

# “Urban Land-Use Planning Using Geographical Information System And Analytical Hierarchy Process Case Study Harda City Madhya Pradesh”

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**Abstract-** Urban land-use plan for Harda city in Madhya Pradesh using an integrated GIS-AHP approach. Keeping in view the future planned development of Harda town, the revised development plan for 2025 has been prepared for an estimated population of 1 million (10 lakh). This plan includes proposals for various land uses and development along with provisions for service facilities. The economic structure of the town is primarily based on agricultural products, commercial, and administrative activities. Most of the people here are engaged in agriculture, commerce, and small-scale industries. The economic structure of the town is of a medium level. Harda, one of the main advantages of AHP is its flexibility, logic, and ease of application, which has been reflected in the significant growth of publications that use this method. Decision-making is virtually every research area. For this reason, the application of AHP has been applied in areas such as engineering, computer science, business and management, mathematics, or social sciences. The possibilities of AHP adjustments are also relatively wide one of the fastest-growing cities in the region is facing immense pressure from rapid population growth and unplanned urbanization. Despite several planning interventions, such as the recent Detailed Area Planning (DAP), the outcomes have been limited. The DAP employed GIS for city-scale land-use planning but suffered from several shortcomings, including inadequate specification of data requirements, poor database quality and underutilization of the GIS database for spatial analysis to support effective decision-making. To address these issues, this research proposes a conceptual model for building a high-quality geographic database to resolve the first two problems and applies the GIS-based AHP method for advanced spatial analysis to tackle the third. Following a literature review and selection of the study area, planning criteria were identified through expert consultation. The collected GIS data was structured into a geo database, conceptualized using the Unified Modelling Language (UML). Expert inputs and further literature were used to compute Eigen values through AHP operations, representing the relative priority of each criterion. Using these Eigen values, raster-based criterion maps were generated from the geo database. These maps were then overlaid to create a

composite suitability map, which was subsequently classified into zones based on suitability.

## I. INTRODUCTION

### 1.1 INTRODUCTION

Urban land-use planning is a useful tool for the expansion development of a city land use planning tries to formulate activities to be proposed, administer potential changes and protect incompatible changes. Such administrative and management strategies through land-use planning guide to ensure sustainability of a city. So, land-use planning is an essential component of urban planning.

A database be use to safely store, change and search for data. Some methods that consider multiple factors can be combined with GIS to help find out which location of land are good for uses. several methods, techniques or models could be embedded with GIS for land-use suitability analysis. A wide number of social, economic, physical and environmental indicators are considered for better urban land- use planning. Geographical data within a GIS environment enables the use of indicators in a more sophisticated and informed manner during the urban land-use planning decision-making process. However, working with such datasets in a GIS environment generally requires careful data preparation, integration, and analysis, a geographical data base management system is required, especially, when the datasets are robust and complex. To build such geographical database, at first, it is essential to prepare a conceptual model so that the data requirements and their interrelations are well defined, A database can be used to securely store, modify, and query spatial and attribute data. Furthermore, various Multi-Criteria Decision Making (MCDM) models or techniques can be integrated with GIS to perform land-use suitability analysis. In this context, the relative importance of each land-use planning indicator can be determined in a more sophisticated manner through both subjective and objective judgments. From a literature survey it was found that AHP, which a kind of MCDM technique, could be used for land-use setting up with

support of GIS technology. Thus, the aim of this thesis is preparing urban land-use planning using GIS and AHP, where case study is Harda Madhya Pradesh city.

## 1.2 A CITY

Harda be in the middle Indian state of Madhya Pradesh. Harda town be situated on Howrah-Allahabad-Mumbai railway line, at a distance of 165 kilometres from state capital, Bhopal. It is situated between 21°35' and 22°36' North latitude and 76°47' and 77°20' East longitude, at an altitude of approximately 302 meters above sea level, located on the northern bank of Ajnal and Timran rivers.

It is located on the northern banks of Ajnal and Timran rivers and serves as the district headquarters. Indore-Betul-Nagpur National Highway No. 59-A passes through the center of the town. This town is connected to the major cities of the state not only by rail but also by road. It is the main managerial center of Harda District and is located by the Narmada River, which influences the area's geography, economy, and overall development. The city has witnessed rapid growth in recent years, both in terms of population and urban expansion, placing increasing pressure on infrastructure, land, and civil services.

As one of the growing urban centres in Madhya Pradesh, Harda is undergoing significant transformation due to migration, industrial activities, and government development initiatives. However, the pace of unplanned urbanization has led to issues such as inadequate infrastructure, traffic congestion, and the haphazard use of land, highlighting the urgent need for sustainable and strategic urban planning.

With its strategic location, connectivity to major towns via road and rail, and its growing importance in the regional economy, Harda is an ideal case for the application of modern urban planning tools. includes GIS-based planning and decision-making frameworks like the AHP, which can support city's move toward more structured, efficient, and sustainable development.

Under Section 4 of the Madhya Pradesh Town and Country Planning Act, 1973, Madhya Pradesh has been divided into eight regions. Harda town falls under the Narmada-Tapti region among these. Town primarily serves as a hub for trade and exchange related grains, oilseeds, pulses, small industries, etc. its pure form. Due its rail and street connectivity with major cities of the state like Mumbai, Bhopal, Ahmedabad, Pune, New Delhi, Jaipur, Kanpur, etc., the town also holds regional importance.

## II. LITRATURE REVIEW

**Albrecht 2018** the project's cost is monitored in relation to the progress of the work and the estimate completion time. If there is a significant difference between the actual cost and the budgeted cost, the project team will investigate the reasons behind it and make necessary adjustments. The role of the GIS project manager encompasses the duty to ensure that the project team formulates cost estimates founded upon the most reliable and up to date information and adjusts said estimates as additional or superior information becomes accessible. Moreover, the project manager bears the responsibility of monitoring expenses in contrast to the budget and undertaking an examination in cases where project costs significantly deviate from the initial estimate. Subsequently, the project manager proceeds to implement appropriate corrective measures to guarantee that the project's performance aligns with the revised project plan. [2]

**Bognot et al. (2018)**, Geographic Information Systems (GIS) offers a visual representation of construction endeavours through the creation of maps and three-dimensional models. This serves to communicate well among stakeholders involved in the project, facilitating a more comprehensive comprehension of the project's extent, arrangement, and ramifications on the surrounding environment. Furthermore, it enables the visualization of the monitoring of construction progress. The incorporation of a schedule within GIS results in a easier understanding of the project, while also aiding in the identification and resolution of any potential issues. [3]

**Enwin et al., 2024** The goal of the research is to expose the important uses and approaches of GIS in order to provide the professional and academic communities in urban planning and architecture with a thorough grasp of the topic. A comparative study that clarifies the different functions and approaches of GIS in architecture and urban planning is the research's final product. Through the identification of similarities and differences, the study offers a comprehensive viewpoint that facilitates a basic comprehension of GIS applications and the inconsequence in several research fields. The study concludes by offering practical suggestions for improving the use of GIS approaches in architectural and urban planning research, in addition to adding to the corpus of current knowledge. [4]

**Hugo & Viertel, 2024** Resource conservation, effective land use, and community planning and development are all aided by the study of complex geographical and temporal data made possible by the use of GIS. Despite the increased availability of GIS tools in recent years, US land use planners have not made full use of this technology to include the public and solicit their input throughout the planning process. Best

practices for integrating PPGIS into land use planning procedures in theatre determined by reviewing the literature and analysing the effects of the COVID epidemic. Using training programs, actively participating in community meetings, and engaging the public via a variety of means are some suggestions for enhancing the usage of PPGIS in the US. [23]

**ZhongHuaet al., 2020** GIS can be utilized to gather data for the survey portion, and operations will help with planning and maintenance issues. It facilitates surveying, planning, and maintenance tasks, producing 3D images and even 4D models for better visualization. By integrating databases and satellite imagery, GIS ensures accurate scheduling and quantity calculations, reducing errors and saving time. Moreover, demographic data can be gathered by using GIS as well as it canonises the labour tasks, weather and material testing at the construction sites so that the projects completed effectively and greater quality to satisfy both clients and end-users.

### III. RESEARCH METHODOLOGY

#### 3.1 INTRODUCTION

This research methodology section outlines the approach for case study of Harda city Madhya Pradesh urban land use planning by GIS and AHP. The structure plan for the development of Harda town has been prepared considering current trends and problems along with the need to fulfill the actual requirements of the town. In the development plan, efforts have been made to develop an effective road network by coordinating various work centers, recreational areas, and residential areas while establishing a mutual relationship among them. By directly linking the work centers and residential areas with wide and convenient road networks, it will save time, money, and energy. For the proper, safe, and systematic development of the town, it is essential to determine the structure and circulation pattern according to the actual form and size of the town, so that this structure can remain effectively useful even in the post-plan period.

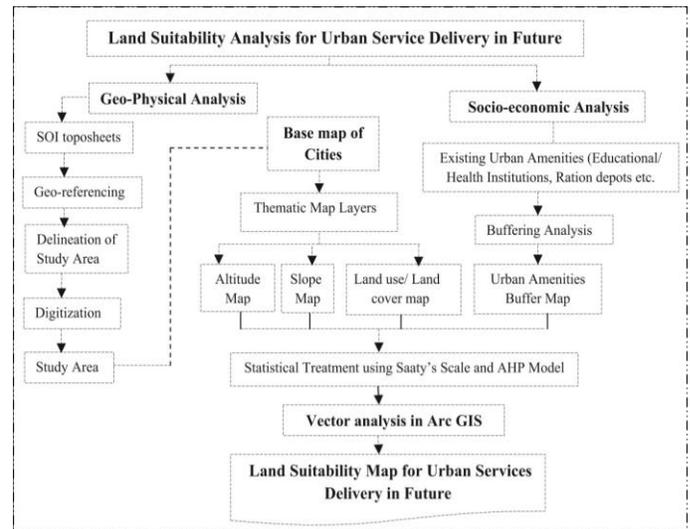


Figure 1 Flow Chart

#### 3.2 Geo Physical Analysis

**SOI Topo sheets:** A Survey of India is a topographic map published by the Survey of India, which be the national mapping agency of India. the use of physical method like seismic, magnetic, gravity, electrical, or electromagnetic techniques to study the subsurface of the Earth. Often used in oil & gas exploration, mining, environmental studies, and archaeology. SOI toposheet are widely use for planning, infrastructure development and resource management. Environmental studies, geological research and disaster management. Navigation and orientation for hiking, trekking and outdoor activities.

**Geo-referencing:** Processing and interpreting data collected from geophysical surveys—often involving signal processing, mapping, plus modelling. Geo referencing is process of assigning spatial coordinates just before a dataset or map, allow it to be incorporated with other geospatial data and analyzed in a Geographic Information System. map aligning scanned maps or images with real-world coordinates. Data integration Combining datasets from different sources and formats. Spatial analysis Performing spatial analysis and modelling on geo referenced data. Mapping and visualization Creating accurate and informative maps and visualizations.

**Delineation of study Area:** Analyzing landforms, tectonics, soil structure, or groundwater flow in a particular location. Clearly articulate the purpose and scope of your study to determine the boundaries of your study area. Determine the specific region, country, state, or city that is relevant to your research question. Decide on the size and shape of your study area, considering factors like climate, topography, or administrative boundaries. Define the time period or duration of your study, including any specific dates or seasons. Utilize

geographic information systems and mapping software to visualize and define the boundaries of your study area. Collect and analyze data related to your study area, such as demographic, environmental, or economic information.

**Digitization:** Digitization is the process of converting information or data from physical formats like paper documents, images, or audio into digital formats that can be easily stored, accessed, and shared electronically. Digital data can be accessed from anywhere, at any time, making it easier to share and collaborate. Digital data can be stored for long periods without degradation, reducing the risk of loss or damage. Digital data can be easily searched, making it faster to find specific information. 4. Digital data takes up less physical space, freeing up storage areas.

**Table 1 Solid Waste Management Action Plan**

S. No	act points For villages / blocks/town municipalities /City corporations	Identification of gap	Action Plan
1	separation of waste at source	separation at source practiced by 100% households and other waste generators.	Time to time IEC programme are organized to promote source isolation.
2	Manual Sweeping	<ul style="list-style-type: none"> <li>• 90% roads covered for regular sweeping</li> <li>• Gaps in manpower</li> <li>• Gap in availability of sweeping tools/equipment</li> <li>• Availability of suitable PPEs-100%</li> </ul>	<ul style="list-style-type: none"> <li>• Residential Area once a day.</li> <li>• Commercial Area twice a day</li> </ul>
3	automatic Road Sweeping & Collection	automatic Road Sweeping & Collection	<ul style="list-style-type: none"> <li>• automatic sweeping engine 1 required.</li> </ul>
4	100% compilation of solid waste	90% compilation achieved	Waste gathering vehicles with

			separate compartments will be bigger
5	Arrangement for door to door collection	Arrangement for door to door provided: 100%	Waste collection vehicles with separate compartments will be increased to cater demand of increasing population. Route chart optimization to cover maximum area in minimum time.
6	Waste Collection trolleys with separate Compartments	Available-waste will be collected through NGO / PRO authorized by ULB	Waste collection trolleys will be procured
7	Waste declaration Centres (for household dangerous wastes)	Number of Deposition Centres Available-1	consult agencies for disposal of such waste as per SPCB norms.
8	Wet-Waste organization: On-site Composting by Bulk Waste Generators	Whether number of bulk waste generators identified for installation – Yes	Door to door home composting awareness program is carried out by municipality to increase onsite composting
9	Wet-waste Management: Facilities for Central Bio Methanation / Composting of Wet Waste.	Wet waste processing compost plant exists, which need upgradation	Composting and biometanation plants with sufficient capacity to be unit
10	Dry-Waste Management: Material	• Material Recovery Facility	Mini MRF be but existing facility

	Recovery for Dry-Waste Fraction	(MRF) exists. • refuse Derive Fuel (RDF) not available	inadequate wants upgradation. Strengthening of existing infrastructure and manpower agreement to be done
11	Disposal of Inert and Non-Recyclable Wastes:- hygienic Landfill	• Does the organization still disposing waste in dumpsites - Yes • Whether sanitary landfill available - No • Plan for construct sanitary landfill or agreement with ULBs Proposed	• Action plan to build sanitary landfill – common hygienic landfill for whole district Harda should be measured. • Action plan to reduce land filling- By recycle more wastes and by organizing IEC programme to shrink generation of wastes.
12	Remediation of Historic / Legacy Dump Site	Whether existing old dumpsite if any required remediation as per rules- Yes	Bioremediation and capping of dumpsites for legacy waste to be done for land reclamation .

proceed according to a phased action plan. The regulations related to land use and land development management are mentioned in the Madhya Pradesh Land Development Rules, 2012, and the Madhya Pradesh Town and Country Planning Act, 1973. The implementation of the Harda Development Plan will be carried out by the urban and rural planning authorities, and until the authority is constituted, the responsibility will remain with the Harda Municipal Council. The implementation of the development plan will primarily be carried out by:

- Madhya Pradesh Housing Board
- Public Health Engineering Department
- Public Works Department
- Industries Department

**4.2 Suitability analysis for the provision of amenities in Harda city**

Suitability analysis for the provision of amenities in a city like Harda involves evaluating various factors that affect the optimal placement and availability of essential services and infrastructure. The aim is to ensure that amenities are distributed in a way that maximizes accessibility, efficiency, and sustainability for residents. This kind of analysis is typically done by urban planners and local authorities to guide development and improve the quality of life for citizens.

- **Basic Services:** Water, sanitation, electricity, waste disposal.
- **Social Amenities:** Schools, hospitals, parks, libraries, community centers.
- **Recreational Amenities:** Sports facilities, cinemas, shopping centers, restaurants.
- **Transportation Infrastructure:** Roads, bus stops, train stations.

**4.3 Land utilize / Land cover up map**

Land utilize/Land cover map has been prepared by using satellite image. The land utilize/cover information help in formulation of policies and programmes for urban development. It has been observed that thirty percent area is under built up followed by plantation (twenty two percent), [agriculture](#) (twenty five percent), [horticulture](#) etc. Lowest area is under wetland category

**IV. RESULT AND DISCUSSION**

**4.1 GENERAL**

The main reason for the Harda Development Plan 2011 not being implemented as intended was that the organizations related to development, the administrative mismanagement of departments, and the delays in the planning period caused them to focus on other tasks. As a result, it was not possible to develop land use plans aligned with population-based fundamental infrastructure development proposals. Partial or selective implementation of the plan is not sufficient for urban development but is also essential for improving urban living standards and economic development. For successful implementation, it is necessary to

**Table 2L and Cover Category**

Land Use / Land Cover Category	Area in KM square
Crop land	2085.56
Plantation	1.6
Ravenous land	1.18
Scrub land	111.75
Mining	.51
Rural	44.63
Urban	10.76

**4.4 Integrated analysis for urban suitability**

As per the methodology of determination of suitability analysis, "More importance is given to physical factors by comparing each one with the others. The importance given to each factor is based on Saaty’s scale, as shown below.

**Table 3 Saaty’s scale**

Intensity of Importance	Definition	Explanation
1	Equal value	Two performance contribute equally to the objective
3	Moderate	skill and decision slightly favour one activity over another
5	Strong significance	knowledge and decision strongly favour one activity over another
7	Very strong or confirmed importance	An activity is favoured very strongly over another; its dominance established in exercise
9	Extreme value	The proof favouring one movement over another is of the highest possible order of confirmation

(2, 4, 6, 8) can be used to represent compromise or intermediate judgments.

**Table 4 Importance matrix for suitability analysis**

	A	B	C
A	1	3	2
B	1/3	1	1/5
C	1/2	5	1
Sum	11/6	9	16/5

The values in column add up to 1

$$\begin{array}{l}
 A \quad B \quad C \\
 A \quad 1/(11/6) = 6/11 \quad 3/9 \quad 2/(16/5) = 5/8 \\
 B \quad (1/3)/(11/6) = 2/11 \quad 1/9 \quad (1/5)/(16/5) = 1/16 \\
 C \quad (1/2)/(11/6) = 3/11 \quad 5/9 \quad (11/6)/5 = 5/16 \\
 \text{Sum} = \quad \quad \quad 1 \quad \quad 1 \\
 1
 \end{array}$$

Average the value of each row to get corresponding rating

A	B	C	Row Average
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Deciduous	872.84
Scurb forest	233.82
River /canals /stream	74.86
Water bodies	39.12

$$\begin{array}{l}
 A \quad 6/11 \sim .5455 + 3/9 \sim .3333 + 5/8 \sim .6250 = 1.5038/3 = .5012 \\
 B \quad 2/11 \sim .1818 + 1/9 \sim .1111 + 1/16 \sim .0625 = .3544/3 = .1185 \\
 C \quad 3/11 \sim .2727 + 5/9 \sim .5556 + 5/16 \sim .3803 = 1.2086/3 = .3803 \\
 \text{Sum} = \\
 1.000
 \end{array}$$

Where A = Residential, B = Industry , C = Plantation

The exhibits since Harda city has flate shape as altitude increases from north-east to north west. This altitude factor exerted influence on the establishment of urban services in Harda city. The older city wards have better urban facilities compared to the outer wards. As a result, the peripheral wards generally show medium to high potential for setting up new urban amenities. Although the peripheral areas in the north-east and north-west parts of the city have favorable conditions like gentle slopes and low elevation, they still lack enough urban services because they are relatively newer developments. hence have short history than the old city wards. The municipal wards lying on the north-eastern and south-eastern parts of the city exhibit low suitability on account of several factors like land use, altitude, slope, existing amenities etc. The ward have more under built up followed by plantation and agriculture. Moreover, these wards have medium altitude and .5 slope. North side rijhariya, pidgaon, harda khurd and abgaon khurd. East side uda, potlya khed and pateliya. West side birja khedi, kadola and rehta khrd. South side samarda rijhariya and nahalkheda. in their respective sectors through construction and development activities. Therefore, it is necessary that all government and non-government departments and agencies pay special attention to the coordination of the implementation system of the development plan and the organization of development activities. The expansion plan includes proposals for the period up to the year 2025. It suggests setting aside and

budding 1,206.86 hectares of land for different types of land use.

Additionally, expenditure on the development of 70% of the land will include construction of roads on new roads and other development works.

The average land acquisition rate has been considered as ₹20.00 lakh per hectare. At this rate, the development-related expenditure is estimated to be approximately 10 times the land acquisition expenditure.

## V. CONCLUSION AND FUTURE BENEFITS

### 5.1 INTRODUCTION

The study on the provision of public facilities in Harda city depicted that since the core wards of the city have adequate urban amenities as compared to peripheral wards, Therefore, the outer wards generally show a medium level of suitability for setting up urban amenities. Although these areas currently lack enough urban facilities, factors such as low elevation contribute to their potential for development, flat slope, inaccessibility etc. these wards fall in medium level of suitability. The municipal wards lying between core and peripheral wards depict high suitability for the provision of urban amenities because of favourable slope, altitude, accessibility etc. plus lack of existing urban amenities. In Harda urban center it revealed that since Harda city has terraced shape as altitude increases from south-west to north-east. This altitude factor exerted influence on the establishment of urban amenities in Harda city. The old city wards have adequate urban amenities as compared to peripheral wards; therefore tangential wards in universal demonstrate medium to high level of aptness for establish urban services. The marginal ward in both north-west and north-east city though have favourable conditions like gentle slope, low elevation etc. but lack adequate urban amenities on account of being newer in history. These wards are the result of urban sprawl of the city; hence have short history than the old city wards. The municipal wards lying on the north-eastern and south-eastern parts of the city exhibit low suitability on account of several factors like land use, These wards include areas with higher elevation and steeper slopes, and they mainly consist of built-up land, followed by plantations and agricultural land. Despite having fewer urban services, their physical features influence their development potential. The findings of this study offer useful insights for planning urban expansion and can support policy makers and decision-makers. However, more research is needed in key areas of urban service delivery in both urban centers to achieve better outcomes. Important research areas that still need attention include how geographical factors affect road and rail

networks, the feasibility of developing a metro system, reducing congestion in central areas, and creating planned residential zones. The Harda expansion Plan will be carried out by the Urban Development and Town & Country Planning departments Until it is constituted, its responsibility will remain with the Harda Municipality. Primarily, the implementation of the development plan will also be done by the MP Housing Board, Public Health Engineering Department, Public Works Department, and the Industries Department in their respective areas of work.

Implementation of schemes requires serious efforts to improve citizens' excellence of life. evaluate the performance of development schemes since 2011 clearly indicates that a lot of proposals contain not been successfully executed. Reasons for the impact on schemes in certain areas, due to lack of appropriate management, are discussed in Section-1. Revisiting these issues, it is needed to devise policies used for the successful performance of schemes. Therefore, policy formulation for the implementation of schemes is necessary to get the following objectives:

- Administrative planning plus city development levels.
- Planning and execution of decentralized schemes and public councils.
- Assembly of thematic groups.
- Mobilization and integration of communities and organizations.
- Analysis of thematic issues and community participation within scheme frameworks.
- Conducting public hearings regarding urban wastewater projects. This was organized for those divisions of the municipal corporation that are significantly involved in: Planning and evaluation of schemes and their implementation, Urban operations and management of civic facilities.
- Detailed technical and field-level discussions and site visits for scheme implementation concerning community-based water systems. During this process, the divisions will be required to draft technical proposals for implementing community-based water systems.
- At present, there are only nine urban local bodies in which community-based water systems are being implemented; no other city has undertaken such an initiative.

#### 5.1.1 Ecological organization and conservation programme

- Effective measures to stop waterlogging in ponds and previous water bodies.
- Preventing the pollution of ponds through land use management in catchment areas of ponds.
- Preventing land encroachment in water catchment areas by stop maps and encouraging controlled land use for agriculture in these areas.
- Effective implementation of management norms in the surrounding areas of ponds.
- Independent monitoring of stream level and water quality.
- Institutional coordinated arrangements for the management of contamination and other ecological hazards in irrigate catchment areas of every irrigate bodies.

### 5.1.2 Street Lighting, Fire Fighting and Power

Details of Sub-projects to be undertaken

**Addition of Streetlights:** The Nagar Palika needs to add 788 street lights to match the demand of 2015. By the year 2025, city would require to add around 1173 street lights to provide 100% coverage of the city road network.

**Underground Cabling:** To cover all street lights with underground cables, city would require to lay around 24 kms of cable by year 2025 and additional 35 kms by year 2025.

**Fire Fighting:** To ensure a safety against the fire, municipality should procure 1 foam crash tender, 1 small fire engine, 1 motor fire engine, 1 rescue tender and 1 portable pump in the short-term and 2 foam crash tender, 2 small fire engine, 1 motor fire engine, 2 rescue tender and 2 portable pump in the long term. In addition to the procurement of above items, municipality should also undertake the construction of fully equipped fire stations.

**Power:** Municipality should carry out feasibility studies to explore the potential of alternate power sources in Harad. If found feasible, relevant projects should be undertaken to achieve self-sufficiency

## 5.2 FUTURE BENEFITS

**Objective Criteria Weighting:** AHP's hub power lies in its ability to count subjective preferences and prioritize criteria based on expert decision through pairwise comparisons. When combined with GIS, this means urban planners can assign objective weights to various factors (Environmental sensitivity, accessibility, economic viability, social equity) when determining land suitability for specific uses. This

moves beyond intuition, leading to more defensible and transparent decisions.

**Multi-Criteria Spatial Analysis:** GIS excels at integrating and analysing diverse spatial data layers (Topography, earth type, existing land use, population density, infrastructure networks, hazard zones). AHP allows for the systematic weighting of these layers based on their importance to a particular planning goal. This creates powerful multi-criteria decision models that can identify optimal locations for urban expansion, green spaces, infrastructure projects, or even areas for urban renewal.

**Scenario Modelling and Simulation:** The combined power of GIS and AHP will allow for the rapid creation and evaluation of multiple urban development scenarios. Planners can adjust the weights of AHP criteria and instantly visualize the spatial implications in GIS, helping them understand the trade-offs and select the most sustainable and beneficial options. This will significantly speed up the planning process and reduce errors.

**Environmental Protection and Mitigation:** By incorporating environmental criteria (proximity to protected areas, flood risk, air quality, green space availability) and weighting them appropriately with AHP, urban planning can proactively minimize negative environmental impacts and promote sustainable land use practices. GIS enables the visualization and analysis of these impacts, leading to better mitigation strategies.

**Climate Change Adaptation:** GIS and AHP can be used to assess climate-related risks flood vulnerability, heat island effect and plan for climate-resilient infrastructure and urban designs. AHP can help prioritize adaptation measures based on their effectiveness and cost, while GIS visualizes the susceptible areas and the crash of proposed solutions.

**Green Infrastructure Planning:** AHP can help prioritize the expansion of urban green seats based on ecological, social, and economic benefits, while GIS provides the spatial study to be familiar with ideal locations for parks, green corridors, and urban forests, contributing to biodiversity and citizen well-being.

**Smart City Initiatives:** GIS is already a cornerstone of smart city development, and its integration with AHP will further enhance its capabilities. AHP can help prioritize smart city initiatives (e.g., stylish traffic management, smart waste collection, public safety systems) by weighing various factors like economic viability, social impact, and technological

feasibility. GIS then provides the spatial platform used for implementing and monitoring these initiatives.

**Improved Infrastructure Planning and Management:** From optimizing transportation networks and traffic flow to planning value communications (water, electricity, sewage), GIS provides the spatial framework. AHP can assist in prioritizing infrastructure projects based on community needs, cost-effectiveness, and long-term sustainability. In essence, the future benefits of GIS and AHP in urban land planning will revolve around creating more efficient, sustainable, resilient, with liveable city by transforming complex, multi-faceted preparation challenges into systematic, data-driven, and transparent decision making processes.

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