haryana state uses graphic land records depicted in Mussavies (part of a village map). 1 mussavi is composed of 16 murrba and 1 murrba composed of 25 killa. Each Killa is represented by positive integer starting from 01(one) to 25 (twenty five). Killa is the smallest land parcel further divided to title change and mutation. In that case, killa is represented by BATA viz 22/1, 22/2, 22/3… etc. 25 killa representing (1) one murrba which are also represented by positive integer continuing throughout the mussavi. The total number of murabha in mussavi will depend on the shape and area of the hadbast. These killa and murrbas are rectangular in shape of fixed dimensions and area as shown in the table below.

Table 1: Land Units

Sr. No.	*Land Units*	*East to West Dimension*	*North to South Dimension*	*Unit {01 Karam = 66 inches (5.5 feet/1.6764meter)}*
1	Killa	40	36	Karam
2	Murrba	200	180	Karam
3	Mussavi	800	720	Karam

2. Study Area

The villages which previously protested against land consolidation are the poorest one and have low land value. This is due to improper management of land. My study area consists of one such village named Nindana which is under Maham Tehsil of Rohtak district, Haryana, India. It is Haryana's one of the biggest village (as seen in figure 1).

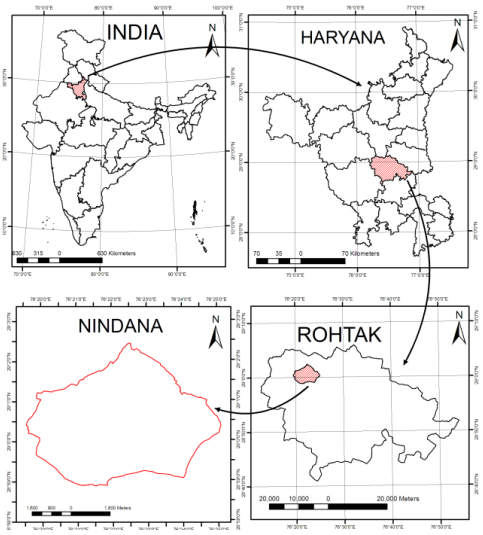

Figure 1: Study Area

It is located on the Gohana to bhiwani road and is surrounded by Kheri Meham, Farmana Badshapur, Farmana Khas, Bheran, Ajaib, Bainsi, Shekhpur Titri villages. Nindana lies within the coordinates 29°0'31"N and 76º22'91"E. It has a total population of 11553. It has a total area of 36sq km according to official record.

Data Used

Satellite data – World View-II multispectral
Software used – Arc GIS 9, Microsoft office 2007
Other data – Mussavi of the concerned village and ROR data of the surrounding villages which were collected from Revenue department

3. Methodology

Musavies are scanned and cropped with Arc Map 9.3software. They are then mosaic to form the complete village map (Sajra) as shown in Figure2.

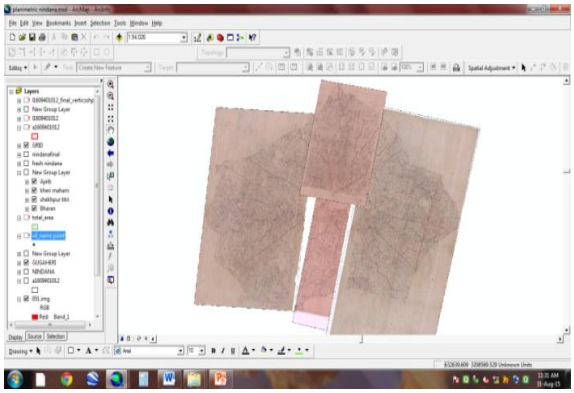

Figure 2: Showing scanned copies of mussavies of the village

This is done as it becomes easy for us to work with the data on computer and also it works as a permanent data for further use. With the help of the sajra and dimensional information in the field book (Khasra Paimaish) available from revenue department, dimensional digitization is done. It is then georeferenced with the satellite image. Thus the Cadastral Map of Nindana village as shown in figure 3 and figure 4 is made, which provides us the information of the existing land owners and their field position with details.

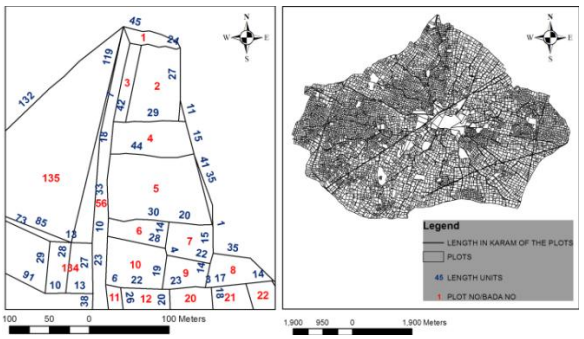

Figure 3: Generation of cadastral map form mussavies

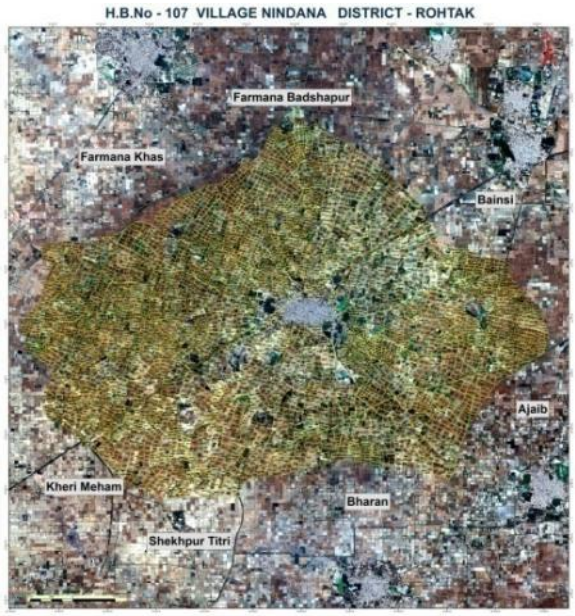

Figure 3: Cadastral Map georeferenced with satellite image

The cadastral maps of the surrounding villages are then overlaid on satellite image and spatial adjustment is done. Taking the grids of killa and murabba lines of the surrounding village as reference lines, the inner circumscribed village area is divided. The killa lines of the surrounding villages are extended and joined to create a network of killas and murabba grid structure. The attribute of the killas and murrabas so formed is same as that of the surrounding villages. Thus the reference killa and Murabba grid map as seen in figure 4 of the study area is generated.

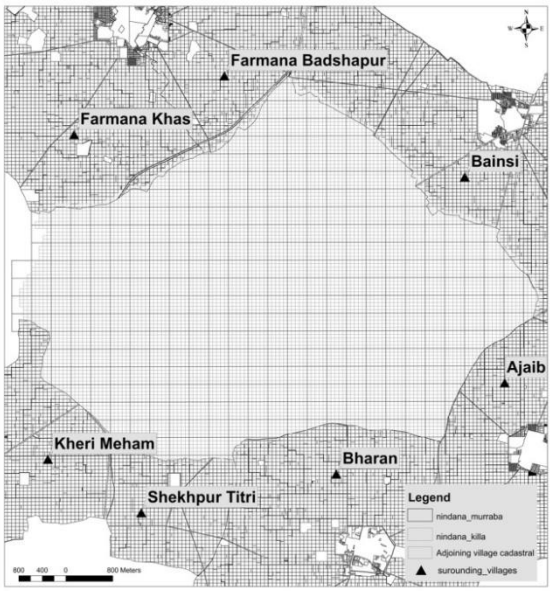

Figure 4: Killa and Murraba grid map

The last step is known as Kaiami. It is a process of fixing some permanent structures or control points which can easily be identified in the satellite image as well as in the field. For example a school boundary or water work boundary. These structures are digitized, demarcated and then there dimensions are marked. The distance of these structures from the adjacent killa is also marked.

Permanent structures like roads and canals are also marked and there distance from the reference killa grid is shown. The boundaries of the surrounding villages are marked from the cadastral data of the respective adjacent village. Since the surrounding villages are consolidated before hand and taking into consideration that the measurements are correct the cadastral maps of the surrounding village is used to demarcate the boundary of Nindana Village as seen in figure 5.

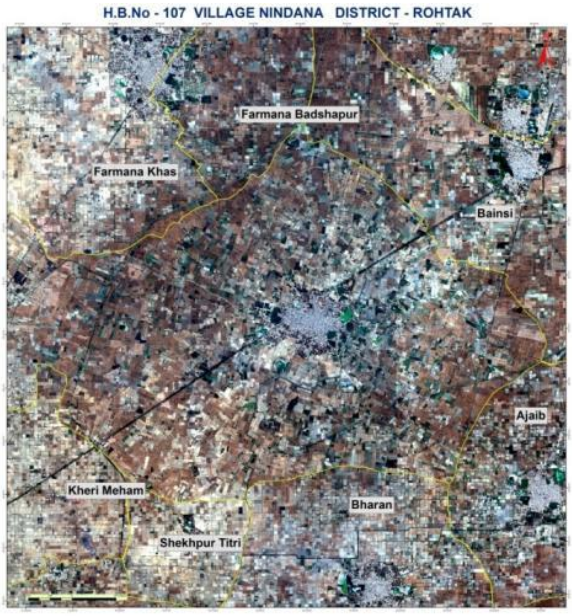

Figure 5 - Map showing village boundary of surrounding village

This helps to give the position of the village boundary. Thus the kaiami map is generated as seen in figure-6 and figure-7 which have all the necessary structures and there distances from the nearest killa junctions.

Figure 6: Map showing Kaiami of Nindana

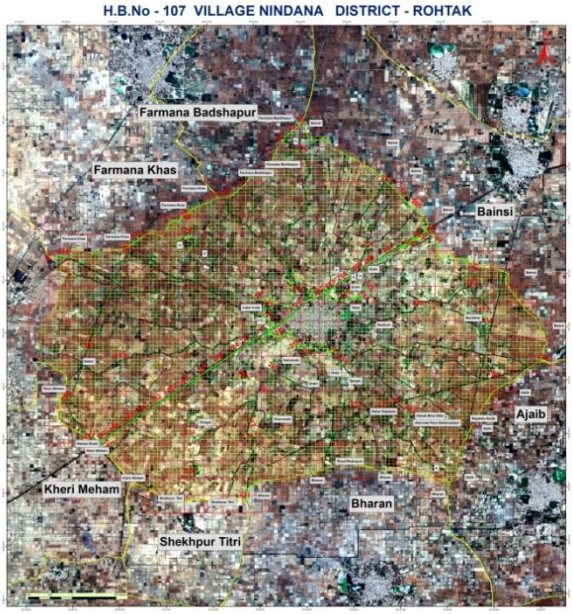

Figure 7: Kaiami Map of the village

4. Result and Discussion

Previous records in mussavies or the trace copies (Lathas) are damaged and illegible. These maps were generally drawn on cloths. The sajra map which is composed becomes an electronic document and can be saved and preserved for future use. Hundreds of copies can be generated from the electronic document thus made and preserved. This map is rather used as a reference map to see the older position of land owners along with their respective land measurements of the Nindana village.

The Killa and Murraba grids which are generated, helps to systematically divide the village land into rectangular blocks,

which is a very important part of land consolidation. It acts as a re-allotment design of the plots. These grids will be numbered systematically in later stage and help in calculating land valuation of each land owner.

Based on the land value they shall be provided new lands of rectangular shape of equal value and a unique Killa numbers. The cadastral map which is prepared by dimensional digitization from the sajra gives us the details of land holders. Apart from that, it gives actual measurement as per ground reality. The area of a single land parcel can be easily calculated and can be cross checked with the values inscribed in field book. Missing values of a particular side of a land parcel can be recovered by tallying with the adjacent land parcel area. Thus giving a complete sajra of the village free of errors and missing values. This sajra is later on used in the field for verification from the land holders and registering the values permanently in government document or we may say the later processes of consolidation of land.

The Kaiami map acts purely as a scale to make the killa grids and murabba grids on ground. The actual ground distance of a permanent structure is matched and the junctions of the killa and murabba grids are demarked in the field.

5. Conclusion

Remote Sensing GIS helps in accurate land parcel location and also generation of missing data. The time consumed to do so is also very less. The sajra map which is composed becomes an electronic document and can be saved and preserved for future use. On the other hand Land consolidation helps in better land shape, better agricultural use of land, improve effectiveness of farming, through decrease in cost of transport and facilitate mechanization of farming. Land consolidation also increases land value by giving better road and housing system. Not only so Land consolidation helps in over all better land administration. Green Revolution or Harit Kranti in India was the result of land Consolidation. GIS Remote Sensing helps all this occur accurately and in a better planned manner. So the method was quite useful for the administrative level to carry on their work in a more methodological way.

Acknowledgement

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Author Profile

Monalisa Mitra received B.Sc and M.Sc degree in Geology with specialization in Hydrogeology, Remote Sensing GIS from Burdwan University, India in 2009. Joined as Project Assistant at Oceanography Department, Jadavpur University and worked there till December 2010, later joined West Bengal State Council of Science and Technology, Department of Science and Technology, Kolkata, Government of West Bengal as JRF. Presently working as Project Assistant at Haryana Space Application Center, India