

Digital Data Creation for Property Tax Management

Anu Singh

Suresh Gyan Vihar University

Shruti Kanga (✉ shruti.kanga@mygyanvihar.com)

Suresh Gyan Vihar University <https://orcid.org/0000-0003-0275-5493>

Research Article

Keywords: Property Tax, GIS, Geodatabase, Spatial Data, Decision Support System

Posted Date: July 12th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-40155/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

In India, the municipal corporations are facing issues in property tax collection and major reason for it is lack of count of assessed properties under its jurisdiction. Also the storage of information of the properties are majorly based on manual efforts which lead to data redundancy and failure to appropriate tax collection. The study has been carried out in the Hauz Khas Ward, South Delhi Municipal Corporation, Delhi. The purpose of this paper to develop spatial database for the property tax management which include capture of building footprint, road, land use such as Parks, paved area, Drains etc and demarcation of boundaries such as locality, slums etc on basis of regular grid net with cell size of 250 m by 250 m. Along with this, to create a unique no. to each building polygon called BUID (Building Unique ID) to provide individuality to each polygon. This data will be useful for the collection of information of properties related to property evaluation parameters for tax calculation through ground survey.

1. Introduction

Property tax is a levy on property that the owner is required to pay to the governing authority of the area where property exist. For any development, Property tax is one of major source of income state or country to cover the expenditure of development (Pavi, 2011). The local or municipal authorities are bound for the development of their administrative and without capital, it became a challenge for them. Apart from that, taxation can be used as urban management tool which can track land use, urban expansion, land market and transactions related to properties (Kundu & Ghosh, 2011).

As a matter of fact, for property taxation, location is foremost as it matters to unit value for tax calculation. Location of property as a spatial attribute of property is crucial for analysis or estimation of many studies related to property or urban management. Earlier, It was very difficult to identify the impact of location on land value as determination of accurate location was very challenging (Stylianidis, 2009). Nowadays, using GIS there are many techniques to analysis spatial attribute of any entity (Arbia, 1989; Tomlin, 1990; Huxhold, 1991; Star & Estes, 1990). Also, GIS mapping is of great significance in scientific, research, planning and management. GIS is not a standalone method. To achieve desired result, it require hardware, software and human effort (Arnof, 1995). GIS technologies are capable of handling large volumes of data from multiple sources, integrating them to produce information in a spatial context in the form of maps, and models (Fedosin, 2014). Applying GIS based municipal information tools can lead to solution of these data management problems. Thus GIS can be an extremely useful tool for municipal planning and decision-making that involves evaluation and assessment of assets. Not just the worldwide but in India also there are many local and municipal government such using GIS as decision making tool to design and support development programmes (Farooqi, 2014).

In Delhi, calculation of property tax is on basis of unit area method. Since 2004, the collection of property tax has been moved to self-assessment method. Since then the no. of assess properties has been decreased (Simanti, 2013). Also because it is self-assessment basis, MCD have information for those properties only which have filed the property tax. The properties which have never paid tax, have not come under the notice of MCD. So the primary concern it to create a database of all the properties comes under tax net of MCD by capturing all the building under the jurisdiction boundary. The unit for the tax calculation depends on the category of colony which vary from A to H. This category of colony depends on the infrastructure of the colony such as type road, drainage etc. Again for this evaluation, the municipal evaluation committee depends on manually documented information. The spatial digital data will be more feasible and reliable for these kind of decision making system.

However currently, the municipality do not yet have adopted GIS technology. It is very important to make them aware of how powerful tool GIS can be to support and facilitate planning and many decision-making at the municipal level. This paper is focusing on creation of spatial database of consisting multiple layers which can interact each other on GIS environment, can store information from other sources, have capabilities to provide solution through various ground reflective analysis and easy to access through any intranet or internet application. The current technologies have potential to design enterprise GIS for municipalities that can customise attributes and geospatial data with spatial and non-spatial models and operations to create a service oriented architecture from Geo web services (Samadzadegan, 2008).

2. Literature Review

Property tax collection has existed since ancient times, and land tax assessment has been a foundation of open funds in both Europe and Asia through many years. It has all but ceased to be a significant revenue source in any part of the world (Ehtisham et al., 2014). In India, tradition of taxation been followed from the Mughal period and in 1901, during British India, taxes of land were more than half of the total revenue tax which was about 5% of GDP (Borsio, 2014). Later on, as per Government of India Act 1935, control of property tax comes under the elected state government and other modern tax such as income, customs and exercise come under Central government. The political strategies changed, as the elected political representative don't show concerns taxing local vote. There was therefore pressure on the Centre to use its instruments, and to feature to the quality of the colonial power. This leads the fall of property tax and as result in 1947 it was just 7% of total revenue.

For any local or municipal body, property tax is reflecting the relation between the types of services financed at the local level vs the benefit to property values, so it is considered as a good tax Slack (2011). Unfortunately, Property tax is most hated tax by taxpayers. One of the reasons is that tax rates are different for the residential and non-residential properties, to make it unpopular among citizen. The other reasons for unpopularity as it is visible tax or can say direct tax and transparency of its expenditure is not very visible. The other reason is that it is an inelastic tax, which does not increase automatically over time. Again, increasing the tax rate to increase tax revenues will lead greater taxpayer resistance. In addition, most important, poor administration is major reason for its fall, which affects not only the revenue collection but also on the equity and efficiency of the revenue.

Any given local governing authority which is collecting tax face on following issues: Large number of properties are not taxed because of the loopholes, inexplicable and expensive issues barred new properties to bring into the taxation regime, Outdated mapping of properties, Compliance of laws, Mismanagement of the information and technology, Inadequate staff and equipment (Nieminen et al., 2002). In most of the developing countries, the most

common problem is growth of illegal land subdivision, which causes growth of urban sprawl as unauthorized or unapproved colonies. The study also brief the reason of this rapid growth of unauthorized colonies on the point of buyer, colonizer and political aspect which shows inefficiency of governance in reference of management, policy implementation, poor economic structure, corruption and political influence. The recommendation has been given in term of regularization of Policy objective and Process and implementation of scheme, Penalization charges, Property & Vacant land tax, Level of Awareness, Alternate Scenario for Regularization, Land Registration, Purchase and Sale of land, regulations of Building byelaws, Identification of unauthorized colonies(Swain et al., 2016). It can be outlines that major issues behind the lesser taxation of properties are lack of complete database having data of properties in term of spatially and non-spatially information with the capability of transparent interaction with both government as well as citizen.

Considering the issue, GIS is a modern technological tool for effective and efficient storage, retrieval and manipulation of spatial and non-spatial data for deriving scientific, management and policy making information (Mathur et al., 2009). It has the capabilities to supply statistical and spatial record and capability for creation of base-maps, formulation of designing proposals and to act as monitoring tool during implementation phase of any planning scheme (Gupta et al, 2001). Integration of IT and GIS has capability to modernize the current process of Government (Garg, 2015). Geographical information System has been successful used for the count of properties under concerned jurisdiction by few urban bodies, which result improvement in revenue. The record of the property should be kept on the categorization of properties based on its usage such as commercial, health, education and its exemption such as religious, charitable of government so that it will be feasible for the study of tax assessment. Other important part is gap between tax billing and collection. Using CAD or ESRI platform software the data can be store in one spatial database as feature dataset enable with access through the structured query based language, both geographic as well as its attribute.

3. Objective

The aim of this study to capture land use such as building footprint, Roads, Drains, parks, location boundaries etc under the jurisdiction of Hauzkhas Ward, South Delhi Municipal Corporation in GIS environment. All feature will have independent layer with attribute fields which are essential for municipal decisions for management planning and understanding of real time consequences.

- ◦ STUDY AREA

Delhi is located at a latitude of 28°34' N and a longitude of 77°07'E having an average elevation of 233 m (ranging from 213 to 305 m) above the mean sea level. The NCT has three local municipal corporations: Municipal Corporation of Delhi (providing civic amenities to an estimated 13.78 million people), New Delhi Municipal Council (New Delhi) and Delhi Cantonment Board. Total geographic area of Delhi is 1483 sq.Km (Rural-689 Sq.Km, urban- 624 Sq.Km and forest- 170 Sq.Km.).

Recently Delhi Municipal Corporation of Delhi has been trifurcated into three smaller Municipal corporations - North Delhi Municipal Corporation, South Delhi Municipal Corporation, East Delhi Municipal Corporation.

Among all the corporations, South Delhi Municipal corporation is the largest one having area of 667.38 Km Sq. The South Delhi municipal corporation is further divided into four zone and 104 wards. Hauzkhas ward (Ward No.62S) falls under South Zone of South Delhi Municipal corporation. It consist of planned, unplanned as well as commercial properties.

- ◦ DATA AND SOFTWARE USED

For this study primary concern is building as it is basic for property tax calculation. To have a good visual interpretation, for this study World View -2 has been used. The resolution of world view is 0.5 met which is good enough for the interpretation of building edges and partitions. Visible feature like Building, Land-cover, and Drains can be capture with the image but demarcation of localities is not possible with it. For interpretation of localities, blocks, colonies other sources such as google and Eicher maps are very much useful. For this reason, reference of Eicher map (2007) and Google map has used. For this task, Arc GIS (ver-10.1) which is an ESRI suit platform has been opted.

4. Methodology

As clear as objective, to create the spatial database, all the required entity has been captured stored in stored in geodatabase. Other possible attributes has been depicted in the related database using secondary input data i.e. Google and Eicher. Below illustrated diagram is high overview of the methodology.

To achieve the desired database, following are the major steps involve in this task.

1. Design of Geodatabase
2. Attribute Design on the basis of objective
3. Identification and digitization of feature.
4. Creation of BUID (Building Unique ID) for building.
5. Demarcation of location boundaries using secondary data source.
6. Updating the attributes using secondary data source.

- ◦ Design of Geodatabase

Geodatabase is structured way to store multiple shapefiles of different feature type whether it is point or line or polygon (Idrizi, 2018). To cover the area, multiple layers have been capture. The set shapefiles have been categorise in geodatabase on the basis of its entity type

- ◦ Attribute Design on the basis of objective

Before capturing the data, in the shapefile, required fields with name has been created as per data type and length of the field.

- ◦ Identification and digitization of feature

Creation of spatial data, is majorly an image interpretation job. Before capture of any building, a grid has been created of 250* 250 met. This grid has been created using the fishnet tool in Arc GIS. Each grid have been assign with unique number as shown in map as figure 4.

Same grid no. will be update in the building that falls under the respective grid. It will not just help in tracking of digitization of data but also will be helpful for creating a unique ID for Building. Identification of features has been done with the help of tone, texture, pattern and association of the entity on satellite image. All the list out feature has been capture in its specified shapefile.

- ◦ Creation of BUID (Building Unique ID) for building:

Since for property taxation "Property" is the foremost requirement which comes under building. There are various distribution of property on the ground. It can be one building or part of building or cluster of buildings. Addressing this concern, while digitization, all building has been assign with an BUID which will unique no. for each building so that these building polygons can be used to map real world properties. All building will be assign with a reference no. which will be the range of 1to N with in the grid where N is the maximum count of buildings in any grid having limits of 99999. This reference no. will be design to building ID will be 5 digit alpha-numeric text. To make it 5 digit, additional pre "0" has been added to reference no. (RN) in attribute. For eg. in the given grid no. 30274, the building has been given reference no. from 1 to 114. The build Id will be "00001",00010, 00100 etc.

The URN is 10 digit no. which is combination of Grid no. and Building ID. This will create a unique reference no. for each building throughout the data. In Table (1) the design and creation of BUID has been shown

- ◦ Demarcation of location boundaries using secondary data source

For digitization of location boundary, Eicher image has been used. Eicher is nothing but an image having visualised major base layer information. In general the colonies and location are divided by any natural or manmade boundary such as road, drain, building or landcover pattern. Reference Google image has also been taken for this task.

- ◦ Updating the attributes using secondary data source

Information like name of major road, major drains, localities and major landmark has been added in the data using Eicher and Google.

5. Results

In result, a digital profile of Hauz Khas ward has been created which has visual information of building, road, use of lands and locality. Land use and land cover information are important for several planning and management activities concerned with the surface of the earth (Lillesand & Keifer, 1994). The land use types are statistics of study area is given in the Table (2) and percentage distributions of all classes' shows by Figure (7). The landuse distribution can define and predict the human activity in term of use agriculture or housing or institutional etc.

Ward Area of Hauzkhas is 3.14 sq. Km having 5620 buildings under its jurisdictions. The covered area of building is 0.93 sq. Km in Hauzkhas i.e. 29% of the area which is the tax-net for corporation. Through this approach only horizontal expansion of built-up can be determined but again for actual covered area it is very important to calculate the vertical built-up which can be best possible through door to door survey of these building. Apart from this approx. 20% of the area is covered by road and paved area. Since Hauzkhas ward is a planned area, 23% of area has been dedicated to the gardens and park. Since many of these portion owned by the privately, this can be maintained same in consecutive years. One more thing is very focal in this study for the municipal that approx. 23% of the area is open land which are very much prone to have unauthorised construction leading unauthorised colonies.

Apart from land use profile, this database has also resulted a building polygons having unique ID to each. The decided range for building reference is 99999 for each grid which is quite enough as the area of each grid is 250*250 sq. met. Since the data type of Building ID is alpha numeric so for any adverse condition such as partition or new building construction in same building, an alphabet can be added in the ID.

This BUID is key to smooth access of these polygon to use it for the collection of property information through field survey or to link it with other digital database or to mapping any other attributes. For the development as well as maintaining the ward, this exercise can provide a foundation where multiple analysis and prediction can be done.

6. Conclusion

Municipal applications need databases at a large scale for micro-level planning. The digital database creation is most primary and most important step towards the development. But this not just enough for the application of municipal government. For property tax assessment, Property address, Colony Name, Category of colony, No. of floor, Covered Area, Vacant Land area, Type of Property (Residential/Commercial), Type of Occupancy (Owner/tenant), Type of Structure(Kaccha, Pacca, Semi Pucca), Year of Construction and Owner Type (Single/Joint) are essential parameters. All this information cannot be captured through the image, a door to door ground survey is essential to complete this database.

Since the data has been capture on GIS platform, for field work activity and transfer of multiple attributes of field data, it will be act as powerful tool. Again for evaluation and development of colonies other information of infrastructure such as type of road and drain, governing bodies etc are vital. For this all information are available with the department and should be converted in digital platform to link with spatial database. This one time task will be the key for multiple solution of municipal challenges. This database is capable to store historic as well current and future database consecutively and can be utilised for, analysis or development. Since there are many GIS platform, this can be used and access through any IT enabled GIS application.

Declarations

Declaration of Interest

We have no conflict of interest to declare.

References

1. Arbia, Giuseppe. (1989). *Spatial Data Configuration in Statistical Analysis of Regional Economic and Related Problems*. London: Kluwer.
2. Aronoff, S. (1990). *Geographical Information Systems: A Management Perspective*. WDL Publications, Ottawa, Canada.
3. Bandyopadhyay, Simanti. (2013). Property Tax Reforms in India: A Comparison of Delhi and Bangalore. *International Center for Public Policy*, 13-21.
4. Ehtisham Ahmad, Giorgio Brosio & Caroline Pöschl (2014). *Local Property Taxation and Benefits in Developing Countries - Overcoming political resistance?*. Asia Research Centre, LSE.
5. Fedosin, S.A., & Yamashkin S.A. (2014). Technological process of solving the problem of modeling the structure of land use based on remote sensing data. *Scientific and Technical Bulletin of the Volga region*, 6, 356–359.
6. Garg, P.K. (2015). Development of an Approach for Municipal GIS. *International Journal of Chemical, Environmental & Biological Sciences*, 3 (1), 39- 41.
7. Huxhold, W. E. (1991). *An Introduction to Urban Geographic Information Systems*. Oxford and New York: Oxford Univ. Press.
8. Idrizi, B., Sulejmani, V., & Zimeri, Z. (2018). *Multi-Scale Map For Three Levels Of Spatial Planning Data Sets For The Municipality Of Vitia In Kosova*. 7th International Conference on Cartography and GIS, (2018), Sozopol, Bulgaria .
9. Internet 1: ArcGIS Help <http://desktop.arcgis.com/en/arcmap/10.3/manage-data/geodatabases/what-is-a-geodatabase.htm>. (12.09.19)
10. Internet 2: Election Department Interface <http://www.elections.in/delhi/mcd-elections/mcd-ward-list-2017.html>. (12.09.19)
11. Internet 3: SDMC Portal http://mcdonline.gov.in/tri/sdmc_mcdportal/ (12.09.19)
12. Kundu, D., & Ghosh, D. (2011). *Innovations in property taxation systems in India in: Innovative Land and Property Taxation*. United Nations Human Settlements Program.94-110 Nairobi, Kenya.
13. Lillesand, T. M., & R. W. Kiefer. (1994). *Remote Sensing and Image Interpretation*, 3rd Ed. New York: John Wiley and Sons.
14. Mathur, Om Prakash., Thakur, Debdulal., & Rajadhyaksha, Nilesh.(2009). *Urban Property Tax Potential in India*. National Institute of Public Finance and Policy, New Delhi.
15. Nieminen, J. (2002). *Property tax based revenue collection GIS in the developing cities - a new approach for sustainable urban development*. Soil and Water Ltd: Finland
16. Pawi, Soeb., Martin, David., Yusoff, Wan Zahari Wan., & Shafie, Fazira. (2011). Property Tax Management Model of Local Authorities in Malaysia. *Chinese Business Review*, 10 (1), 1-12.
17. Samadzadegan, F., Alvand, A., Abootalebi, A., & Hasanlou, M. (2008). *Enterprise GIS For Municipalities – A Service Oriented Approach*. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B4.
18. Slack, Enid., & Richard, M. Bird. (2002). *Land and Property Taxation: A Review*, Report, 1-47.
19. Star, J., and Estes, J. (1990). *Geographic Information Systems: An Introduction*. Englewood Cliffs, NJ: Prentice Hall.
20. Stylianidis, E., Roustanis, N., & Karanikolas, N. (2009), A Geographical Information System for Real Estate (GEOVAL), In Location Based Services and TeleCartography Efstratios Stylianidis, Themistocles Roustanis, Nikolaos Karanikolas (Eds.), Part of the [Lecture Notes in Geoinformation and Cartography](#) book series (LNGC), 317-329
21. Swain, Swapna. Sarita. (2016). Process and Impacts of Illegal Land Subdivision: It's Relevance to Planning. *International Journal of Applied Engineering Research*, 11 (7), 4886- 4892
22. Syed, Aasif Farooqi., & Gazali, Sohieb. (2014). Application of Geographical Information System in Urban Management and Planning: A Case Study of Kulgaon-Badlapur, Dist-Thane, Maharashtra, *International Journal of Advanced Remote Sensing and GIS*, 3 (1), 476-485
23. Tomlin, C. Dana. (1990). *Geographic Information Systems and Cartographic Modeling*. Englewood Cliffs, NJ: Prentice-Hall.

Tables

Due to technical limitations, Tables 1-2 are provided in the Supplementary Files section.

Figures

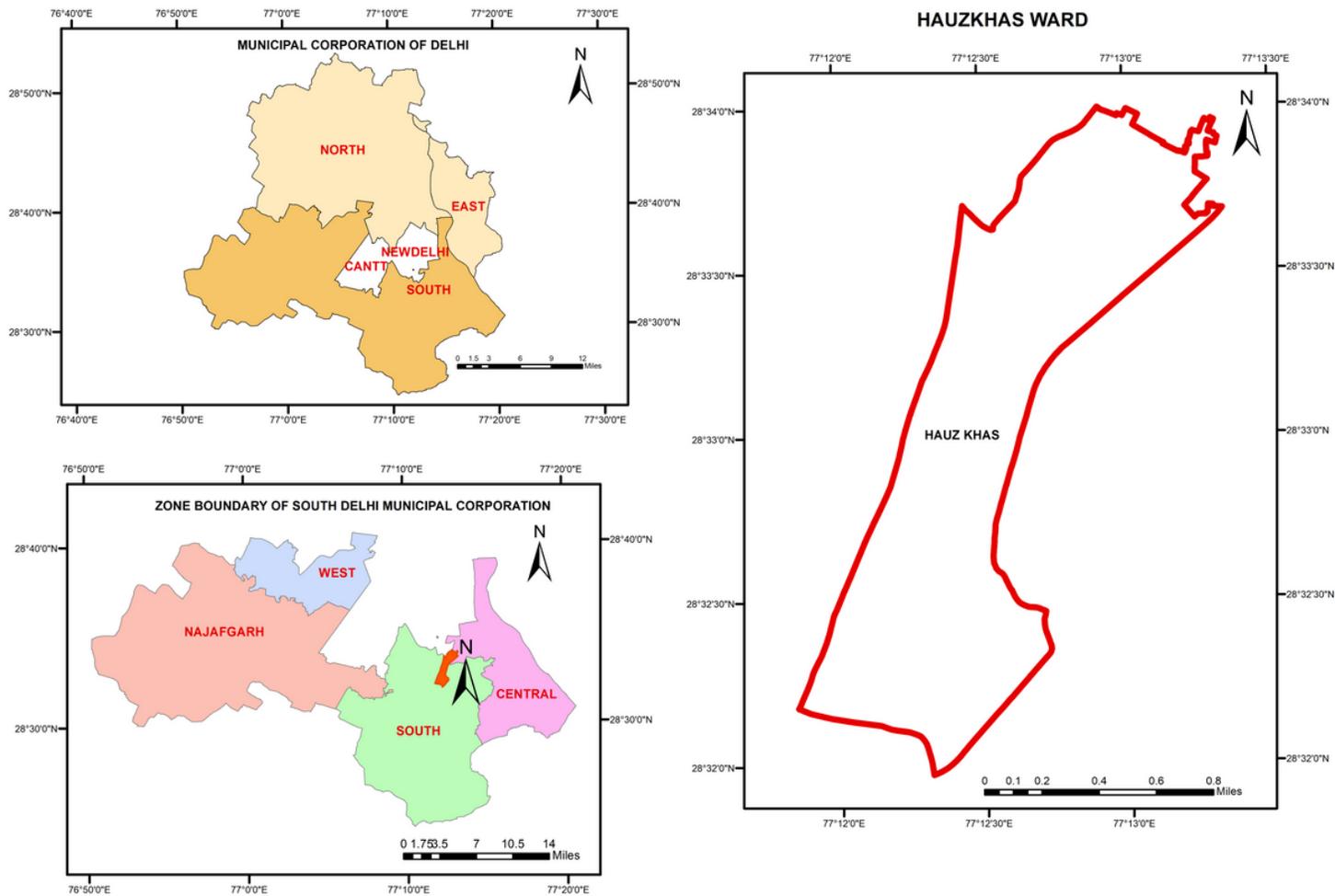


Figure 1

Map showing Municipal Corporation Boundaries of Delhi

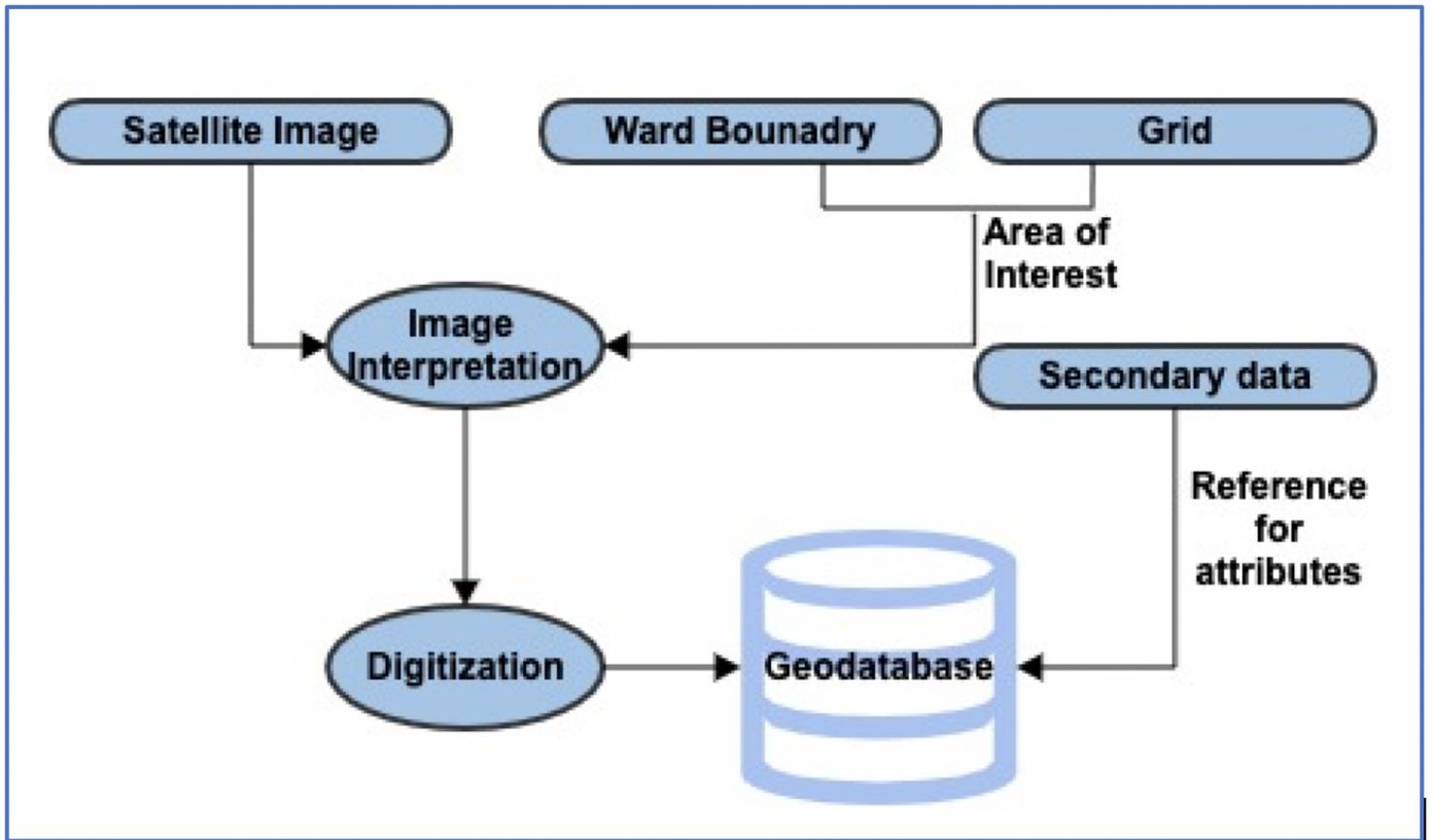


Figure 2

High overview of methodology to create database of spatial dataset

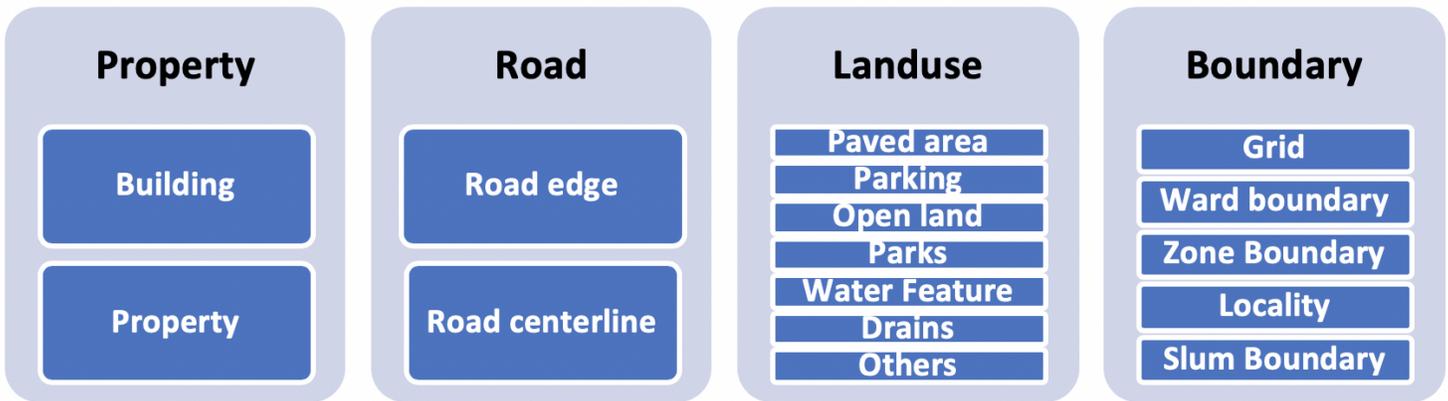


Figure 3

Structure of Geodatabase for this task

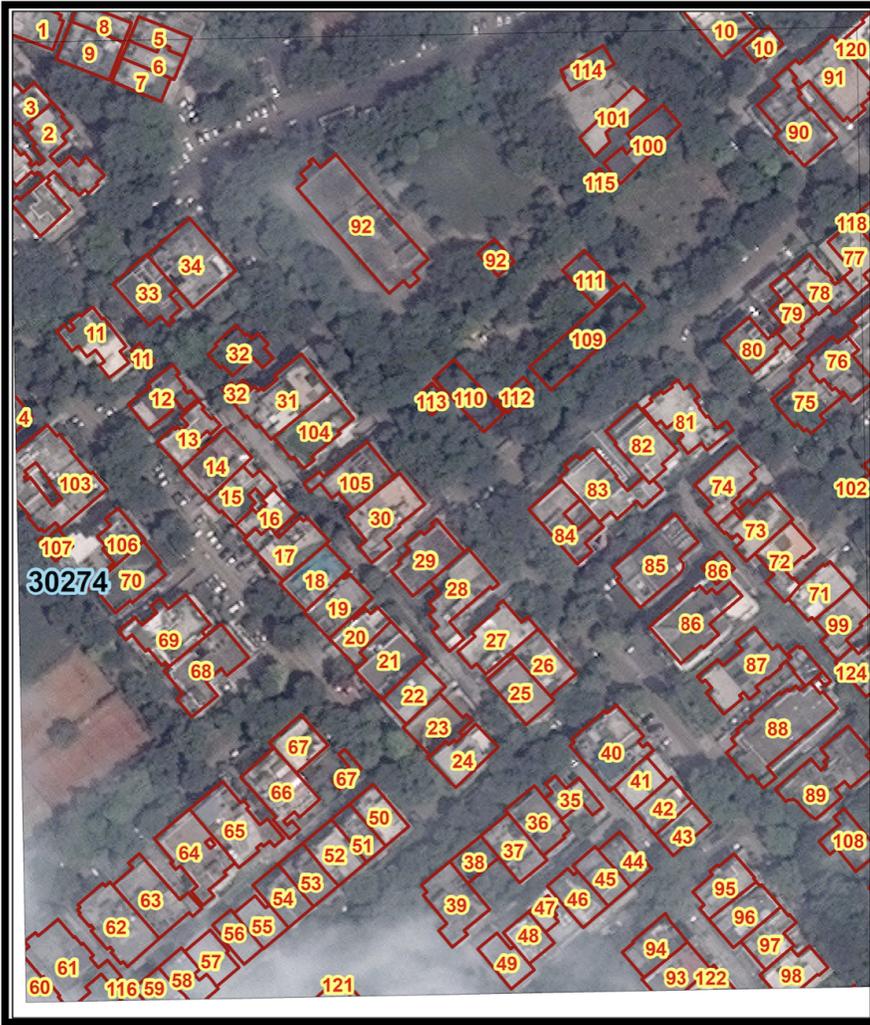


Figure 5

Reference No. on Building of grid no. 30274

Landuse Profile of HauzKhas Village

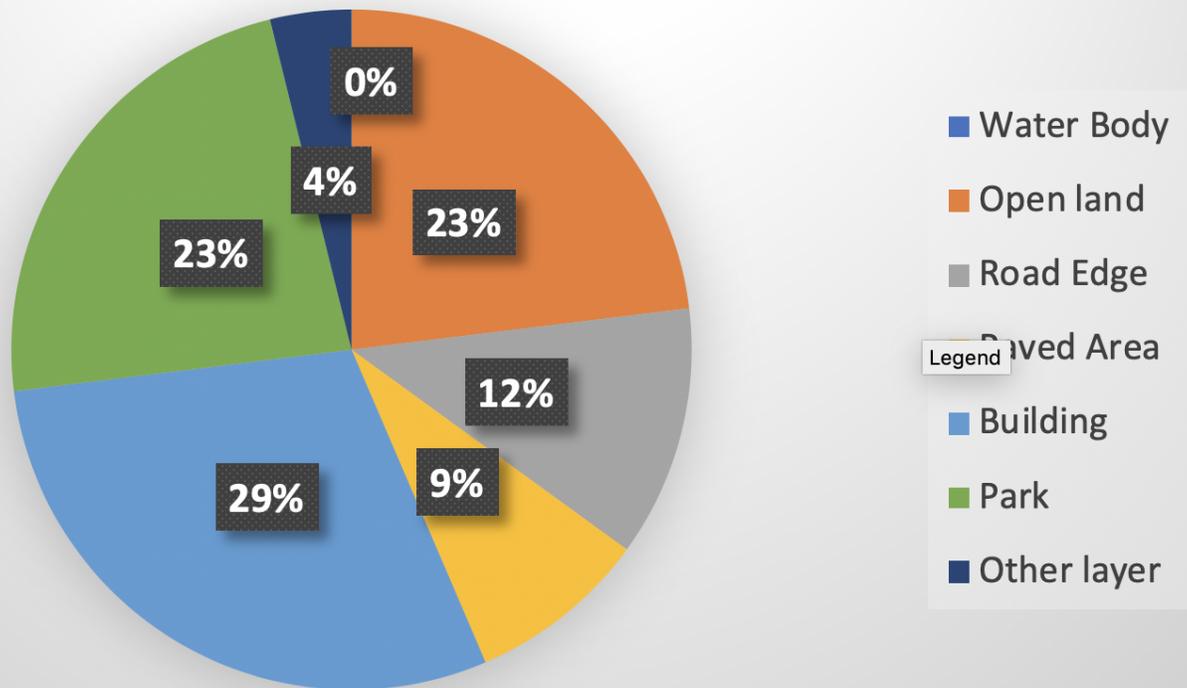
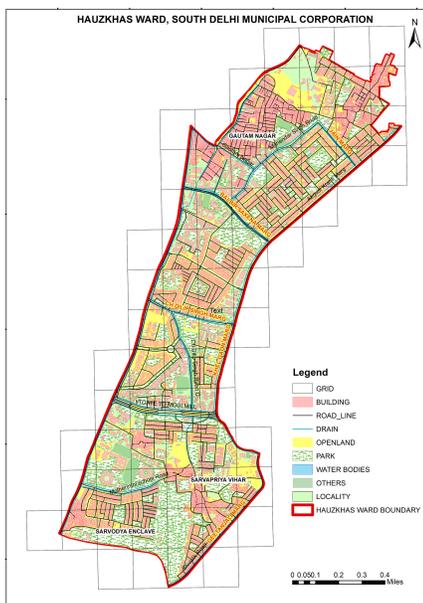


Figure 6

Pie chart of Land-use Profile of HauzKhas ward

A



B



C

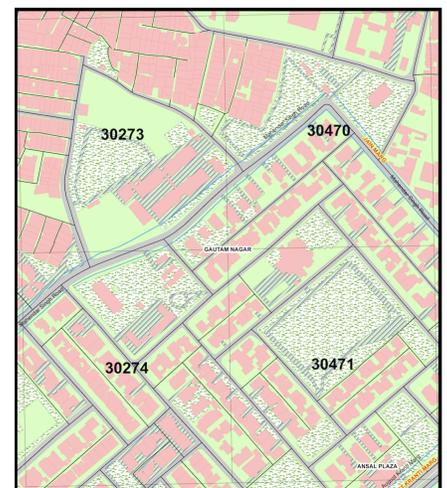


Figure 7

A.Map showing land use map of HauzKhas Ward. B.Map showing land use map of HauzKhas Ward. C.Map showing land use map of HauzKhas Ward

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table1.CreationofBuildingUniqueID.tiff](#)
- [Table2.StatisticoflanduseofHauzKhasWard.tiff](#)