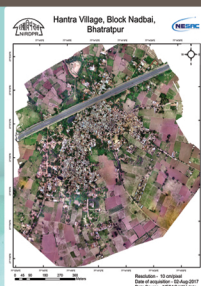
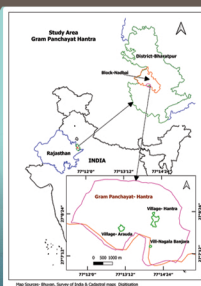


GIS-Based Study of Existing Community Infrastructure and Optimum Requirements at Gram Panchayat Level for Assessment of Gaps Using Participatory and Departmental Approach

A Case of Hantra Gram Panchayat, Bharatpur District, Rajasthan

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"If we knew what we were doing, it would not be called research, would it?"

-Albert Einstein

Executive Summary

Introduction:

Planning at the Gram Panchayat (GP) level is a crucial aspect of rural development, which is done in pieces and scattered manner. Every department is having its own norms and guidelines whereas villagers are having their own problems. Execution of works has been continuing since the birth of villages, more formally after independence, and now with more expectations with the involvement of more funds and convergence approaches. The Gram Panchayat Development Plan approach started under the Fourteenth Finance Commission is also spreading its wings to cover all the schemes and functions under one umbrella. Many other ambitious programmes of the Government of India like Saansad Adarsh Gram Yojana (SAGY), Rurban, etc., are also functioning parallelly for making some more models of development in the country.

As the works are continued without having a holistic approach in planning, there will not be any entry or exit point in this development cycle. Hence, having an entry criterion like, 'what are the existing assets in the village', and continuous further inventory of assets and intermediate steps like working on questions such as, 'what are the problems/demands of villagers', 'what are the norms of the departments', and as per those, 'what is the saturation/optimum level for all the infrastructure facilities', 'what are the working possibilities between existing and saturation levels', and exit criteria like 'what are the gaps between possibilities and demands'. These are the basic research question or the primary steps in holistic planning to attain the saturation level of infrastructure with further investment in maintenance aspects and incremental investment requirements.

Further, almost all regions in Indo-Gangetic Plain have less slopes and poor drainage facility, resulting in villages facing stagnation of water. This is a major concern after the issues related to drinking water in the areas having flat terrains and poor slopes. The study also involves applications of drone survey for analysing and proposing solutions to drainage-related problems in villages.

The study dealt with these concerns. For having a focused approach from diverse sectors of development at the grassroots levels, only community infrastructures have been taken into consideration for analysis under the study.

Objectives

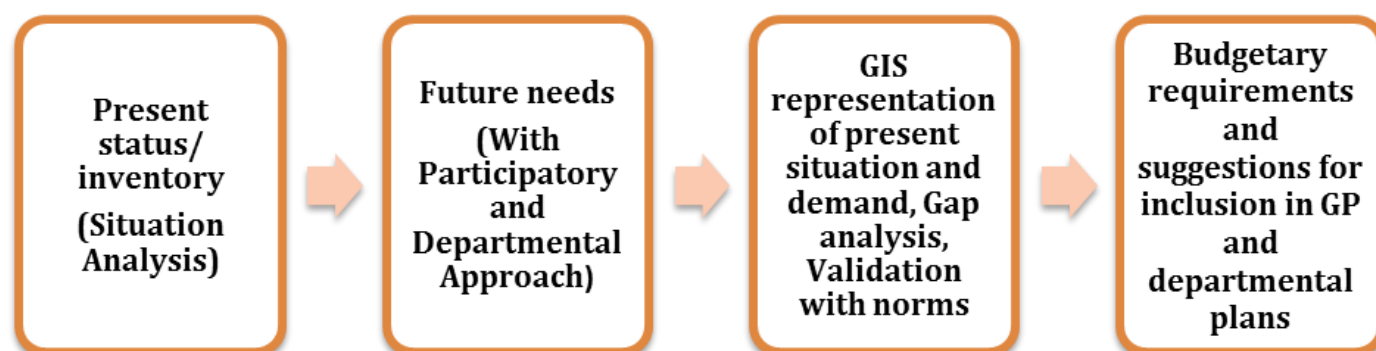
- To survey and map the existing community infrastructure of Gram Panchayat

- To assess ideal/optimum community infrastructure requirement of Gram Panchayat through Participatory and Departmental Approach
- To analyse and map the gaps in community infrastructure and suggest infrastructure development plan for GP
- Estimation of tentative cost for works and suggestions on inclusion in GP and departmental development plans

Method:

The area taken into consideration is Hantra Gram Panchayat in Nadbai Block of Bharatpur district covering three villages, namely Hantra, Arauda and Nagla Banjara.

For the inventory of existing infrastructure open source mobile-based Android app OSMAND was used and for all GIS related analysis, Open Source QGIS software was used. Public needs/demands were collected 'ward-wise' and validated and refined at the village and GP level through public meetings, focused discussions. Relevant departments at GP, block, district and State level were contacted for norms of having new assets and repairs and maintenance, etc. The demands were analysed with respect to the saturation level of assets as per norms. Gaps were identified between possibilities and demands. Based on feasibility and demand, and eligibility in guidelines, schemes or alternative resources were suggested. Drone/UAV survey generated 2D and 3D images which were analysed for applications in drainage plans, in particular, and other general aspects. The study involved the following broad workflow.



Study Area:

Hantra Gram Panchayat in Nadbai Block of Bharatpur district comprises three villages, namely Hantra, Arauda and Nagla Banjara. Hantra Village (Latitude 27° 8' 8.62" N, Longitude 77°14' 10.91" E), and Arauda (Latitude 27° 7' 57.21" N, Longitude 77°13' 5.85" E) are situated on NH- 11 between Jaipur and Agra and the third small village named Nagla Banjara (Latitude 27° 7' 26.00" N, Longitude 77°14' 0.43" E) is situated in the southern side of NH-11.

Findings:

- While road construction is at first priority at the national and State level in Gram Panchayat Development Plan (GPDP) and Fourteen Finance Commission (FFC), it is the fifth priority of villagers. Further, the demands of villagers and priorities are having variations from official GPDP at the GP level.
- In health, education and electricity sectors, concern should be given to service delivery when compared to the quantity of the assets.
- Technical norms are less valued in comparison to public or political pressure and these norms are at times changed for public demand which may lead to severe stress on natural resources like groundwater.
- When more than one parameter like population, distance, time, etc., is under consideration in norms, the weightages and priorities within parameters are not clearly defined.
- Many strong local demands are not permissible in general schemes (Like Gaushala and solution for open electric wires), but these are on high priority of villagers in comparison to permissible demands/works.
- The demands like CCTV at selected places/towers, street lights, community toilets, etc., were felt as secondary demands and much interest was not shown by villagers, while these are more stressed in missions such as RURBAN, SAGY, etc.
- Maintenance of assets is a growing concern now with the increase in infrastructure at the GP level and requires more systematic and formal approaches.
- For the inventory, visualisation and analysis of internal assets, and drainage management, drone/UAV surveys of Gram Panchayats are essential to work in GIS at household/parcel/ward/village levels.

Conclusion/Recommendations:

- Point-wise details are as follows:
- Coding and inventory of existing works with continuous update/addition with time is necessary.
- Scope of wards has to be increased as planning unit
- Local demands of high priority like Gaushala and solutions for open and low hanging high voltage electric wires should be included in GPDP and be addressed with alternative resources and political will.

- To remove local infrastructure disparity, the concept of village-wise asset density may be considered as a criterion in planning.
- During planning, the focus should be on problems and best solutions, not the budget and type of assets.
- More stress is required on service delivery aspects in health, education and electricity sectors in comparison to infrastructure.
- Balance is required to be maintained in public demand and technical feasibility.
- In PMGSY, population criteria should be linked to the latest census survey for new connectivity.
- Prioritisation and integration of norms/parameters are required if more than one parameter is to be considered in the execution of any work.
- Saturation-centric, independent planning is required at the initial level rather than budget and scheme/guidelines-centric planning
- Proper guidelines for maintenance aspects of assets are required
- Environmental sustainability is to be given due priority in all norms
- Training and capacity building of selected Block and Panchayat functionaries on the use of GIS data generated from the study is necessary.

Conclusion on use of drone in village-level planning and generation of drainage plan:

- Including MGNREGA, each Panchayat of the country may be spending on an average around Rs. 1 crore per annum on the development of their Gram Panchayat. Drone/UAV survey is recommended at GP/village/ward level for fulfilling the requirements of proper depiction, planning and monitoring at village/ward/asset levels. Drone/UAV survey is looked at as an essential step towards 'Smart Village' concept and in comparison to the quantum of work and fund flow to the villages/GPs, investment of Rs.2-3 lakh average on each Gram Panchayat will be a boon for having proper planning. If drone/UAV surveys can be repeated after every 3-5 years, this will be the ultimate resource for monitoring also, as the temporal variations and development in infrastructure and natural resources can be monitored precisely. Many prevailing and perpetual problems of villages can be handled well with the availability of original drone surveys in an open source GIS environment along with free mobile mapping tools.

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Acronyms

CSC	:	Common Service Centre
CSR	:	Corporate Social Responsibility
DEM	:	Digital Elevation Model
DTM	:	Digital Terrain Model
DSM	:	Digital Surface Model
EPSG	:	European Petroleum Survey Group
FFC	:	Fourteenth Finance Commission
FTP	:	File Transfer Protocol
GPS	:	Global Positioning System
GPDP	:	Gram Panchayat Development Plan
GIS	:	Geographic Information Systems
GLR	:	Ground Level Reservoir
ICDS	:	Integrated Child Development Scheme
ISRO	:	Indian Space Research Organisation
MLALADS	:	Member of Legislative Assembly Local Area Development Scheme
MPLADS	:	Member of Parliament Local Area Development Scheme
MJSA	:	Mukhyamantri Jal Swablamban Abhiyan
MGNREGS	:	Mahatma Gandhi National Rural Employment Guarantee Scheme
NHM	:	National Health Mission
NHAI	:	National Highway Authority of India
NESAC	:	North Eastern Space Application Centre
NBA	:	Nirmal Bharat Abhiyan
NRuM	:	National Rurban Mission
PDS	:	Public Distribution System
PHED	:	Public Health and Engineering Department
PHC	:	Primary Health Centre
PHSC	:	Primary Health Sub Centre
PMGSY	:	Pradhan Mantri Gram Sadak Yojana
PURA	:	Provision of Urban Amenities in Rural Areas
PPP	:	Public-Private Partnership
RGB	:	Red-Green-Blue
SECC	:	Socio-Economic Caste Census
SAGY	:	Saansad Adarsh Gram Yojana
SGSY	:	Swarnajayanti Gram Swarojgar Yojana
SFC	:	State Finance Commission
TDS	:	Total Dissolvable Salts
TFC	:	Thirteenth Finance Commission
UAV	:	Unmanned Aerial Vehicle
UTM	:	Universal Transverse Mercator
WGS84	:	World Geodetic System-1984

1. Introduction

1.1. Background and Research Questions

What are the existing community infrastructure and optimum requirements of my Gram Panchayat? Where are the gaps? What cost will be required? Who will do that and where are the resources? These are the basic questions that the team tried to answer in this study carried out at Hantra Gram Panchayat comprising three villages.

In most of the cases, planning in Gram Panchayats is related to the availability of funds, awareness/knowledge of GP functionaries and support of the administration. Even within the Gram Panchayat and village, infrastructure development is generally found skewed spatially towards some specific habitation clusters.

In planning, mostly schemes and budget comes into the picture first, and the exercises are made to fit the requirements under the scheme, guidelines and budget.

This may be called a top-down approach as illustrated in Figure 1.



Figure 1: Top-down Approach of Planning

But the integrated plans should be prepared without the consideration of schemes or budgetary limitations at least once in a period of 5 or 10 years and the plan may be divided further scheme-wise and as per budget availability. If the budget is less, prioritisation of works may be done and further resources may be demanded/generated. This may be called as bottom-up approach as illustrated in Figure 2.



Figure 2: Bottom-up Approach of Planning

Further, the integrated plan at GP level may include three broad components (see Figure 3) which can have direct assistance from geoinformatics, say:

- a) Basic infrastructure/amenities
- b) Natural resources/agrarian aspects

c) Individual household needs like pension, shelter, PDS, sanitation, drinking water to each household, etc.

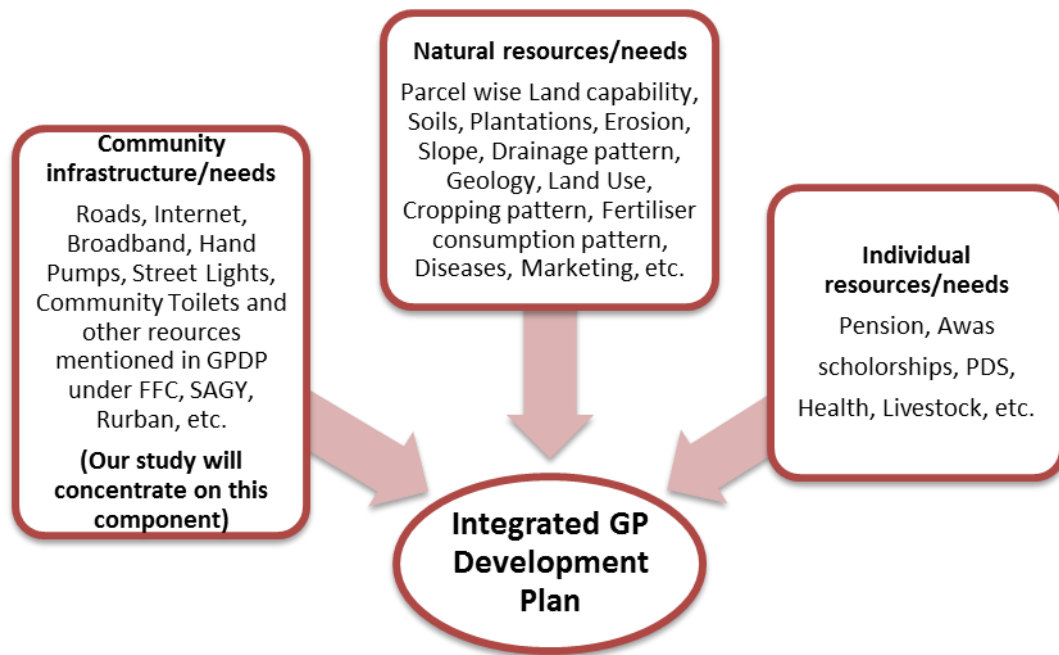


Figure 3: Three Broad Components of GP Level Planning

Other than these, general aspects like livelihoods/skills development, human resources and behavioural aspect, etc., which cannot be plotted in GIS environment, should also be the part of planning. Only then, a holistic development of GP/Village will emerge.

Out of the above components, basic community infrastructure is covered under this study in order to have a focused approach. The agrarian aspects including parcel-wise land use/land capability, soils, plantations, erosion, drainage pattern, geology, cropping pattern, etc., may be covered by taking large area/micro watershed into consideration in a separate study.

To decide the optimum level of resources, norms of the departments concerned, and people's participation are used as back-up before finally analysing the gaps. In this study, the gap analysis is considered as the basis for the integrated infrastructure planning under the bottom-up approach, as described above.

The Gram Panchayat and villages of the area are mainly facing the problems of drainage and it is the common problem of villages in Bharatpur district as the land area is plain. Subsequently, water is accumulated at various places due to lack of slope and outlet points, and poor programme implementation. Hence, the study will have an additional focus on the requirements of drainage and integrated drainage plan, along with levels of road, which is also one of the priority components of the National Rurban Mission (NRuM). For this, a drone/UAV survey of the village habitation areas has been done through NESAC, ISRO, Meghalaya. A separate section is available in the report for

analysing the use of UAV/drone surveys in drainage planning and general rural development planning and monitoring aspects.

All the analyses are backed up by proper mapping of existing and required assets and overlaying results on base maps in the GIS environment.

1.2. Literature Review

NRDMS, Department of Science and Technology, Government of India is supporting and funding initiatives of 'Village Information System' for the development of exhaustive village information system for mapping almost all natural and physical resources of villages. But merely getting a bunch of information through GIS is a matter of the past and now it should answer something to the stakeholders. Hence, analysis like gaps in infrastructure and resources is also important (NRDMS, DST, GoI 2019).

Space-Based Information Support for Decentralised Planning (SIS-DP) project has been initiated by the National Remote Sensing Centre (NRSC) of ISRO under the aegis of National Natural Resources Management System (NNRMS) and is being jointly executed by the National Remote Sensing Centre and State Remote Sensing Centres of the country. The goal of the project is to empower the Panchayati Raj Institutions (PRIs) and the stakeholders with space-based information support for decentralised planning and governance in the country (NRSC, ISRO 2020).

The visualisation of the project has been designed with the name of web portal Bhuvan Panchayat along with one mobile application for asset mapping in the field. The app provides the facility to register as a citizen or as PRI. The initiative requires extensive training and pilot studies in the country with making the asset capture formal and binding on PRIs, otherwise, the success of this excellent project will remain limited. Further, the programme is limited only to create a spatial data bank of assets.

Bhuvan IWMP-SRISHTI: Monitoring and Evaluation (M&E) is a web-based GIS application (geoportal) enabling the monitoring and evaluation of IWMP watersheds, using satellite remote sensing and sample field data using mobile smartphone applications. This geoportal facilitates M&E of all IWMP watersheds for 10 States and 50 special watersheds in 16 States. The geoportal provides image and map display, monitoring tools, summary statistics of all the IWMP watersheds. The application enables national, State, district and watershed level access for information and report generation. The application is associated with Bhuvan IWMP-DRISHTI, a smartphone app for online field data collection along with geo-tagged photographs (DoLR, MoRD, GoI 2019).

Further, in an ambitious bid to transform rural areas into economically, socially and physically sustainable spaces, the Government of India has approved the National Rurban Mission (NRuM) on

21st February, 2016. To ensure an optimum level of development, 14 components have been suggested as desirable for the clusters that are listed in this framework. States may choose the components based on the detailed analysis of their cluster through their Integrated Cluster Action Plans (ICAPs). The mission aims at development of rural growth clusters that have latent potential for growth, in all States and UTs, which would trigger overall development in the region. The Rurban Mission will thus develop a cluster of Smart Villages (MoRD, GoI n.d.).

The 14 components suggested as desirable for the cluster include skill development training linked to economic activities, agro-processing/agri services/storage and warehousing, digital literacy, sanitation, provision of piped water supply, solid and liquid waste management, village streets and drains, street lights, fully equipped mobile health unit, upgrading school/higher education facilities, inter-village road connectivity, Citizen Service Centres- for electronic delivery of citizen-centric services/e-gram connectivity, public transport, and LPG connections. These clusters would be strengthened with the required amenities, for which it is proposed that resources be mobilised through the convergence of various schemes of the Government, over and above which a Critical Gap Funding (CGF) would be provided under this Mission, for focused development of these clusters (MoRD, GoI 2015).

The Rurban Mission looks like a modification of 'Providing Urban Amenities in Rural Areas (PURA)' scheme, which has the objective of holistic and accelerated development of compact areas around a potential growth centre in a Panchayat (or group of Panchayats) through Public-Private Partnership (PPP) by providing livelihood opportunities and urban amenities to improve the quality of life in rural areas. The primary objectives of the scheme were the provision of livelihood opportunities and urban amenities in rural areas to bridge the rural-urban divide. The PURA scheme was based on the vision of the then President of India Dr. A.P.J. Abdul Kalam. During his address to the nation on eve of Republic Day in 2003, Dr. Kalam visualised providing four types of connectivity: physical connectivity, electronic connectivity, knowledge connectivity leading to economic connectivity of rural areas. Out of these, electronic connectivity looks very important as it helps to connect the whole world at a very cheaper cost. Hence, in infrastructure development broadband connectivity, availability of internet/mobile network is very important (MoRD, GoI n.d.).

Bharat Nirman is also one of the ambitious initiatives of the Ministry of Rural Development, Government of India for the upscaling of rural infrastructure of India by concentrating on six major sectors. This is a time-bound plan for rural infrastructure by the Government of India in partnership with State governments and Panchayat Raj Institutions. Under Bharat Nirman, the action was proposed in the areas of irrigation, road, rural housing, rural water supply, rural electrification and rural telecommunication connectivity. There are set specific targets to be achieved under each of these goals so that there is accountability in the progress of this initiative (NIC, GoI 2012).

Under one of the basic objectives of the SAGY scheme, it is mentioned to have improved basic amenities of the village for substantially improving the standard of living and quality of life of all sections of the population (MoRD, GoI n.d.).

Now, the XIV Finance Commission has awarded a substantial grant of Rs.200292.20 crore exclusively for the Gram Panchayats to be devolved over a period of five years. Over this period, as per the existing trend, GPs are likely to get at least an equivalent amount from MGNREGS. Further, the State Finance Commission (SFC) transfers, own source revenues and flows from State and Centrally sponsored schemes would enlarge the financial resources of the GPs (MoPR, GoI 2018a).

People are well-versed with the situations that have been influencing their lives. Situation analysis is a process through which the issues and the needs of the community and the gaps that require intervention are identified. Situation analysis refers to the assessment of development status of the GP. It is primarily required to assess the existing scenario of the GP on various development issues. It also provides basic information on the gaps in infrastructure, amenities and services that exist as well as the potential for future development. This analysis can serve as the basis for setting priorities for the issues to be incorporated in the GPDP (MoPR, GoI 2018b).

The major drawback felt under these schemes is the limitation to sectors, and top-down approach. The planning should remain holistic for the infrastructure development and it should be in a bottom-up manner. Further, the GIS/remote sensing based projects are not stressing much on the planning aspect and gap analysis at local levels, and are mostly limited to the inventory of assets and visualisation.

1.3. Objectives

- ◇ To survey and map the existing community infrastructure of Gram Panchayat
- ◇ To assess ideal/optimum community infrastructure requirement of Gram Panchayat through Participatory and Departmental Approach
- ◇ To analyse and map gaps in community infrastructure and suggesting infrastructure development plan of GP
- ◇ Estimation of tentative cost for works and suggestions on inclusion in GP and Departmental Development plans

2. Method

2.1. Location/Demography and Justification of Area

Hantra Gram Panchayat in Nadbai Block of Bharatpur district comprises three villages, namely Hantra, Arauda and Nagla Banjara. Hantra Village (Latitude 27° 8' 8.62" N, Longitude 77°14' 10.91" E), and Arauda (Latitude 27° 7' 57.21" N, Longitude 77°13' 5.85" E) are situated on NH- 11 between Jaipur and Agra and the third small village named Nagla Banjara (Latitude 27° 7' 26.00" N, Longitude 77°14' 0.43" E) is situated in the southern side of NH-11.

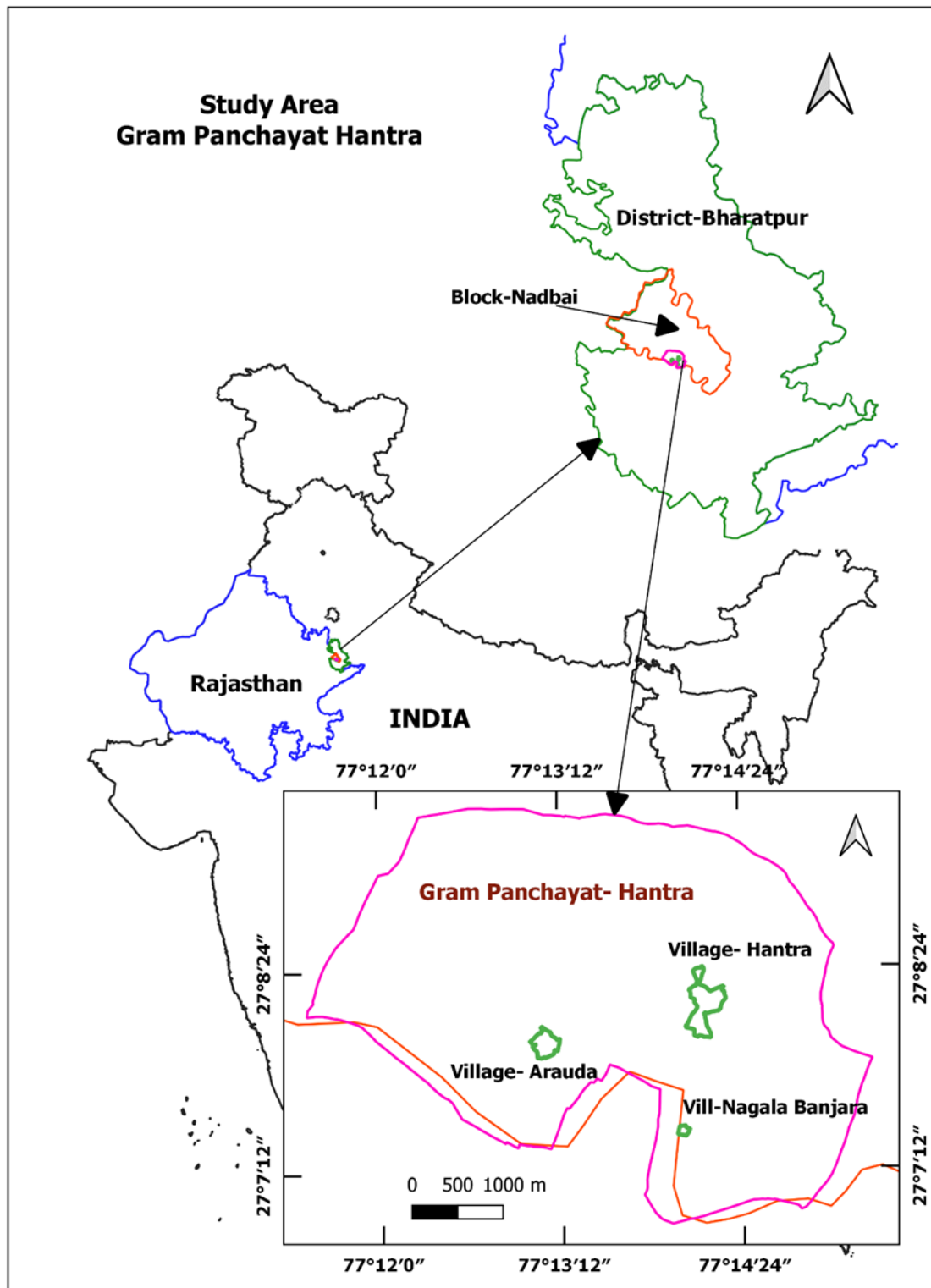
Local Government Directory (LGD) codes for all three villages and GP are 74492 (Hantra), 74490 (Arauda), 74491 (Nagla banjara) and 35425 (Hantra Gram Panchayat) (MoPR, GoI n.d.). For location map, see Figure 4.

As per census 2011, the three villages of Hantra GP are having the pattern of demography as shown in Table 1.

Table 1: Village-wise Demographic Details of Hantra Gram Panchayat

Name of Attribute	Hantra	Arauda	Nagla Banjara	Total
Geographical area (Hectares)	748.8	909.30	112.0	1770.1
No. of Households	614	435	110	1159
Total Population	3730	2905	550	7185
Male	1987	1507	286	3780
Female	1743	1398	264	3405
Literate Males	1495	1169	167	2831
Literate Females	762	649	63	1474
Schedule Cast	1087	458	4	1549
Schedule Tribe	36	8	0	44

Source: Census 2011.



Map Sources- Bhuvan, Survey of India & Cadastral maps Digitisation

Figure 4: Study Area

2.1.1. Area Justification

The study required extensive communications and involvement of villagers to check/validate existing and required community assets and in field surveys also. As the researcher is well versed with the language, topography, culture of the area, Hantra Gram Panchayat has been selected for the study. The other reason for selecting Gram Panchayat was the presence of well-educated (MBA), supportive and young Sarpanch.

2.2. Materials

2.2.1. Software and Tools Used for Data Collection

For GIS visualisation and analysis, Open Source QGIS 3.4 Madeira (Long Term Release) (<https://qgis.org/en/site/>) software was used. For field GPS data collection of points and lines, OSMAND 2.6 version free mobile mapping app for Android phones was used. The OSMAND app can work without internet connectivity in the field by using the GPS connectivity of phone (<https://osmand.net/>). To collect ward-wise and village-wise data, meetings and group discussions were held and the help of individuals like ward members and Panchayat functionaries were taken. To validate the data and getting the overall problem and solutions, common Gram Panchayat level meetings were also arranged. Data on existing assets were collected mostly by keeping the requirements of GPDP guidelines.

Both the community members and departmental officials were contacted frequently during the study along with collecting field data on assets. Attribute data like general details of assets were collected from Panchayat functionaries and departmental officials concerned.

2.2.2. Secondary Data Sources

Secondary data was collected for knowing the departmental norms for various assets from all relevant departments including Panchayat. Census data for the years 1991, 2001, and 2011 were collected from State Census Department for analysing the primary census abstract and Village Directory data.

Mostly open-ended questions were asked about the details of assets and status of service delivery under various sectors in group meetings. NRSC IRS LISS-IV data of 5.8-metre spatial resolution and Cartosat-2 data with about 1-metre spatial resolution were used at the initial stage for checking the possibilities of application as base map and as an aid for other analyses.

To get the most refined base map and for other analysis of the village habituated areas, unmanned aerial vehicle (UAV)/drone survey of settlement areas of all three villages under the study Gram Panchayat was also carried out with the help of North Eastern Space Applications Centre (NESAC), Umiam, Shilong, Meghalaya, which is a regional centre of the Indian Space Research Organisation (ISRO). Data was taken with 5 cm pixel resolution and 10-15 cm of accuracies. A separate chapter has been dedicated to the details of the drone survey conducted.

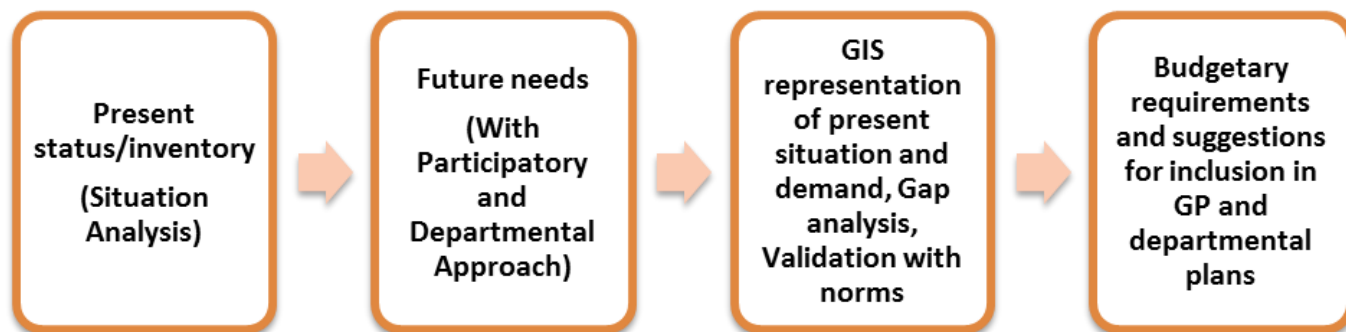


Figure 5: Process Flow Diagram

The process flow as illustrated in Figure 5 is showing a gross flow of study and the micro details of process flow are described further. The flow described above was not in the exact sequence in the field, and processes run in parallel also based on time suitability, availability of villagers and departmental officials and data.

2.3. Detailed Process Flow

2.3.1. General Preparation

The study was introduced to District Collector, Bharatpur and a request was made to issue instructions to District, Block and Gram Panchayat officials for support in the study. Common instructions were released to the district officials of relevant departments and Block level officials like Sub Divisional Officer and Block Development Officer, Nadbai Block. The Block Development Officer issued instructions to Gram Panchayat and cluster level officials for supporting the study.

2.3.2. Collecting and Mapping Existing Assets

The data of existing structures were collected using the mobile mapping app. The research associate was accompanied by ward members or Panchayat functionaries concerned during data collection. Various village/GP/cluster level officers were contacted for collecting secondary information on assets, and confirming the works, locations and details. The revenue maps were collected from the district level office of Revenue Department and the same were scanned, georeferenced and digitised to get the Gram Panchayat and village boundaries. To get the present extent of habitation, digitisation of habitation areas was done in Google Earth and tentative current habitation boundaries were digitised for all three study villages in the Gram Panchayat. These were compared with the areas allocated for settlement/habitation in revenue maps.

Various available remote sensing data were tried to work as a base map for the presentation of assets in GIS environment but the resolution of LISS-IV data was also not found suitable for better visualisation of roads and assets. Later, when the data of drone survey was received from NESAC, it was used as base maps for GIS visualisation. Primarily, the drone survey was done for analysing the

application potential of UAV/drone data in village-level drainage and sanitation plans, which is a major problem of the area. Further details are available in the chapter concerned.

After collecting data on existing assets, the same was validated by the departmental officials concerned as well as Panchayat functionaries, and later imported into the GIS environment for mapping and visualisation.

2.3.3. Collecting Demands from Villagers and Mapping

Data were collected on the problems of the villagers and solutions. The inputs were translated to get the possibilities of creating any assets as a solution to the problem. To remain focused under study, no individual problems were discussed. The data were collected ward-wise to stay more concerned with the last unit of administration of the Indian governance system. However, the wards are mainly meant to support the election process of India (as observed during discussions). An attempt was made to get fair boundaries of wards with the help of ward members and Panchayat functionaries for collecting the problems and accordingly, solutions were demanded. This helped the study team to obtain more numbers of instances of the same problem to assess its acuteness and to become more precise on assets required. While gathering their demands, no discussions on schemes, budgets, and guidelines were made and every available person was having an equal opportunity to discuss the common infrastructure or basic amenities-related problems and future requirements. If the solution of any problem could be physically marked on the ground, its location was taken by the research staff on site, with the help of mobile mapping app with other details.

After collecting the ward-wise data, village-wise meetings were conducted to further validate the collected data and to get additional problems and solutions at the village level. The next round of discussions was made at the Gram Panchayat level in which all the Panchayat members and Panchayat level officials were invited to validate and finalise the demands collected. They were asked to provide the details of common problems and demands of Gram Panchayat for basic infrastructure and amenities specifically.

After collecting the problems and solutions sought, the demands which could be marked and located on the ground were mapped in the GIS environment as GIS layers for various assets demanded. The general problems and general solutions that require decision on location in the later stage (like Bank, Gaushala) were not mapped in GIS. The problems which were not convertible to any structure could not be mapped in the GIS environment (like raising/removal/insulation of electricity wires).

2.3.4. Collecting Norms from Departmental Officials

In addition to collecting data on existing assets and demands, norms of the departments

relevant to the study were also collected. These were mainly focused on the parameters used for constructing new assets, repair of assets, etc. The secondary data was searched in departmental websites also. The departments were contacted at Gram Panchayat, Block and district levels.

2.3.5. Analysing Demands and Norms and Suggesting a Work Plan

After collecting data on existing assets from the field, demands from villagers, norms from relevant departments, and analysis of demands and norms were made keeping the status of existing assets in view. Many findings were derived and presented in the results section. Resource-stressed or resource-relaxed conditions were observed and presented for all demands of the villagers. Based on the nature of assets demanded, departments and schemes are also suggested.

2.3.6. Cost Analysis of the Plan

After coming to a final possible infrastructure plan, a resource envelop was prepared for assessing the financial capacity of Panchayat as per income and expenditure trend of five years including all schemes. The total cost of the demanded assets was also estimated based on the suggestions of the relevant departmental officials, expenditure norms of assets and villagers' opinions.

2.3.7. Recommendations

Based on the study findings and discussions, recommendations are made for further consideration.

3. Data Presentation and Analysis

3.1. Demographic Trends of the Villages in Gram Panchayat

The census data and village directory data of 1991, 2001 and 2011 were drawn from Census of India data purchased from Census of India, Rajasthan State office (Directorate of Census Operations, Rajasthan n.d.), and analysed for the trends in various sector so that the demands of the villagers can be linked to the population trends. The trend of various census data over three censuses in Hantra Gram Panchayat is shown in Figure 6.

Primary Census Abstract (PCA): Trend over 20 Years					
Parameters	Yearly Values			Graphical Trend	% Change
	1991	2001	2011		
No. of Households	751	1090	1159		54.33
Total Polulation (Including institutional and houseless population)					
Persons	4896	7006	7185		46.75
Males	2672	3819	3780		41.47
Females	2224	3187	3405		53.10
Population in the age-group 0-6					
Persons	1106	1338	1081		-2.26
Males	587	676	578		-1.53
Females	519	662	503		-3.08
Scheduled Castes Population					
Persons	1080	2199	1549		43.43
Males	548	1242	836		52.55
Females	532	957	713		34.02
Scheduled Tribes Population					
Persons	44	19	16		-63.64
Males	22	9	21		-4.55
Females	22	10	23		4.55
Literates					
Persons	1562	3496	4305		175.61
Males	1341	2534	2831		111.11
Females	221	962	1474		566.97
Illiterates					
Persons		3510	2880		-17.95
Males		1285	949		-26.15
Females		2078	1931		-7.07
Total workers					
Persons	1321	3380	2924		121.35
Males	1229	1965	1811		47.36
Females	92	1605	1113		1109.78
Main Workers					
Persons		1900	2337		23.00
Males		1705	1637		-3.99
Females		195	700		258.97

Figure 6: Demographic Trend of Hantra GP over Three Censuses

Source: Census of India

Differences were found between Census-2011 and Socio-Economic and Caste Census (SECC-2011) data and the reason may be different sources or timings of data collection. However, for the study purpose, Census 2011 data was taken into account. The period of enumeration of SECC is different than Census 2011 as quoted on SECC site, <https://secc.gov.in/> (DoRD, MoRD, GoI 2011).

In village directory data, it was found that different/additional items, naming conventions, etc., were there over the three censuses of 1991, 2001 and 2011. For instance, some of the assets were given in numbers while others were given in codes like 'Yes' and 'No' on availability status without actual numbers. Hence, a proper trend generation like primary census abstract was not possible.

3.2. Existing Assets and GIS visualisation

Following are the major community assets available in the GP. These are presented in description/list and map formats on A4 size papers. However, for proper visualisation of data, it may be seen in Open Source GIS environment.

3.2.1. ATAL Seva Kendra

ATAL Seva Kendra was made under MGNREGA scheme in year 2012. It has three rooms and is being used for Gram Panchayat meetings and other GP-related planning. The building is in good condition and has internet/telephone facility. There is a major demand for the posting of peon on permanent basis for attending to cleaning and other regular routine cares.

3.2.2. Panchayat Bhawan, Hantra

Panchayat Bhawan is an old building having three rooms. Constructed in the year 1985, it is now used as a veterinary hospital. The condition of the building is not good. A room is being used as 'Prerak' office, a post under the Saakshar Bharat Mission.

3.2.3. 'Five Shops' Building, Hantra

Five Shops Building in Hantra was constructed under the Swarnajayanti Gram Swarojgar Yojana (SGSY) scheme in the year 2001 and it has five shops allotted to BPL families. The floor level of shops is lower than road and it needs to be raised.

3.2.4. Schools in Hantra Gram Panchayat

In Hantra Gram Panchayat, four government schools are functioning: Government Girls Upper Primary School, Hantra, Government Senior Secondary School, Arauda, Government Senior Secondary School, Hantra, and Government Primary School, Nagla Banjara. The private schools in the GP are Lokendra Secondary School, Hantra, Chaudhary Kanya Vidyalaya, Hantra, Mamta Sikchan Sansthan, Hantra, Gyandeep Public School, Arauda, Neetu Academy, Arauda and Madhu Vidya Mandir, Arauda.

3.2.5. Anganwadi

Four anganwadi centres are functioning in Hantra Gram Panchayat – two each in Hantra and Arauda village. There is a demand for a centre in Nagla Banjara village. The anganwadis, which are presently working in private buildings and school buildings, are seeking own buildings. Also, separate drinking water and other facilities are not available here. All employees are female, who are engaged by the ICDS department on temporary basis.

3.2.6. Post Office Hantra

The PIN code for Hantra is 321601. Hantra post office belongs to Bharatpur Division of Jaipur HQ Region, Rajasthan Circle. Hantra is a branch post office and they have delivery facilities.

3.2.7. Hospitals

The Central government established a norm for setting up primary health centres to provide medical facilities to a large number of people. The health planners in India think primary health centres and sub-centres as the proper infrastructure to provide health services to the rural and tribal population.

In Hantra Gram Panchayat, one primary health centre (PHC) is available whereas Arauda village has a primary health sub centre (PHSC).

3.2.8. Water Tanks

Hantra Gram Panchayat has a total of 18 water tanks constructed by the GP - 11 in Arauda village and 8 in Hantra village. Hantra village has an overhead water tank and two ground level reservoirs (GLRs) and Arauda has one GLR. The villagers have sought water tanks at different places in all three villages.

3.2.9. Hand pumps

A total of 41 hand pumps are available in the Gram Panchayat. Of this, PHE department has installed 11 pumps and 30 were installed by Gram Panchayat. However, only a few hand pumps are working whereas others are operated through electric motor and pipe. Out of these, only 7 pumps are giving potable water while the rest are non-functional or having non-potable water.

3.2.10. Roads

In Hantra Gram Panchayat, a total of 206 different types of roads are digitised as per the Panchayat records. Roads were categorised as internal roads connecting mostly the internal locations of villages and external roads connecting the village with external locations or other villages or habitations far from the main village. A total of 59 roads were marked/recorded in Arauda

and are codified as Arauda Internal Roads (AIR) and Arauda External Roads (AER). In Hantra village, 133 roads were recorded and codified as Hantra Internal Roads (HIR) and Hantra External Roads (HER). Similarly, in Nagla Banjara village, 17 roads were recorded and codified as Nagla Banjara External Roads (NER) and Nagla Banjara Internal Road (NIR). Two roads belonged to Public Works Department (PWD), one was National Highway and the other was the Gaurav Path constructed under the Gaurav Path Scheme of the PWD. In whole, the road condition in Hantra Gram Panchayat is good but the drainage water is flowing on roads due to flat or lesser slopes or choked drainages. Therefore, frequent damage and construction of roads happen in each plan. Laying of blue metal on roads is pending at few places and it needs to be completed.

3.2.11. Public Distribution System (PDS) Shops

Hantra Gram Panchayat has three public distribution system (PDS) shops - one in Arauda village and two in Hantra village. Nagla Banjara village has no PDS shop is available. Shops are functioning in private buildings and there is a demand to shift the shops to government buildings or permanent designated places having basic facilities.

3.2.12. Drainage

Drainage is a major problem faced by Hantra Gram Panchayat. Due to poor drainage system and blockages of drainage channels, wastewater is stored on roads at water stagnation points. Though drainage channels are constructed along the roads, they are not maintained well. Neither regular cleaning is done nor are any norms available. Drone images were interpreted for the overall slope and terrain condition of the village, water stagnation points and as per slope conditions, suggestions are made to resolve the problem. The drone images are used as base maps also for proper visualisation of assets. The applications of drone have been dealt with separately in further sections in detail.

3.2.13. Reverse Osmosis (RO) Plants

Two Reverse Osmosis (RO) plants – one each in Arauda and Hantra are available in Hantra Gram Panchayat. Both the villages have demanded an additional RO plant. Nagla Banjara village doesn't have RO plant facility.

3.2.14. Electric Transformers

A total of 171 electric transformers are available in different capacities like 5 KW, 10 KW, 16 KW, and 25 KW. Hantra village has a total of 113 transformers, Arauda village has 65 and Nagla Banjara has 5. All transformers are in good working condition. Grid Sub Station (GSS) is situated at Dehra mod, which is nearly three kilometres away from the GP.

3.2.15. Wells

Hantra Gram Panchayat has a total of 54 wells. Hantra village has 26 wells, Arauda has 23 wells and Nagla Banjara has 5. All wells have gone dry and are not being used. The water level is very low and its quality is poor.

3.2.16. Bandh (Earthen Bunds)

One Bandh (बंध्य) which is also called Bandha (बंधा) is an earthen structure constructed along a long line to conserve/divert the flow of water or reduce the speed of runoff. Such kind of a structure is available in Hantra village and stretched to ward numbers 6, 8 and 9 and a structure is available in Arauda. Bandh area in Hantra village has almost come under encroachment.

3.2.17. Water Ponds

The Gram Panchayat has a total of 10 ponds. Of these, three major ponds are situated in Hantra and two are in Arauda. Nagla Banjara village does not have any pond.

3.2.18. Shamshan Ghats/Cemeteries

Five cemeteries are available in Hantra Gram Panchayat - two each in Hantra and Arauda and one in Nagla Banjara.

3.2.19. Deep Borewell

Hantra Gram Panchayat has a total of seven deep bore-wells generally called deep bores. Four of them are in Hantra village - three constructed by Gram Panchayat and one by PHED. Arauda village has three deep bores - two constructed by Gram Panchayat and one by PHED.

3.2.20. Brick Kilns

Hantra Gram Panchayat has 20 private brick kilns – 16 in Hantra village and 4 in Arauda village. Nagla Banjara does not have any brick kiln. Basic facilities are available at kilns but the living conditions of labourers are not good.

3.2.21. Mobile Communication Towers

Four mobile communication towers of BSNL, Vodafone, Reliance and TATA are installed in Hantra Gram Panchayat.

3.2.22. Others

The GP has other assets like two beer factories, a petrol pump, three Common Service Centres (CSCs), two bus shelters on the highway, four restaurants, a veterinary hospital operated in Panchayat Bhawan building, and 10 temples.

The consolidated asset-wise details are presented in Table 2.

Table 2: Total Existing Community Assets in Hantra Gram Panchayat

S. No.	Type of community Assets	Total GP Assets	Code/Label for map
1	Anganwadi (without own building)	4	A
2	Brick Kilns (privately owned)	20	B
3	Bus stops	2	BS
4	Cemeteries	5	SG
5	Communication Towers	4	CT
6	Common Service Centres	3	E
7	Deep Bores	7	DB
8	GP buildings (Atal Seva Kendra and Five Shops Building)	2	(ASK, GPS)
9	Hand pumps	41 (Working 7): 5 Arauda, 1 Hantra, 1 Nagla Banjara)	HP
10	Hospital (one PHC& one PHSC)	2	H
11	PDS Shops	3	PDS
12	Post Office	1	PO
13	Government Schools	4	SC
14	Private school	6	PS
15	RO plants	2	RO
16	Beer factories	2	BR
17	Temple	10	T
18	Transformer	171	TR
19	Veterinary Hospital (sub-centre) without own building, being run in old Panchayat Bhawan	1	VH
20	Water Tank (One Overhead, 3 GLR and other as small PVC tanks)	18	WT
21	Wells	54	WL
22	Bandh (Earthen Bunds)	2	Bandh
23	Roads	206	R, prefixed as A, H and N for Arauda, Hantra and Nagla Banjara village. Further prefixed by E for external and I for internal roads. NH for National Highway
24	PWD Roads	4	
25	Ponds	10	P
26	Petrol Pump	1	PP
27	Restaurant	4	RS

3.3. Ward-wise Mapping of Existing Community Assets

The details of existing community assets of the whole GP were collected using open source mobile mapping apps, with details like type, executing agency, scheme, cost, etc., of the asset. Accordingly, assets were overlaid on UAV/drone-generated images for proper visualisation. The mapping was divided into ward-wise maps to see a larger view of the existing assets and ward-wise situation of existing assets.

Map for ward number 1 is depicted below as a sample ward-wise mapping. All the assets were codified as shown in Table 2 with numbers where the first few letters represented codes followed by the asset number. The map for ward 1 is showing an RO plant, a school, a transformer, a well, two hand pumps and two water tanks along with few roads as illustrated in Figure 7. The other ward maps are also prepared in a similar manner.

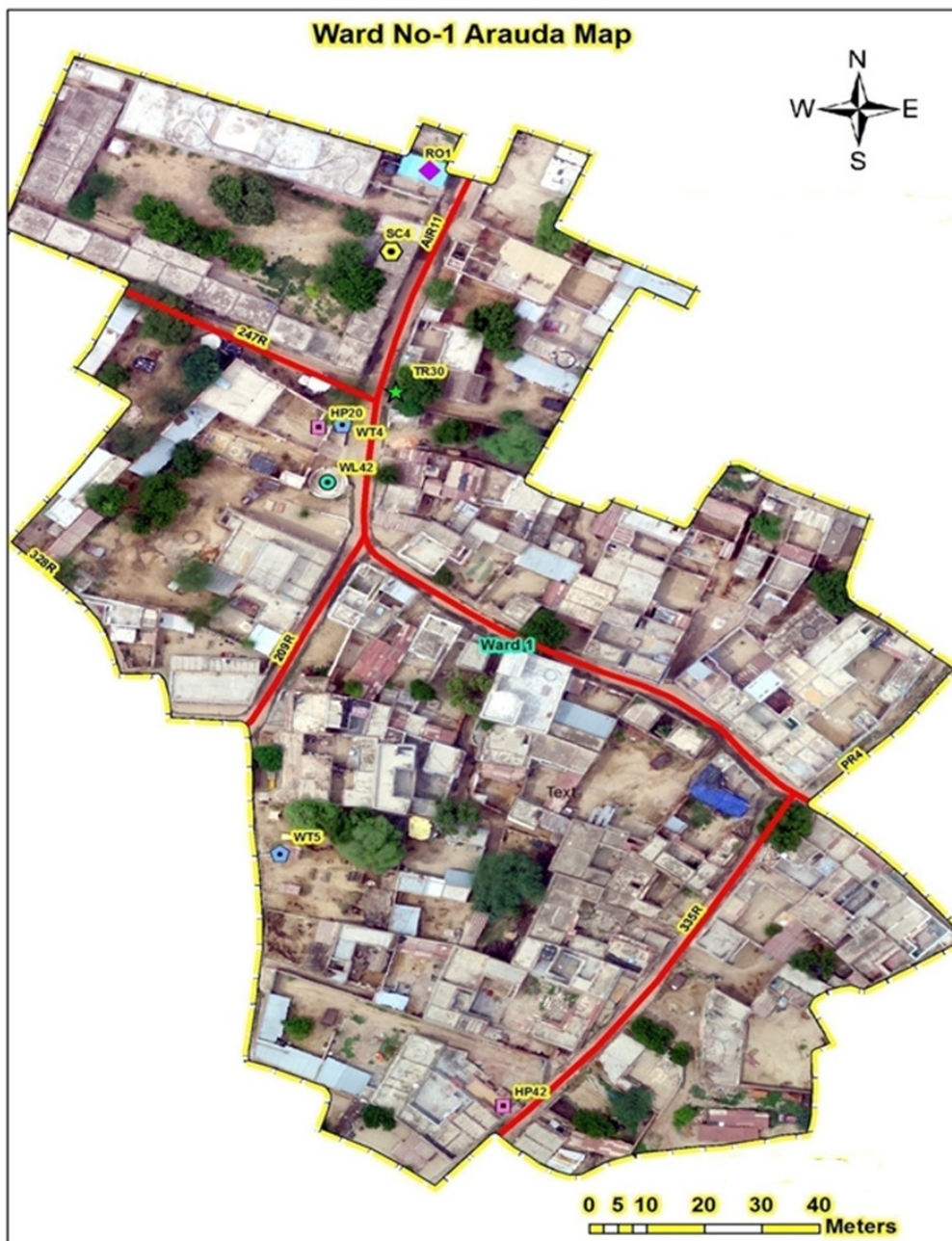


Figure 7: Existing Structures of Ward No. 1

3.4. Ward-wise Status of General Needs/Demands of Assets

The general problems and needs/demands of assets were noted in ward-wise meetings and group discussions were held with villagers and Panchayat functionaries. The demands were divided into two sections as 1) general demands and 2) demands for construction of community assets which can be shown on the map.

3.4.1. Demands of Ward No.1

Village Name: Arauda

General Problems and Demands

1. Wells in Arauda village are dried up. During rains, the water level in wells goes up temporarily. But, due to poor water quality and polluted water, the water from the well is not used for drinking or other purposes.
2. The water level has gone down and only one hand pump is being used. Therefore, some villagers have made groups and at the personal level, they have fitted electric submersible pumps in hand pumps for extracting water through PVC pipes to their homes. The water level is 250-350 feet below ground level.
3. High voltage (11 KV) wires are hanging open in ward no. 1 and these wires should be insulated with plastic/PVC.
4. Light and fan with other basic facilities are needed at anganwadi centre.
5. Soak pits can be constructed at areas having no natural water drainage slope.

Demands of Community Assets

1. Construction of deep bore well of 8-inch diameter in the vicinity of main pond.
2. Wi-Fi and computer facility in school
3. Common drinking water facility for animals.
4. Soak pit

3.4.2. Demands of Ward No.2

Village Name: Arauda

Demands of Community Assets

1. Water tank
2. Veterinary hospital in Arauda
3. Metal to be laid on road near highway

3.4.3. Demands of Ward No. 3

Village Name: Arauda

General Problems and Demands

1. High voltage open wires
2. Demands of community assets
3. Hand pumps (two)
4. Covering open drainage channel

3.4.4. Demands of Ward No.4

Village Name: Arauda

General Problems and Demands

1. Minimum road width should be 20 feet
2. Demands of community assets
3. Drinking water facility for animals
4. Veterinary hospital in Arauda
5. Deep bore well in the vicinity of the existing deep bore well
6. Brick/RCC street roads
7. Overhead water tank or ground level tank near deep bore well
8. Widening of roads

3.4.5. Demands of Ward No.5

Village Name: Arauda

General Problems and Demands

1. In this ward, water stagnation occurs; hence, a proper drainage system is needed
2. All wells are dry except a few near the ponds with seasonal water availability
3. Streets road should be repaired.

Demands of Community Assets

1. Water exit/drainage facility

2. Repair of street roads
3. Anganwadi building

3.4.6. Demands of Ward No.6

Village Name: Hantra

General Problems and Demands

Metal is yet to be laid on the common road from the National Highway to ward no.7.

Groundwater depth is up to 350 and the water is salty also.

Demands of Community Assets

1. Metaling of the road from National Highway to ward no. 7
2. Deep bore well

3.4.7. Demands Ward No.7

Village Name: Hantra

General Problems and Demands

1. Primary health centre road is not clean and broken at different places.

Demands of Community Assets

1. Piped water supply
2. Water tank near PHC
3. Brick/RCC roads inside the ward
4. Hand pump near 'Weir wali road'
5. Repair of PHC road
6. Hand pump

3.4.8. Demands of Ward No.8

Village Name: Hantra

Demands of Community Assets

One Hand pump

Repair of a road from the ward member's home to priest's home

3.4.9. Demands of Ward No.9

Village Name: Nagla Banjara

General Problems and Demands

1. The salinity of water makes it unsafe for consumption and currently no RO plant is available in Nagla Banjara village.
2. Disposal of wastewater
3. Cleaning of choked drainages and letting out stagnated drainage water
4. As the compound of the lone school in the village is below road level, water stagnates on the school premises. This is affecting the movement of students during rainy season.

Demands of Community Assets

1. One Reverse Osmosis (RO) plant
2. RCC road connecting Nagla Banjara to main road
3. A pit outside the village for dumping of sewage/wastewater
4. Drains along the roads lacking proper drainage facility
5. Piped water supply
6. Anganwadi centre with a building.
7. Drainage mechanism to let stagnated water out of the school building
8. Road to Weir side called 'Weir wali Road' is damaged at few places and it requires need-based repairs
9. A hand pump

3.4.10. Demands of Ward No.10

Village Name: Hantra

General Problems and Demands

1. Open high voltage electric wires (11 KV) should be insulated with PVC
2. The height of electric poles supporting high voltage wires needs to be raised
3. Salinity of drinking water

Demands of Community Assets

1. Drainage facility should be provided at all places where it is not available.

3.4.11. Demands Ward No.11

Village Name: Hantra

General Problems and Demands

1. Either one RO plant for 3000 people or one RO for two wards
2. Stagnation of polluted water
3. Groundwater pollution due to mixing of Water Closet (WC) water and bathing water
4. Widening of roads
5. Insulation of 11 KV HT lines with plastic/PVC
6. Pruning of trees that come in contact with the power lines
7. HT lines should be under ground or insulated with plastic
8. Usage of telephone poles as electricity poles
9. Burning of crops due to open low-lying high voltage power lines.
10. Low groundwater level
11. Free-roaming cattle like cow (non-productive) and bulls destroy crops
12. Lack of cleanliness

Demands of Community Assets

1. A new RO Plant (one already exists)
2. River water linkage for irrigation in crop land
3. RCC road from the settlement finishing point to the cemetery
4. RCC metaling on road from beer factory to the main village
5. Tightening of the low hanging wires over the crop field
6. Insulation of high voltage lines with PVC
7. Rescue centre (Gaushala) for animals (cow/bulls).
8. Retaining wall in the pond

9. Timely cleaning of stagnated water and chocked drainages
10. Widening of roads
11. Anganwadi building

3.4.12. Demands of Ward No.12

Village Name: Hantra

General Problems and Demands

1. Changing the location of Grid Sub Station

Demands of Community Assets

1. Deep borewell
2. Straight brick/RCC road from National Highway to Bharkau village

3.4.13. Demands of Ward No.13

Village Name: Hantra

General Problems and Demands

1. Bhumiyan to cemetery roads is broken at different places
2. No provision to let out the stagnated water

Demands of Community Assets

1. Metaling of roads
2. Repair of 'Bhumiyan to cemetery road'
3. Piped drinking water
4. Proper drainage to address water stagnation

3.5. Validation of Ward-Wise Demands at Village and Gram Panchayat Level

The demands were cross-verified and discussed for their general applicability and intensity at the village and Gram Panchayat level. The following demands were not found suitable for further consolidation or out of the scope of the study, based on various reasons described along with the demand. Accordingly, these demands were removed from further analysis.

1. Cleaning of streets and drainage channels & manpower arrangements for cleaning - The demands were not directly convertible to the physical assets; however, the same is further discussed in the analysis of demands of physical assets.

2. Primary health sub-centre - The centre is almost completed and functional, hence may not be part of demand.
3. Upgradation of Government girls upper primary school to senior secondary school- As the Gram Panchayat already have two Co-education senior secondary schools, the demand for a third exclusive Girls Senior Secondary school was not found feasible.
4. Instrument supports at Common Service Centre (CSC) in Atal Seva Kendra- It was informed by the Panchayat functionaries that the basic required instruments as per norms are available at the centre.
5. Police Chauki- It was informed that the existing Police Chauki is situated at distance of nearly 2.5 km from Hantra village. Even though it is located a bit away far from other villages, a separate police Chauki in GP at this point of time is not required.
6. Construction of Bus Stand- National Highway Authority has constructed two stoppages on either side of the highway and it was informed that the GP cannot construct or modify any work. Further, the present structure was found sufficient and no additional bus stand is required inside the village.
7. The shifting of Electric Grid Sub Station (GSS) to a nearer place - The current GSS is located at Dehra Mod which is 3 km away from Hantra village. It may be little far from other villages but it was found that there is not much requirement and in case of requirement, the load-bearing capacity of GSS can be increased. Electric infrastructure for GP is sufficient at this point of time.

3.6. Priority of All Demands as Shown by Villagers (first five)

1. Drinking Water
2. Proper drainage and removal of stagnated water
3. Controlling the freely roaming animals
4. Insulating/raising open electric wires
5. Roads

The above ranking is based on the views of the common public in group discussions, however, views of Panchayat functionaries were different on this and roads were shown as third priority by them. For the study purpose, views of the common public have been taken into consideration for further analyses. The demands collected at ward levels were consolidated in a tabular manner (see Table 3) and segregated in various sectors, with the frequency of demand and priority of sectors.

Table 3: Village-wise General Thematic Break-up of Demands with Frequency/Instances

S. No.	Demands Type	Village/Location	Frequency of demand	Priority
Water				1
1	Deep bores	2 Hantra, 1 Arauda	3	
2	Hand pumps	3 Arauda, 2 Hantra, 1 Nagla Banjara	6	
3	Water tanks	2 Hantra, 2 Nagla Banjara	4	
4	Reverse Osmosis plants	1 Arauda, 1 Hantra, 1 Nagla Banjara	3	
5	Piped water supply	1 Nagla Banjara	1	
6	Extension of piped drinking water supply to cover all homes	GP General	General (3)	
7	Ponds (desilting)	1 Arauda, 1 Hantra,	2	
8	River water linkage for irrigation in crop land	1 Hantra	1	
9	Retaining wall in pond	1 Hantra	4	
10	Common drinking water facility for animals	2 Arauda	2	
			29	
Hygiene/Sanitation/Waste Management				2
1	Drainage to solve water stagnation on road	1 Arauda, 2 Hantra, 2 Nagla Banjara	5	
2	Wastewater dumping pits	1 Nagla Banjara	1	
3	Covering of open drainage	1 Arauda	1	
4	Septic tank	1 Hantra	1	
5	Soak pits	1 Hantra	1	
6	Drainage arrangement for water stagnation problem under National Highway-11	1 Hantra	1	
7	Community toilets	GP General	General (3)	
8	Recharge well construction in wastewater dumping pit for groundwater recharge	GP General	General (3)	
9	Drainage channel along road	1 Nagla Banjara	1	
10	Drainage mechanism to let stagnated water out of school	1 Nagla Banjara	1	
			18	
Roads				5
1	Roads (New)	1 Arauda, 1 Hantra, 1 Nagla Banjara	3	
2	Road repair/upgradation	8 Arauda, 3 Hantra,	11	
3	Widening of roads	1 Hantra, 1 Arauda	2	
			16	

Contd...

S. No.	Demands Type	Village/Location	Frequency of demand	Priority
Electricity				4
1	Covering high voltage wires with PVC or underground cable	2 Arauda, 1 Hantra	3	
2	Raising Height of poles supporting high voltage wires	1 Hantra	1	
3	Removal of electric wires from Telephone poles	1 Hantra	1	
4	Raising Height of low lying wires in crop fields	GP General	General (3)	
5	Street lights	GP General	General (3)	
			11	
Health				
1	Building for existing veterinary hospital	1 Hantra	1	
2	New veterinary hospital	1 Arauda	1	
			2	
Education				
1	Wi-Fi and computer facility in school	1 Arauda	1	
2	Government college for graduation	GP General	General (3)	
			4	
Women and Child Development				
1	Anganwadi centre with building	1 Nagla Banjara	1	
2	Light, fans and basic facility for anganwadi centre	1 Arauda	1	
3	Building for anganwadi centres	1 Arauda, 1 Hantra	2	
			4	
Banking/Financial Inclusion				
1	Bank	GP General	General (3)	
			3	
Surveillance/Security				
1	CCTV at selected places/towers	GP General	General (3)	
			3	
Other Civic Infrastructure				
1	Community hall	GP General	General (3)	
			3	
Cooperative/Public Distribution System				
1	Constructed of permanent shops	GP General	General (3)	
			3	
Specific Demand				
1	Animal (cows/bulls) rescue centre (Gaushala)	GP General	General (3)	3
			3	

Note: General demands have been given weightage as three instances as per three villages in GP.

In Table 4, demands of assets raised by villagers are compared with the priorities of FFC, SAGY and RURBAN schemes to map variations and similarities in local demands of villagers and priorities of national schemes. Demands matching with the villagers' demands are shown in bold.

Table 4: Demands Raised by Villagers versus Priorities of Various Guidelines (FFC, SAGY, RURBAN)

Demands Raised by Villagers	FFC Guidelines	SAGY Guidelines	RURBAN Guidelines
Deep bores, hand pumps, water tanks (Overhead/GLR), Reverse Osmosis plants, piped water supply, extension of piped drinking water supply, ponds, desilting of ponds, retaining wall in pond, common drinking water facility for animals, drainage for water stagnation on road, wastewater dumping pits, covering of open drainage, septic tank, soak pits, drainage arrangement for water stagnation problem under National Highway-11, community toilets, cleaning of streets, cleaning of drainage channels along road side, drainage channel along roads, drainage mechanism to let stagnated water out of school, road repair/upgradation, widening of roads, covering high voltage wires with PVC or underground cable, raising height of poles supporting high voltage wires, removal of electric wires from telephone poles, tightening of the low-lying wires over crop fields, Pruning of trees to prevent electric shocks, street lights, building for existing veterinary hospital, new veterinary hospital, Wi-Fi and computer facility in school, upgradation of government girls upper primary school to senior secondary school, government college for graduation, anganwadi centre with building, light & fans and basic facilities for anganwadi centre, manpower and proper instrument support to Common Service Centre (CSC) and other services at Atal Seva Kendra, bank, police chauki, CCTV at selected places/towers, community hall, construction of bus stand, animal (cows/bulls) rescue centre (Gaushala)	Community water tank, community well, hand pumps construction and maintenance, drinking water and sanitation (wells, ponds, tanka, hand pumps, bore wells, glr, Janta Jal, Panghat, etc.), water supply pipelines, motor/pump for water supply, washroom at common places for ladies and gents, toilets in schools for boys and girls, drainage channel for wastewater, liquid and solid waste management (garbage dumping points), locating water stagnation points and suggesting the solutions, community assets location and their maintenance, maintenance of parks, and play grounds, maintenance of roads, street light arrangements, sewage management	Internal all-weather roads with covered drains, all-weather road connectivity to the main road network, street lights including those using alternative sources of energy, especially solar, pucca infrastructure for public institutions- anganwadis, schools, health institutions, Gram Panchayat office and libraries, civic infrastructure including community halls, buildings for SHG federations, playgrounds and burial grounds/crematoria, village markets, Infrastructure for PDS outlets, micro mini banks /post offices/ATMs, broadband connectivity and Common Service Centres, telecom connectivity, CCTVs in public places	Agro Processing, agri services, storage and warehousing, upgrading school/higher education facilities provision of piped water supply, solid and liquid waste management, village streets and drains, street lights, inter-village road connectivity, LPG connections, digital literacy, Citizen Service Centres (CSC) - for electronic delivery of citizen-centric services/e-gram connectivity

3.7. Status of Departmental Norms

Under the study, various relevant departments were contacted for information on norms and parameters for constructing related new assets so that the same can be used for assessing the optimum level of asset requirements as per departmental norms. Most schemes/works have the main criteria/parameters as public demand only. However, whenever parameters like population, water quality, distance, etc., are properly available, these supersede the public demand.

These norms were collected by personally contacting the departmental officials at Block, district and State levels or from guidelines if available in guidelines. These norms are always subject to change with changes in the guidelines and policies of departments/ministries. The following departments/offices were contacted under the study.

- District PDS (Supplies) Department, Bharatpur, Rajasthan
- Office of the Block Chief Health Officer, Nadbai Block (Bharatpur)
- Department of Information Technology and Communication, Government of Rajasthan
- Police Department, Bharatpur, Rajasthan
- PNB Bank Lead Bank District Manager (LDM) office, Bharatpur, Rajasthan
- JVVNL (Jaipur Vidyut Vitran Nigam Limited) Electricity Department, Bharatpur, Nadbai, Rajasthan
- Rajasthan Cooperative Department
- Public Health and Engineering Department Norms
- Public Works Department
- Integrated Child Welfare Department (ICDS)
- Education Department

3.8. Demand Analysis Considering Existing Structures and Departmental Norms

All demands were analysed in GIS environment (wherever possible) with reference to the existing assets of similar nature, departmental norms. GIS visualisation was done in reference to various relevant parameters.

Densities are calculated on unit population or unit area basis as the case may be, and described in text suitably. For population basis, the population of Hantra, Arauda and Nagla Banjara has been counted from Census 2011 and for area basis, GIS-derived habitational areas of villages are counted.

The basic data for the three villages is presented in Table 5 for ready reference.

Table 5: Basic Data of Three Villages to be Used in Further Analysis

Name of Attribute	Hantra	Arauda	Nagla Banjara	Total	Source
Geographical area (hectares)	748.8	909.30	112.0	1770.1	Census 2011
No. of Households	614	435	110	1159	
Literates	2257	1818	230	4305	
Illiterates	1473	1087	320	2880	
Total Population	3730	2905	550	7185	
SC/ST Population	1123	466	4	1593	
Population in the age group 0-6	593	370	118	1081	GIS
Habitation area as per revenue record (hectares)	14.86	6.5	1.02	22.38	
Habitation area as per Google Image (hectares)	63.98	32.37	2.09	98.44	
Length of roads constructed in total village area (kms)	28	16	3	47	
Length of roads in habitational area (metres)	9505	4691	677	14873	

Using the GIS tool, it is possible to capture the proximity of assets and calculate the ward, village or GP area-wise asset density. This is helpful to understand the fair distribution of assets over the area. Population-wise asset density also can be visualised by knowing the number of assets falling under a particular area divided by the total population of the area.

The analysis has been made for the assets which are having population, area or distance/time criteria. For the assets where GIS visualisation is not feasible for very few data or not feasible for mapping, descriptive details are given.

3.8.1. Hand Pumps

The Gram Panchayat has a total of 41 hand pumps and the asset density of existing hand pumps per 100 population basis comes to 0.51, 0.61 and 0.54, respectively, for Hantra, Arauda and Nagla Banjara villages. The concentration of hand pumps was more towards central parts of villages (see Figures 8 & 9).

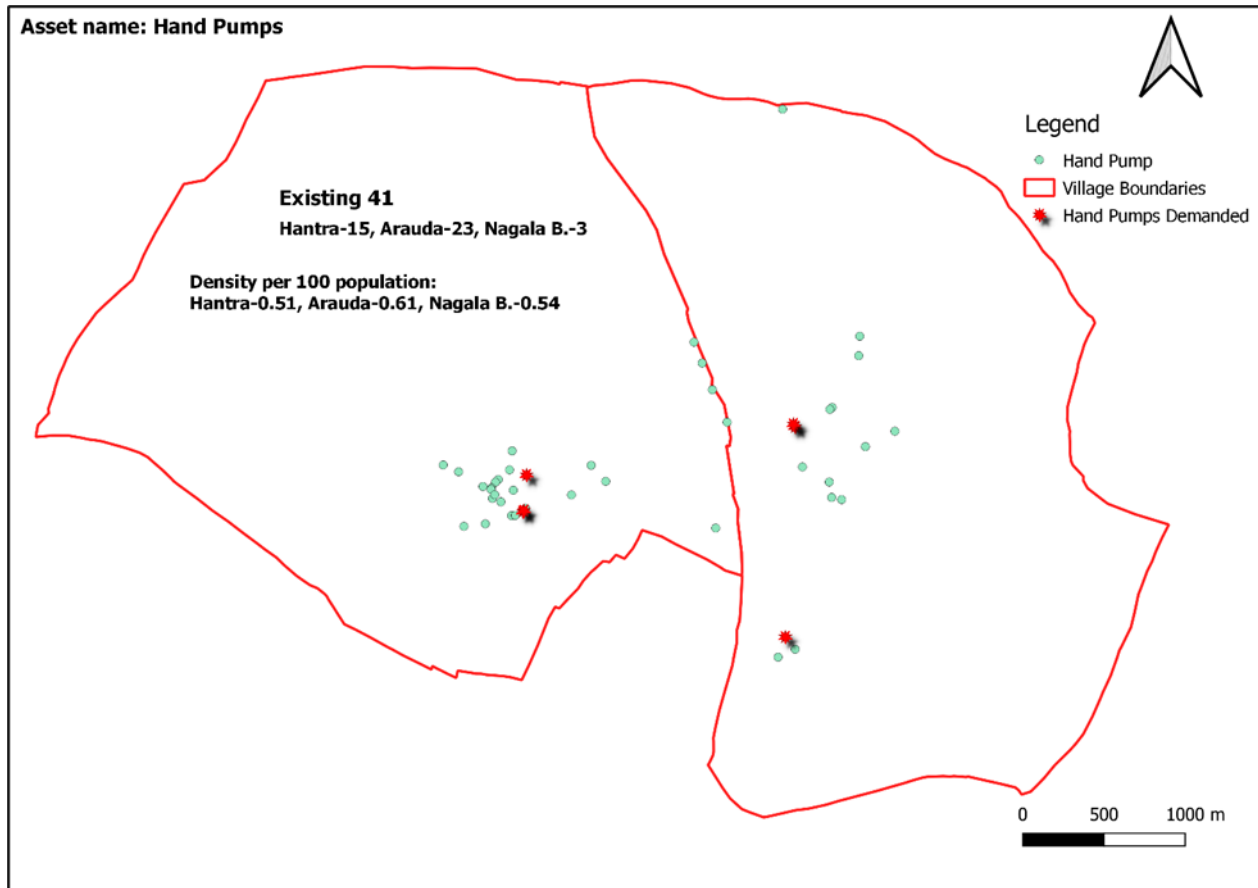


Figure 8: GIS Visualisation of Assets - Hand Pumps

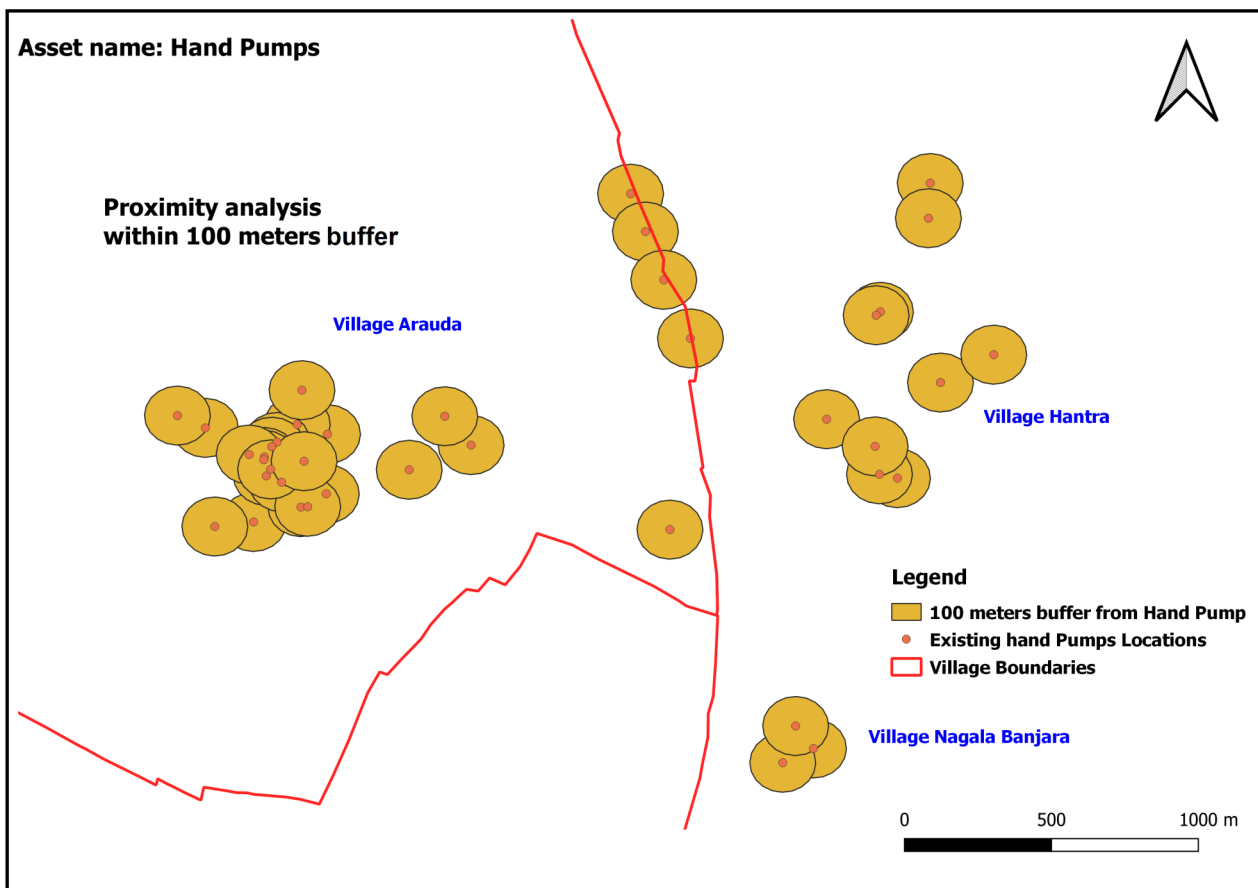


Figure 9: Proximity Analysis for Hand Pumps

Almost all hand pumps are ineffective due to low water table or poor water quality (the water from hand pump near the school in Hantra village was tasted and found not fit for consumption). Generally, people are making groups and putting submersible pumps in hand pumps for drafting water. Hence, hand pumps are just for namesake and later used as submersible bores. At present, the hand pump system is a failure in the area. Moreover, villagers and departmental officials do not want further hand pumps in the areas where water table is 100 feet below the ground level or water is not potable. Manual operation of hand pumps at a depth of more than 100 feet was not shown feasible by the PHE department officials.

3.8.2. Other Water-Related Assets

3.8.2.1. Ponds

The village has a total of 10 ponds. Maintenance and construction of retaining walls and structure to ensure inflow of water is required in different ponds. There are no proper norms for desilting and maintenance of ponds and as per public demand, works can be performed. As a general norm, it was informed that the ponds desilted under the Mukhyamantri Jal Swablamban Abhiyan (MJSA) cannot be taken up again for desilting and all the eligible ponds in the GP have been desilted under the MJSA scheme of State government. However, it will be better to have specific norms for desilting of ponds as desilting can break the hard clay base of ponds. If the pond is mostly used for water harvesting, animal/human drinking purpose, irrigation, etc., the activity may be carried out with precaution at proper intervals. If the structure is used only as a recharge pond, then the activity may be performed frequently also. In villages, most of the ponds are used for water harvesting with slow percolation; hence, the norms may be fixed for the time gap between the desilting activities of ponds of different areas/terrain conditions. In Hantra village, two ponds are not getting enough water and the remaining are mostly dry.

Most of the ponds are being used for dumping waste and letting out excess water of the village, thereby making it non-usable for drinking/bathing purposes. Consequently, the ponds have been used as waste/excess water collection points. The practice of draining out domestic wastewater into ponds should be banned and it must be drained into soak pits/separate pits.

Another substantial demand was construction of retaining walls for four ponds.

3.8.2.2. Water Tanks

The village has a total of 19 water tanks and four new ones have been demanded. As per the norms, the minimum population for a tank is 500 for 'Single Point Scheme' and 1500 for 'Pump and Tank Scheme'. With respect to both criteria, water tanks are already saturated in Gram Panchayat. Considering the village as a unit, Nagla Banjara has no water tank and there is no demand for one.

3.8.2.3. Deep Boring

The Gram Panchayat has a total of seven deep bores and three new ones have been demanded. As one deep bore can be installed for a population of 1500, these are already saturated in Hantra and Arauda. There is no demand from Nagla Banjara; also, it is very less populated also for the establishment of deep bore as per norms.

The water table has gone down and potable water is available only after 300 feet and below. Hence, the demand for deep bore is increasing with the population increase and the habit of not moving far from the house to fetch water.

3.8.2.4. Reverse Osmosis Plants

The GP has two RO plants - one each in Hantra and Arauda villages. One RO is demanded in Nagla Banjara. As per norms, the minimum TDS required is 3000 and the minimum population is 500. As per Census 2011, Nagla Banjara village is eligible for the setting up of an RO. As per population norms and budget availability, more ROs can be established in Hantra and Arauda.

However, Nagla Banjara requires one on priority as the village with a population more than 500 as per the 2011 Census, has no RO plant.

Note: For some of the demands, the villagers were not able to show locations of choice and those demands are not mapped in the GIS environment. Suitable sites for those demanded assets depend on the department concerned.

Other water-related assets as per the existing and demanded assets are represented separately in Figures 10 and 11.

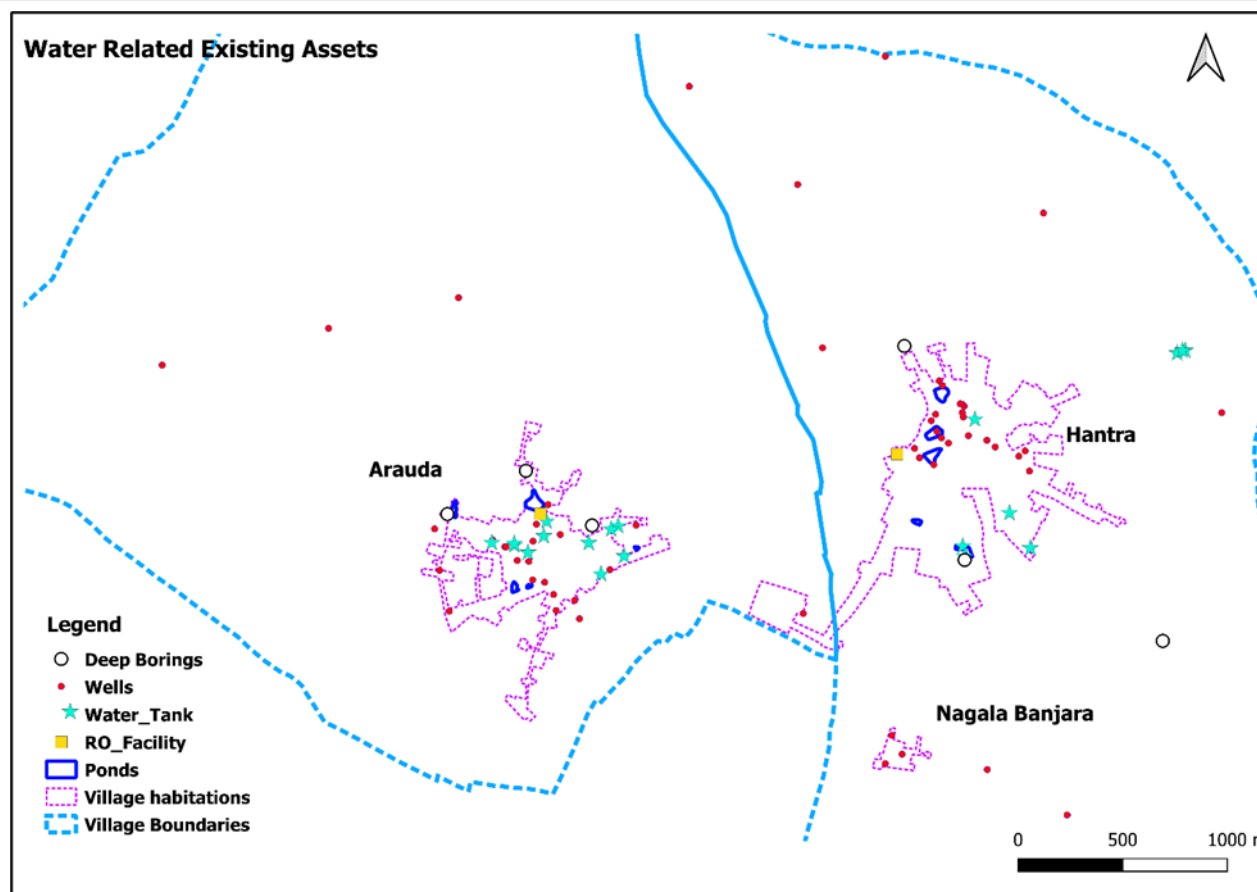


Figure 10: GIS Visualisation of Assets- Other Water-Related Assets

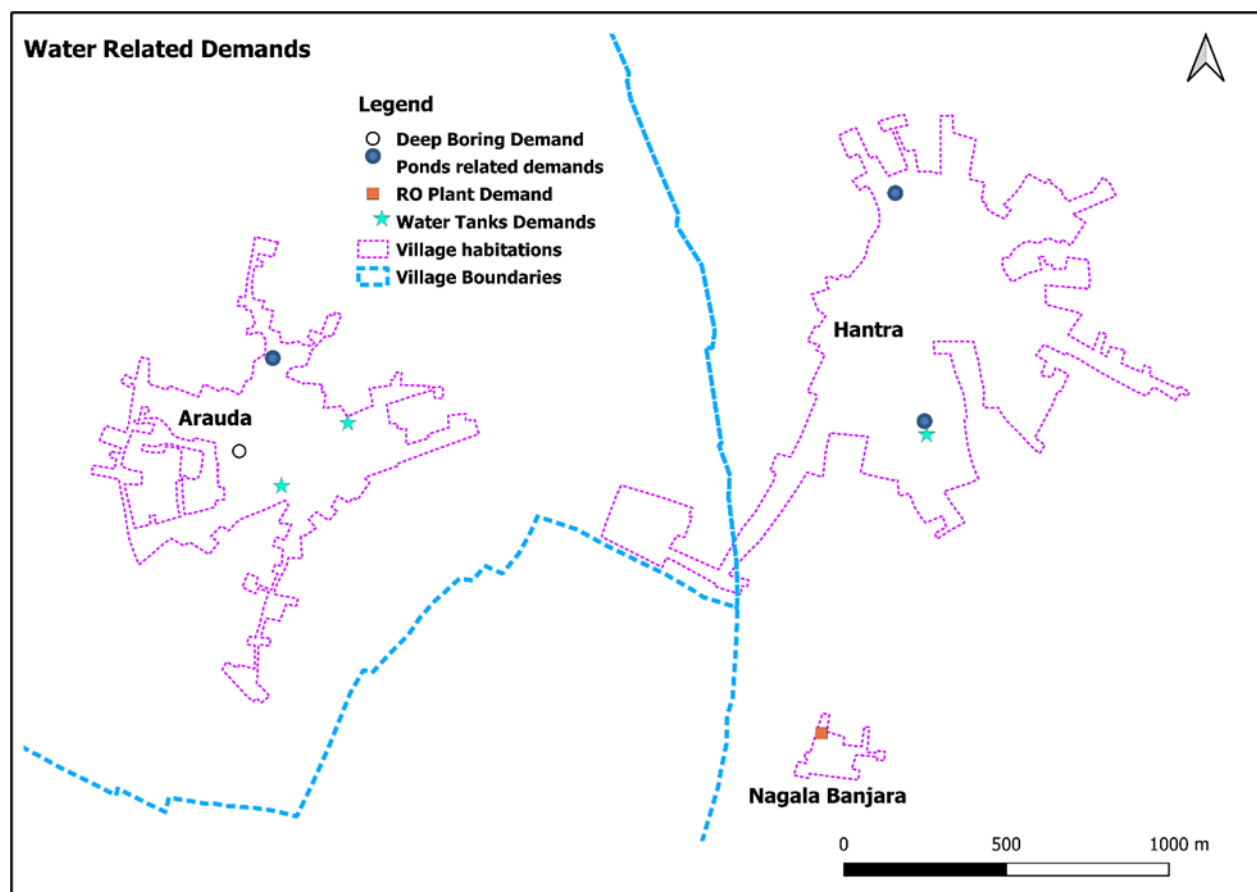


Figure 11: Water-Related Demands

3.8.2.5. Extension of Piped Drinking Water supply to Cover All Homes

This activity is already under process and as informed, the demand will be fulfilled soon by the efforts of Gram Panchayat and departments concerned. However, as the Nagla Banjara village is not coming under the Janta Jal Yojana, deep bore or even partial piped water supply system is not available. Efforts can be done to bring the village under the scheme as it is equally eligible for it.

3.8.3. Sanitation

During the study, it was observed that drinking water and sanitation are the most common and demanding requirements at the village level followed by roads. Sanitation requirements cover cleaning, proper surface drainage, solid and liquid waste management, etc. One major demand in sanitation is to have a proper drainage system to clear stagnated water on roads round the year.

To resolve the problem, the Gram Panchayat is having roadside drainage channels and a few pits outside the village for wastewater collection. Here, the Gram Panchayat functionaries are not technically capable or dare to make a consolidated holistic drainage plan for the villages. The problem can be solved only with the involvement of the departments concerned.

In plain areas, water stagnation on roads resulting from choked or poorly planned drainages is a reason for the maintenance of a large number of roads every year. The roads are constructed without scraping off the previous road material; subsequently, the road levels are going up whereas the levels of houses along roads are going down. The poorest of the poor are severely affected by this practice as their houses are vulnerable to water stagnation and they do not have the capacity to raise the ground level.

No norms are in place in Gram Panchayats with regard to cleaning of choked drainages and proper procedure for keeping/engaging manpower for the purpose. It was informed that almost all villages in the area are saturated with road construction works. Due to water stagnation at different places, roads were getting damaged or construction of new roads is required. If proper and well-maintained drainage channels are available in villages, the road constructions activity can be minimised to a great extent. Doing work in a sporadic and scattered manner will be a never-ending solution to the problem.

The requirements or demands are clubbed for the existing and demanded assets and is shown in Figure 12. The problem of stagnated water on roads round the year is shown at one place with an enlarged view.

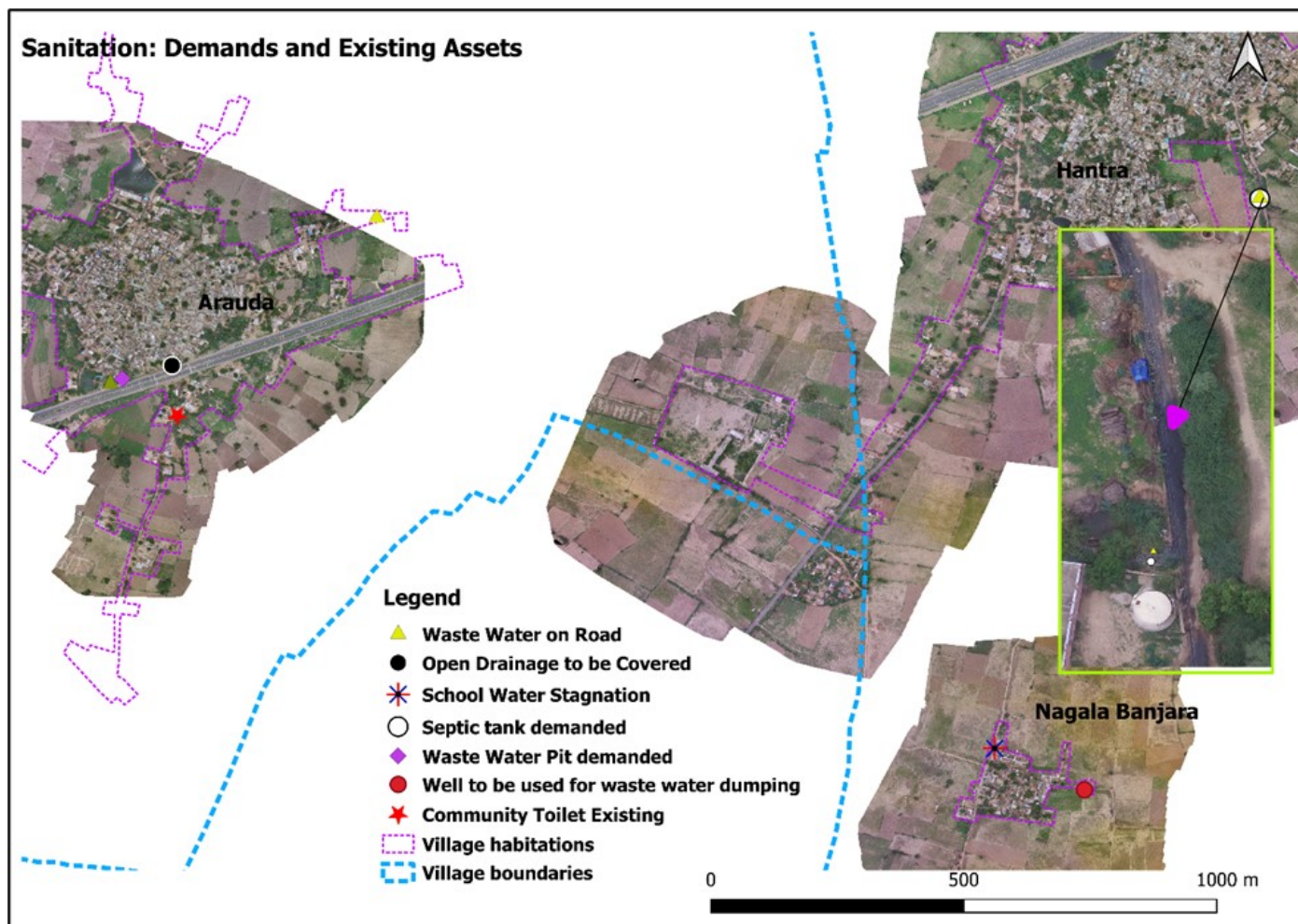


Figure 12: Sanitation Demands and Existing Assets

The above problem was analysed with 3D Digital Elevation Models of drone/UAV images. All water stagnation points were identified and mapped using Drone images and vertical heights of connecting points of roads and elevations at different points along the roads were taken. One road direction was analysed and it was found that even after the presence of natural slope on the road, water stagnates at many places, which is an indication of poor programme management and failure to take care of road levels (A further verification of height levels in the field is required). Hence, failure to maintain the proper slope of roads is also one of the major causes behind this significant problem of water stagnation. The case is represented with drone image inputs in Figure 13.

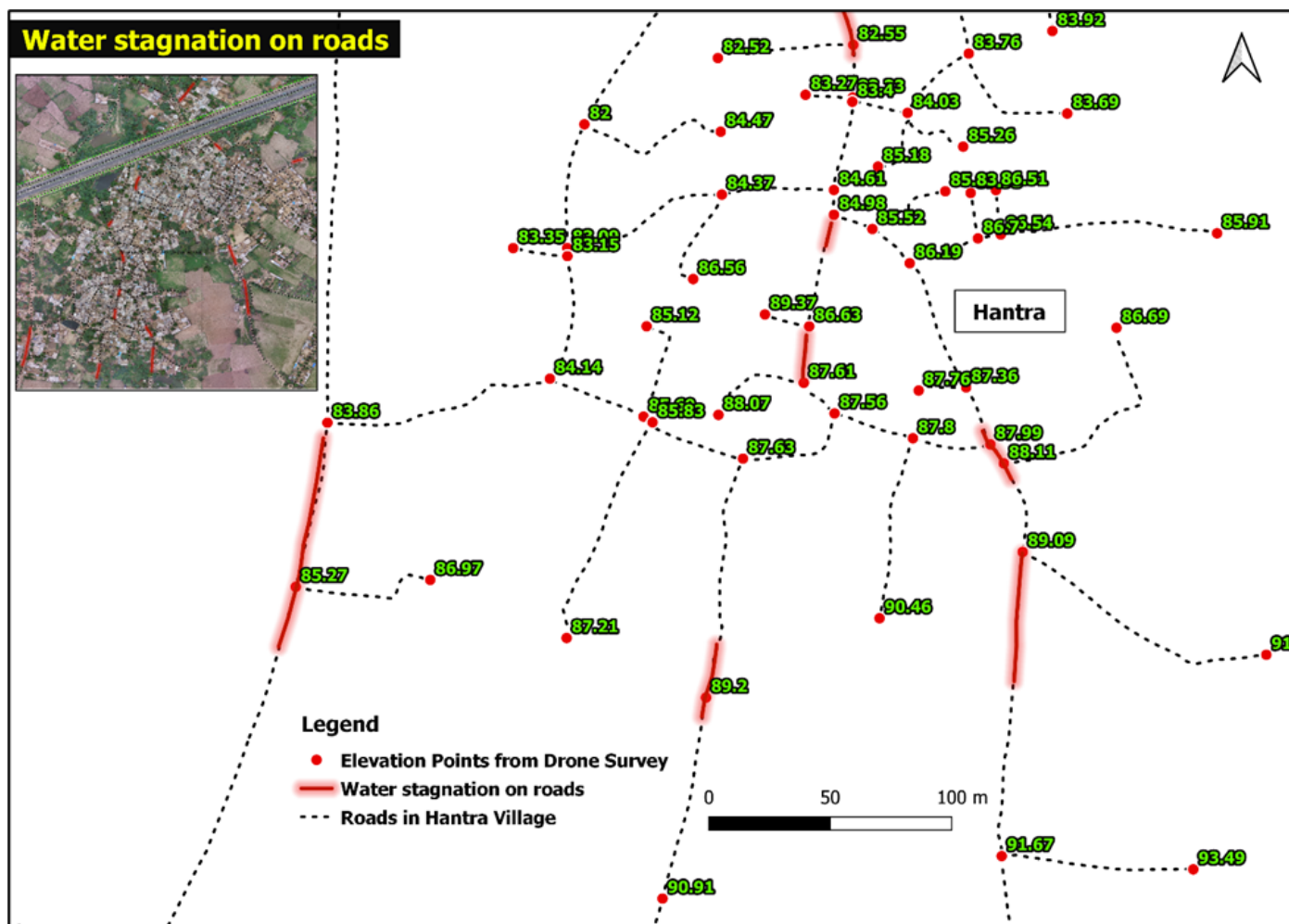


Figure 13: Depiction of Water Stagnation on Road with Vertical Levels

The Gram Panchayat needs a solution to massive water stagnation below the National Highway 11. As the construction of the highway disturbed the natural flow of water towards ponds, the water has been accumulating for months, especially in rainy season, on the road under the highway bridge, affecting the movement of the villagers.

Water stagnation under National Highway 11, even with the availability of sufficient drainage channels, can be attributed to the poor or wrong slopes of drainage channels constructed along the highway. The drainage is either uncovered or broken at various places and it is posing danger to animals and vehicles.

The demand is visualised in the GIS environment for further clarification in Figure 14.

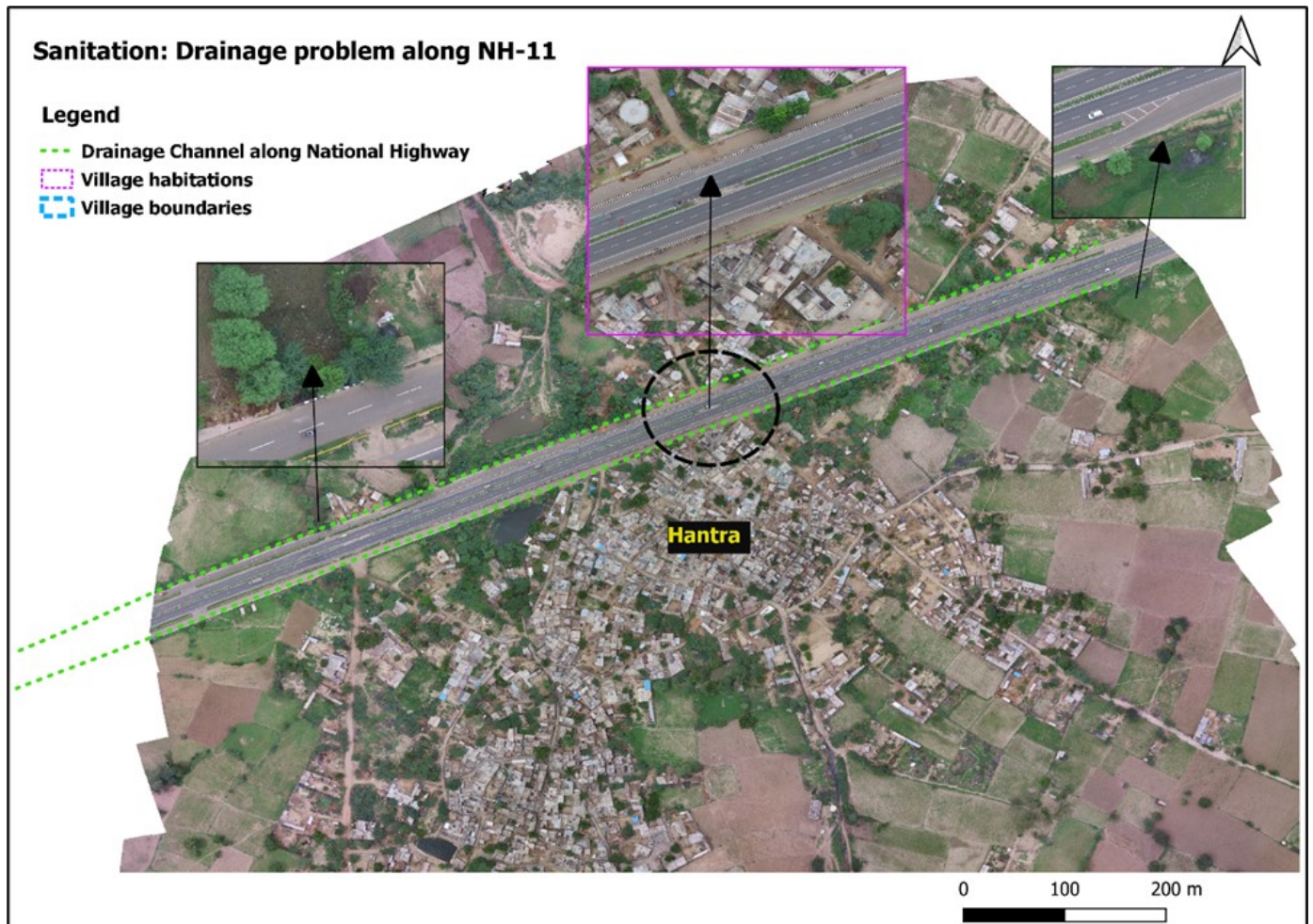


Figure 14: Drainage Problem along National Highway 11

3.8.4. Wastewater Dumping Pits:

On the outer side of villages in this area, wastewater is mostly dumped on a few pits where the direction of flow is outward. As the terrain is flat and water stagnation is the main problem in the village, such kind of pits/soak pits on feasible sites inside or outside villages are demanded.

However, wherever feasible, the wastewater is being dumped in the old ponds of the villages, making the water non-usable for any purpose and also contaminating the groundwater.

3.8.5. Soak Pits

Soak pits were demanded for discarding the wastewater but proper maintenance was shown as a problem since repeated cleaning is necessary to clear the chocking of the upper layer. Proper designing of structure as per wastewater inflow is also a necessary aspect as informed by GP functionaries.

3.8.6. Septic Tanks

This activity is not properly demanded due to lack of awareness. This need holistic planning as per the number of households and the activity requires regular maintenance. Presently, individual household latrines are not connected to the septic tanks.

3.8.7. Roads

Roads are critical assets in villages and most of the demands are related to new roads or upgradation of roads if community assets are concerned. In Hantra Gram Panchayat, the habitation areas and length of roads have been calculated using QGIS software in UTM Zone 43/WGS84 projection. The total geographical area has been taken as per Census 2011 record. The values are given in Table 7.

A total of 211 roads were mapped in the study with attributes within the boundaries of Gram Panchayat. Of these, one belongs to the National Highway Authority of India (NHAI), which is not included in density calculations. Village linking roads are constructed by Public Works Department (PWD), Government of Rajasthan and internal roads are constructed by the Panchayat department. These road numbers are as per work sanctioned and executed by various departments, and if 'start node to end node' roads will be counted, these numbers will be reduced. Hence, the number of roads is not included in the analysis and only length is counted for density, etc.

Of the total roads under total geographical area, road densities are 37 (Hantra), 17.59 (Arauda), 26.78 (Nagla Banjara) metres per hectare. On a population basis, for total roads under total geographical area, road densities are 750 (Hantra), 550 (Arauda), 545 (Nagla Banjara) metres per 100 population.

In habitational areas or for internal roads, it comes to 148.56 (Hantra), 144.91 (Arauda), 323.92 (Nagla Banjara) metres per hectare. On a population basis, for roads under habitational areas or internal roads, road densities come to 254.82 (Hantra), 161.48 (Arauda), 123.09 (Nagla Banjara) metres per 100 population. For the calculations, Table 5 may be referred to.

On the demand side, a total of three roads demanded upgradation or new construction coming under the jurisdiction of the PWD department. The name and length of these three roads are as follows: 1) Hantra to Bharkau road - bitumen road to be constructed; gravel is available; a length of three kilometres to be covered; 2) Weir wali road - 500 metres to be covered by CC; 3) Nagla Banjara to the main road - bitumen road to be constructed, a length of one kilometre to be covered.

Totally, demands were made for the repair or construction of 12 roads (internal roads) in the village. However, seeing the availability of roads everywhere in the village, this activity is seemingly linked to the budget and scheme availability and can be contracted and expanded as per the choices of villagers and Panchayat functionaries accordingly. The GIS representation of road densities is shown in Figures 15 and 16 for total roads and internal roads, respectively.

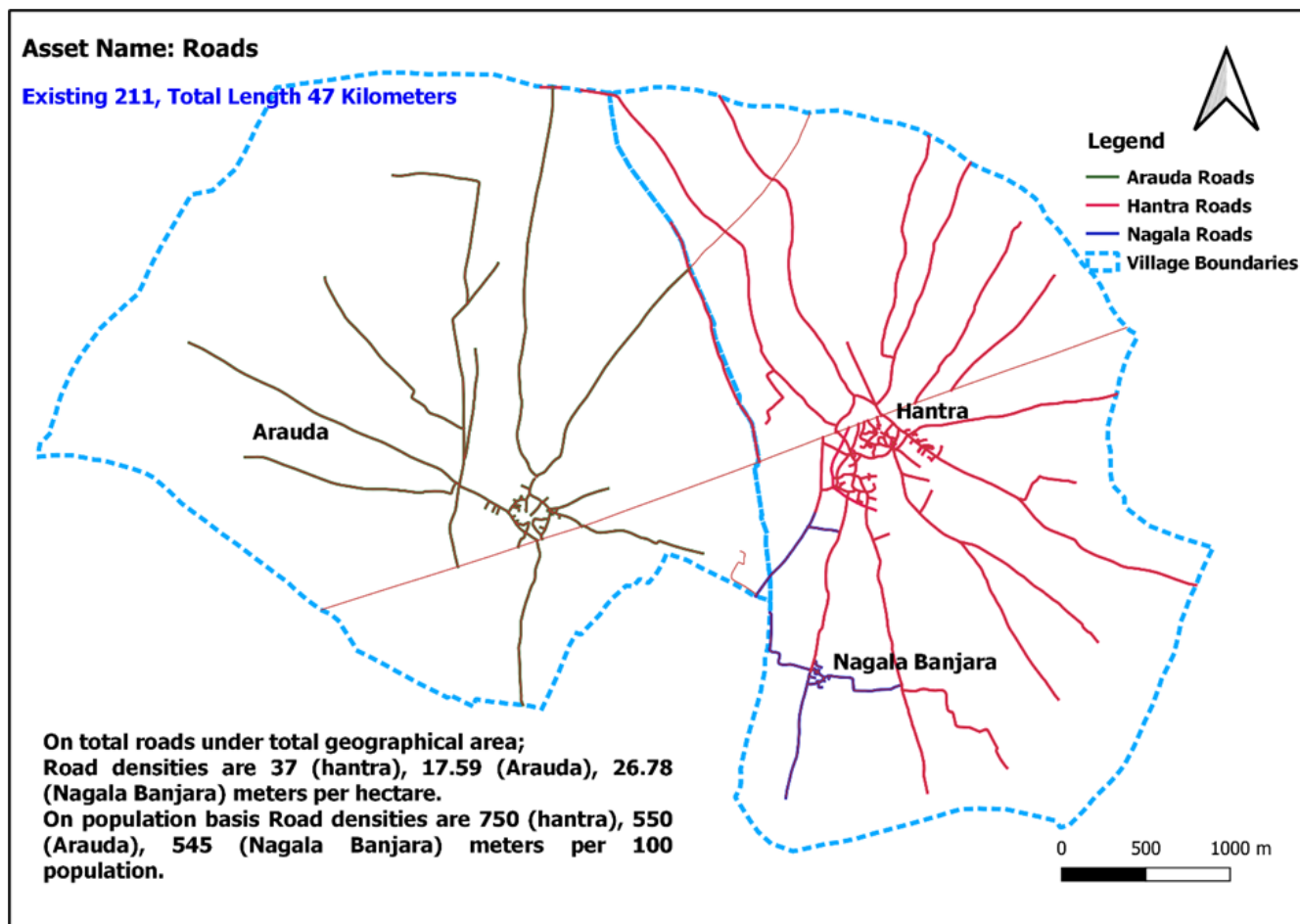


Figure 15: Road Density in Gram Panchayat

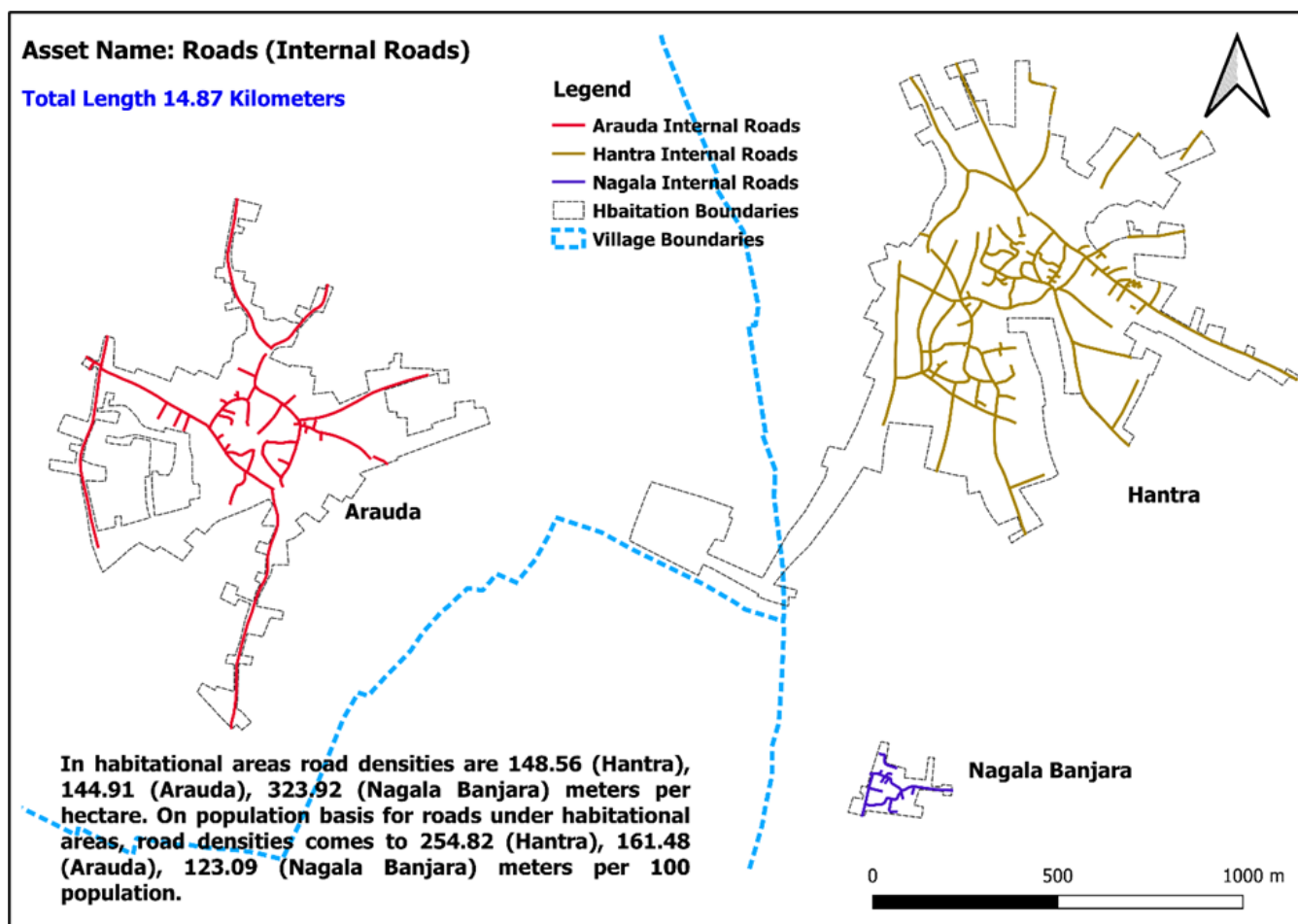


Figure 16: Road Densities (Internal Roads)

GIS representation of road demands including new roads and repair/upgradation of roads is shown in Figure 17.

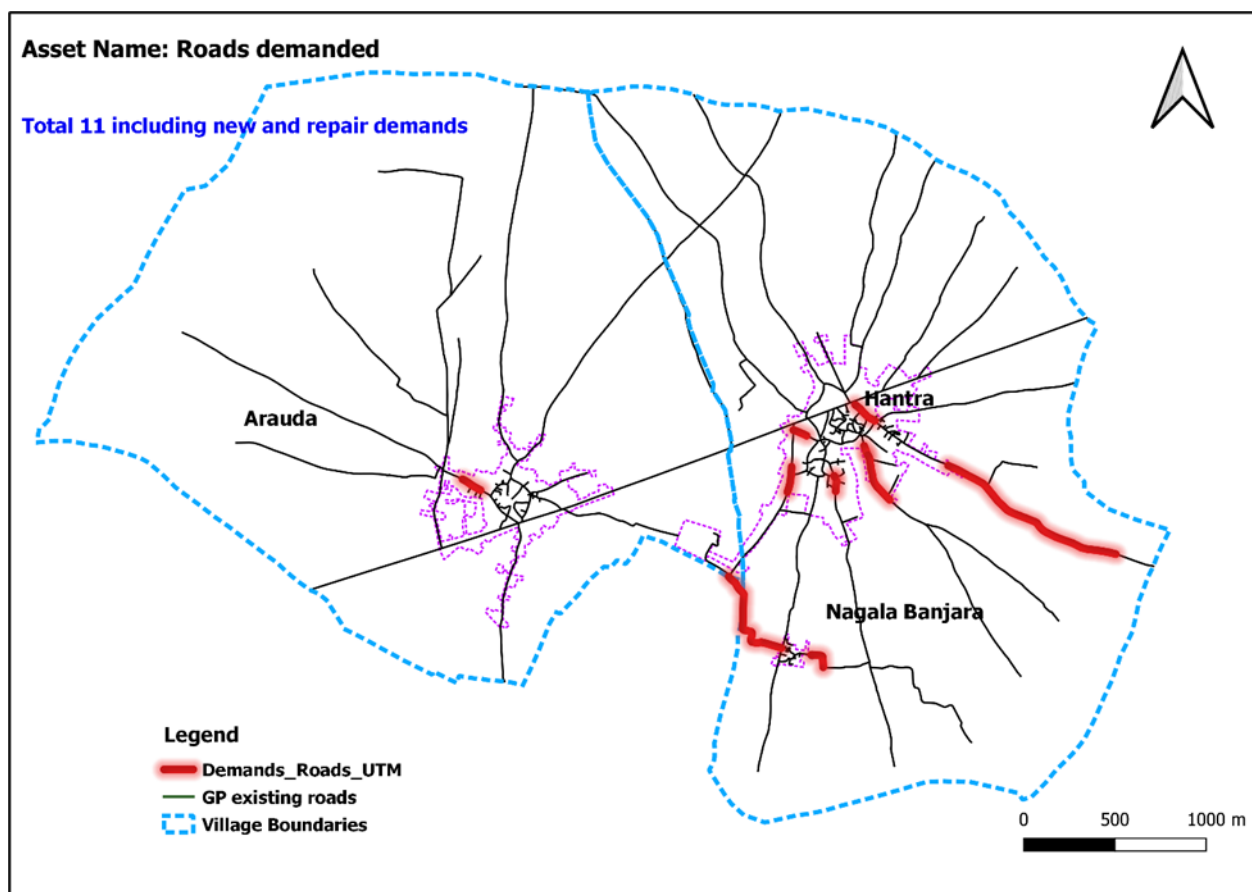


Figure 17: Roads Demanded

3.8.8. Widening of Roads

Widening of roads is also a critical demand and general for the area. The house owners extend their constructions towards roads which are mostly narrow. Most of the time, two vehicles cannot pass from the same road and one vehicle has to go reverse or stopped inside a gully till the other vehicle is passed. The narrow main connecting roads having water stagnation would make the situation worse during marriage functions or other social functions. The problem is the result of poorly planned, haphazard house constructions, regular encroachment and competitive mentality.

3.8.9. Electricity

There is no physical new asset was demand for electricity and it was observed that the requirements are not much related to assets but to proper management of assets and service delivery. In a few instances, electric lines were connected to the telephone poles. The 11 KV high-tension lines are hanging above the houses and consequently, electricity-related accidents are common in the village. For this, PVC coating on wires or underground wiring arrangement is required. High voltage electric lines are hanging close to the crops in farm fields and tightening of wires is required.

Covering the high voltage lines with PVC or underground cable is the fourth important priority of demands. When we met the Chief Electrical Engineer at the State headquarters, it was informed that at the time of installation of wires all procedures were followed correctly and later the villagers extend or construct their house near beneath the wires. Sometimes constructions are done directly below the power lines without taking its position into consideration. Individuals, local corporations, PWD and other agencies also should consider minimum height as per the Electricity Rules, 2005 while constructing new roads. At times, cable operators also use the electricity poles illegally and as the height and distance of that cable are less, the possibility of accidents has increased.

Media can play a major role in increasing awareness in this regard.

In order to avoid the danger posed by low hanging wires over crop fields, timely tightening of wires should be required. In Gram Sabhas, compulsory attendance of persons from the electricity board is necessary for the proper exchange of dialogues.

In total, 171 transformers are installed in Gram Panchayat. A broad GIS view of locations of these transformers is illustrated in Figure 18.

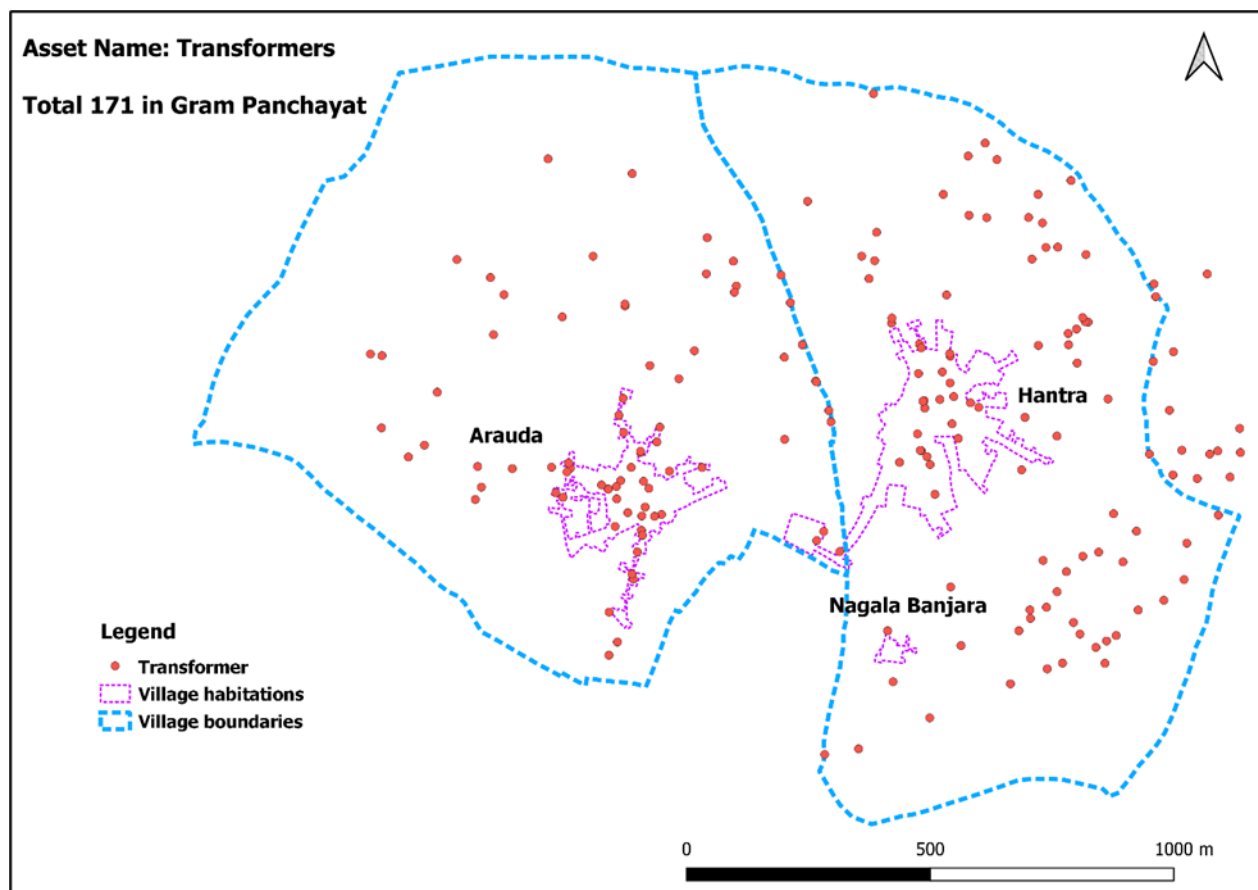


Figure 18: Visualisation of Assets - Transformers

3.8.10. Education

There was a ward-level demand for the upgradation of the Girls Upper Primary School to Girls Senior Secondary School. This was found inessential as two Senior Secondary schools have already been functioning in the Gram Panchayat. The GP has equal number of private schools and government schools, but people prefer the private ones in anticipation of additional attention to their wards and higher marks even if the infrastructure is inferior to government schools. Another demand was the establishment of a college in Gram Panchayat. In this regard also, as in the case of electricity, the main concern is service delivery, not the assets.

On the other side, parents from Nagla Banjara are contented over the performance of the government schools.

3.8.11. Health

As per norms, the Gram Panchayat has sufficient infrastructure. In addition to the primary health centre (PHC) in Hantra village, a primary health sub-centre has also been constructed in Arauda village. In the health sector, the problem of infrastructure is less visible than service delivery aspects.

3.8.12. Anganwadi

Four anganwadis are functioning (two in Arauda and two in Hantra) in the GP without own building and proper facilities. There is a demand to start an anganwadi in Nagla Banjara village as it meets the criterion with respect to the number of children. As per Census 2011 (see Table 5), the village has 118 children in the 0-6 age group but the population is less than 1000 and does not come under population criteria. Based on the distance criterion, it is observed through Shortest Path analysis in GIS that the nearest anganwadi is located around 1 km away from the centre of the village. (The shortest path analysis from Nagla Banjara to Anganwadi is illustrated in Figure 19). As a result, out of three criteria for opening an anganwadi, the village fulfils two criteria but fails to meet the population criterion.

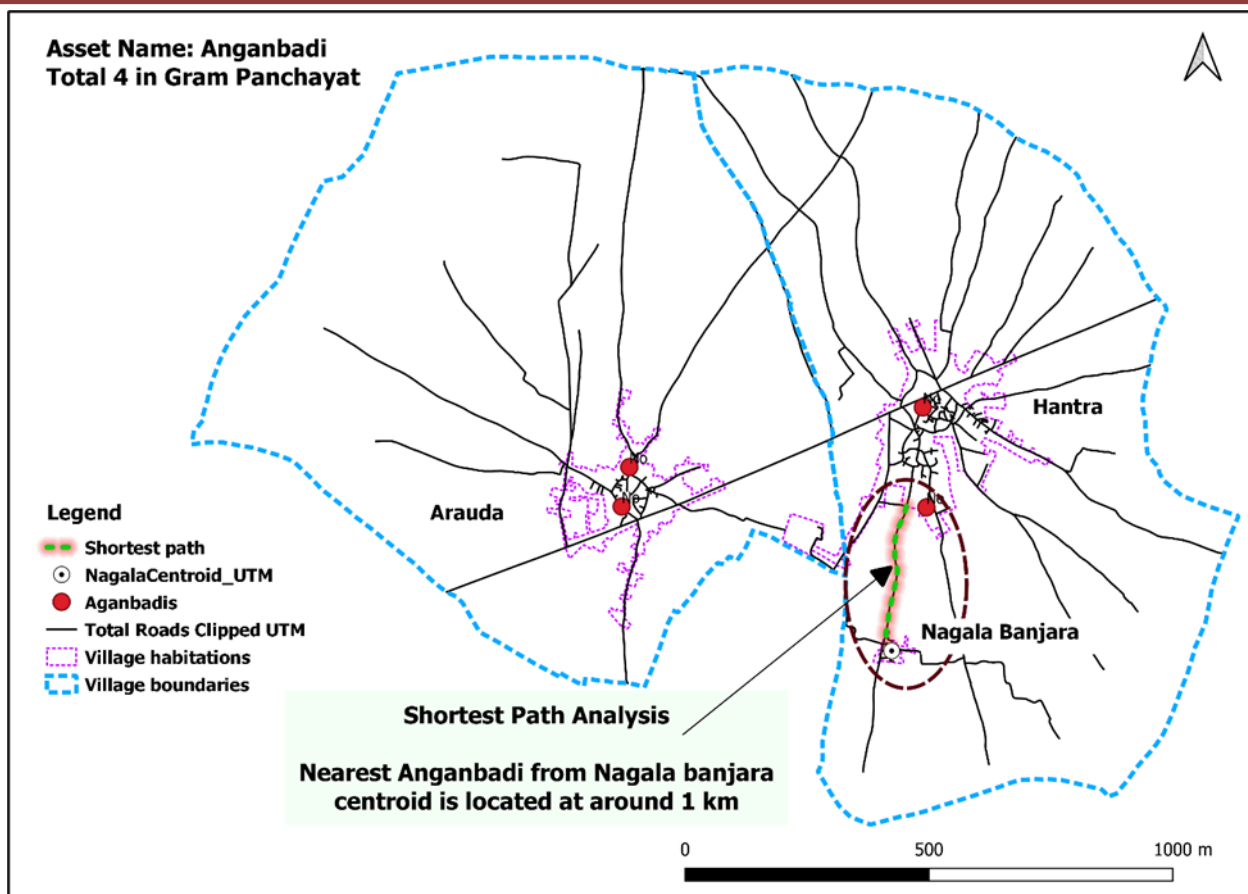


Figure 19: Shortest Path Analysis for the Construction of Anganwadi in Hantra Village

3.8.13. Animal (Cows/Bulls) Rescue Centre (Gaushala)

The handling of free-roaming cattle is a common problem not just for the study area but for the whole Rajasthan, as informed by villagers. Generally, unproductive buffalos are sold to slaughterhouses but cows and bulls (number of bulls is more) cannot be killed and these are roaming freely on farm fields and roads. A proper planning and management strategy is required in this direction. The immediate solution suggested was to construct and manage a cow rescue centre (Gaushala). It was informed that in previous times, 'Kaji Houses' functioned to keep free-roaming animals with provisions of levying penalty. A large-scale interlinked business model of these Gaushalas may be conceptualised for the rearing of these animals. A chain of Gaushalas can be launched at appropriate distances and effective use of urine, cow dung during life and skins, bones after their natural deaths may be planned. Indian customers may like the leather or similar products made using skin of such animals based on the conviction that these are generated after their natural deaths.

3.8.14. Bank

Two beer factories, 20 brick kilns and a petrol pump are located in Gram Panchayat. The population is also more than 5000. A bank is situated at a distance of 3 km from Hantra village but it is around 5 km from Arauda and Nagla Banjar. As sufficient business is available, the establishment of a bank is feasible in Hantra village of Gram Panchayat.

3.8.15. CCTV at selected places/towers, Street Lights, Community Toilets

The above three demands were not demanded in the initial phase and it was felt that these are not coming under the immediate actual needs of the villagers. It was observed that the villagers require gradual development and in that process, these demands are not mentioned. If these are installed without proper thrust, the maintenance aspects will be difficult for these assets, especially in the villages of the study area.

3.8.16. Building for Veterinary Hospital

Presently, the hospital is functioning in the old Panchayat building and a new building is required for the hospital.

3.8.17. Other General Assets:

- Community hall
- River water linkage for irrigation in cropland
- Common drinking water facility for animals

3.9. Ideal/Optimum Community Infrastructure Requirement of Gram Panchayat

The demands raised by villagers were tested and analysed on the basis of departmental norms and accordingly, the possibilities on demands have been shown. The detailed discussion on each demand is available in the discussion section. The possibilities for fulfilling demands at the GP level have been provided, but may be possible at the village level also. The analysis of the ideal/optimum community infrastructure requirement of Gram Panchayat is shown in Table 6.

In the table, negative values in Column 5 indicate that asset/solution already exists for more than the saturation level or the technically feasible number/quantity in the Gram Panchayat as per norms of nodal department/scheme concerned. Positive values in Column 5 indicate that the existing asset/solution is less than the maximum possibilities or saturation level as per norms of nodal department/scheme and can be sanctioned in future.

Column 7 indicates over demand (negative values), or under demand (positive values) status of assets. It may be called a stressed or relaxed condition of demand. Zero in this column indicates that the demands are matching with the possibility.

The availability of funds under any scheme for sanctioning the work should always be the second condition after passing this stage for any asset.

Table 6: Analysis of Ideal/Optimum Community Infrastructure Requirement of Gram Panchayat

Types of Demands	Existing Assets	Maximum Possible assets as per department/ scheme norms	Gap between existing and possible assets (Scope of work) (4-3)	Assets demanded by villagers/Instance Numbers/Instance	Difference between Gap and demanded (resource strain/ availability) (5-6)	Technically Feasible (Yes/No); Remark
2	3	4	5	6	7	8
Deep bores	7	5	-2	3 (No.)	-5	No
Hand pumps	41	23/72	-18/31	6 (No.)	-24/+25	No/Yes
Water tanks (Overhead/GLR)	18	5	-13	4 (No.)	-17	No
Reverse Osmosis plants	2	14	+12	3 (No.)	+9	Yes
Piped water supply	2	3	+1	1	0	Yes
Extension of piped drinking water supply to cover all homes	0	3	+3	2	1	Yes; depends on the tank and deep bore capacity
Ponds (desilting)	0	0	0	2 (No.)	-2	No; all eligible ponds desilted
River water linkage for irrigation in crop land	0	0	0	1	-1	No
Retaining wall in pond	2	8	+6	4 (No.)	+2	Yes
Common drinking water facility for animals	0	2 (As demanded)	+2	2 (No.)	0	Yes; Depends on fund availability
Drainage to solve water stagnation on road	0	5 (As demanded)	+5	5	0	Yes; Proper drainage plan is required
Wastewater dumping pits	2 (Base 0)	1 (As demanded)	+1	1 (No.)	0	Yes
Covering of open drainage	General	As demanded	As per Demand	Demand General	0	Yes
Septic tank	0	1 (As demanded)	+1	1	0	Yes; Norms are to be verified
Soak pits	0	1 (As demanded)	+1	1	0	Yes, Norms are to be verified
Drainage arrangement for water Stagnation problem under National Highway-11	0	1	+1	1 (No.)	0	Yes; A proper drainage plan is required
Community toilets	0	As demanded	As per Demand	Demand General	0	Yes; Cleaning, water, operational issues, optimum numbers, location, land
Recharge well construction in wastewater dumping for groundwater recharge	0	As demanded	As per Demand	Demand General	0	Yes; Depends on fund availability

Contd...

Types of Demands	Existing Assets	Maximum Possible assets as per department/ scheme norms	Gap between existing and possible assets (Scope of work) (4-3)	Assets demanded by villagers /Instance Numbers/Instance	Difference between Gap and demanded (resource strain/ availability) (5-6)	Technically Feasible (Yes/No); Remark
Drainage mechanism to pass stagnated water from school	0	1	+1	1	0	Yes; A proper drainage plan is required
Roads (New) (PWD)	210 (206+4) (Base 0)	3 (As demanded)	+3	3 (No.)	0	Yes; Depends on fund availability
Road repair/upgradation	0 (Base 0)	12 (As demanded)	+12	12 (No.)	0	Yes; As per norms
Widening of roads	0	2 (As demanded)	+2	2	0	Yes; Common Consensus is required
Covering high voltage lines with PVC or underground cable	0	0	0	3	-3	No; Not in norms; Norms need to be revised
Raising Height of poles supporting high voltage wires	0	0	0	1	-1	No, Not in norms
Removal of electric wires from telephone poles	General	As demanded	As per Demand	Demand General	0	Yes; on complaint
Raising the height of low-lying HT lines over crop fields	General	As demanded	As per Demand	Demand General	0	Yes; on complaint
Street lights	General	As demanded	As per Demand	Demand General	0	Yes
Building for existing veterinary hospital	0	1	+1	1 (No.)	0	Yes
New veterinary hospital	0	To be checked		1		
Wi-Fi and computer facility in school	0	1	+1	1	0	Yes
Government college for graduation	0	0	0	1 (No.)	-1	No; College is available in 15 km
Anganwadi centre with building	4	4	0	1 (No.)	-1	No, Norms/priorities may be revised
Light, fans and basic facility for anganwadi centre	0	4	+4	4 (No.)	0	Yes
Bank	0	1	+1	1 (No.)	0	Yes; Business is available
CCTV at selected places/towers	0	As demanded	As per Demand	Demand General	0	Yes
Community hall	0	2	+2	1 (No.)	+1	Yes
Animal (cows/bulls) rescue centre (Gaushala)	0	0	0	1 (No.)	-1	No; Alternative sources may be searched

Points to be noted for the above table:

The demands mentioned without writing (No.) in parentheses are instances of demands, not the actual numbers. For example, if a demand has been asked two times in two different wards is mentioned as 2 in demand. But if a demand can actually be converted into numbers (not a general demand), then an indication in parentheses as (No.) has been mentioned.

Where total possible assets cannot be calculated, the existing assets are mentioned as '0' to count the gap between possible and existing assets (Column 5). Then in such cases, this gap is equal to the demanded assets, if permissible as per norms.

3.10. Estimation of Cost

The cost part was estimated based on the prevalent models of works, sanctioned costs, due discussions with the villagers, Panchayat functionaries and departmental officials, and an attempt was made to generate the total cost of the plan. In cost analysis, items that require recurring and regular expenditure and are not related to permanent asset generation, such as cleaning of roads, drainage channels, etc., are not covered. Only technically feasible items are included in the cost analysis. Based on due discussions, nodal departments and schemes have also been suggested for the works. Cost analysis of the permissible demands is shown in Table 7.

Table 7: Cost Analysis of the Permissible Assets/Demands

S. No. (themes)	Demands Type	Nodal department	Scheme	Assets Demanded Numbers/ Instance	Estimated cost in Lakhs
1	2	4	5	8	10
1 Water	Hand pumps	PHED, Panchayat	FFC, MLA, MP	6 (No.)	5
	Reverse Osmosis plants	PHED	General	3 (No.)	25
	Extension of piped drinking water supply to cover all homes	PHED, Panchayat	FFC	3	20
	Retaining wall in pond	Panchayat	FFC, SFC	4	30
	Common drinking water facility for animals	Panchayat	FFC, SFC	2	5
Water Total					85
2 Hygiene/ Sanitation/ Waste Management	Proper drainage to solve water stagnation on roads including covered drainage channels along roads	Panchayat	FFC, SFC	Demand General	200
	Wastewater dumping pits	Panchayat	FFC, SFC	1	2
	Covering of open drainage	Panchayat	FFC, SFC	Demand General	50
	Septic tank	PHED, Panchayat	FFC, SFC	Demand General	50
	Soak pit	PHED, Panchayat	FFC, SFC	1	2

Contd...

S. No. (themes)	Demands Type	Nodal department	Scheme	Assets Demanded Numbers/ Instance	Estimated cost in Lakhs
2 Hygiene/ Sanitation/ Waste Managemen t	Drainage arrangement for water stagnation problem under National Highway-11	NHAI	NHAI	1 (No.)	10
	Community toilets	Panchayat	FFC	Demand General	15
	Deep bore construction in wastewater dumping places for groundwater recharge	PHED, Panchayat	FFC, SFC	Demand General	10
	Drainage mechanism to let stagnated water out of school	Panchayat	SFC	1	5
Hygiene/Sanitation/Waste Management					344
3 Roads	Roads (new/upgradation)	PWD	Various schemes	3 (No.)	150
	Road repair/upgradation	Panchayat	SFC	12 (No.)	25
	Widening of roads	Panchayat	SFC	2	Based on consensus
Roads					175
4 Electricity	Removal of electric wires from telephone poles	Electricity	General Schemes	Demand General	-
	Raising the low-lying HT lines over crop fields	Electricity	General Schemes	Demand General	5
	Street lights	Panchayat	FFC	Demand General	5
Electricity					10
5 Health	Building for existing veterinary hospital	Veterinary	General	1 (No.)	20
	New veterinary hospital	Veterinary	General	1 (No.)	20
Health					40
6 Education	Wi-Fi and computer facility in school	Education	General	1	5
Education					5
7 Women and Child Developme nt	Light, fans and basic facility for anganwadi centre	ICDS	General	4 (No.)	5
	Construction of building for anganwadi	ICDS	General	4	18
Women and Child Development					23
8	Bank	Various banks	General	1 (No.)	On Rent
Banking/Financial Inclusion					-
9	CCTV at selected places/towers	IT	General	Demand General	5
Surveillance/Security					5
10	Community hall	Panchayat	MLA, MP	1 (No.)	20
Other Civic Infrastructure					20
11	Animal (cows/bulls) rescue centre (Gaushala)	No scheme		1 (No.)	40
Site Specific Demand					40
Total Cost in Lakhs					747

3.11. Weightage of Sectoral Demands

The community asset requirements or demands have been segregated into various sectors as described in the previous table and have been given weightage on two criteria. The first criterion is the frequency/instances of demands which are analysed by how many times the different assets related to the sector were asked, and the second one is the intensity or thrust for assets which can be taken from the priority of assets. General demands of GP are given numbers as three in the calculations of frequencies. The priority is given weightage of 5 times and ranges between 1- 5 with higher number to higher priority and low number to low priority. Priority on demands has been shown as follows;

Drinking Water – value $-5 \times 5 = 25$

Drainage and stagnated water - value $-4 \times 5 = 20$

Controlling free-roaming animals - value $-3 \times 5 = 15$

Open electric cables - value $-2 \times 5 = 10$

Roads- value $-1 \times 5 = 5$

Other sectors are given an equal number as 2 on priority rating. The details are shown in Table 8. The outputs are further illustrated in Figures 20-23 for comparison as per sectors.

Table 8: Weightage of Sectoral Demands

Assets Category	Frequency/ Instances	Priority of asset (Top priority is given high weightages)	Total
Water	29	25	54
Hygiene/Sanitation/	18	20	38
Roads	17	5	22
Electricity	11	10	21
Specific Demand			
Animal (cows/bulls) rescue centre (Gaushala)	3	15	18
Education	4	2	6
Women and Child	4	2	6
Banking/Financial	3	2	5
Surveillance/Security	3	2	5
Cooperative/Public	3	2	5
Other Civic Infrastructure	3	2	5
Health	2	2	4

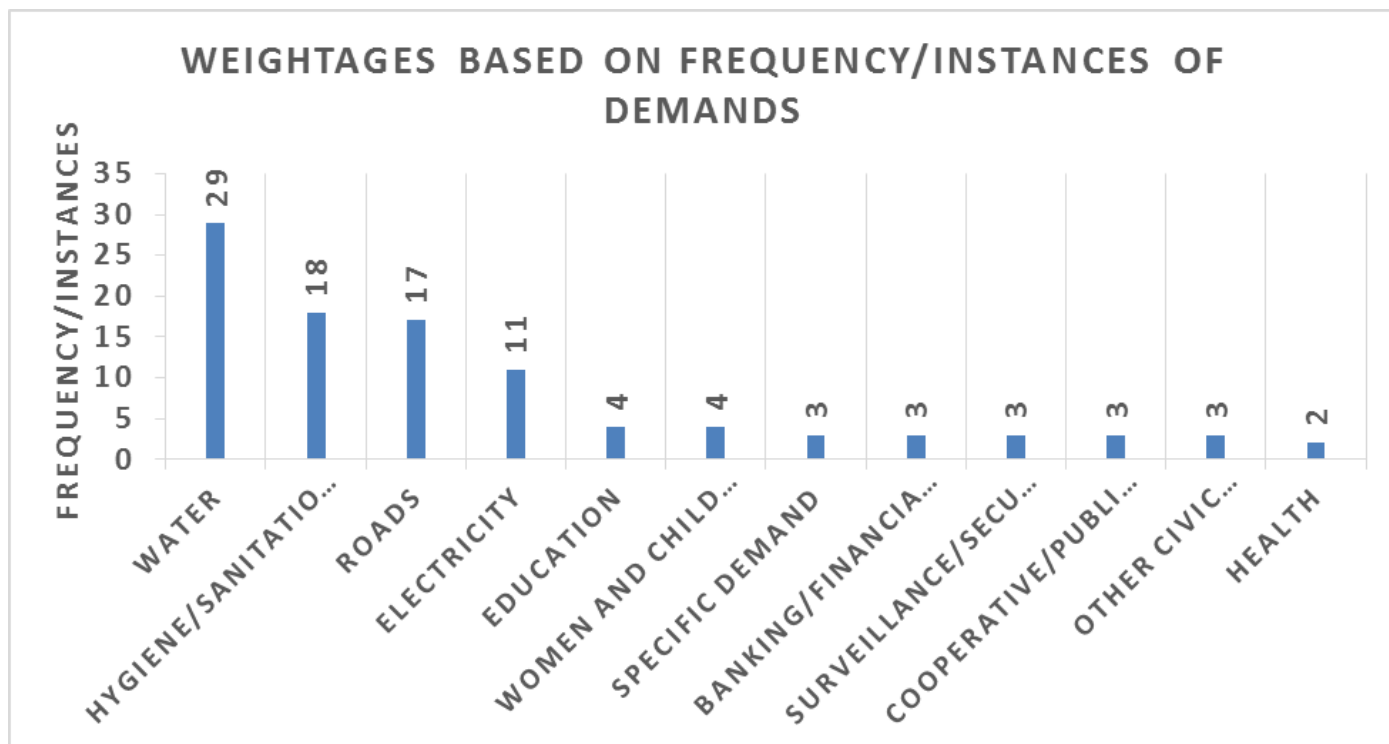


Figure 20: Weightages Based on Frequency/Instances of Demands

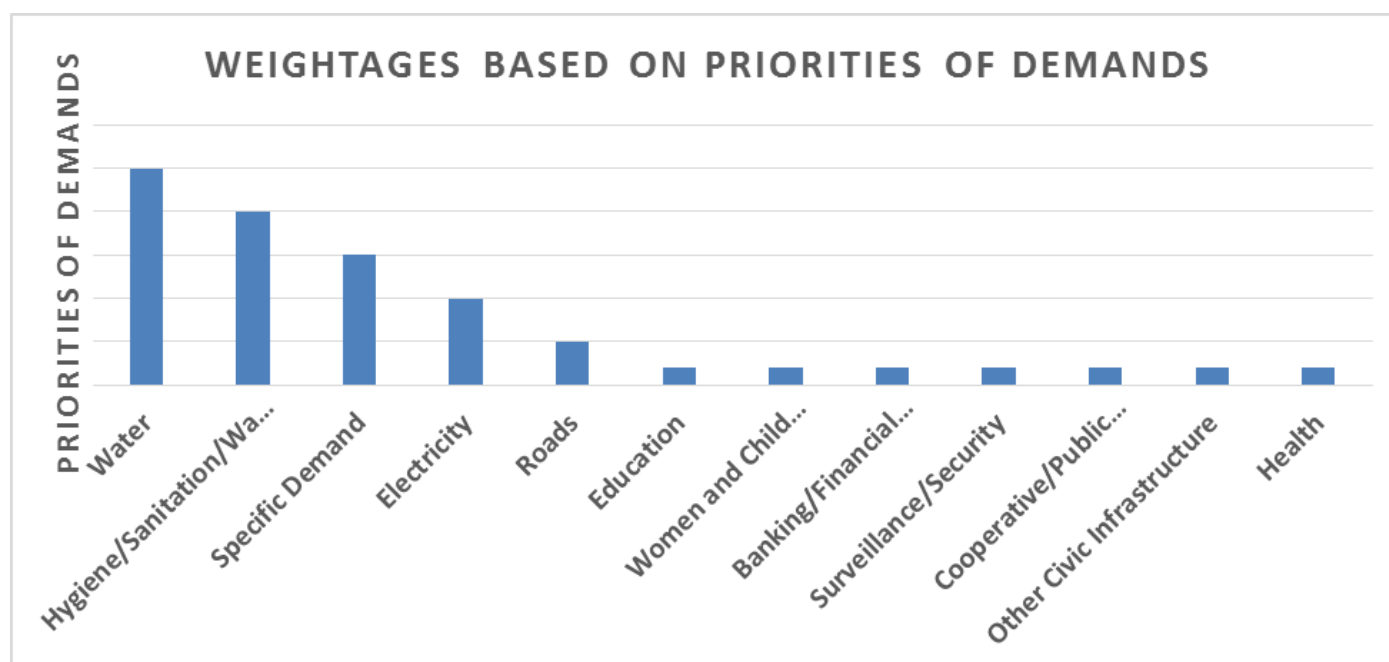


Figure 21: Weightages Based on Priorities of Demands

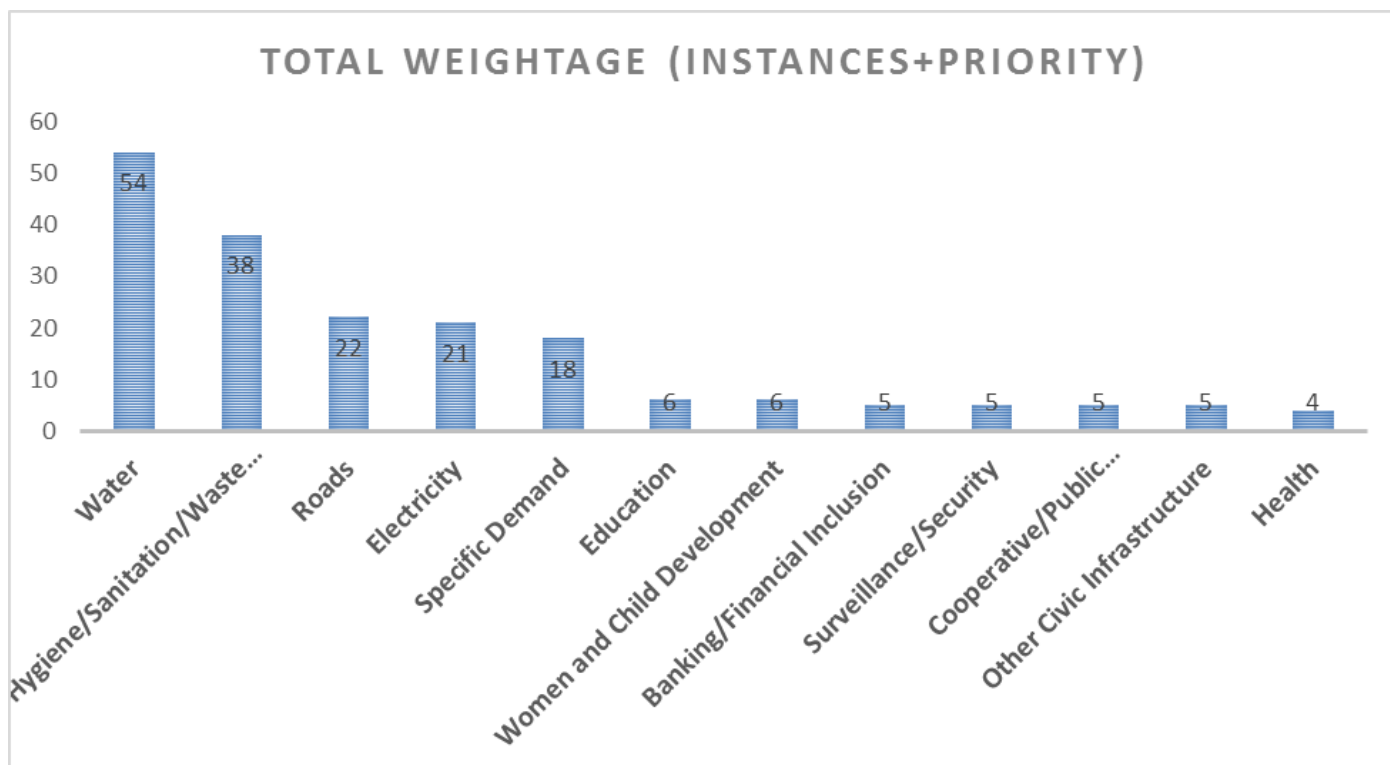


Figure 22: Total Weightage (Instances & Priorities)

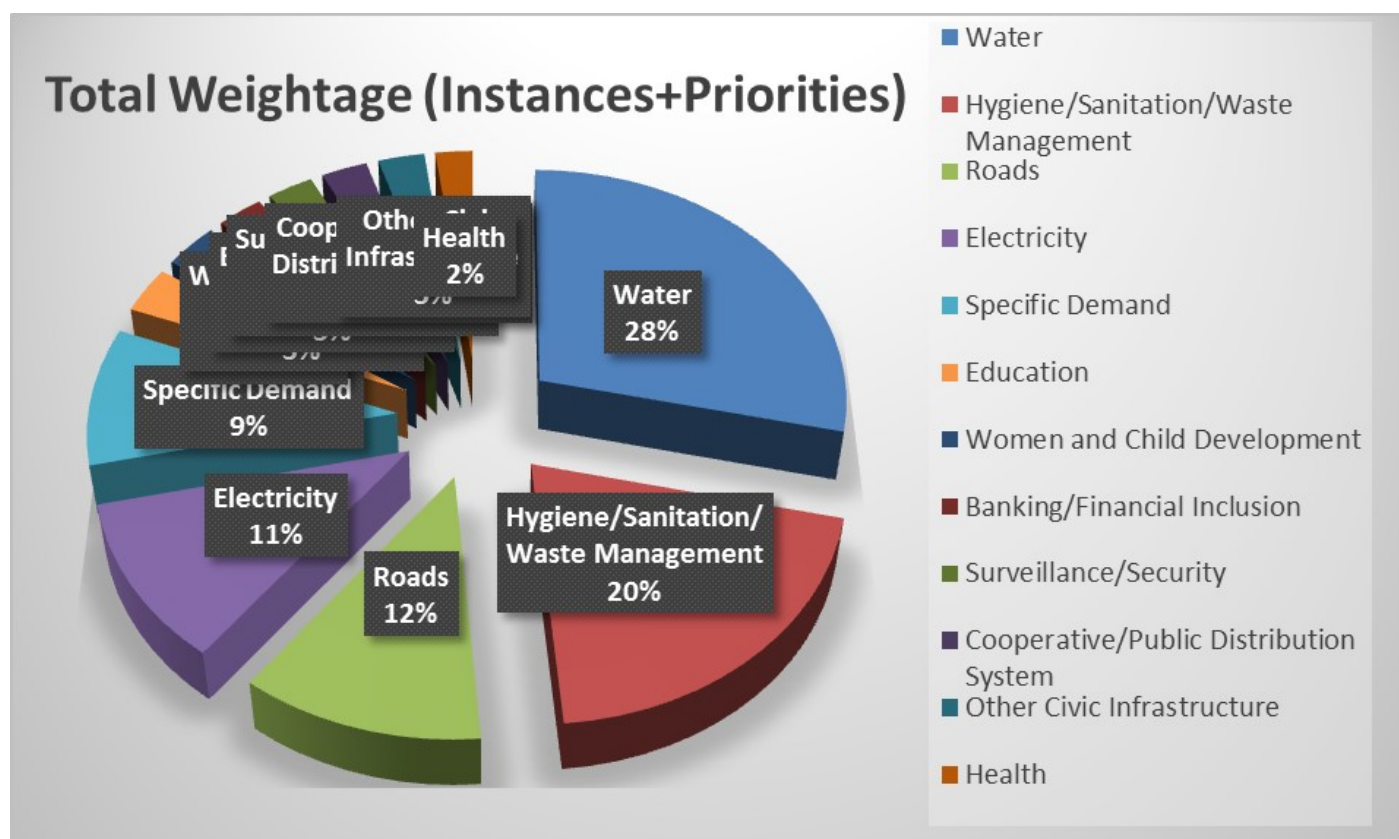


Figure 23: Pie Chart for Total Weightage

3.12. Comparison with Focuses of Country and State Plans

Focus area-wise (which can be considered as priorities for study comparison) GP plan, number of works (which can be considered as instances or frequencies for study comparison) and fund allocation figures of GPDP and FFC are available with plan plus website 'http://www.planningonline.gov.in' at page 'http://www.planningonline.gov.in/ReportData.do?ReportMethod=getGPDPDashboardMapData'. These figures are used for comparison of study outcomes with national and State trends in GPDP focus areas for the financial year 2018-19. The trend is almost the same for all previous and 2019-20 GPDP also. The following tables and graphs used only the first 10 focus areas out of 32 areas prescribed in Plan Plus for the planning process (MoPR, GoI 2019).

3.12.1. Country level

Tables 9, 10 and 11 and bar graphs in Figures 24, 25 and 26 illustrate the focus area trends in GP Plan, numbers of works and fund allocation at country level for the first 10 focus areas.

Table 9: Focus Area-wise GP Plan Country Level (2018-2019)

S. No.	Focus Area Name	GP Count (GPDP)	GP Count (FFC)
1	Roads	152260	133612
2	Health and sanitation	122710	109326
3	Drinking water	102911	86148
4	Rural electrification	77862	64944
5	Education	60152	51804
6	Maintenance of community system	41598	33815
7	Social welfare	39267	30010
8	Women and child development	23654	20053
9	Agriculture	15618	8441
10	Rural housing	14839	11264

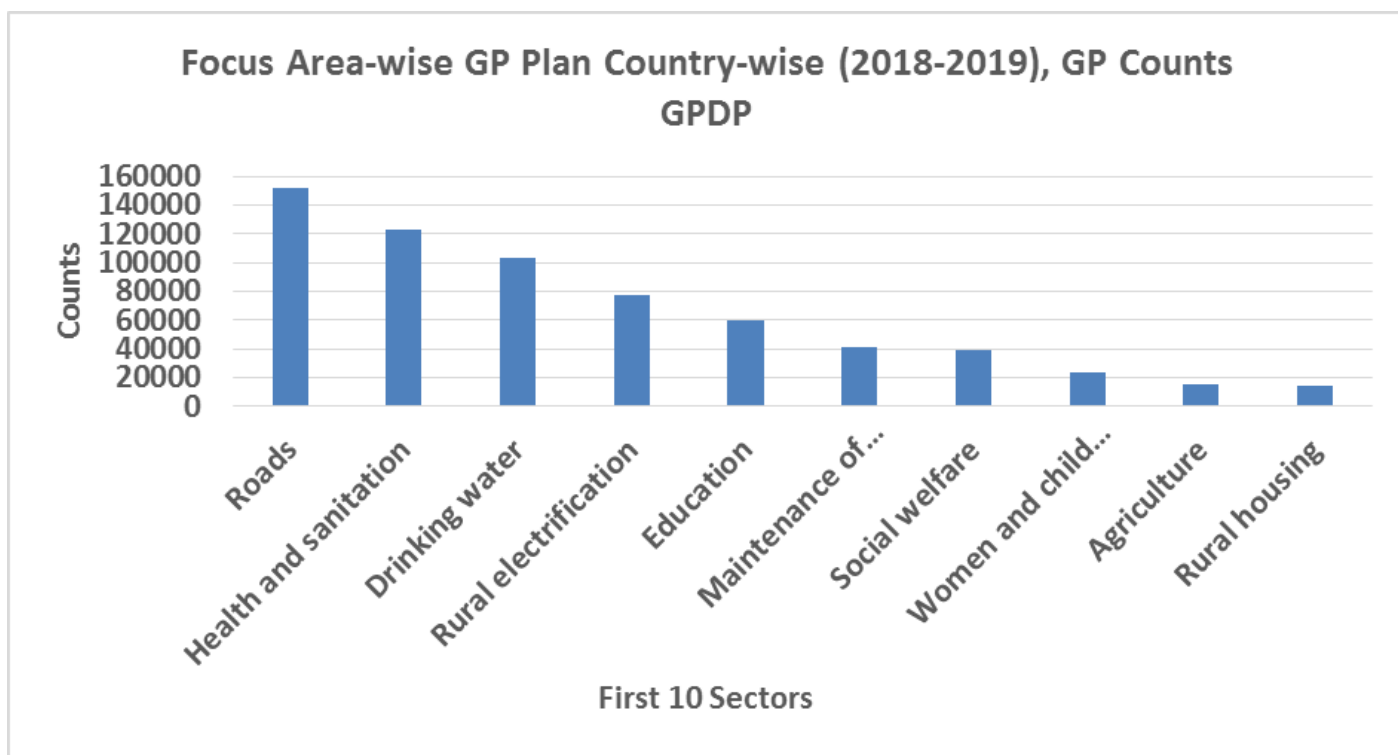


Figure 24: Focus Area-wise GP Plan Country-wise (2018-2019), GP Counts GDP

Table 10: Focus Area-wise Work Country-wise (2018-2019)

S. No.	Focus Area Name	No. of Activity (GPDP)	No. of Activity (FFC)
1	Roads	1683866	1227771
2	Health and sanitation	807265	576599
3	Drinking water	405710	311208
4	Education	177494	142274
5	Rural electrification	171231	129383
6	Maintenance of community system	125803	91105
7	Social welfare	118864	82540
8	Women and child development	49931	40467
9	Land improvement	38214	14686
10	Rural housing	36560	24392

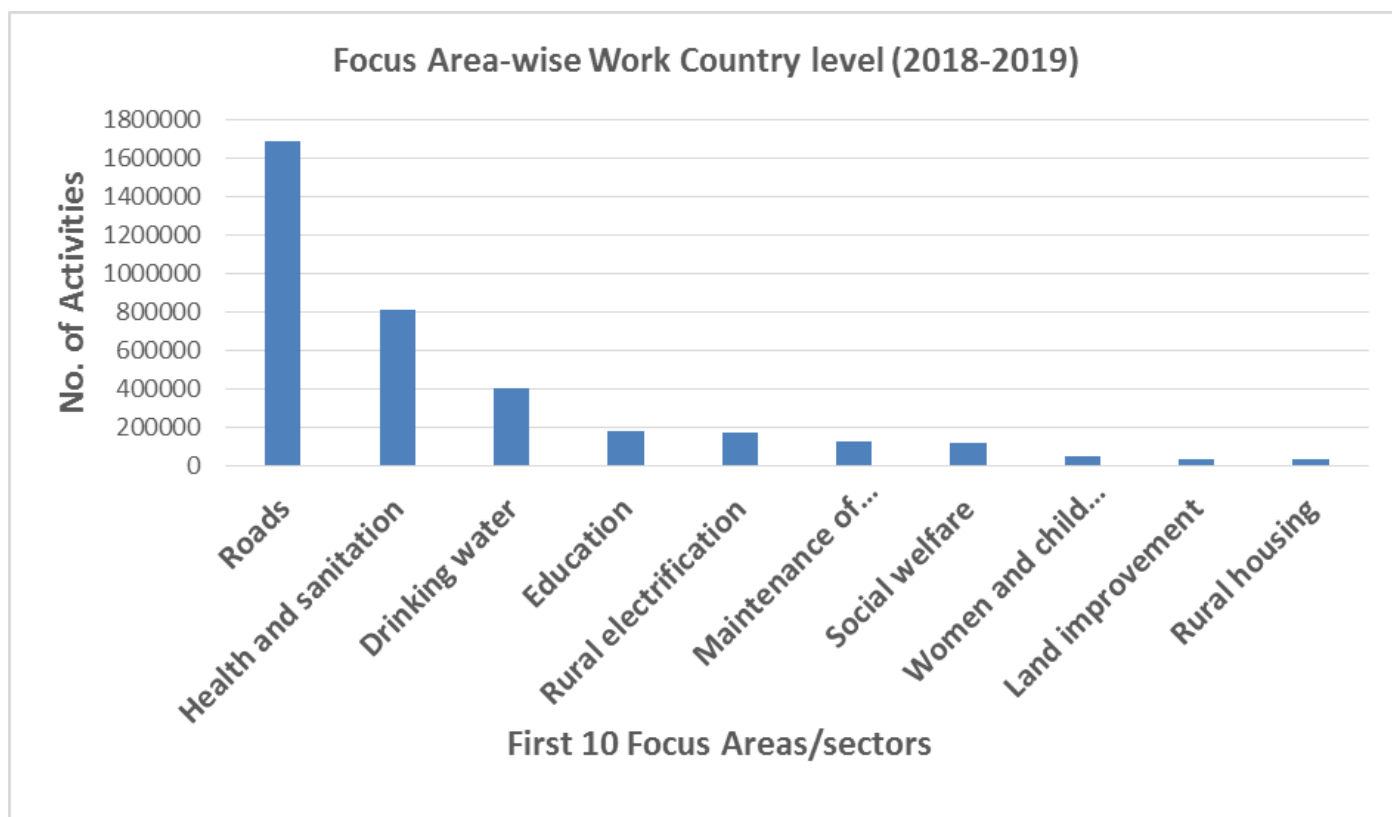


Figure 25: Focus Area-wise Work Country Level (2018-2019)

Table 11: Focus Area-wise Fund allocation Country Level (2018-2019)

S. No.	Focus Area Name	Fund Allocated (GDP) (Cr.)	Fund Allocated (FFC) (Cr.)
1	Roads	38282.56	26899.39
2	Health and sanitation	12555.16	9125.39
3	Drinking water	7732.23	4976.73
4	Rural electrification	3110.95	2377.16
5	Education	2949.34	2353.56
6	Maintenance of community system	2917.59	2067.49
7	Social welfare	2811.15	1701.59
8	Rural housing	1884.93	712.23
9	Agriculture	1044.21	268.3
10	Minor irrigation	942.44	314.02

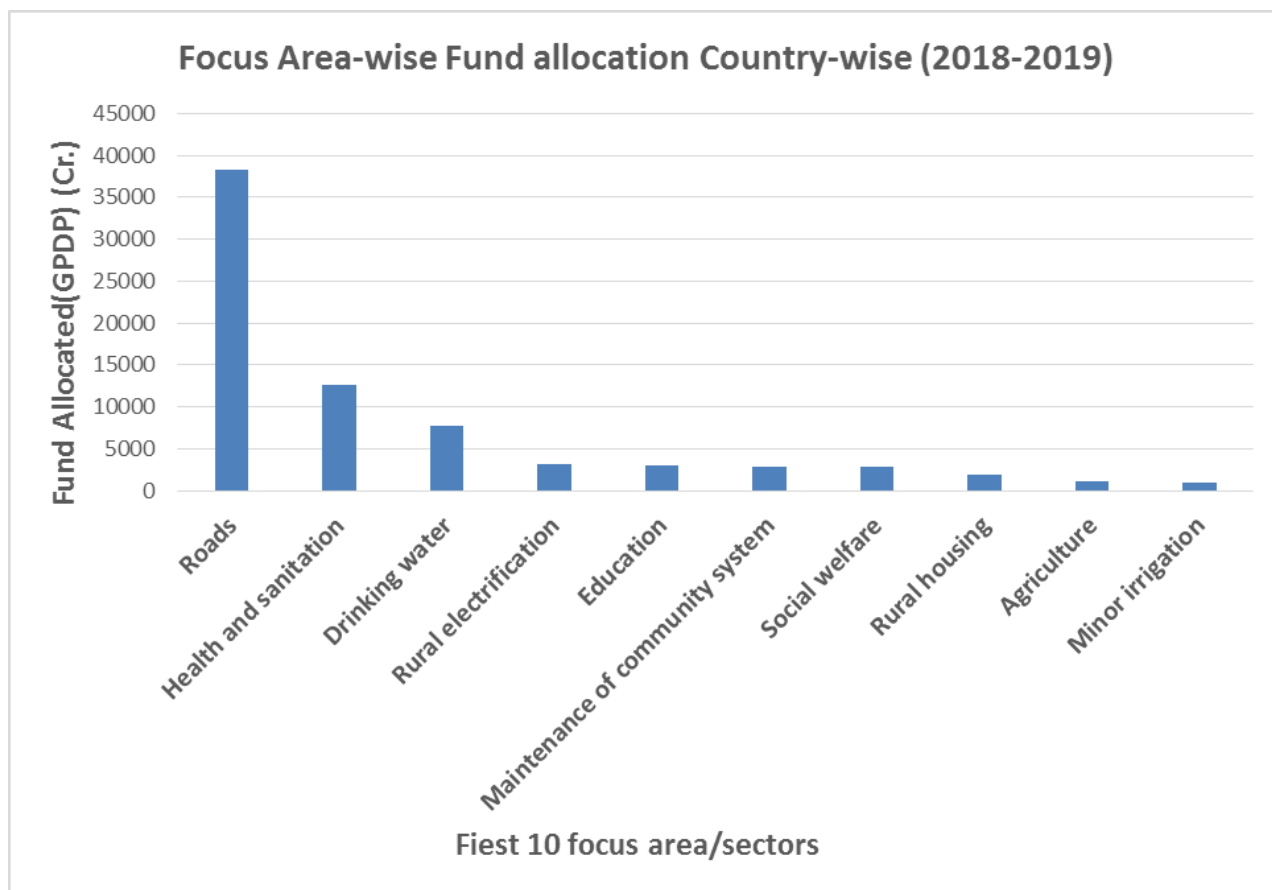


Figure 26: Focus Area-wise Fund Allocation Country-wise (2018-2019)

3.12.2. State level - Rajasthan

Tables 12, 13 and 14 and bar graphs in Figures 27, 28 and 29 illustrate the focus area trends in GP plan, numbers of works and fund allocation at Rajasthan State level for the first 10 focus areas.

Table 12: Focus Area-wise GP Plan State: Rajasthan (2018-2019)

S. No.	Focus Area Name	GP Count (GPDP)	GP Count (FFC)
1	Roads	8729	5910
2	Drinking water	7775	6842
3	Health and sanitation	5614	4817
4	Maintenance of community system	2373	1605
5	Social welfare	1962	1445
6	Education	1591	951
7	Rural electrification	1470	990
8	Land improvement	914	604
9	Cultural activities	717	440
10	Rural housing	691	449

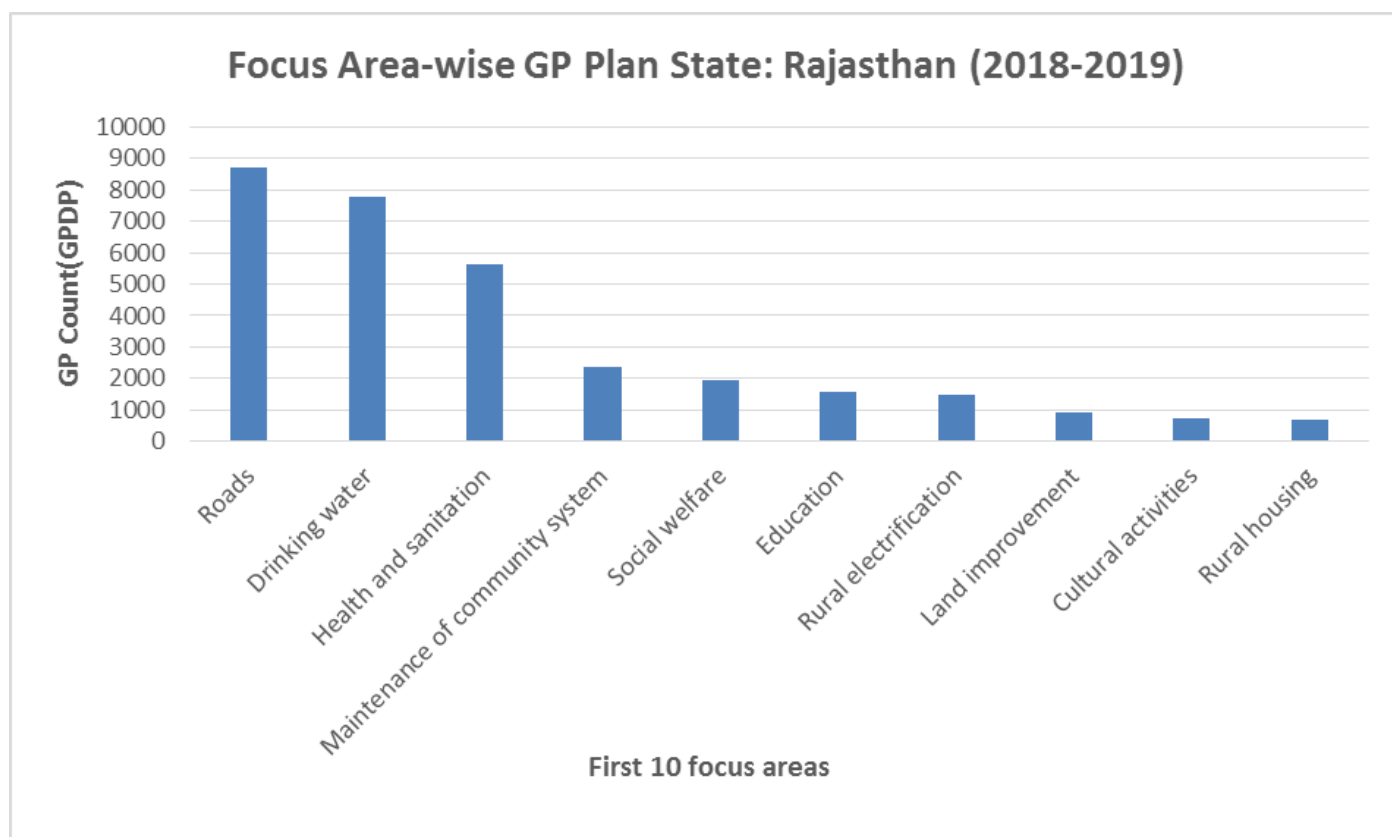


Figure 27: Focus Area-wise GP Plan State: Rajasthan (2018-2019)

Table 13: Focus Area-wise Work State: Rajasthan (2018-2019)

S. No.	Focus Area Name	No. of Activity (GPDP)	No. of Activity (FFC)
1	Roads	96128	35134
2	Drinking water	73150	57965
3	Health and sanitation	35152	25220
4	Maintenance of community system	9323	5412
5	Social welfare	9322	5893
6	Education	3806	1863
7	Rural electrification	3095	2005
8	Rural housing	2411	1387
9	Land improvement	2251	1184
10	Cultural activities	2202	1054

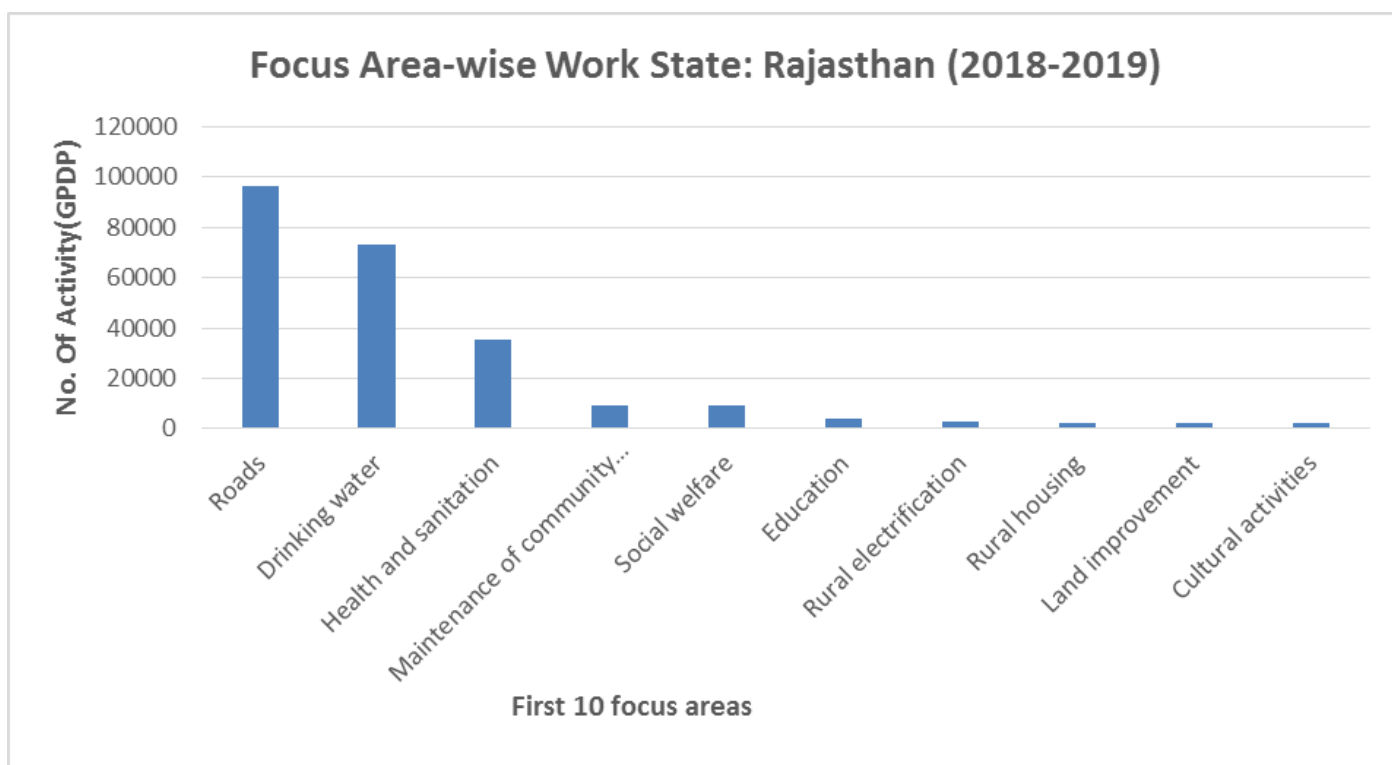


Figure 28: Focus Area-wise Work State: Rajasthan (2018-2019)

Table 14: Focus Area-wise Fund Allocation State: Rajasthan (2018-2019)

S. No.	Focus Area Name	Fund Allocated (GPD) (Cr.)	Fund Allocated (FFC) (Cr.)
1	Roads	3259.06	1277.91
2	Drinking water	1342.1	1036.17
3	Health and sanitation	862.35	610.01
4	Maintenance of community system	243.64	134.56
5	Social welfare	225.77	141.02
6	Education	106.95	50.07
7	Rural housing	89.83	54.36
8	Rural electrification	78.76	48.82
9	Cultural activities	74.37	34.13
10	Land improvement	64.98	34.03

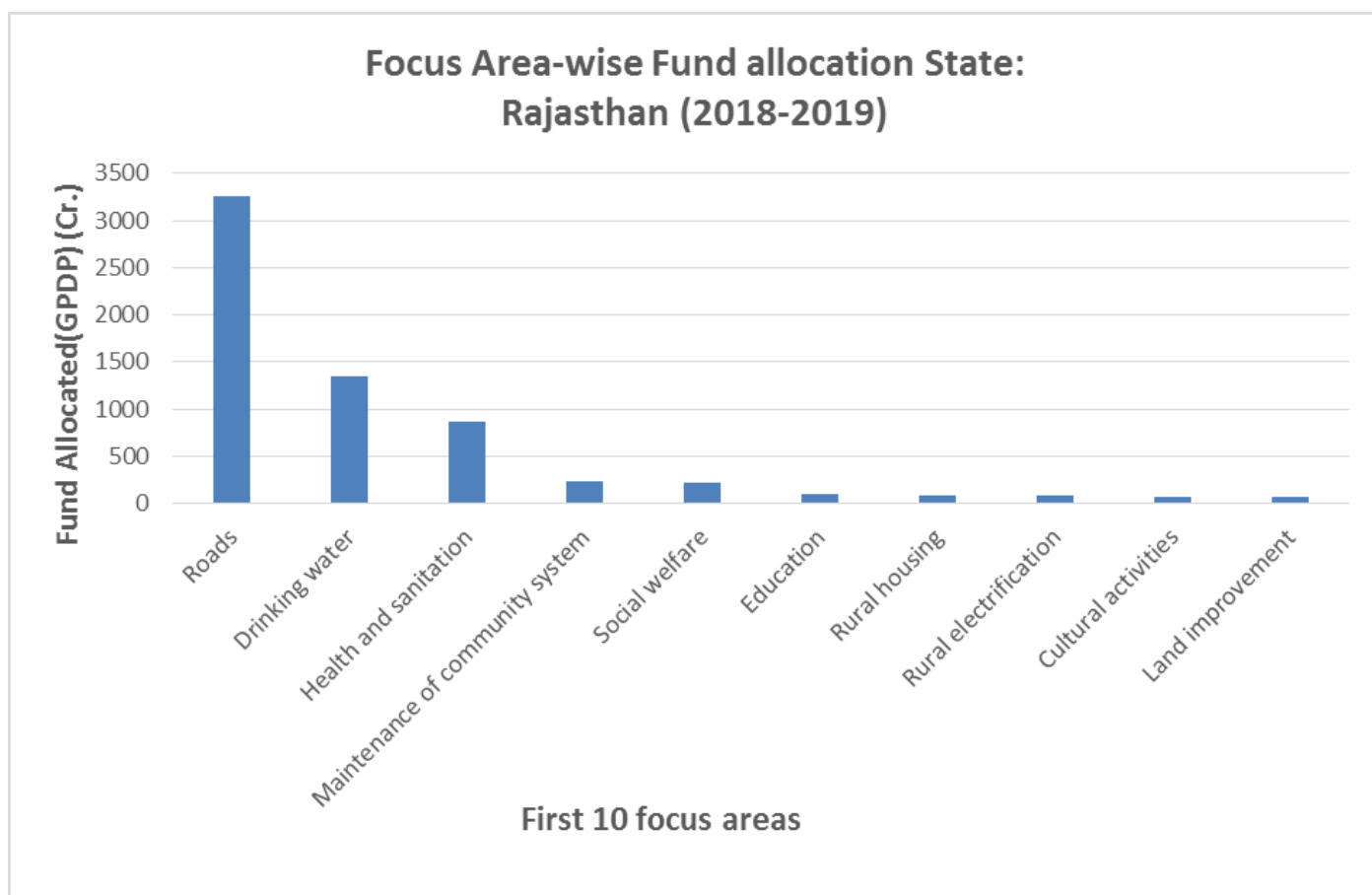


Figure 29: Focus Area-wise Fund Allocation State: Rajasthan (2018-2019)

It was observed from the above analysis that at the country level, roads, health & sanitation and drinking water are the first three priority areas followed by rural electrification, education, maintenance of community system, social welfare, women and child development, agriculture and rural housing, with a slight variation in priorities, while in Rajasthan, roads, drinking water, health and sanitation are first three areas and others are maintenance of community system, social welfare, education, rural housing, rural electrification, cultural activities and land improvement with a slight change of place in the plan, numbers and fund allocation.

Roads are at the top priorities at the national and State level in all phases including plan, the number of works and fund allocation while at GP level as per the study (see Table 8), roads are at third priority (after combining priority with instances/frequency of demand). When taking only priority into consideration, roads are at fifth position and Gaushala and prevention of electricity accidents and electricity-related problems were at third and fourth positions, and drinking water is the first priority, as per the study. Health and sanitation is the second priority at the national level while drinking water is the second priority at the State level and sanitation/waste management is the second priority at the GP level as per the study. Drinking water is third priority at the national level, while health and sanitation is third priority at the State level. The results are presented in Table 15.

Table 15: Priorities of National, State (As Per Portal) and GP Level (As Per Study)

Priority	National (GPDP Plan)	Rajasthan (GPDP Plan)	GP Study (Combined Priority plus Frequency)
1	Roads	Roads	Water
2	Health and sanitation	Drinking water	Hygiene/Sanitation/Waste Management
3	Drinking water	Health and sanitation	Roads
4	Rural electrification	Maintenance of community system	Electricity Problems
5	Education	Social welfare	Specific Demand Animal (Cows/Bulls) Rescue Centre (Gaushala)
6	Maintenance of community system	Education	Education
7	Social welfare	Rural electrification	Women and Child Development
8	Women and child development	Land improvement	Banking/Financial Inclusion
9	Agriculture	Cultural activities	Surveillance/Security
10	Rural housing	Rural housing	Cooperative/Public Distribution System

3.14. Resource Envelope of Gram Panchayat, Hantra

To understand the general income and expenditure pattern, the resource envelop of the last five years from 2014-15 to 2018-19 were mapped with the help of information available with Panchayat (see Table 16). It was collected to estimate the regular income and expenditure pattern of Gram Panchayat and to elicit the financial capacities of Gram Panchayat. Scheme preferences and expenditure patterns of Hantra Gram Panchayat over the five years are analysed in Figures 30, 31 and 32.

Table 16: Resource Envelope of Hantra Gram Panchayat

Scheme	Financial Year										Total	
	2014-15		2015-16		2016-17		2017-18		2018-19			
	Income	Exp.	Income	Exp.	Income	Exp.	Income	Exp.	Income	Exp.	Income	Exp.
TFC/FFC	13.55	10.52	21.28	15.22	25.74	20.59	25.33	9.40	17.42	14.25	103.32	69.98
S.F.C	26.49	19.46	10.04	14.36	21.46	25.54	22.05	9.23	28.38	32.42	108.42	101.00
Untied Fund	13.33	6.92	0.00	5.79	0.00	0.00	0.00	0.00	0.00	0.00	13.33	12.71
Compensatory fund	3.42	6.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.42	6.60
MLA LAD	10.72	12.71	12.66	13.00	2.60	0.00	0.00	0.00	0.00	0.00	25.98	25.71
MP LAD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Own Source	0.92	0.67	0.71	0.85	1.02	0.77	1.91	1.54	1.54	0.69	6.11	4.51
Nirmal Bharat Abhiyan	5.00	4.99	2.87	2.90	0.00	0.00	0.00	0.00	0.00	0.00	7.87	7.88
M.J.S.A	0.00	0.00	20.00	11.28	0.00	1.02	0.00	0.00	0.00	0.00	20.00	12.30
Others	0.99	1.18	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.05	1.18
Total	74.43	63.05	67.62	63.38	50.82	47.91	49.29	20.17	47.34	47.36	289.50	241.88
MGNREGA	22.00	22.00	35.35	35.35	12.49	12.49	15.93	15.93	2.79	2.79	66.56	88.56
Grand Total	96.43	85.05	102.97	98.73	63.31	60.40	65.22	36.10	50.13	50.15	356.06	330.44
Here Exp. means expenditure: figures are rounded off to two decimals												

Here Exp. means expenditure; figures are rounded off to two decimals

Source: Gram Panchayat Hantra

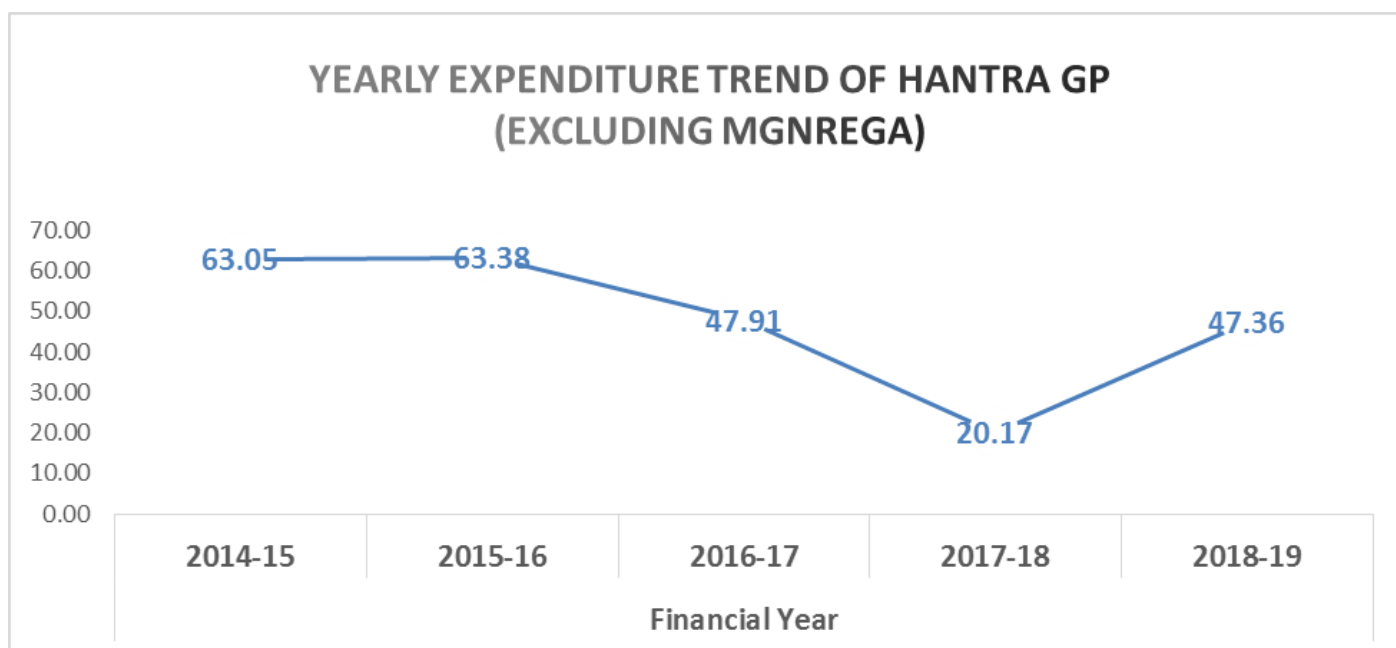


Figure 30: Yearly Expenditure Trend of Hantra GP (Excluding MGNREGA)

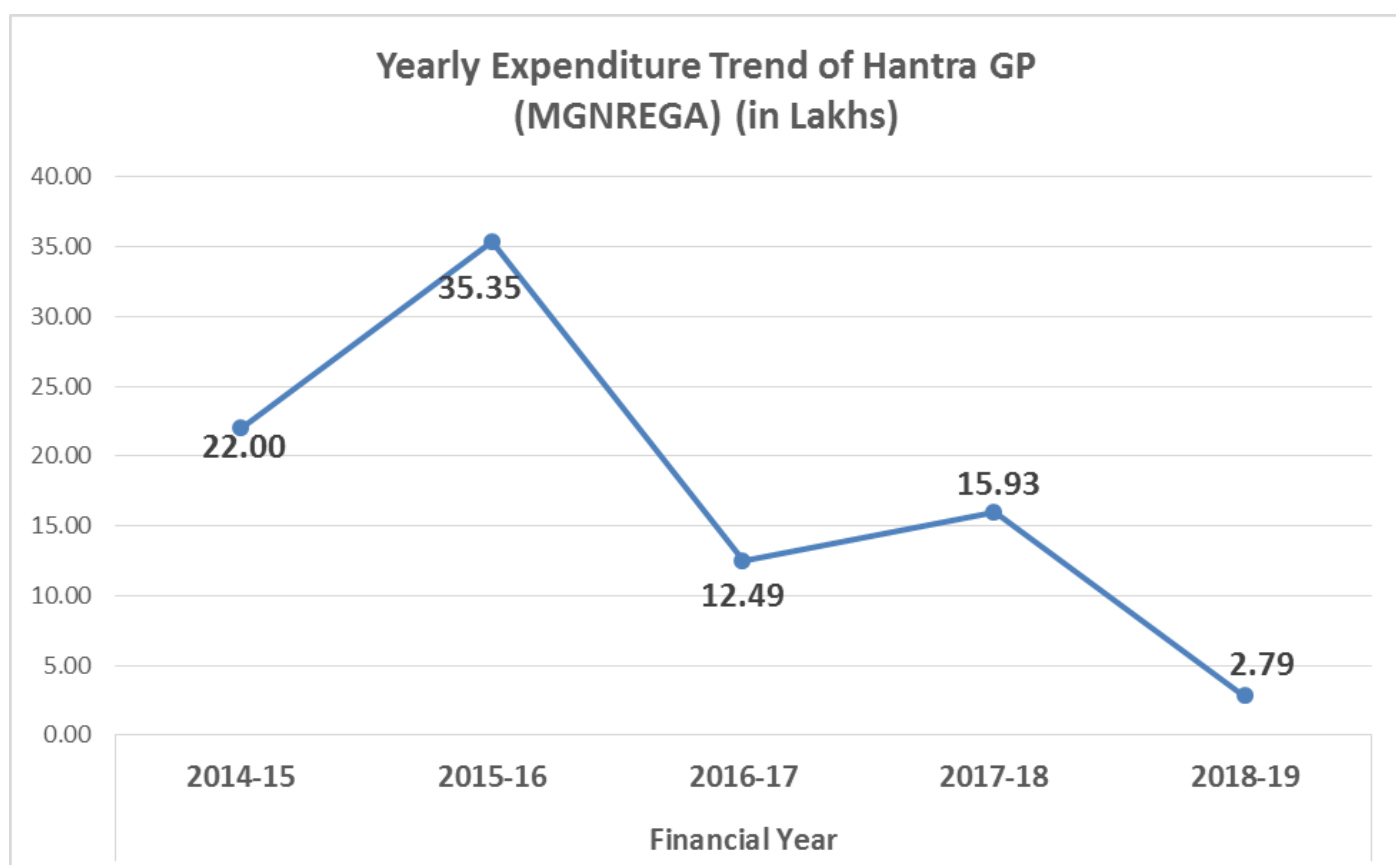


Figure 31: Yearly Expenditure Trend of Hantra GP (MGNREGA)

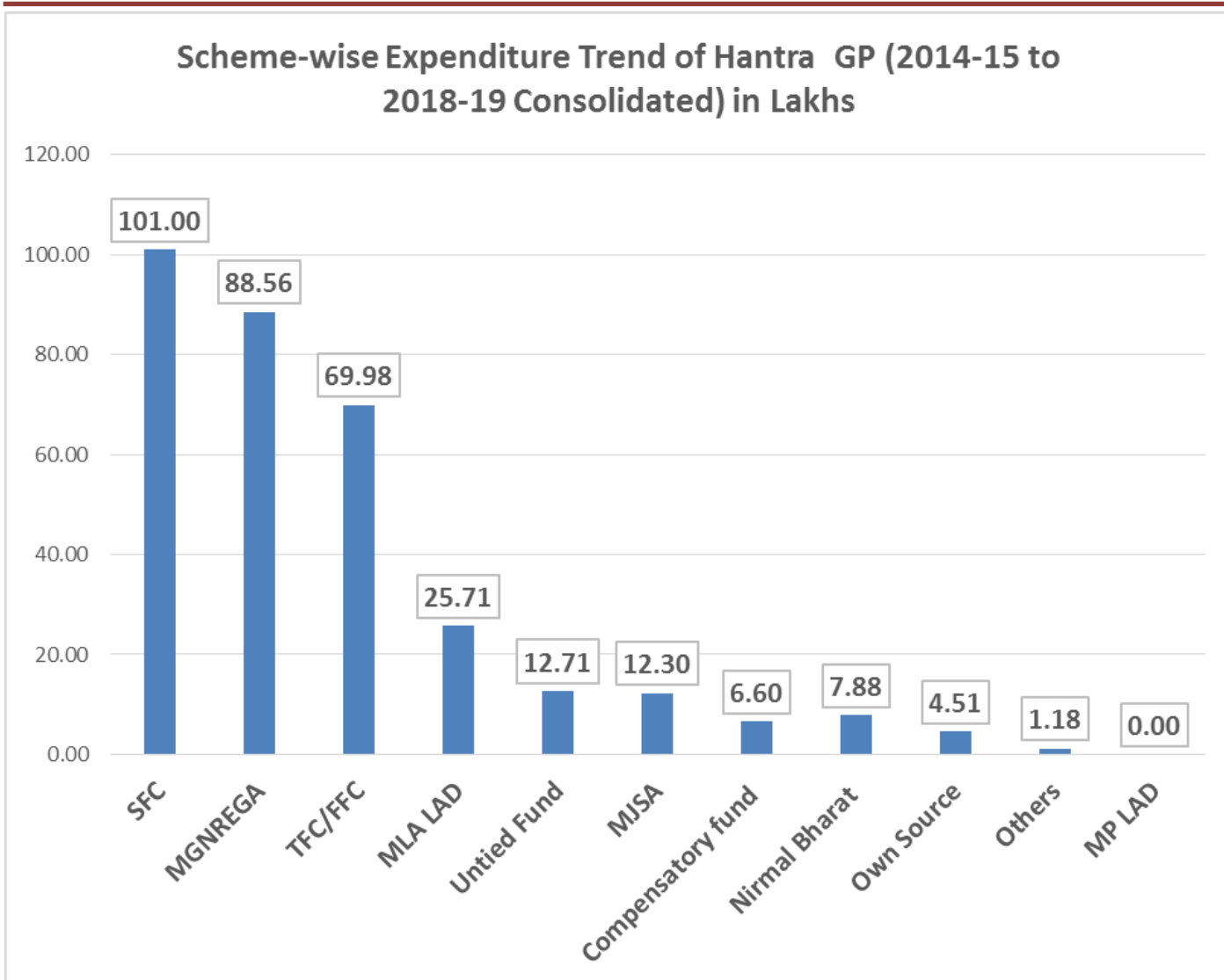


Figure 32: Scheme-wise Expenditure Trend of Hantra GP

4. Discussion

The discussion is based on the initial research questions and related objectives.

4.1. Objective 1: To Survey and Map the Existing Community Infrastructure of Gram Panchayat

For fulfilment of objective one and answering research question: 'what is the existing community infrastructure', the existing community infrastructure were marked and mapped successfully along with attribute data of community assets using free and open source mobile technology. The assets were draped and visualised on drone images and it was found that for visualising assets at village level and generating the drainage plans, drone images and surveys through reputed agencies using the highest level of data processing tools is the need of the hour. The following supportive observations (except those discussed under results section) were made during exploration under the first objective.

4.1.1. One-time Inventory of Works in Gram Panchayat: After independence, many departments are doing the work in Gram Panchayats. The employees concerned are getting retired and frequently transferred; hence, the present employees working in Gram Panchayat or other various departments are only able to tell about works executed during their tenure. They hardly have any information about the previous record available. In this study, the Gram Panchayat Secretary was able to provide the record from 2009 and as per available record only. He was not able to tell the exact location of many works carried out during the tenure of the former Gram Panchayat secretary.

In the case of roads along with drainage channels and desilting of ponds, mostly same roads or ponds are constructed/upgraded/desilted many times even without considering the permissible age of previous works done (in the case of roads), which the Panchayat technical staff are not aware of. If a proper record is not maintained since independence or at least from a critical start point, and an MIS is not generated, these works cannot be monitored properly. GIS visualisation is also difficult for the different work layers of different times in the same location. GIS/remote sensing can mostly map on the basis of the current surface situation.

4.1.2. Roads: Public demand is mostly the main factor for road construction; however, if the road is being permitted for a second time in the same place, the permissible age of the previous road should be a factor to be considered for proper compliance. Road repair activity should be based on the age and maintenance requirement of the road. Timely repair of village roads is not an essential part of the road construction proposal, especially in village roads constructed by Gram Panchayat. For the roads constructed by PWD or by Gram Panchayat, a proper social audit is required from time to time for compliance with the norms.

4.1.3. GIS Visualisation of Roads: Getting the data and presenting it in the GIS environment was found difficult as the roads may be constructed in different timings under different schemes in different layers, one over another. For example, a road may be initially constructed of Garvel/Murum from point A to B in a particular scheme in time T1. Then other roads of CC category or bituminous road of different length in time T2 and may be done in future on same roads after its ageing. So, instead of the number of different roads constructed at different times in different layers, GIS can represent only the length of the topmost layers with current attributes of roads.

The same condition applies to any asset which is constructed for the same places many times repeatedly, like the desilting of village ponds. Further, it is difficult to get data pertaining to the previous works if the time gap is more and officials concerned are transferred. However, if visualisation can be compromised, the entries can be made in a GIS environment. The representation view of the construction of roads at a different time in the same place is presented schematically from the side view in Figure 33.

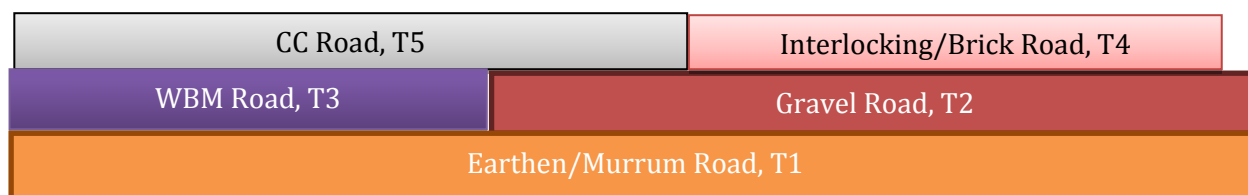


Figure 33: Schematic Representation of Road Layers - Side View

4.1.4. Ward Boundaries: Ward boundaries are not clearly understood and well defined and mostly related to the families, not the area. These are basically demarcated for the election purposes. One Gram Panchayat should have at least nine wards. If a family left the ward and living outside the ward anywhere in India and sold their property, still the members will be considered as voters of the same ward. Ownership of ward boundary and maintenance is also not clear. Gram Panchayat Secretary, revenue officials, etc., were able to give indicative ward boundaries and no proper documentation/record of the area in this regard was available. Hence, all ward boundaries depicted in the study are indicative or approximate based on the best knowledge of ward members concerned.

4.1.5. Concept of Asset Density: Road densities or densities of any other assets are not the criteria for the construction of assets. The norms may be linked to asset densities for repairs and construction of new assets. The inclusion of asset density as a criterion will be helpful in reducing local disparities within the Gram Panchayat. For example, if you take the case of Hantra Village in the Gram Panchayat, which is habituated with 'Banjara' community coming under backward class, it is devoid of RO plant any kind of GLR or piped drinking water supply, whereas the rest of the villages are having large extent piped drinking water supply, RO and GLR or overhead water tank. The concept of asset density can put the village under higher priorities in these assets. This concept may

be a good parameter to be in line with the SDG (sustainable development goal) 10: 'Reduced Inequalities'.

4.2. Objectives 2, 3: To Assess Ideal/Optimum Community Infrastructure Requirement of Gram Panchayat through Participatory and Departmental Approach; To Analyse and Map Gaps in Community Infrastructure and Suggesting Infrastructure Development Plan of GP

For answering the research questions 'What are the optimum community infrastructure requirements of my Gram Panchayat?', 'Where are the gaps?' and fulfilling the relevant second and third objectives, the villagers were asked for the community infrastructure requirements. Ward-wise demands were collected and validated at the village and Gram Panchayat level. Norms of departments concerned were collected and matched for assessing the optimum requirements and analysing the gaps or resource relaxed or resource strained or neutralised conditions by analysing the demands with possibilities under the norms of departments. Following supportive observations (other than the previously discussed under results section) were made during the exploration under second and third objectives.

4.2.1. Solution versus Assets: Villagers were able to describe the need or problem but finding a proper solution or converting it into assets is the responsibility of departmental officials concerned as villagers are not aware of the norms, guidelines, availability of budget, etc. Sometimes, the problems can be solved with low cost or no cost. Hence, instead of asking the villagers about the requirement of hand pumps or roads in a particular ward or village, questions about the problems hindering their daily life or ease of work may be asked. Based on the answer, a decision on whether it may be solved by a physical asset or something else or by just convergence or proper communication can be taken.

4.2.2. Asset versus Service Delivery: In some sectors like Health, Education and Electricity, assets are a secondary concern of the villagers whereas service delivery is the primary concern. Villagers are ready to accept poor condition of the building, improper equipment, unhygienic conditions, etc. But if the staff is incompetent or infrequent or non-responsive, the villagers keep the concern on high priority.

4.2.3. Social Demand V/S Technical Feasibility (Overlapped Works): Most of the works carried out by departments like hand pumps, roads, water and sanitation-related works can be executed by the Panchayat also. It was found that departments generally follow the norms strictly but Panchayats are giving more weightage to the public demand or pressure. This sometimes causes an imbalance in development within the Panchayat and over expenditure. This can be reduced by making the relevant departments nodal for checking the technical feasibility of works.

4.2.4. Social Demand versus Technical Feasibility (Change of Norms): Again the social demands are handled by public representatives and technical feasibility by the technical officers concerned. It was observed that under social pressure, the technical norms can be revised through a higher level of political pressure. This was observed in the case of hand pumps. Previously, one hand pump was provided to a population of 250 and now it has been made 100 people. When the matter was discussed with officials, it was found that the norms were changed under the socio-political pressure. If the norms are not matching with the real feasibility, then technical norms will not be have any significance and there will be pressure on natural resources in future, resulting in untimely exhaustion of resources.

4.2.5. Environmental Concerns: The absence of rigid technical norms and lack of proper enforcement will pose serious threats to natural resources (water in general, and drinking water in particular). Satisfying the short-term immediate demands at the cost of the environment will lead to the mass destruction of resources.

4.2.6. Future of Hand Pumps and Wells: As discussed previously, hand pumps do not have any feasibility if the water level is below 100 feet or the water is not potable. Also, wells have been abandoned or being used for dumping wastewater. In this context, the villagers are against the continuation of hand pump scheme or any well-related expenditure as wells in the area are almost abandoned. Villagers suggested promotion of solar pumps in those areas in place of hand pumps.

4.2.7. Relaxation in PMGSY Norms: Nagla Banjara Village has a population of 550 as per the 2011 census and according to PMGSY norms, the population parameter of a minimum 500 population is considered from the 2001 census. Nagla Banjara was not a revenue village at the time of census 2001 and hence, it is not connected to main roads. Now, there may be several villages around the country having a population greater than 500/250 (as the case may be as per guidelines) but cannot be linked under PMGSY as they are not having a satisfying population in the 2001 census.

4.2.8. Life of Asset: Life of asset criteria is not clear for internal assets of villages and public demand generally supersedes these criteria. Hence with every pucca asset, apart from the norms for constructing new asset, it should be very well defined that after how many years the asset can be considered for reconstruction. This may be specially suitable for various kinds of roads where the reason for deterioration is poor quality and water stagnation, and the cyclic construction of roads is going on with a chain of newly elected representatives without scratching the previous road materials. Consequently, the level of houses along the roadside goes down whenever a new layer of road is constructed.

4.2.9. Maintenance Aspect of Activities/Works: The maintenance of drainage channels is a very crucial aspect. However, it is crucial for the roads, other buildings and assets also. For

maintenance, norms are not very clear and even if maintenance is a permitted activity in SFC guidelines, Panchayat functionaries are not able to use this for the lack of proper instructions and rate criteria. In the absence of clear maintenance norms, roads and choked drainages are not cleared regularly resulting in water stagnation and deterioration of roads.

4.2.10. Prioritisation and Integration of Norms/Parameters if More Than One Indicator is to be Considered: In the departmental norms where more than one criterion is being used for construction of the new asset, proper integration, weightage and prioritisation are needed. In the case of hand pumps, population, distance and time to fetch water are the criteria but it is not mentioned if all the criteria are to be satisfied or one or two criteria are also sufficient and what are the permissible priorities and combinations in those cases. In the case of anganwadi also, population, distance and number of children are criteria. But the decision on opening anganwadis in the villages fulfilling the criteria of distance and number of children but not the overall population is not clear. Nagla Banjara faces the same problem as it deserves an anganwadi based on the children's population and distance norms but fails to meet the overall population criterion.

4.2.11. Compulsory Inclusion of Departmental Officials Concerned in Every Planning: In Gram Sabhas, attendance of relevant departments are mostly for getting their works to be included in Gram Sabha proceedings as it is a mandatory condition. A proper three-way relationship between departments, villagers and Gram Panchayat is yet to be established. The absence of departments from Gram Sabha or their partial absence is not taken seriously. The representatives of line departments attend the meeting as if they are bestowing mercy on Gram Sabha and Gram Panchayat. The demands are not analysed in Gram Sabhas for this reason and departmental works are done like blessings on the villages without involving them much on the need analysis.

4.2.12. Variation in National, State and Local Priorities: Analysis and comparison of the national and State GPDP performances/priorities and status of villagers' demand indicate that some local demands like cow shelter (Gaushala) and prevention of electrical accidents are higher priority after drinking water and sanitation. Roads are fifth priority at the local level while it is high priority at the national and State levels. GPDP is not including these activities, may be not permitted or for any other reasons. But, to make it a holistic approach, all the local demands are to be part of GPDP even if they are low cost or no cost, permissible or not permissible and proper priorities are to be decided. Accordingly, actions that will lead to an increase overall happiness and satisfaction level of the village may be initiated.

4.2.13. Situation of Roads, Wells and Hand Pumps: As per the study, it was found that hand pumps are not feasible for GP as water level is below 100 feet and not of good quality. The situation of existing hand pumps is shown in the photo gallery for reference. Wells are also abandoned completely and we can say that wells and ponds are discarded for regular uses gradually and these

are made waste disposal pits and ponds. The photo gallery may be referred to for the current situation of wells and ponds. Internal roads have already been constructed at almost all the places in the villages, but new roads are required now due to lack of proper drainage facility. The absence of proper water disposal system will result in water getting stagnated on roads, eventually damaging it or giving the impression of low level road. Without having an appropriate drainage mechanism in the villages situated in Indo-Gangetic plains, the construction or maintenance of the roads will be a never-ending story - the height of roads will be temporarily raised, causing deposition of water in nearby areas, or it will be executed to satisfy the powers within the village and consume the public money. Roads, within the current quantum of work, are not actually required and the real need is a proper drainage system. The functionaries are showing lack of competency in the planning of that GP. A few success models have to be prepared for making them aware of the need for planning, and deciding proper technology and norms for it. Hence, regarding the demands related to internal roads, wells and hand pumps, utmost care is required to cross-validate the demand with technical feasibility.

4.3. Objective 4: Estimation of Tentative Cost for Works and Suggestions on Inclusion in GP and Departmental Development Plans

Under the research questions - 'What cost will be required? Who will do that?' and 'Where are the resources?' - the cost estimates for consolidated final demands (after excluding the non-feasible works) were taken with the help of departmental officials and Gram Panchayat functionaries. As per eligibilities under various guidelines, the works are proposed to be executed by various departments under relevant schemes.

For the works that are feasible and required but no scheme is permitting, alternative sources like MPLADS/MLALADS, Own Source or CSR funding are suggested. Even villagers can contribute and set an example for such cases like the construction of Gaushala (cow rescue centre).

4.4. A Diagram to Represent Demand Situation at the Grassroots Level

The diagram (see Figure 34) suggests the general pattern and relationship between existing assets and demands at the grassroots level.

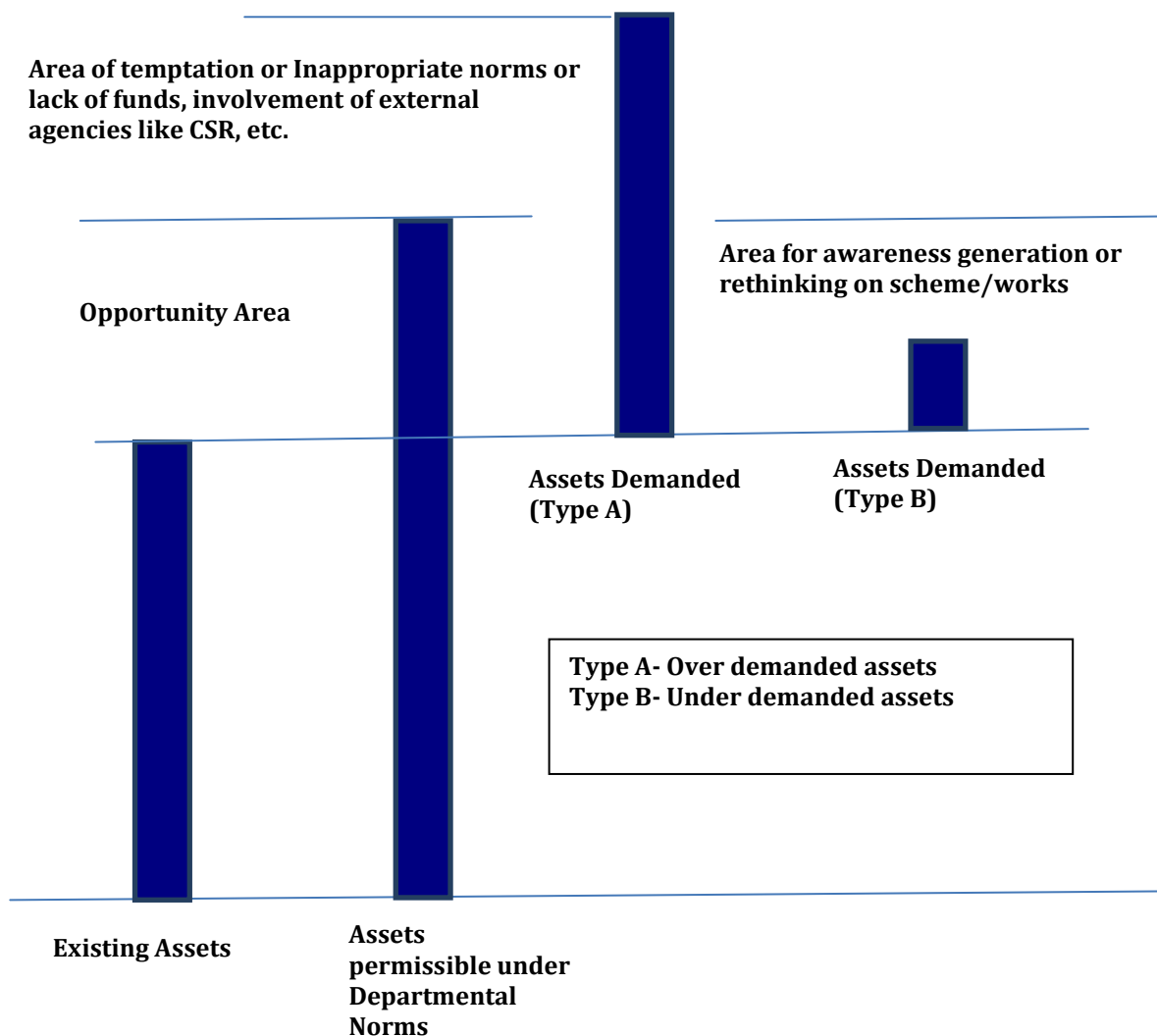


Figure 34: Relation between Existing Assets and Demands at the Grassroots Level

4.5. Suggestive Procedure for Planning of Works Based on Demand Analysis

Based on the above analysis of demand and departmental norms, the suggestive procedure for recommending works at the village level may be as per Figure 35.

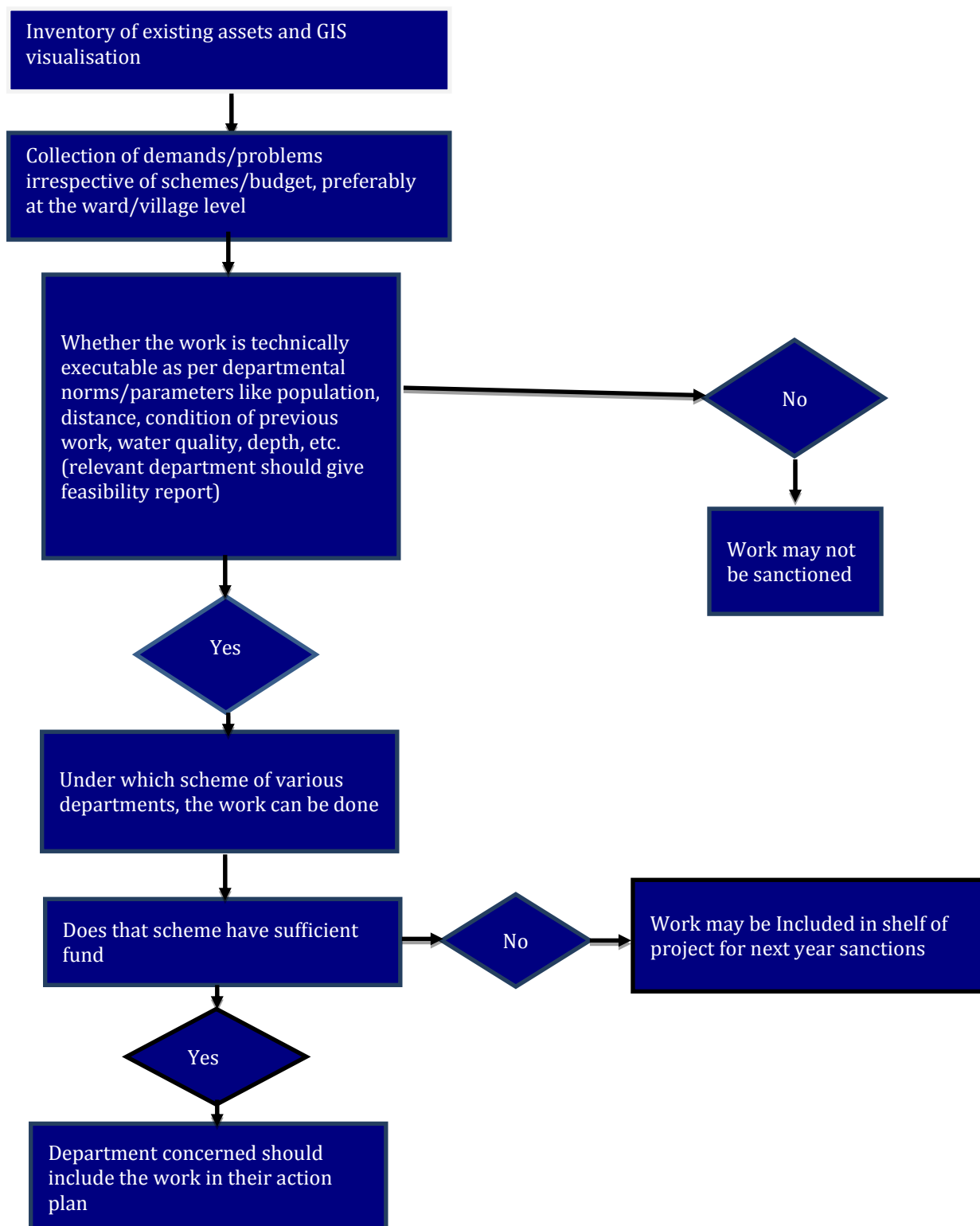


Figure 35: Suggestive Procedure for Recommending Works at GP/Village Level

4.6. Out-of-the-box Demands

- i. Gram Sabhas used to be conducted previously four times a year (26th Jan, 15th August, 2nd Oct, and 1st May). Now, these are being conducted 15-17 times a year, which is causing incomplete quorum.
- ii. MGNREGA labour-oriented works are less in the area. Desilting of ponds cannot be done in the area as it has already been carried out under MJSa and not permitted under MGNREGA now. Anicuts are not constructed due to lack of drainage lines, roads cannot be constructed during agriculture season as both sides of the roads have crops, and opportunity for new roads are also less. It was suggested to link farming operations with MGNREGA.
- iii. Pay scales of Gram Panchayat secretaries are less and it is difficult for them to instruct and monitor officers, who are higher to them in pay and post.
- iv. The involvement of Panchayat in skill and employment related schemes of the Central and State governments is minimal. Panchayats are unaware of the activities and persons trained under various schemes.

One Gram Panchayat Sarpanch described the procedural difficulties at the grassroots level in simple words as mentioned in Figure 36.

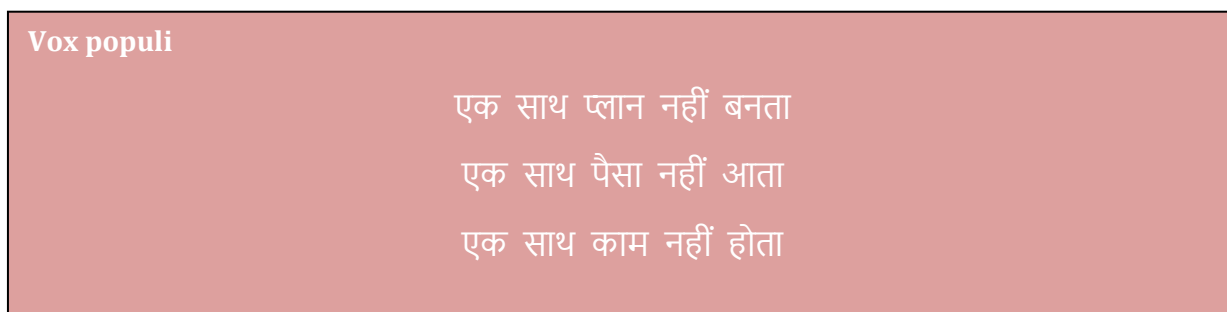


Figure 36: Vox Populi- Sarpanch of Nearby Paraswara GP, Nadbai Block, Bharatpur District, Rajasthan

4.7. Future Research Direction Emerging Out of Study

As the parts of previous roads are generally not removed while carrying out the construction works and levels are not maintained properly, the floor levels of houses along the roads also go down from the level of roads. This causes diversion of rainwater and drainage water into the premises of houses along the roads. This leads to unhygienic living conditions, especially for poor residents who cannot afford to raise levels of house floors or reconstruction of houses as per road conditions. A further study is required to quantify the causes, impact and suggest proper solutions in this direction. Already existing drone images can support immediate sampling of vertical levels of

roads at selected places and vertical levels of houses along the roads corresponding to sampled points on roads. The same can be validated on the ground with further analysis.

Web visualisation of all data of Gram Panchayat in an editable dynamic manner for their local planning is required. Hantra Gram Panchayat GIS portal can be developed on a pilot basis where drone data along with other statistics may be uploaded on the portal and access may be given to the Gram Panchayat functionaries to update and edit it, prepare the planning maps and contribute local data collected from time to time through various mobile applications. The same scheme can be replicated in other Panchayats and all GPs can have their own GIS portal for local-level planning.

Most of the studies are limited to urban sprawls. A detailed study is required to estimate the spread of settlement areas in villages of various States with terrain conditions, time, distances from urban settlements and main roads, etc. This may be an additional concern with the problem of migration and may correlate with migration and population.

Every block in Rajasthan and probably India has a block census handbook prepared by the Census department. Apart from the data of previous census, the books have a lot of other local data. Using this data and corresponding field GIS surveys, the book may be converted into a web-based dynamic GIS portal named “Block Census GIS- Block.....” where locations can be attached with the attribute data from the book. The public may be allowed to access the data and download it.

The open wells were once a primary source of water, especially drinking water, in the region. Now almost all wells are either abandoned or not being used. The reasons are apparent but further exploration of the problem may be required.

A study is required on the possibilities of linking farming operations with MGNREGA in eligible areas.

A study is required to estimate the present status of Panchayat-SHG convergence and involvement of Gram Panchayats in skill and livelihood related State and Centrally sponsored programmes.

A few models of all-inclusive village-level sanitation, drainage and waste disposals have to be prepared and executed for testing the benefits, cost structures and deciding the technical norms towards this as GPs are not able to prepare the plan and execute them financially, technically or procedurally for the whole village/GP on their own. If the work will continue in a piecewise manner, then construction of the roads and drainages will be a never-ending practice in villages.

5. Recommendations

Based on results and discussions, the following recommendations are made for consideration at appropriate levels.

Proper Enforcement of Technical Norms: For spending Panchayat funds (MGNREGS, FFC, Untied, MP LAD/MLA LAD, etc.), generally the public demand is a hidden criterion that may not be technically feasible in many circumstances especially when:

- Asking for a new work in the same place when previous work done was of inferior quality.
- Asking for a work when the actual fault lies with the beneficiaries, like asking for tightening of HT electric lines or shifting of electric lines when they were laid as per norms and later road height was increased by PWD or building portions were extended illegally under the lines.

Technical Feasibility Filter: All the works and demands should pass technical feasibility and saturation criteria in a formal manner; only then, it should be part of the shelf of the project, even if sufficient budget is available and nature of works are eligible as per guidelines.

Saturation-centric Budget and Scheme/Budget Independent Planning: Freeing of rural development plans from funds, functions and functionaries in the initial phase of planning and making it more need-specific and saturation-centric is need of the hour. All the departments with schemes, budget and functionaries (technical experts) should remain on the periphery and support only when asked by the Gram Panchayat. Giving an indication of budget and guidelines put a limit on planning and encourage exaggerated planning also. Once the saturation-centric approach is started, the plans in later phases may be very less budget consuming and mainly dependent on maintenance aspects.

Relaxation in PMGSY Norms: As described in the discussion section, the PMGSY Census 2001 is being taken into account for connecting the villages having a population of 500/250 as the case may be. But Census 2011 is already over and if the revised consideration is done, many new villages may be benefitted and be connected to the all-weather roads. In the study area, as per Census 2001, Nagla Banjara is not in the PMGSY criterion. But as per Census 2011, its population is 550 and it is eligible for connectivity but not eligible under PMGSY. Hence, the eligibility criteria for PMGSY may be made the population as per the immediate previous Census. Further, in the normal areas also, norms may be different for villages having more backward population.

Placing Dedicated Technical Staff at Each Gram Panchayat: Panchayats are not capable of handling bigger technical plans. Panchayats are also having limitations in technical sanctions and the assistance received from higher offices are less, as the technical staff posted at Block offices serve many Panchayats at a time. Seeing the fund flow and technical requirements, each Gram Panchayat should have a dedicated and capable technical staff.

Proper Guidelines for Maintenance: Maintenance is a critical aspect, especially in roads, sanitation, cleaning, etc. In the absence of proper norms and guidelines, individual Panchayat functionaries are hesitant and afraid of framing separate norms due to audit and other aspects. Hence, proper and detailed guidelines for maintenance aspects of works are required.

Inventory and Coding of Existing Works with a Continuous Update: All the physical works at the Panchayat level should be inventoried from a proper critical start time with proper coding of works. Later, every physical work in the village should be entered in MIS or preferably in the National Asset Directory module of Panchayat Enterprise Suite (PES). This may be a replacement of the Asset Register being maintained at the GP level and the scope of this register is to be extended to all the assets (including other departments also) being executed at the GP level. This may be called as E-Asset Register. The register should have a track and record of works done by line departments also, with full financial and technical details of the assets duly verified by the department/officials concerned. The suggestive coding pattern of works is shown in Table 17.

Table 17: Suggestive E-Asset Register

State Code	District Code	Block Code	GP Code	Village Code	Department Code	Scheme Code	Year	Work S. No.	Central GPS coordinate
As per LGD									

Dumping of wastewater in ponds may be banned by Gram Panchayat and instead, this should be dumped in pits made exclusively for this purpose.

Asset Density as a Criterion in Planning: Average road density per hectare or per hundred of the population of the particular villages' settlements under Gram Panchayat may be a parameter to check the disparity in roads construction within the Gram Panchayat. This may be a basis for sanctioning new roads in a village where road density is less in comparison to other villages of the same Gram Panchayat. This may be extended to other assets also within Gram Panchayat to reduce the unequal development within the Panchayats.

Age of Previous Work: Public demand is mostly the main factor in rural road construction using Gram Panchayat budget; however, if the road is being permitted for a second time in the same place, the permissible age of the previous road should be a factor to be considered at the time of sanctioning new roads.

Road Levels to be Maintained and Fixed: Internal road levels from a permanent benchmark

in each village needs to be established preferably on 30 metres of chainage and those points have to be marked properly in the GIS environment (points may be recorded by DGPS for future reference and levels may be decided by the PWD using Auto levels from Permanent Benchmark). In future, new road construction should not cross these road levels. If new material is used for construction, the previous material on the road should be scrapped off first and dumped/used in other constructions.

Social Audit of Roads/Works: For the roads constructed by PWD and Gram Panchayat, a proper social audit is required from time to time for checking compliance with norms. Other than roads, this may be applicable for activities done by other key departments such as PHED, Electricity, Education and Health.

Systematic Waste Management System: Having a systematic waste disposal system is the most required activity but it has not been kept on high priority in the area due to social acceptance of prevailing behaviours. In this regard, thorough awareness generation and capacity building for the Panchayats are required. This activity is not demanded also properly due to lack of awareness. Capacity building material prepared by NIRDPR may be translated into Hindi and distributed to Panchayat functionaries.

Construction of Gaushalas: Roaming of free unproductive animals is a common problem not only in the area and but also in whole Rajasthan and the country. Generally, unproductive buffalos are sold to slaughterhouses but cows and bulls cannot be killed and these are roaming freely on farmlands and roads, eating plastic waste. A proper planning and management strategy is required in this direction. The immediate solution suggested was to construct and manage a cow rescue centre (Gaushala) with proper management and a self-sustained model. With the involvement of NGOs, every GP or cluster of GPs can have a Gaushala where animal wastes like dung, urine and also their skin and bones can be used in natural ways and a commercial model can be evaluated.

Proper Combinations and Prioritisation of Norms if More Than One Parameter as Criteria are Involved: In the villages where the population is less than the criteria of the asset but the distance is more from nearby facility, then distance criterion should be followed if other conditions are satisfied. For example, if a village has a population of less than 1000 and more than 20 children eligible for anganwadi centre, and its distance is more than 500 metres from nearby anganwadi centre, then the village may be given an anganwadi centre. A similar pattern may be followed in the cases pertaining to other infrastructures also. Hence, if more than one parameter is involved, proper priority and combination of parameters may be rigidly defined, taking all kinds of possibilities into consideration.

Refinement of MPLAD/MLALAD Guidelines: In MPLAD and MLALAD scheme guidelines, only 'works not to be recommended' are mentioned, but 'doing the works as per guidelines of Nodal

Department only' is not mentioned . Hence, it should be an essential part of work guidelines of MP/ MLA-LAD works that the 'Works can be executed only when complying with the norms of nodal department.'

Concept of Nodal Technical Department: Panchayats are doing almost same type of works like laying of roads, hand pumps, ponds related works, construction works, etc., which are executed by relevant expert/line departments also. The technical guidelines of other departments and Panchayat should be the same at least for the technical norms and should not deviate from norms of specialised departments like PHED/PWD, etc. Or else, Public Health and Engineering Department and Public Works Department should be the nodal department in Rajasthan State, respectively, for all drinking water-related and Road works. Panchayats should get a clearance, technical feasibility report from PHED or PWD as the case may be before executing any hand pump/RO/road, etc., and related works. This will help maintain similarities in the quality of works.

Priority for Environmental Concerns: In deciding technical norms, environmental sustainability should be on top priority and should not be compromised with public demand or political will; otherwise, the whole population will be at risk in the long run. Moreover, NIRDPR should try to get environmental concerns included in Section 243G of the Constitution like “..... preparation of plans for economic development and social justice, keeping environmental sustainability on priority”

Control over Hand Pumps, Open Wells and Internal Road Activity: The same is deliberated in detail in the discussion section and on this basis, it is recommended to have stringent norms for sanctioning these activities. Alternative facilities like solar pumps, proper drainage instead of roads, etc., need to be suggested.

Training and capacity building of selected block and Panchayat functionaries on the use of GIS data generated from the study: Training and capacity building of selected Panchayat functionaries and relevant Cluster/Block level officials on the use of GIS data generated from the study will be useful to make them aware of the project outputs. For this, a post-project training cum workshop for the selected Gram Panchayat functionaries, progressive and educated youths from project villages, and a few selected Block level officials is recommended by utilising the remaining fund of study.

6. Applications of Drone Images in Rural Development

6.1. Background

As per the study, it was found that the prime need of the villagers is to have a proper drainage plan along with a survey of villages for understanding the proper water flow situation on roads and general slopes. Secondly, it was felt necessary to have base maps for proper depiction of the existing and demanded assets with fair accuracy. For this, different sources like Cartosat 2 data from NRSC and Google Earth images were tried. Data resolution of Cartosat 2 data from NRSC and Google Earth images were not found suitable for depicting internal roads, houses, and other internal community infrastructure assets of villages. Further, there are certain limitations in using the products and images of Google Earth (Google, 2019).

Hence, NESAC, ISRO, Meghalaya was contacted for support in getting the drone survey of Hantra Gram Panchayat done. As the data processing cost was higher and only community infrastructure assets and Digital Elevation Models (DEM) were the main concerns, drone survey of settlement areas of all three villages under Gram Panchayat was only planned under the project.

6.1.1. Image Comparison

Cartosat-2 data procured from NRSC and drone survey images from Hantra village were extracted from QGIS software and depicted for comparison for a small portion of Hantra village, keeping the same extent and zoom level/scale (see Figures 37 and 38). Cartosat-2 is of 1-metre pixel resolution (best resolution available with NRSC, ISRO) and drone image is of 5-centimetre pixel resolution.

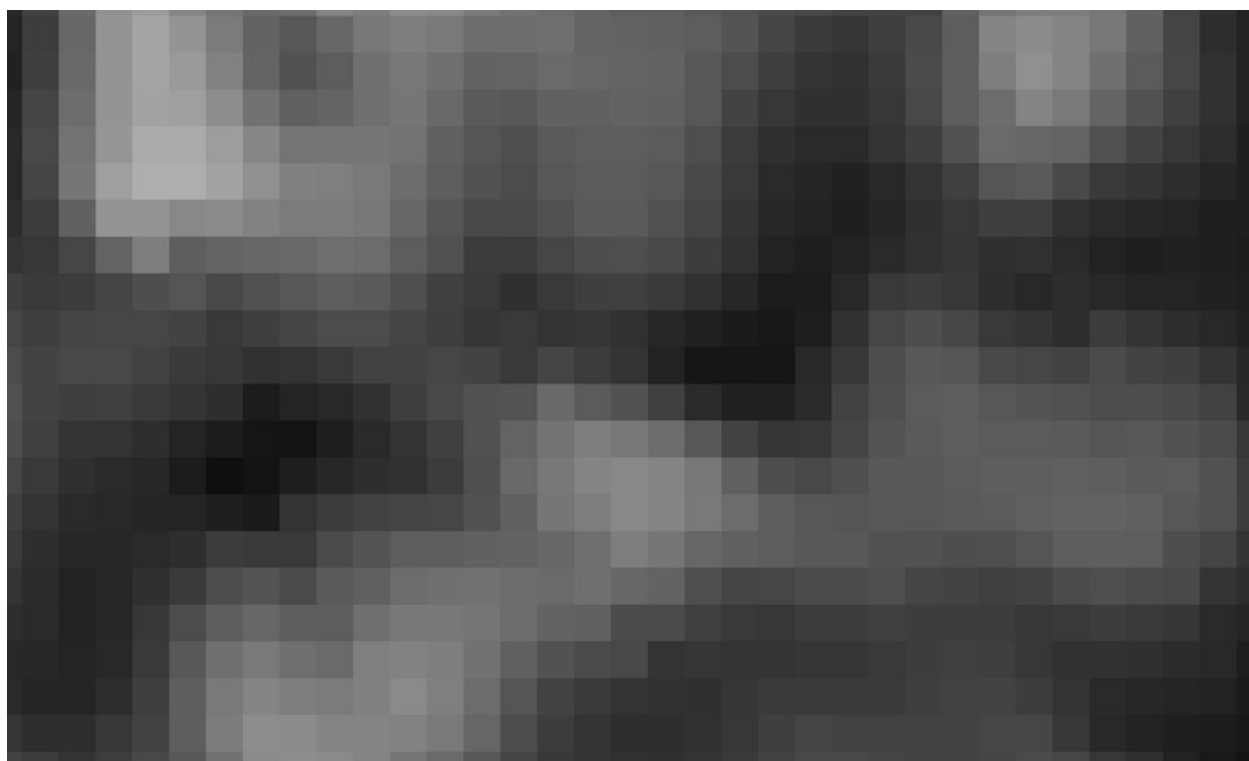


Figure 37: Cartosat 2 Image of Hantra Village for a Particular Area (1-Metre Resolution)



Figure 38: Drone Image of Hantra Village for the Same Area and on Same Zoom Level (5-cm Resolution)

6.2. Objectives

- To get high-resolution data as base maps for depicting the existing assets and digitisation of other features for other relevant use related to rural development for many years
- To get 3D Digital Terrain Model (DTM) and Digital Surface Model (DSM) images for use in drainage plan generation for the villages

6.3. Methodology

For the drone survey, only the settlement areas of all the three villages were surveyed. The survey covering all three villages was carried out by a team of two scientists from NESAC, ISRO Meghalaya with DJI Inspire 1 model quadcopter for four days. RGB camera DJI Zenmuse X3 12 MP was used for the survey. Orthomosaic images, DTM and DSM were generated as output data with Point Cloud and 3D Mesh. DSM and Orthomosaic data pixel spatial resolution were 5 cm for Hantra and Nagla Banjara villages and 10 cm for Arauda village. DTM data for all three villages were of 10 cm pixel resolution. Contour vector files of 10 cm vertical intervals were provided for all three villages. Small video clips of the flight path of survey were also provided. Data processing was done at NESAC, Meghalaya and final data were shared on FTP. A proper proposal was made before Gram Panchayat and Gram Sabha and proper acceptance was taken from the Gram Sabha and all the procedures and possible benefits were described in the open common meeting of villagers and relevant departmental officials at the GP level. Proper permission was acquired from the district

administration and district police department. During the survey, the district administration attached a police personnel with the team. NIRDPR research team including the Research Associate and Coordinator also were present during the survey with the NESAC, ISRO team.

Mr. Abhilash Prathipati, a student intern in partial fulfilment of requirements for his degree of Master of Science (Applied Geography & Geoinformatics) during the year 2017–18 from the Central University of Karnataka, Gulbarga also worked on the drone data of Hantra village under the guidance of research study coordinator Sh. H K. Solanki.

The data was used for the visualisation and superimposing of all the existing and demanded assets of the villages. Depictions for general use were made ward-wise. Vertical profile for all the roads was generated, and the road ends, crossings, turns, water stagnation or higher points were extracted. The overall flow of water was assessed and an attempt was made to determine the direction of flow. Orthomosaic image was used for demarcating clearly visible water stagnation patches in Hantra village.

6.4. Results and Key Findings

It was found that the overall flow direction of the village is toward the north side and flow is accumulated towards the north-east side of the village. Hence, plans can be made for proper water storage and wastewater dumping and also the draining of excess water in that direction.

It was observed that despite there is a south to north natural flow level difference, the water gets stagnated on roads. This may be an indication of poor slope management of roads due to many reasons. Further ground verification on reasons for water stagnation may be verified at the water stagnation locations. This is a major problem of the area. Even with the availability of proper slope, if water is stagnated at many places along the road, then the causes which may be social or technical may be explored. At some places, water is stagnated as there is no natural slope and water is accumulating to a point. For those areas, piped drains using the slope directions may be proposed. The overall drainage plan is yet to be prepared.

It was observed from the drone image that the drains constructed by the National Highway Authority of India are not having proper slope direction towards the two ponds constructed on both sides and water is flowing in reverse directions. Drain covers are broken at many places and due to broken drain, at one place, water is flowing towards the farmers' fields. The roads were digitised for the full width of the village along with the central line of roads.

The road digitisation with background drone image may be used for planning of roads without even going on roads. The exact areas and length can be measured and exact and the most accurate estimates can be prepared. By this, the lump sum estimation can be avoided which is a current practice in planning including GPDP.

The condition of houses can also be visualised for verifying the eligibility of beneficiaries under the State or Centrally sponsored housing schemes.

Apart from water stagnation points and current garbage dumping points, a suitable location for wastewater and garbage dumping can be proposed.

The images may be used for validating the previous works or horizontal and vertical dimensions in a live GIS environment by providing training to the relevant GP functionaries and departmental officials. For proposing new works and planning, the images can be easily used for 5-7 years.

The images can be used for checking and validating encroachment status and may be used as a supporting tool for primary investigation for revenue officials and administration.

Apart from the previous analyses using drone images, a few more drone-related derived data and analyses are shown in Figures 39-44.

Note: For reducing the clumsiness in images, elevations are shown by reducing 200 metres from the original reduced levels. For the same reason, the decimal place is also kept as two digits. In the original GIS environment, the data may be used with original reduced levels and with convenient decimal places.



Figure 39: Visualisation of Water Stagnation Areas in Hantra Village on Drone Images

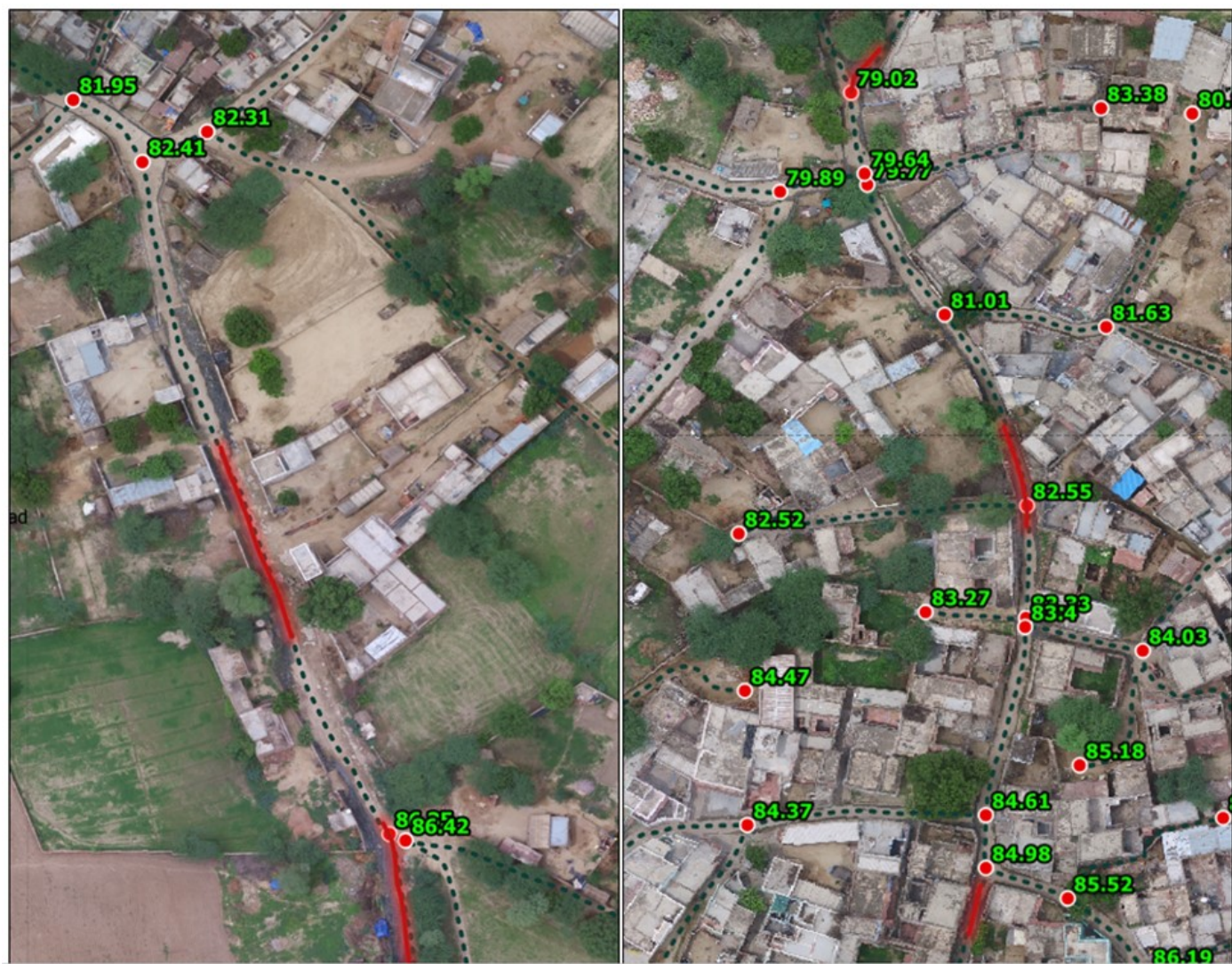


Figure 40: Stagnation of Water Even When the Natural Slope is Present - Levels Taken from Drone Image

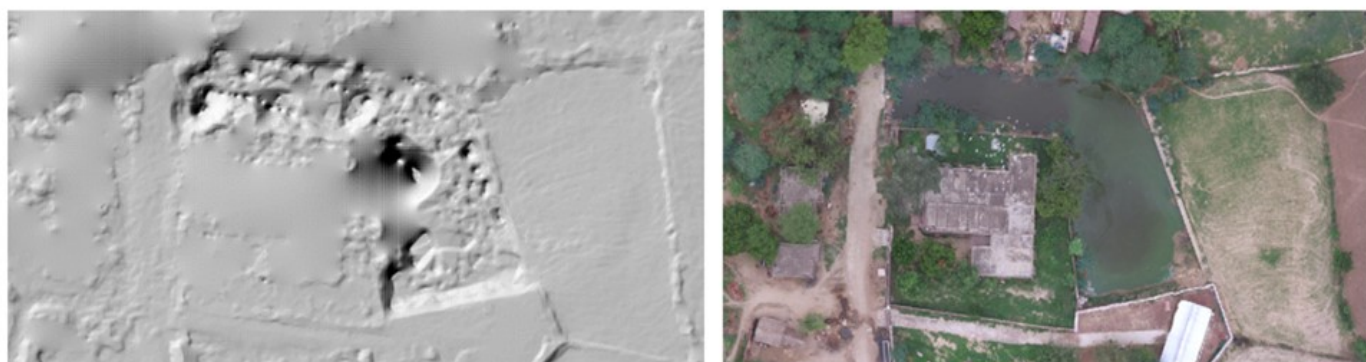


Figure 41: Visualising Small Relative Differences in Elevations; Image on the left is Hill Shade View of Right Side Pond

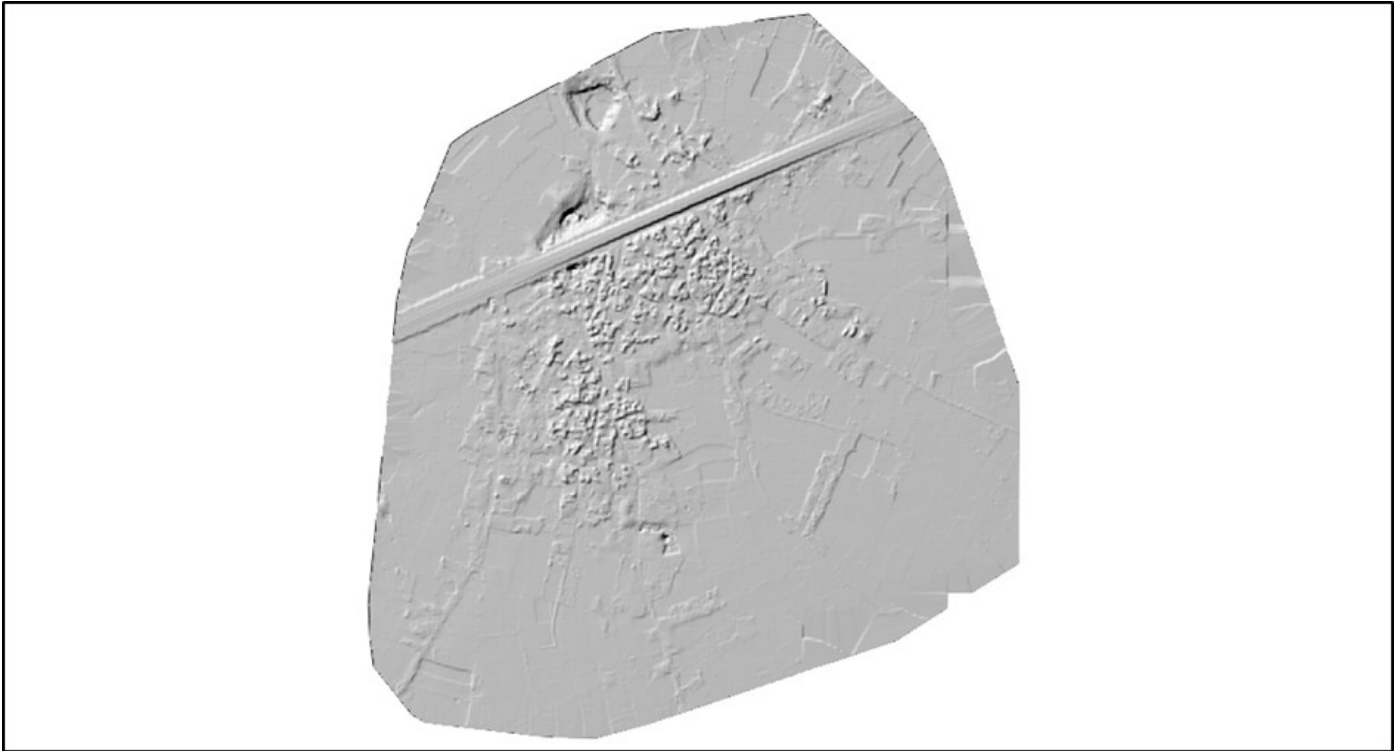


Figure 42: Hill Shade View of Hantra Village- Heights/Depths of Ponds, Houses and Highway are Visible and Measurable

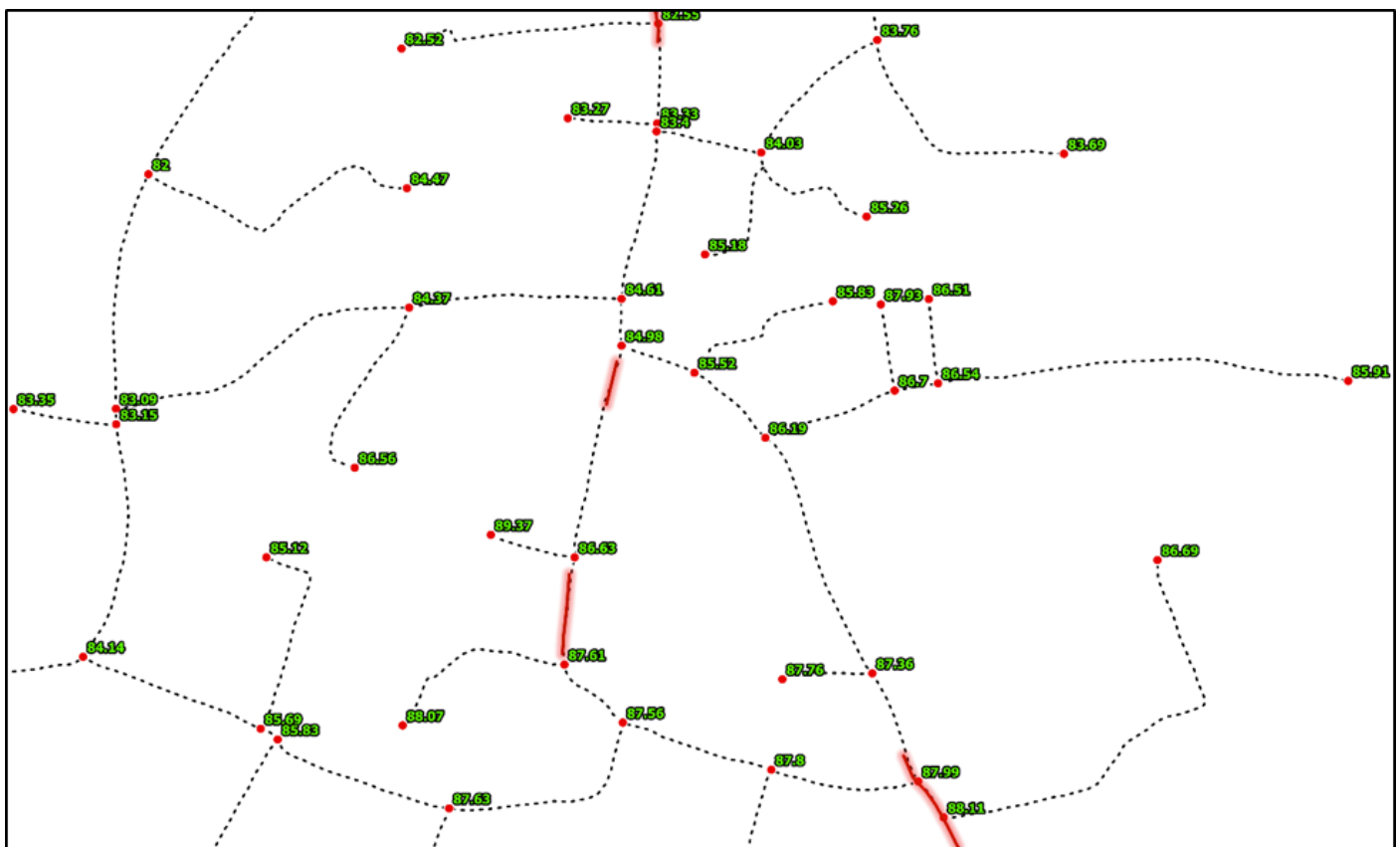


Figure 43: Road Elevations at Junction Points

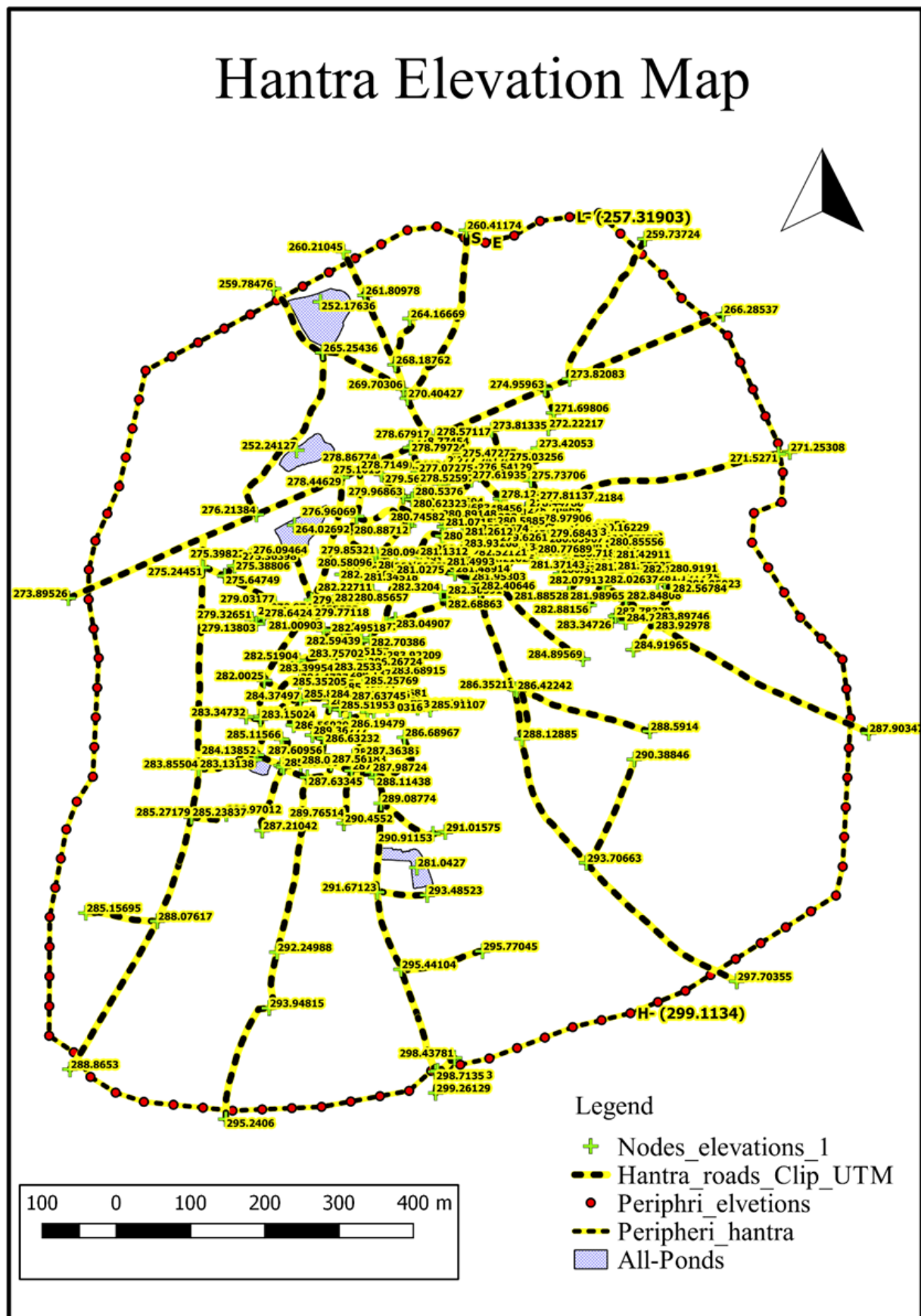


Figure 44: Hantra Elevation Map

6.4.1. Elevation Profiles: Vertical profiles for many road segments and periphery of Hantra village using profile tool in QGIS software and drone DTM image were generated, along with marking the features on drone image. By using these profiles of roads and other linear features, water flow behaviours and overall direction of water flow can be understood (see Figures 45, 46 and 47); however, tree covers at many places gave sudden rise in the elevation profile.

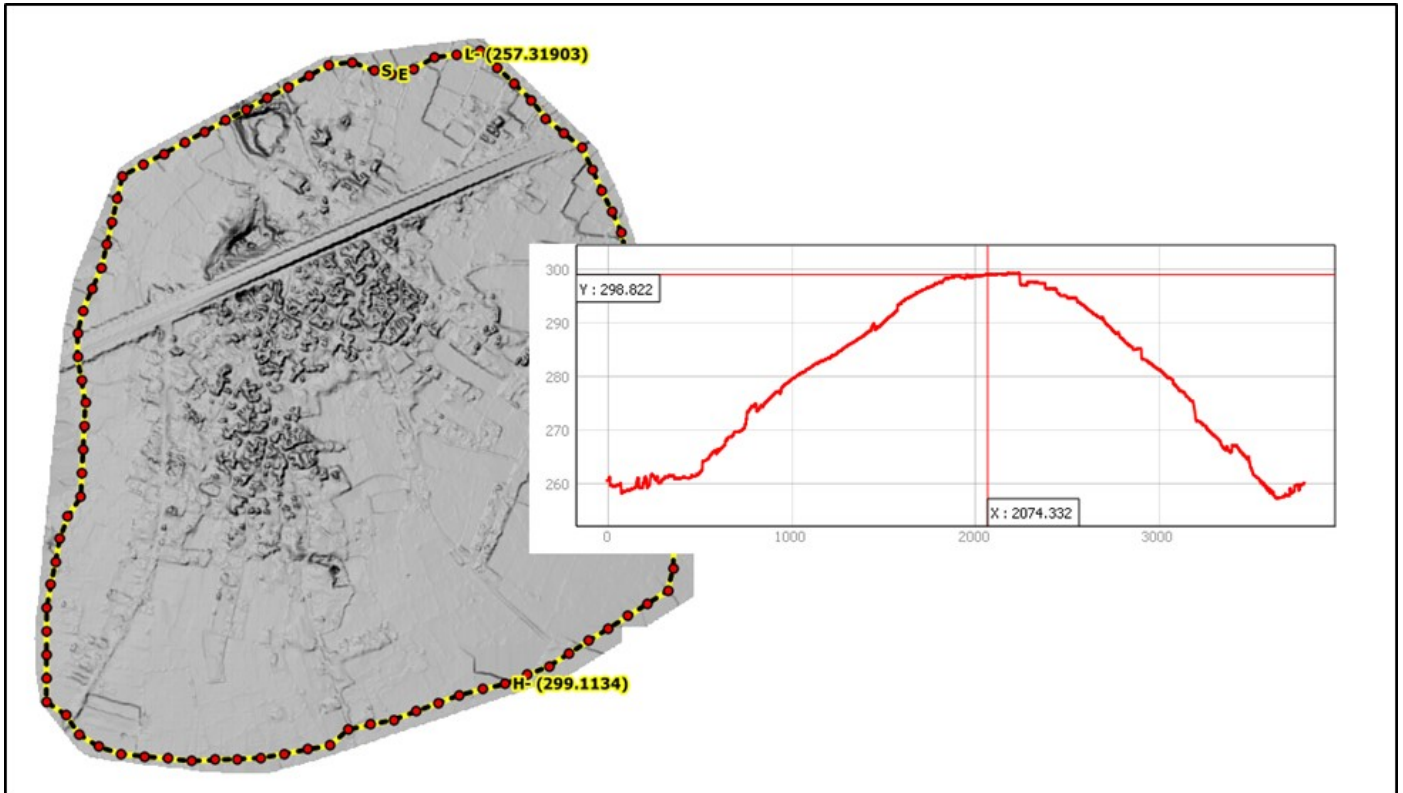


Figure 45: Elevation Profile of Periphery of the Village, Giving High and Low Points Surrounding the Village

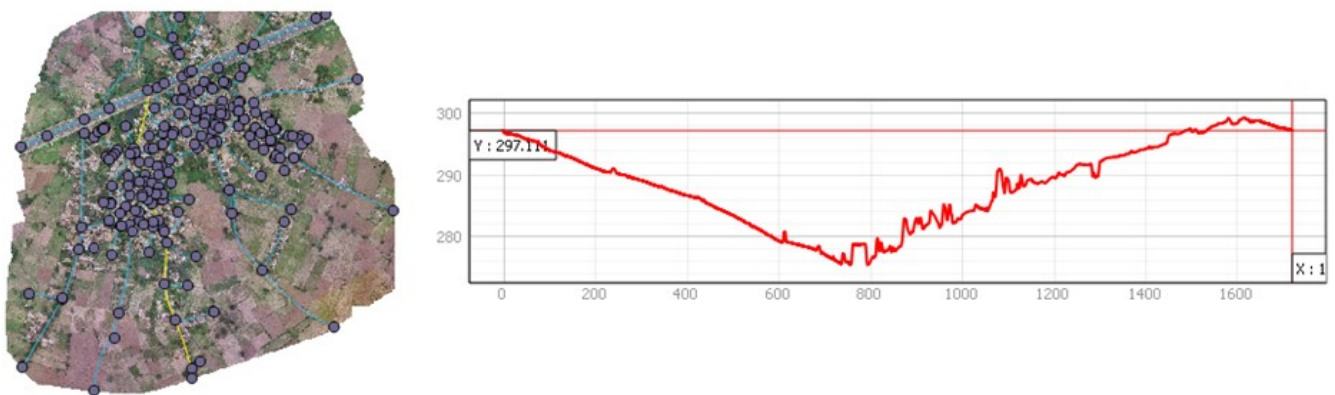


Figure 46: Road Profile of a Main Road of the Village

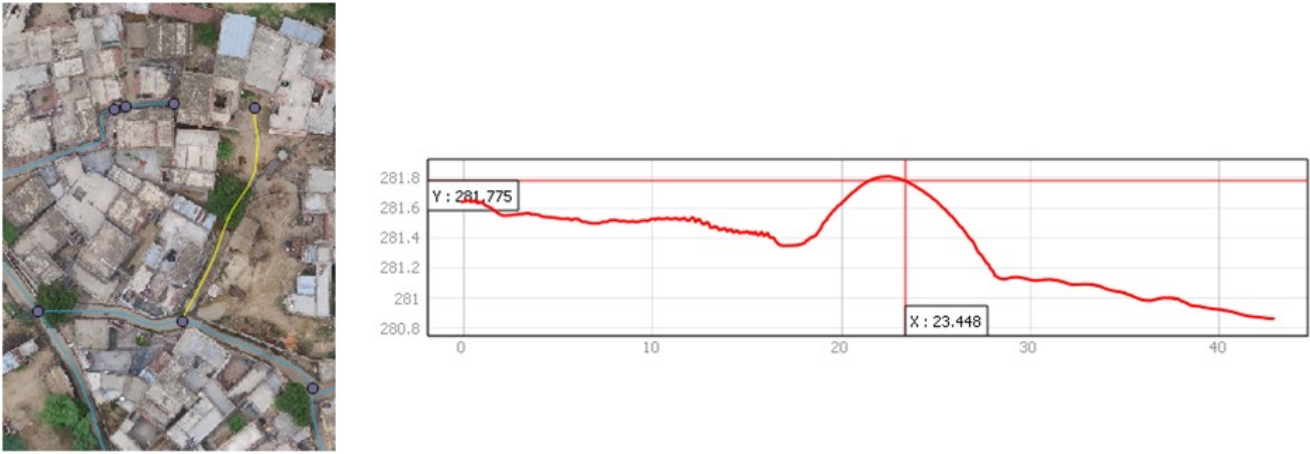


Figure 47: Road Profile for an Internal Street of Hantra village

6.5. Conclusion

Every Panchayat of the country is spending around Rs. 1 crore per annum, including MGNREGA funds, for its development. The available satellite images are not of much use at GP/Village/Ward level for fulfilling the requirements of proper depiction, planning and monitoring of assets. In this situation, drone/UAV survey is looking as an essential step towards the 'Smart Village' concept and in comparison to the quantum of workflow, an average investment of Rs.2-3 lakh on each Gram Panchayat will be a boon for having proper planning. If the same can be repeated after 5-7 years, it will be the ultimate resource for monitoring also the precise monitoring of temporal development of infrastructure and natural resources. Many prevailing and perpetual problems of villages can be handled well with the availability of original drone surveys in open source GIS environment along with free mobile mapping tools.

6.6. Concept of 'Apna Map, Apna App'

The rural development sector is availing the help of NRSC/ISRO for many national and regional GIS/remote sensing requirements. But an indigenous model of GIS and remote sensing having the capability to serve the needs of the Central and State rural development and panchayati raj sectors is found an essential requirement in the present scenario, which will help each Gram Panchayat in having a dynamic and editable GIS portal/tool. In the tool, the first and foremost data will be drone/UAV images of Gram Panchayat with repeated archives in 5-7 years. Once this data is made available, other available data of any source will mostly become non-worthy as most of the data presently available at common platforms in the country are made from 1:250000 scales or at the most 1:50000 scales. When this data is stretched to the levels of 1:100 to 1:1000 or real scales in GIS environment, the data displacement from original positions becomes huge and sometimes few kilometres also. However, in the portal, other data can be called using Web Map Service (WMS) and other APIs of the respective data. All the local databases may be generated using mobile tools to be developed

dedicatedly for rural development and panchayati raj sector and the same can be uploaded on the portal. With available databases, the planning and monitoring of assets on the portal can be done by Panchayat functionaries, revenue departments and other relevant departments by providing them proper editing tools and authorisation. Having an own system for data generation, visualisation, planning and monitoring backed by drone/UAV survey images and indigenous mobile app is the need of the hour.

7. Photo Gallery

Meetings Conducted at the Village



Meeting Regarding Drone Survey Conducted at the Village



General Status of Hand Pumps



Inflow of Wastewater into the Ponds



Status of Open Wells

Wells once used for drinking water now converted into waste and wastewater dumping pits





**The Scientists from NESAC, ISRO describing the operation of UAV/
drone to the villagers, PRI members, and District, Block and GP
officials**

Water Stagnation on Road



Unproductive Animals Freely Roaming in the Village



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Annexure-1

Key Persons/Officers Supported during the Study:

S. No.	Name /Designation	Details (during the study)
1	Dr. N. K. Gupta, IAS	District Collector, Bharatpur
2	Sh. Anshdeep Singh, IAS	CEO, ZP, Bharatpur
3	Sh. Girish Parashar, RAS	Deputy Secretary, Panchayati Raj Dept.
4	Sh. Rajeev Goyal, RAS	SDM, Block, Nadbai
5	Sh. Dinesh Singh	Sarpanch, Hantra Gram Panchayat
6	Sh. Uday Singh Dagur	GP Secretary, Hantra Gram Panchayat
7	Sh. Nikhilesh Kumar	GP Secretary, Hantra Gram Panchayat

Apart from the above, ward members of Hantra GP, various GP/cluster/Block level/District/State level officials from relevant departments supported the study team from time to time during discussions and collection of data.

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