Towards Rural Drinking Water Security: A Perspective of Regional Planning

Submitted in partial fulfillment for the Degree of

M.Tech. in Technology & Development

by

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Declaration

I hereby declare that the report entitled 'Towards rural drinking water security: A perspective of regional planning' submitted by me, for the partial fulfillment of the degree of Master of Technology to CTARA, IITB is a record of the project work carried out by me under the supervision of Prof. Milind Sohoni(CTARA Department).

I further declare that this written submission represents my ideas in my own words and where other's ideas or words have been included, I have adequately cited and referenced the original sources. I affirm that I have adhered to all principles of academic honesty and integrity and have not misrepresented or falsified any idea/data/fact/source to the best of my knowledge. I understand that any violation of the above will cause for disciplinary action by the Institute and can also evoke penal action from the sources which have not been cited properly.

Place:

Date: Signature of Student

Acknowledgement

I sincerely thank my Guide Prof. Milind Sohoni for his guidance and support. I also extend my gratitude to the faculty members of CTARA for their support.

I thank the water group for their insightful inputs that have helped me to understand the subject better. I would specially like to thank Karishma, Gautham and Mohini for their invaluable help and support. I also thank my family for their warmth and encouragement.

Abstract

Rural drinking water security continues to be one of India's development predicament. To overcome this situation the national programme for rural drinking water security, NRDWP, has set the national goal as ‘adequate and safe drinking water for all, at all times’ in rural India. While there may be different approaches that can be adopted to achieve this goal, monitoring and planning are important components of any such program. Our project aims to analyze the existing system of monitoring and planning. Accordingly, Shahapur block of Thane district was selected for deeper analysis and the players, processes and datasets involved in monitoring and planning for Shahapur block of Thane district in Maharashtra were studied. We found that the monitoring framework is weakly defined and planning process focuses on consolidation of individual schemes for allotting finances for next financial year. The core finding of the study was that monitoring and planning for ‘water as a resource’ is missing in the current process. Moreover, there are several lacunae, both in the choice of attributes and in the gathering procedures for the basic datasets. This makes planning all the more difficult.

Thus, in order to strengthen planning, we propose both structural as well as procedural changes to key data sets. Next, we propose and illustrate a Geographical Information System (GIS) which will amalgamate the various datasets in a format which is useful for visualization and planning. Finally, we propose additional protocols for gathering primary data for the fields that we have added. Based on this new representation, we illustrate their use in a few sample processes in planning, monitoring and a scarcity analysis. We also show that the GIS representation can serve as a common framework for discussions between planners, implementers and residents.

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Chapter 1 Introduction

An interdisciplinary group of faculty and students has been working on rural drinking water supply through CTARA, Centre for Technology Alternatives for Rural Areas in IITB. Through their studies, CTARA has collectively carried out multiple studies in the area of rural drinking water supply for about 5 years. The core working area of this group is Thane and Raigad districts of Maharashtra. Some of the studies done by CTARA is study of single village and regional schemes, the design issues specific to these type of schemes and modes of failure, study of groundwater and surface water resources, ways of strengthening institutional setups, increasing people's participation, understanding community issues, understanding various processes, agencies involved in rural drinking water security. All this is done through extensive fieldwork and communication with stakeholders such as beneficiaries, implementers, elected representatives etc. This report is a part of CTARA's study for exploring the role of regional planning in drinking water security.

1.1 Background

Availability and access to drinking water is one of the primary needs of rural population, which is still an unsolved problem in India. India has taken up rural water supply in a mission mode since 1972-73 through centralized, supply driven program called Accelerated Rural Water Supply Programme (ARWSP). Later, with the intervention of World Bank through Sector Reform Project (Swajaldhara), a decentralized and demand driven approach was introduced in 2002. The Government of India launched National Rural Drinking Water Supply Programme (NRDWP) in 2009 on the lines of demand driven approach of Sector Reform Project. The goal of NRDWP is to ensure adequate and safe drinking water to all households at all times with a central role played by community.

The supply driven and demand driven approaches have some inherent differences. These differences are characteristics of their design and could be said to be their propensities. These differences are given in the table below (Agrawal, 2012).

Table 1. Inherent differences in supply centred and demand driven approaches

Supply Driven Approach	**Demand Driven Approach**
Water as social right	Water as economic good
Government as provider	Government as facilitator and enabler
Government responsible for O&M	Community responsible for O&M
Advantage of large economic scale, higher level planning	Faster and less expensive approach because of small scale
High institutional costs for government	Community shares capital cost and pays for O&M
Poor O&M	Improved O&M because of sense of community ownership
Local preferences could often get neglected	Local preferences could be taken into account, but decisions might be still taken by the powerful members of the community
Inequitable distribution because of social inequities (casts, class etc.)	Inequitable distribution because of social inequities as well as individual capacity to pay
Easier to work out source sustainability	Source sustainability is hard to work out because of small, discrete projects

Thus, the advantages of supply driven approach are-

i. Easier to work out source sustainability

ii. Advantage of large economic scale and higher level planning

Whereas, the advantages of demand driven approach are-

i. Consideration of local preferences such as preferring a certain kind of source over other, better understanding of geographical region
ii. Sense of ownership to the community, thus resulting in quicker response to situations

However, the literature review done in (Agrawal, 2012) and field surveys done in (Mishra, 2013) identify that irrespective of the approach followed, there are common lacunae in providing adequate and reliable rural drinking water supply to the rural population.

These problems are-

i. Slower physical coverage and slippages of fully covered habitations to partially covered and not-covered status
ii. Neglect of source sustainability
iii. Escalating expenditure
iv. Poor emphasis on water quality
v. Weak institutional setup at organization and community levels indicating poor planning

As these problems continue to remain unresolved, a need was felt to explore an intermediate approach. Supply driven approach represents centrally driven, top to bottom approach. Whereas demand driven approach represents decentralized, bottom up approach. Thus, if the decision making place is kept at neither top, nor bottom level, there is a possibility to find a balance so that the advantages of both approaches can be availed to resolve the unresolved issues.

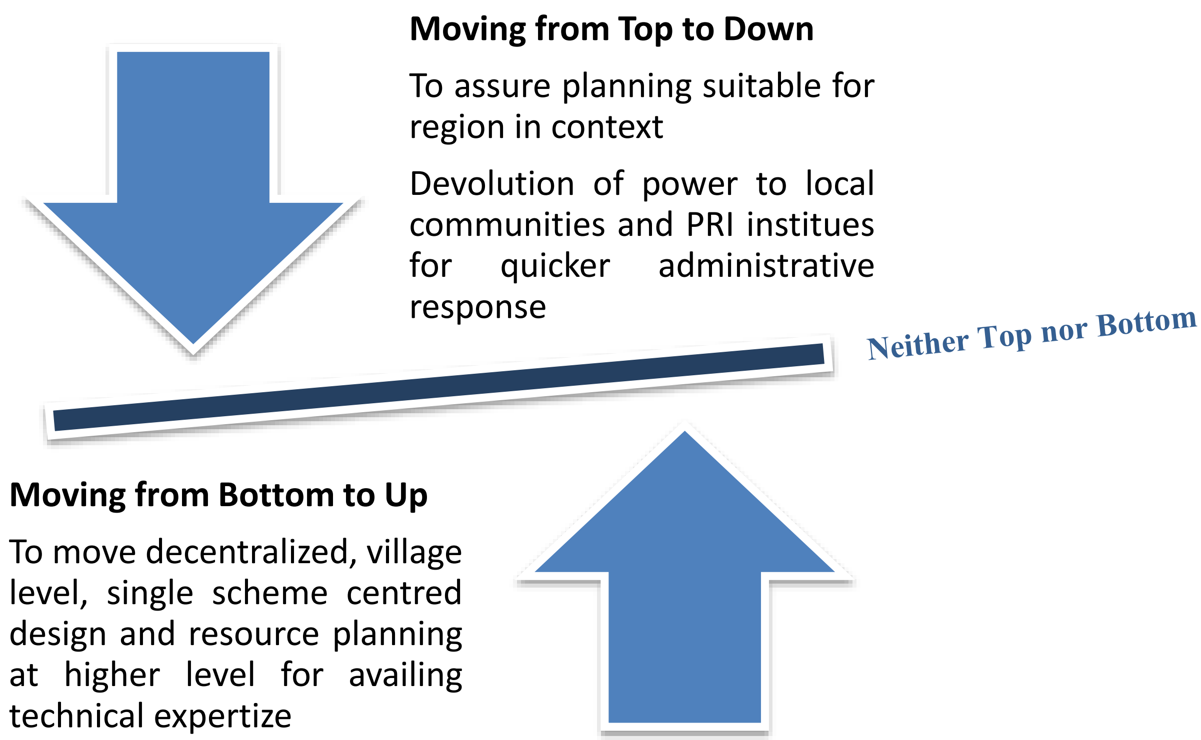


Fig 1. Finding balance in supply driven and demand driven approach

Hence the decision making place is proposed to be moved up from village level, but not to the top level of state.

The various studies carried out by CTARA in Thane and Raigad districts show that these districts have geography that is characteristic to Western Ghats. These areas have highly undulating terrain, high rainfalls and high runoffs. These factors heavily contribute to the challenges in ensuring drinking water security in this area. This indicates that a regional perspective should be incorporated in planning for ensuring rural drinking water security.

Hence, the planning unit is supposed to be an area with almost uniform geographical characteristics, while still being at a higher level than a village or a gram panchayat to be able to avail technical expertize. This place, thus, represents a sizable region where better long term sustainability planning can be carried out without missing the local context. This place also needs to have sound technical expertise to find technically more efficient solutions. Thus, assuring durable working solutions.

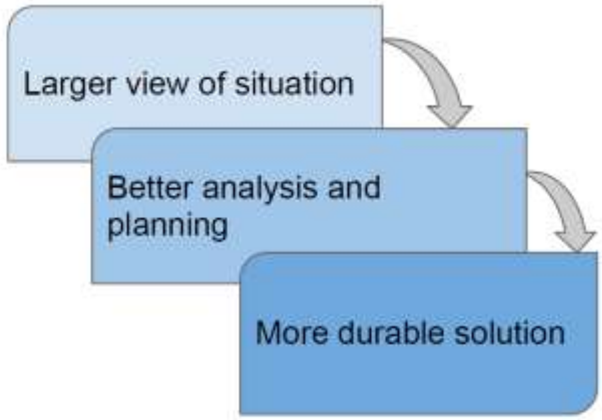


Fig 2. Advantages of regional planning

A Taluka or block can be one such place where decision making can be done. The advantage of choosing administrative boundary over natural boundary of watershed is that the existing administrative setup can be utilized for ease of management.

1.2 Motivation

Planning forms the link that connects the demand with the supply. If we consider demand to be coming from the administrative boundaries, the supply would be water resources, coming from natural resource boundary. The role of planning is to link them together so that efficient, sustainable and equitable transmission of resource can be achieved.

Fig 3. Need to plan for mapping natural resource boundary to administrative boundary

Further, achievement of any goal requires sound planning and monitoring process. The relationship between monitoring, planning and goals is depicted in the figure below-

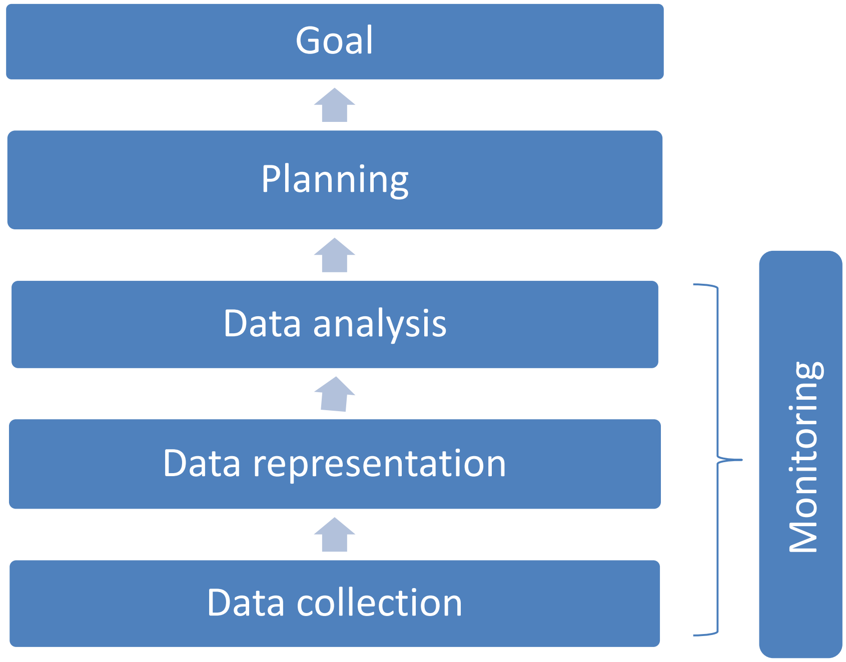


Fig 4. Achievement of a goal needs planning and monitoring

The aforementioned flowchart highlights that in order to meet the goals the first step is collecting the right data (addressing the goals), followed by representing the data in a coherent manner to aid in data analysis. Finally, periodic collection of these data points helps in efficient monitoring and planning. The current research tries to understand the issue of rural drinking water security from the perspective of monitoring and planning which is important for providing water security in a region.

According to 2013 guidelines published by the Ministry of Drinking Water and Sanitation, the national goal of NRDWP is "To provide every rural person with adequate safe water for drinking, cooking and other domestic basic needs on a sustainable basis. This basic requirement should meet minimum water quality standards and be readily and conveniently accessible at all times and in all situations." (National Rural Drinking Water Programme Guidelines, 2013).

This goal can be broken down into five sub-goals to assist in strategic planning towards achievement of national goal. This is depicted pictorially in the following figure.

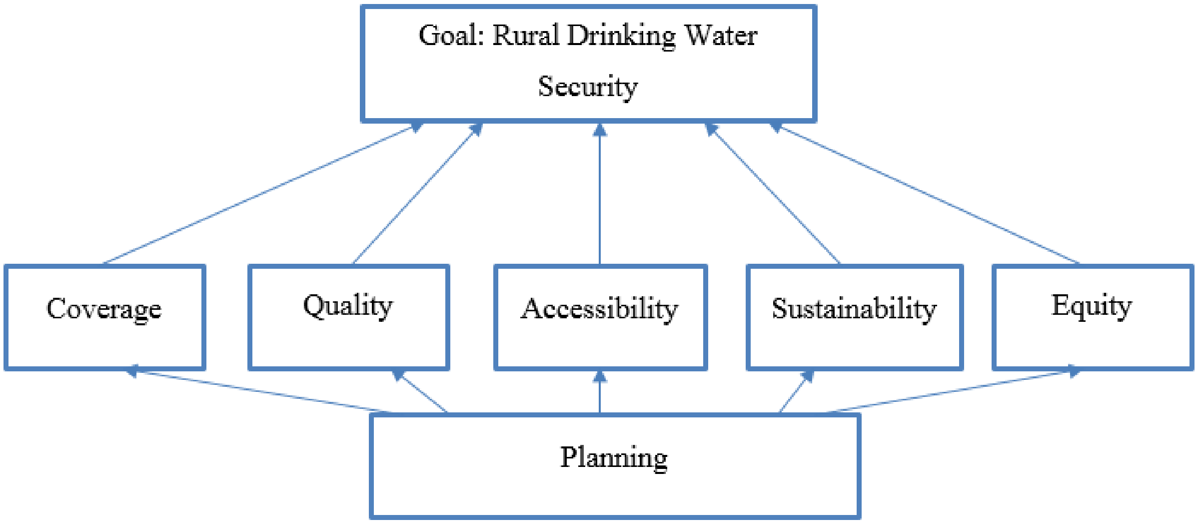


Fig 5. Goals and sub-goals for drinking water security

The following describes each of the aforementioned sub-goals in detail.

1. **Coverage:** This means that a person should get adequate quantity of water
2. **Quality:** This means that the water should be potable, so that the health of the consumer doesn't suffer
3. **Accessibility:** This means that the water should be available with comfortable efforts. There should not be drudgery associated with fetching water
4. **Sustainability:** This indicates at the sustainability aspect. There should be enough water in the system so that enough water can be extracted yet the water availability for tomorrow can be assured
5. **Equity:** This indicates towards the aspect of equity. It is not enough to provide adequate water for the average population. There should be efforts to see that irrespective of their social or economic status of any individual, their drinking water demand should be met.

Even though there is clarity with respect to the sub-goals, there seems to be a lack of clarity in addressing these goals. It was felt that current planning and monitoring procedure does not pursue all sub-goals strategically.

The motivation behind the study is to explore the planning process, see the space for regional planning and showcase a sample prototype of a tool that could aid in regional planning, so as to facilitate strategic planning for achievement of national goal.

1.3 Objectives

The current research focuses on exploring and enhancing data collection, storage and representation for planning and monitoring for rural drinking water security. The specific objectives are defined as follows

- To analyze the existing planning and monitoring process
- To explore capability of current datasets towards facilitating planning process effectively
- To recommend simplifications and rectifications in data collection and storage
- To demonstrate a prototype for effective data representation and analysis

1.4 Methodology

The methodology for the project has been as follows-

First, the learnings from previous studies conducted by CTARA were understood by talking to the students and staff members who worked on those projects. The national guideline for rural drinking water supply were studied.

Visits to related government offices was made in order to understand various processes and players concerned with rural drinking water supply, and their roles were figured out. Meeting of government officials were attended to understand the process further. Along with this, Government Resolutions issued by Water Supply and Sanitation Department, Government of Maharashtra were studied.

The government datasets, namely, NRDWP database, Annual Action Plan document for Shahapur Taluka, 96 columns database for Shahapur Taluka were studied in order to understand the current way of handling and storing data.

Field visits were done to understand the ground reality. Along with visiting villages to talk to the residents, an under construction MI dam, an under construction pipe water supply scheme was visited to understand the asset. Detailed study of five habitations of Ambekhor village was done for analyzing it in GIS.

Prototype of a sample GIS interface was then made with the help of regional data that is available online and through government offices and field visit to Ambekhor village.

1.5 Research Setting

In this project Shahapur block was chosen as the research setting. Shahapur is largest Taluka located in the Thane district of Maharashtra. Shahapur has 110 gram panchayat, 220 villages and 662 habitations. The rural population is totally 2.91 lakhs out of which coverage population is 2.55 lakhs (Block Statistics NRDWP). The weather in Shahapur is generally humid and warm and the annual rainfall is around 2000 mm to 4000 mm from South West monsoon during the month of June to September (District collectorate Thane).Shahapur lies in the western foothills of the Western Ghats. This area is hilly and the aquifers here are shallow thus reducing the ground water potential. Therefore, despite annual rainfall of more than 2000 mm there is water scarcity from January to the onset of monsoons, and tanker water is needed in many habitations.

Fig 6. Shahapur in Thane

Geography of Shahapur

The Sahyadri ranges run North South in the Eastern region of Shahapur. There are also spurs running laterally to the main ranges. The heights of the mountains are maximum on the East and diminish gradually Westwards. The mountain ranges also spread unevenly in the Central region of the district. But none of them rises higher than Sahyadries. It has two major water reservoirs namely Tansa and Bhatsa. Tansa river is a small river and the Tansa lake is embanked by one of the largest masonry dams built in 1892.

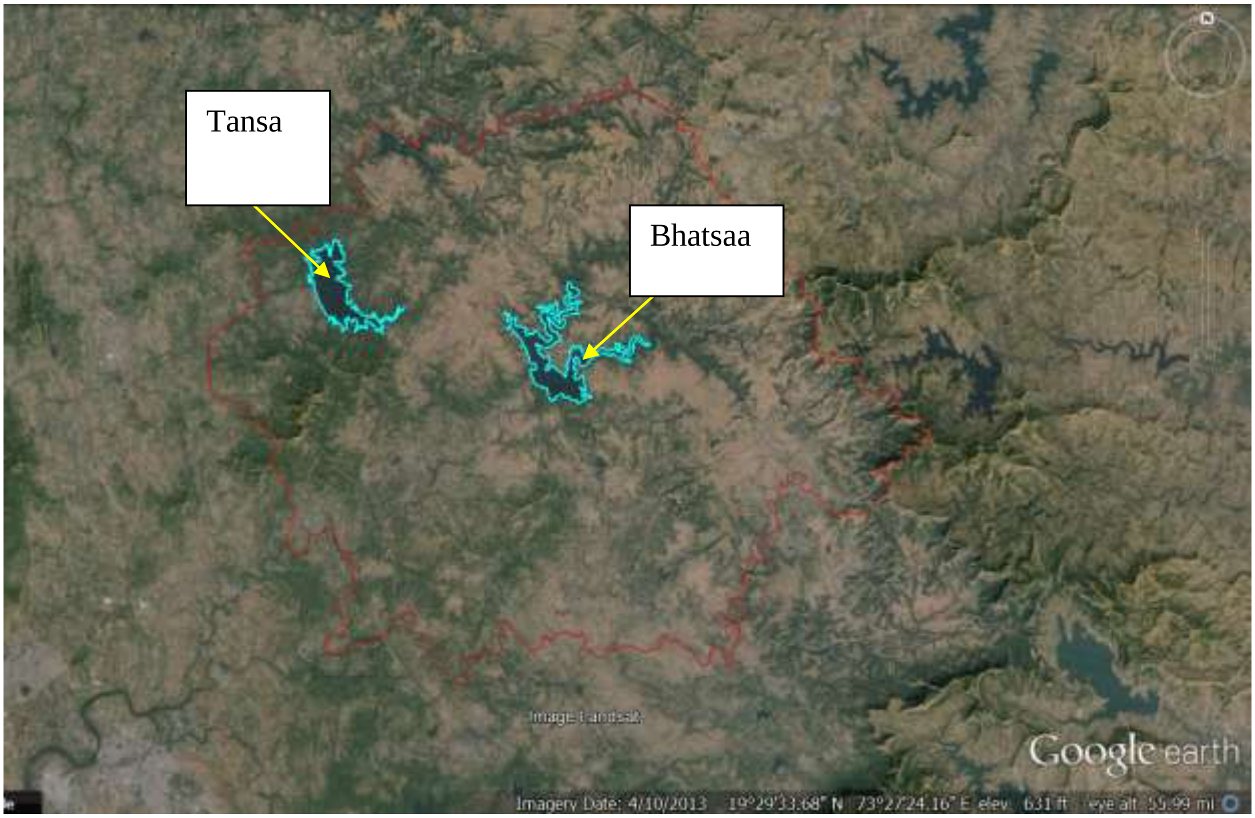


Fig 7. Shahapur on Google Earth

1.6 Scope and Structure of the Report

The project was divided into two stages to be carried out during the course of one year. This report presents the work carried out in the second stage of the project.

The first stage caters to the first objective of understanding the lacunae in current planning process. This report explores various legal provisions, policy space and government orders applicable to the rural drinking water supply sector in the state of Maharashtra, with respect to Shahapur taluka. The report also cited information gathered from various government offices (Water Resources, Water Conservation, Rural Drinking Water Supply Department, District Planning Committee, Groundwater Survey and Development Agency, Block Resource Centre) at the appropriate levels in the context of Shahapur block.

This report, forming the second stage of the project, summarizes the essence of planning and monitoring process from first stage and moves on to analyze current style of data management. It then provides a sample solution to display that appropriate use of technology can empower the implementers, planners and beneficiaries.

Chapter 2 Existing Processes for Planning and Monitoring

Planning is an important aspect of creation and maintenance of public infrastructure. Whether the system is demand-based or supply-oriented, the infrastructure providers (Government, in case of India) would need to have some planning in place for resource management as well as financing. To assist planning, current state of system and an account of past events need to be made available. This brings in focus the role of monitoring in effective planning. Current chapter will explore the existing space for planning and monitoring in the context of Shahapur Taluka of Thane district.

2.1 Understanding lifecycle of single scheme

The lifecycle of a single water supply scheme comprises of all concerned departments/officials at various stages (WSSD, Government Resolution, 2010). The process can be pictorially depicted as in the diagram below. The details of each organization can be found in Annexure.

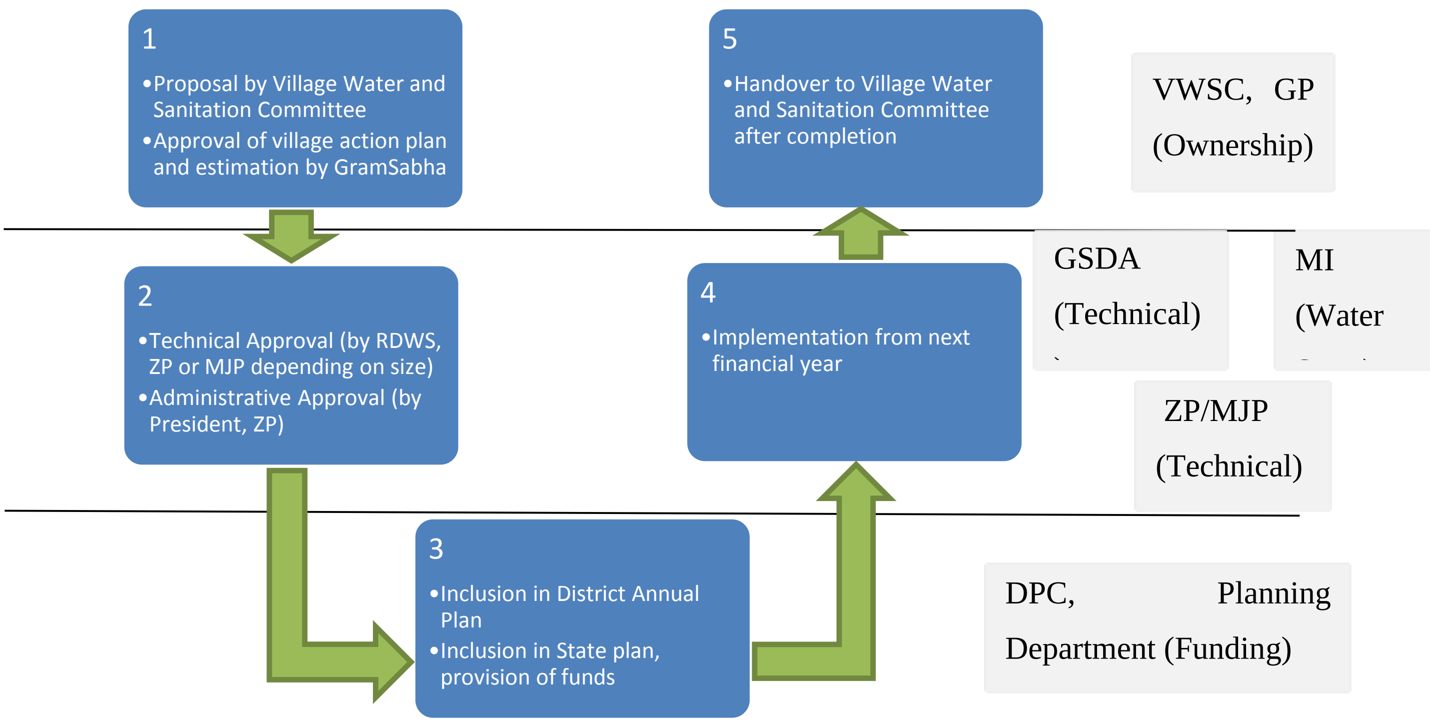


Fig 8. Lifecycle of a single rural drinking water supply scheme

Here, between step 1 and step 2, as per the 2010 GR, CEO (ZP) is supposed to verify the financial and technical viability of a proposed scheme and site through Executive Engineer (RDWD, ZP), Assistant Geologist (ZP) and Block Development Officer of Panchayat Samiti. If the proposal appeared weak, they are supposed to suggest an alternative scheme to the one proposed by VWSC.

However, no documentary proof has been found yet to establish that this procedure is carried out. In addition, no document has been found yet that gives detailed directions for deciding viability of a scheme.

2.1.1 Annual Action Plans

As per the methodology followed for creation of district annual plans, the departments are supposed to prepare their annual action plans for the next financial year. Fig 8creates an impression that the departments plan for water supply schemes together, and every department participates in preparation of annual action plan. However, the field work has revealed that the annual action plans for ZP, MJP, GSDA and MI are prepared independently without a horizontal, pooled communication between all of them. Any communication or exchange that takes place is scheme-based. (Source: interviews with Deputy Engineer of RWSD: Shahapur, Assistant Geologist of GSDA: Thane, Junior Engineer of MI State: Kalawa)

The process for creating annual action plans is similar in all these organizations. The annual action plan consists of

i. accepting various demands raised for schemes throughout the year
ii. obtaining administrative and technical approval from appropriate authority
iii. consolidating the demands that have obtained administrative and technical sanction to form annual action plan

The differences in organizations related to annual action plans arewith regards to two points-

- who raises demand for a scheme
- who is responsible for O&M after completion of scheme

For example, construction of MI structures can be taken up on the demand raised by farmers/local representatives whereas the creation of rural drinking water supply scheme needs demand from VWSC to be made to ZP/MJP through Gram Panchayat or Panchayat Samiti.

Thus, while there is some regional planning happening during preparation of Annual Action Plan and through DPC meetings (read Annexure for information on DPC), mostly, the regional planning is mere consolidation of financial plans of individual schemes. Hence, there is no element of regional overview, or planning of water as a resource at this level.

There is also lack in effective horizontal communication between departments to plan for a technically more efficient and more sustainable solution.

2.2 Provision for Monitoring & Evaluation

Monitoring and evaluation (M&E) is an extremely important component in planning. It can provide valuable feedback to the planning activity. Planning of drinking water security can not be done without understanding the existing ground level situation, and the process can only be strengthened by maintaining an internal account of the impact generated through past processes or designs. These two inputs can be effectively provided by M&E. Additionally, Monitoring and evaluation is needed to correct the past mistakes. Monitoring appears in the NRDWP guidelines in various ways. First is the M&E of the programme itself, which is an activity that may happen at a few specific times instead of being a continuous process. This kind of M&E would focus more on proper functioning of administrative and line departments. Second is the monitoring of the status of water availability, which includes checking if the water sources created so far are functional, are villagers getting adequate drinking water and so on. Third aspect of monitoring and evaluation, that is essentially part of status of water availability, but is separated due to the difference in processes to be followed, is the monitoring of the quality of water that is available for drinking purposes. This aspect needs a special treatment; as laboratory tests, community awareness and local capacity building are must for water quality assurance, maintenance and improvement.

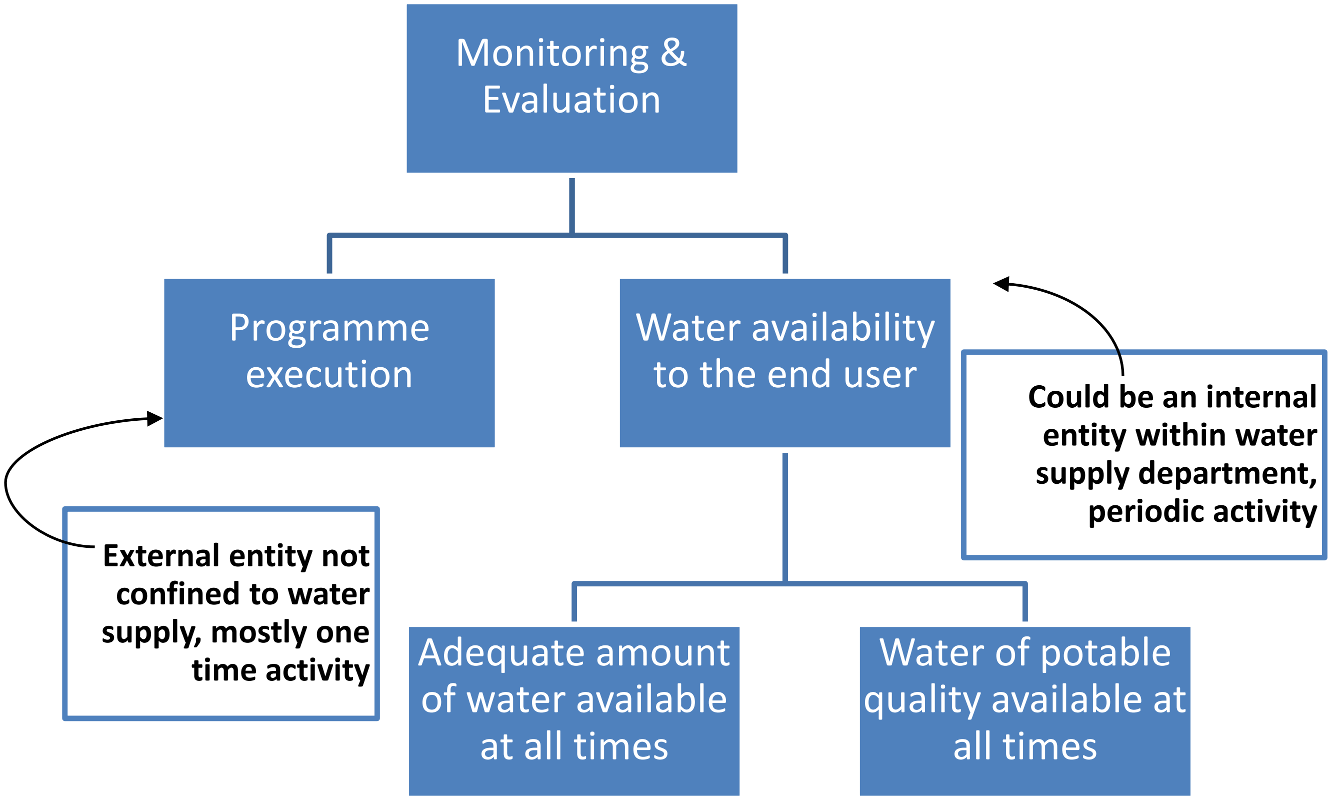


Fig 9. Different aspects of M&E as considered in NRDWP 2010

The 2010 guidelines of NRDWP mention that funds would be made available to states for monitoring and evaluation studies for rural drinking water supply programme as a whole. However, it is not insisted that the states should carry out Monitoring and Evaluation of the programme as centre takes such M&E activities from time to time. Towards the second kind of M&E, guidelines state that there should be monitoring cell at state level. The responsibilities given to this unit is collection of data from various sources such as executing agencies, field level workers etc. covering progress monitoring and water quality. The unit should also monitor the quality of construction for water supply schemes. Apart from this unit, water quality monitoring and surveillance is regarded as a separate activity with high emphasis. Under this activity, each source has to be periodically checked for bacteriological and chemical contamination and is to be reported in the online database. (NRDWP Guidelines, 2010)

The data gathered during monitoring and evaluation of water availability in state is eventually entered in online database at the official website of NRDWP. However, the assessment and evaluation study carried out in Shahapur in(Mishra, Drinking Water Security in Taluka, 2013) reveals that the database has highly erroneous data about habitation coverage and working schemes. Further, the essential elements of seasonality and drudgery do not get captured in the database. This study indicates that monitoring and evaluation is not given enough importance in rural drinking water supply.

2.2.1 Block Resource Centre

As per the NRDWP guidelines, Water Supply and Sanitation Support Organization (WSSSO) has been formed in state in August 2009. (WSSD, on WSSSO, 2011) Subsequently, District Water and Sanitation Mission (DWSM) at district level and Block Resource Centres (BRCs) at Taluka level were formed to assist WSSSO. The broad responsibilities given to WSSSO, DWSM and BRC are-

i. To provide support for capacity building of VWSC, state recognized support organizations and NGOs etc.
ii. To provide training for M&E as well as to carry out M&E of assets created in state
iii. To update and manage online database to reflect the latest data

(WSSD, on WSSSO, 2011), (WSSD, on DWSM, 2011)&(WSSD, on BRC, 2011)

The formation of BRCs throughout Thane was delayed due to some reason and the BRCs became functional in April 2013. The BRC at Shahapur has one block co-ordinator and two cluster co-ordinators to assist the block co-ordinator. As on 3rd September 2013, they were carrying out Information, Education and Communication (IEC) work in villages of Shahapur for Sanitation. Although the BRC staff is supposed to get four weeks' training after their appointment to the post, only a single day training was conducted for them in February 2013. The BRC staff was unaware of existence of NRDWP. (Source: Interview with staff of BRC in Shahapur Panchayat Samiti, 3rd September 2013)

This incident further underlined that the component of monitoring of water supply schemes is suffering due to lack of training and clear direction.

Thus, it can be said that monitoring of present situation is weak in the current system. The concerned departments are not well equipped and important aspects such as seasonality and drudgery are missed from databases. Further, the data that is collected is not reflecting the ground reality.

Chapter 3 Understanding Essential Parameters for Knowledge Tool to Aid in Planning

From last sections, it is seen that there is large scope for improvement in the current system that is responsible for rural drinking water security. The key findings from study of existing processes can be summarized in the below table-

Table 2. Key findings from study of existing processes for planning and monitoring

Process	Current situation	Lacunae	Implication
Monitoring	BRC is responsible	Role not well defined hence unaware of the purpose	The quality of data collection suffers
	Low quality data collection	Does not reflect the ground reality	Planning suffers as current situation is not reflected through data
Planning	DPC is responsible	Focus only on financial planning; not able to focus on planning for water as a resource	Possible benefits that could be harvested from planning for water as a resource are lost
	Many departments have a role to play	Individual departments make their individual plans which get integrated in the end. Thus no effective horizontal communication or co-ordination	

There are various aspects of the system that could be improved for achieving better outcomes. Institutional strengthening, moving from department-centric staff to people-centric staff and using improved knowledge resources and tools are a few of these aspects.

Institutional strengthening would mean assessing the technical capacity of staff, reducing per-head work burden for them and so on. Capacity of institutions need to be improved in terms of size as well as technical knowledge. There is high level of isolation between various organizations concerned with rural drinking water, thus making it hard to compare various possible solutions to answer the water demand. Thus, there is scope to create posts where technically sound staff would be able to put forth people's demand across departments to assist in decision making. Similarly, along with strengthening the institutional and technical capacity, there is scope for using scientific and systematic knowledge tools. These knowledge tools can be useful in various aspects. The tools can be used to assist the technical staff and planners in effective decision making process. They can also be used to create a platform for common understanding of ground reality between people and government representatives. Knowledge tools can also be used for empowering local communities to participate in the decision making process.

As this report tries to explore the place of regional planning in achieving rural drinking water security, an attempt is made at exploring possibility of GIS interface as one such knowledge tool. For easy absorbance in the current system, this interface is designed to be as close to current system as possible. The design objectives behind this tool is as follows-

i. To help in assisting the implementers and planners at District and Taluka level to take better decisions at regional as well as local levels to ensure –
    a. Immediate water security such as drought mitigation
    b. Short term water security such as five year perspective plans
    c. Long term water security, such as restoring the water balance in the region through strategic utilization of source and ground water resources and watershed development etc.
ii. To share a common picture of ground reality between administration and public
iii. To aid in holistic understanding of demand-supply scenario in a region

For these design objectives, a GIS interface seems suitable because it can ensure

i. Capturing of geographical aspects along with administrative and infrastructural aspects
ii. Providing a view of larger region for more effective planning
iii. Capturing of elements such as seasonality and drudgery that are missed in current monitoring system

In order to explore usability of GIS interface for planning, following steps were carried out, and will be explained in the coming sections-

i. Deciding the parameters to capture for GIS
ii. Exploring procedure to capture these parameters
iii. Demonstrating prototype of sample GIS interface

iv. Demonstrating use of the interface for planning a local intervention and regional level overview and planning

3.1 Deciding parameters to capture for GIS

Strategic planning helps in achievement of any goal in an effective manner. A larger goal can be divide into sub-goals and whether each sub-goal is addressed through the planning and monitoring process can be analyzed. This exercise gives an indication of whether the efforts are being put in the right direction to achieve the goal, or are there some aspects of the goal that are not getting addressed.

The NRDWP's national goal: 'To provide every rural person with adequate safe water for drinking, cooking and other domestic basic needs on a sustainable basis. This basic requirement should meet minimum water quality standards and be readily and conveniently accessible at all times and in all situations' (NRDWP Guidelines, 2010). This goal can be divided into following sub-goals for obtaining better understanding –

1. **Coverage:** This means that a person should get adequate quantity of water on a daily basis
2. **Quality:** This means that the water should be potable, so that the health of the consumer doesn't suffer
3. **Accessibility:** This means that the water should be available easily. There should not be drudgery associated with fetching water. Thus, the distance needed to be travelled and time needed to fetch water should be comfortable.
4. **Sustainability:** There should be enough water in the system so that enough water can be extracted yet the water availability for tomorrow can be assured. Sustainability needs to be ensured in following aspects-

   i. Source sustainability: Ensuring availability of safe drinking water in adequate quantity throughout the year

   ii. System sustainability: optimizing cost of production of water, building proper protocols and structures of institutions

   iii. Financial sustainability: proper utilization of funds and at least partial cost recovery through community governed O&M

   iv. Social and Environmental sustainability: involvement of all key stakeholders and proper rejection mechanism

Out of these, the interface tries to capture source sustainability.

5. **Equity:** It is not enough to provide adequate water for the average population. There should be efforts to see that irrespective of social or economic status of any individual, their drinking water demand should be met.

Planning and monitoring needs sound data collection, storage and representation. Whether these five sub-goals are addressed in the monitoring and planning process was explored by looking at the three government datasets. These datasets are –

1. NRDWP database maintained at http://www.indiawater.gov.in
2. Annual Action Plan database maintained by Zilla Parishad
3. 96 columns data maintained by Zilla Parishad

The purpose behind each of these datasets is different. While NRDWP database tries to give various formats to bring transparency to the system, it is extremely scattered to get the overview of any particular region at a glance. The purpose of Annual Action Plan is to aid in financial planning. The 96 columns database is used by the engineers at ZP office to prepare Annual Action Plan. Thus, these datasets are not primarily aimed at aiding in planning for the assets or water resource as such. However, These datasets do collect information that can aid in such strategic planning.

Each sub-goal was analyzed by studying it in the view of data collection that can work as indicator for achievement of the sub-goal. In the following sections, questions specific to each sub-goal are listed, which, when answered, indicate to a good extend whether the current sub-goal is being pursued strategically or not.

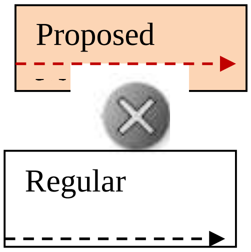
Mind maps were made to establish the connection between three datasets mentioned above and the five sub-goals. Lacunae in current datasets were marked to see if any modification to existing datasets is required. Then for each lacuna, a plausible solution was proposed.

The section also highlights the questions to be asked to meet each of the sub-goals of NRDWP. It describes the mind map in details with respect to the sub-goals and proposes modifications/additions wherever found necessary.

Legend for Mindmap:

SUB-GOAL - Sub-goal derived from NRDWP National Goal

Data Source



- The source of data (Eg. NRDWP, 96 columns, AAP)
- The changes proposed by author
- Chain representing proposed changes
- Lacunae or dead end in existing system
- Existing system
- Chain representing existing system

3.2 Coverage

3.2.1 Questions to be addressed

1. Do the households get enough water for domestic use?
2. Who is responsible for the water assets in the region? (Who is the implementing agency?)
3. Who is responsible for operation and maintenance of the water assets?

3.2.2 Mind map

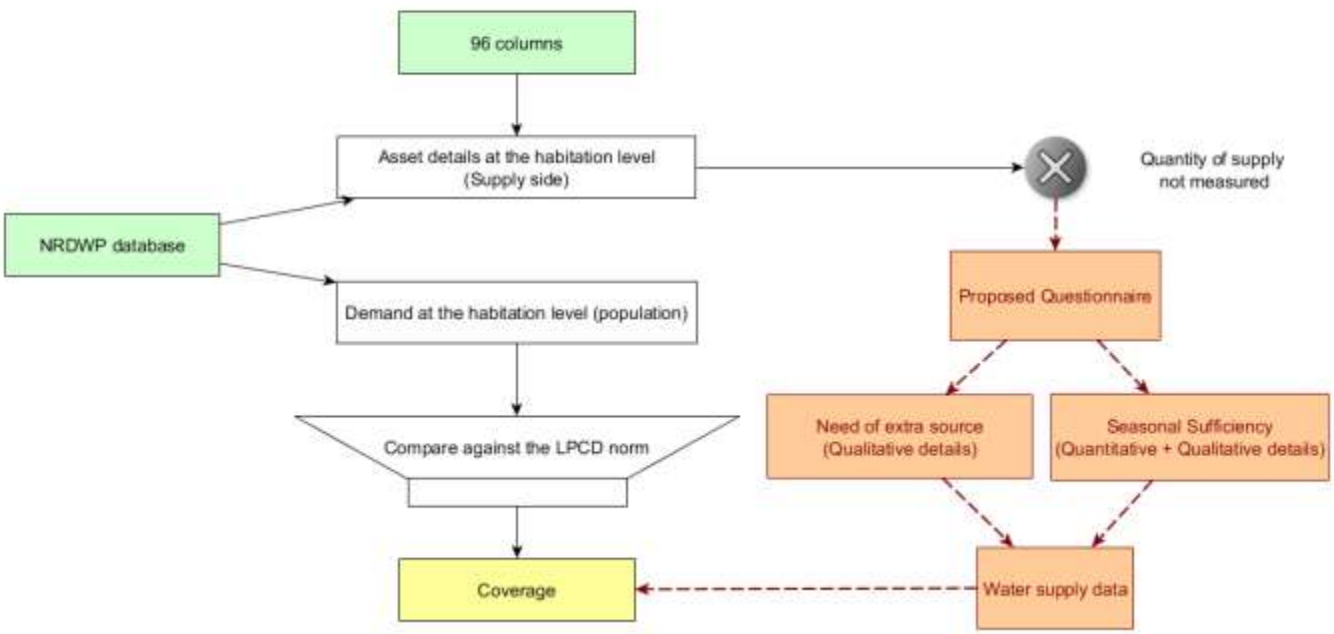


Fig 10. Mind map for addressing Coverage

3.2.3 Lacunae

The current system provides information only on demand for water and this is calculated by comparing population detail at habitation level against the recommended LPCD in rural areas which is 55 liters

. Demand = No. of People in Habitation * LPCD

The major drawback is that there is no way to calculate the supply of water, without which it is not possible to find whether the demand is being met or not.

3.2.4 Proposal

A questionnaire was prepared which included questions targeted towards both qualitative and quantitative aspects of water supply to villagers. It has questions about need for extra source of water sources. This gives a qualitative idea of how sufficient the existing sources are in terms of supply. Moreover, the seasonal efficiency of existing schemes is captured which in return provides quantitative information on the number of months for which supply is sufficient and deficient.

3.3 Equity

3.3.1 Questions to be addressed

1. Does every household get water irrespective of socio-economic status?

3.3.2 Mind map

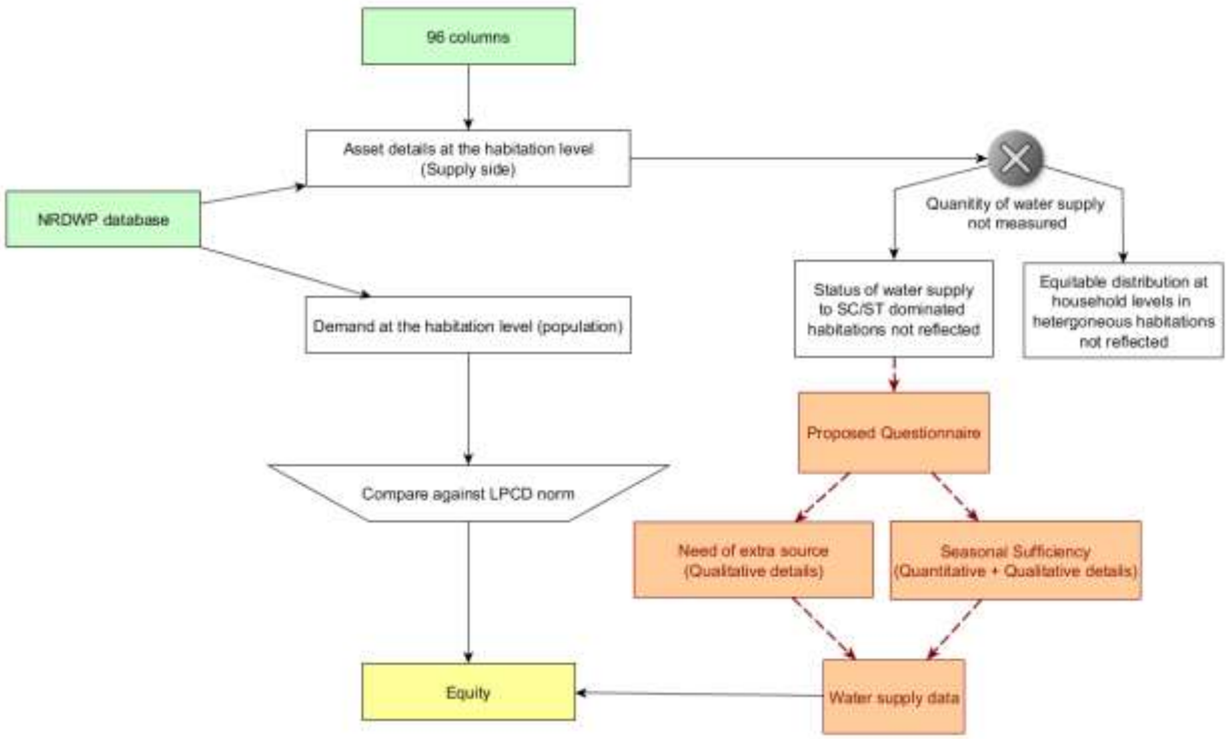


Fig 11. Mind map for addressing equity

3.3.3 Lacunae

The proposed method includes monthly visit to village to capture the seasonality aspect of existing structures. It is not possible to obtain accurate data for seasonality of sources by a one time visit. Questions were also framed that addresses the purpose and location of sustainability structures.

3.3.4 Proposal

The questions framed for adequacy sub goal feed in to equity portion as well. The supply details and need to shift to different source is captured. Survey is conducted to know whether all the people receive water properly or not. The proposed system tries to capture distributional differences that arise due to caste, culture etc. However, in the heterogeneous habitations, capturing these details will be tricky even after proposed changes.

3.4 Quality

3.4.1 Questions to be addressed

1. Are the villagers satisfied with the quality of water?

2. Is the water tested for quality?
3. Is the water safe for consumption as per lab tests?
4. Are there provisions for water treatment?
5. Is water treatment done according to the need and provisions?

3.4.2 Mind map

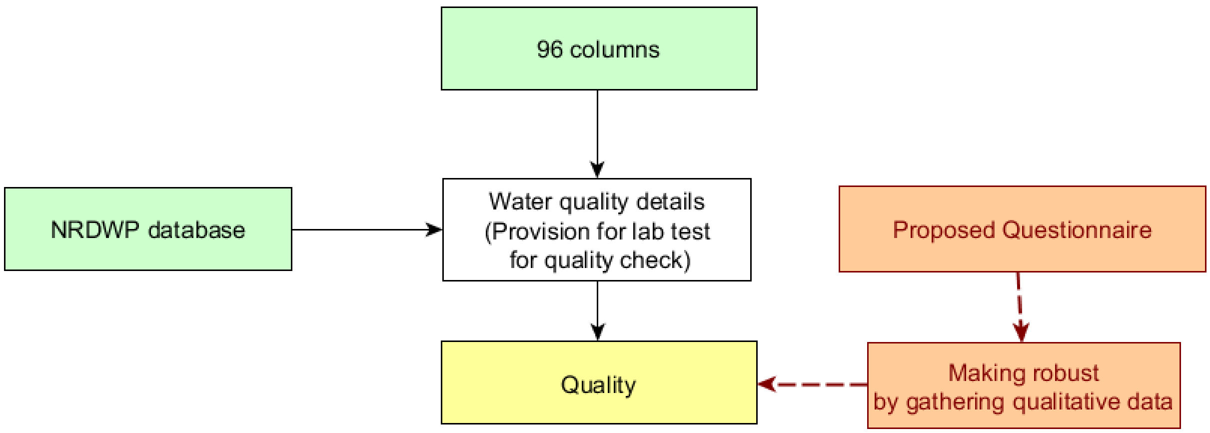


Fig 12. Mind map for addressing quality

3.4.3 Lacunae

Even though provision is there in current system to check the quality of water, the NRDWP reports do not have proper lab test reports. Therefore it is not known whether the lab test are conducted properly and the results do not reach the people. Another problem is that perspective of villagers are not taken in to account. Local criteria to decide potability of water can be different from the chemical lab tests.

3.4.4 Proposal

In proposed questionnaire importance is given to villagers perspective with respect to water colour, smell and taste. The cultural preferences of people with their source of water is captured.

3.5 Accessibility

3.5.1 Questions to be addressed

1. How far is the delivery point from habitation?
2. What is the elevation difference between delivery point and houses?

3. What is the longest distance people need to walk throughout the year and for what duration?

3.5.2 Mind map

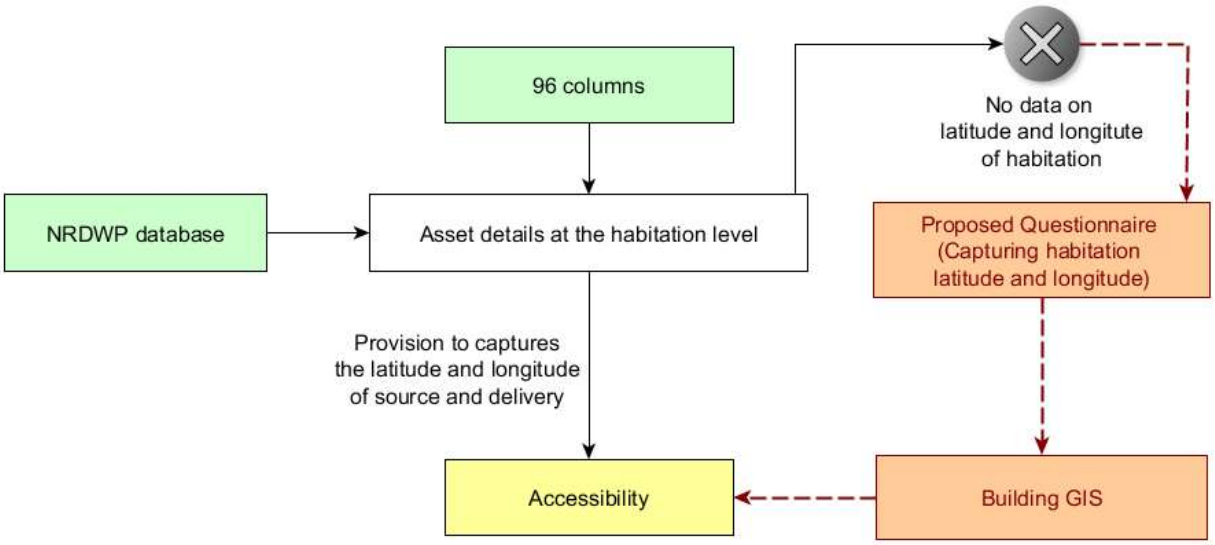


Fig 13. Mind map for addressing accessibility

3.5.3 Lacunae

The current system has two major drawbacks. First it does not provide distance details and it only has the latitude and longitude details. Second it has the geo reference details only for the source and delivery point and not for the habitation. Therefore the distance between habitation and delivery point is not captured and the discomfort faced by people can not be captured through data.

3.5.4 Proposal

The proposed questionnaire module has included measuring the latitude and longitude of the habitation too. Based on this data GIS is built and it helps in identifying the exact distance between the habitation and delivery point. Due to the GIS interface, elevation profile of the region is easy to understand. Thus drudgery due to elevation difference can be seen.

3.6 Sustainability of source

3.6.1 Questions to be addressed

1. Do people get water throughout the year?
2. Are sustainability structures created in the region?
3. Do the structures directly provide water for usage?
4. Do the structures recharge water table?
5. Do the structures provide for water in post-monsoon / pre-monsoon seasons?
6. Can animals access the water in these structures?
7. Who is responsible for these structures? (Who is the implementing agency?)

3.6.2 Mind map

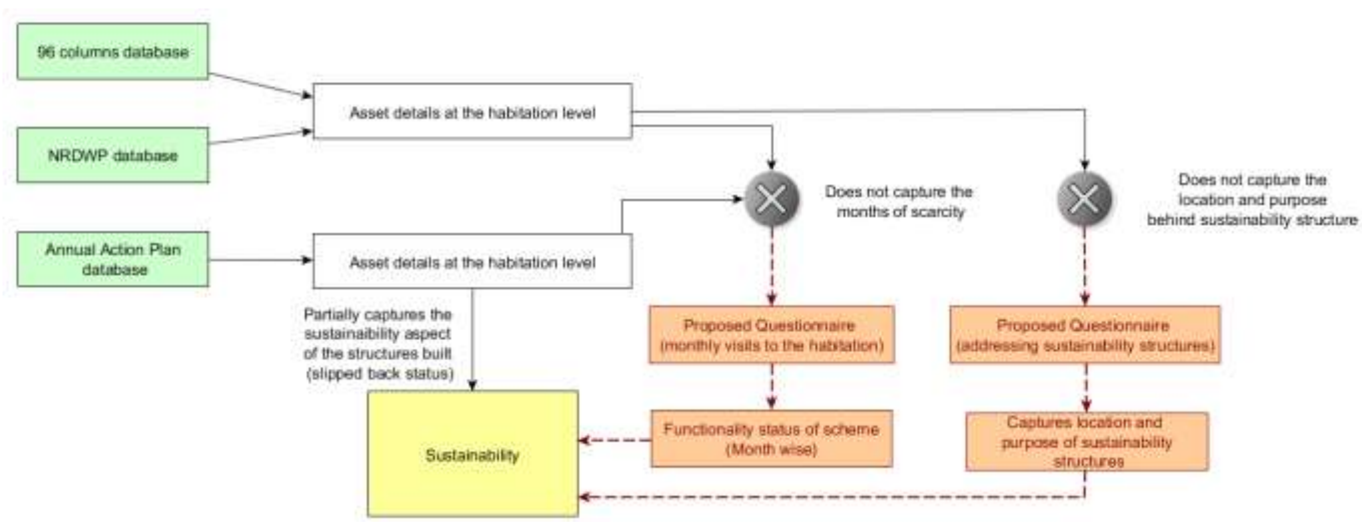


Fig 14. Mind map for addressing sustainability of source

3.6.3 Lacunae

The current system partially captures the sustainability aspect of existing structures through slipped back status. When a fully covered habitation reverts into partially covered habitation due to failure of a scheme it receives slipped back status. However, even this status does not address seasonal water shortage.

The functionality and purpose of sustainability structures such as pits and trenches, bunds, village ponds, rain water harvesting systems drastically differ from each other. However the location and the exact purpose of the structure is not captured in current system.

3.6.4 Proposal

The proposed method includes monthly visit to village to capture the seasonality aspect of existing structures as explained in discussion about coverage. Questions are included to address the purpose and utility of sustainability structures. The location is captured.

S.No.	Sub goals	Is subgoal addressed in monitoring / planning process?
1	Coverage	Partially addressed
2	Accessibility	Not addressed
3	Quality	addressed
4	Sustainability	Partially addressed
5	Equity	Partially addressed

Thus, it is seen that the current data collection does not help in monitoring whether the sub-goals towards rural drinking water security are being addressed. Hence need was felt to understand data required to analyze these sub-goals and the questions regarding them. Hence, an Entity Relationship Diagram (ERD) was created in an attempt to make a concise database, that can be specifically used for strategic planning. The ERD tries to capture the essential relationship between demand (represented by population), provision for supply (represented by assets) and supply (represented by water resource) in a geographic region.

3.7 Entity Relationship Diagram for water resource, demand and supply in geographic region

The ERD is created with the intention of aiding in strategic monitoring and planning process towards fulfillment of the goal of rural drinking water security. Thus, it is an attempt to extract answers to the questions raised in previous sections regarding the sub-goals for rural drinking water security. Focus is kept on effective monitoring and assistance for immediate as well as long term planning. The ERD is presented in the diagram below-

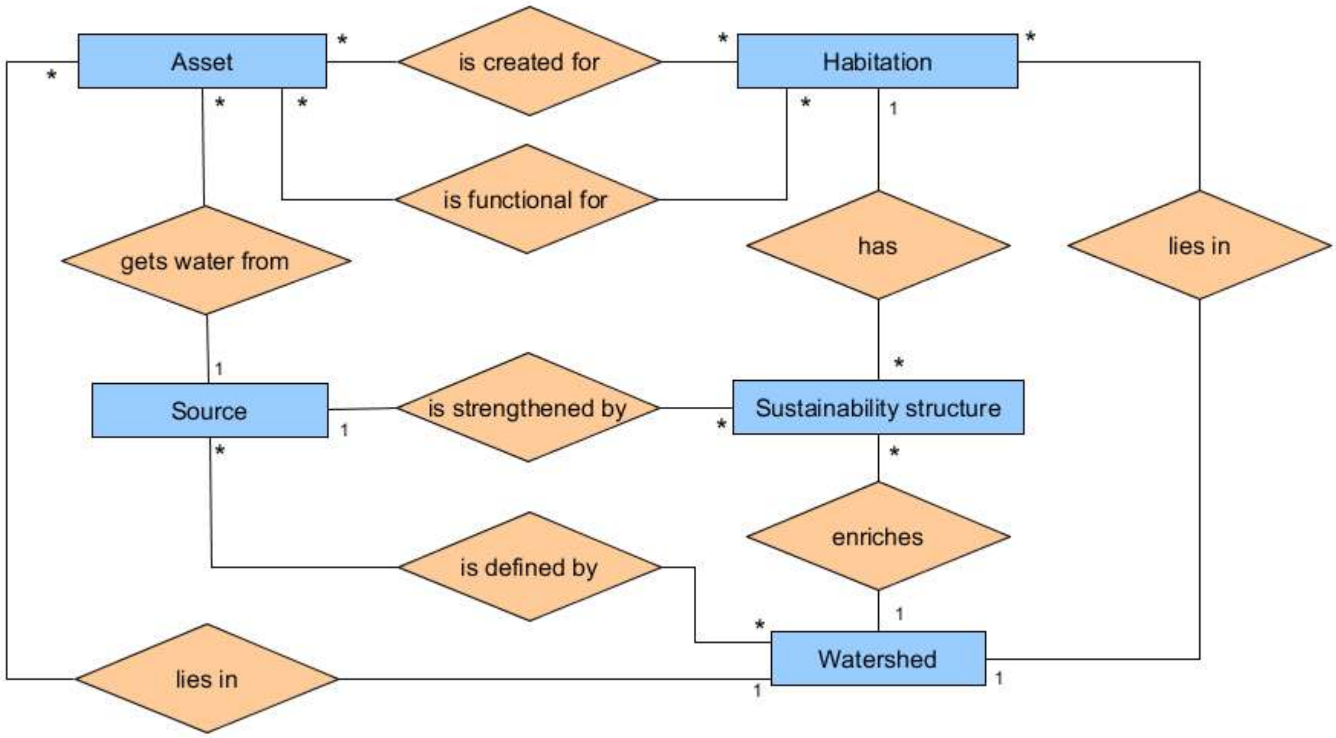


Fig 15. ERD for water resource, demand and supply in geographic region

3.7.1 Entities

Habitation:

Habitation is the smallest identifier of human settlements in India. A village consists of one or more habitations which often have their own characteristics in terms of socio-economic factors, favorable natural conditions, proximity to larger towns and cities etc.

Habitation represents the demand for water.

Habitation	Source of data
Name	GP office
Latitude	Primary data
Longitude	Primary data
Population	GP office
SC population	GP office
ST population	GP office
Households	GP office
village	GP office
GP	GP office
Block	GP office

Table 3. Attributes of Habitation

Asset:

Here, asset is defined as any vessel that helps in extracting water to meet the demand. Asset can be dugwell, pipe water supply scheme, borewell, handpump, tanker, dam or more.

Asset represents the provision to meet the demand raised by habitations.

Asset*	Source of data	Description	Remark
Source Type	AAP column 20	Groundwater or surfacewater	
Source Name / Identifier	Field	Name of water body or source identifier if any	
Delivery Mechanism	NRDWP, Format B22, Column: SchemeType	Piped / Hand Pump / Borewell / Dugwell / Tanker / Storage tank / river / lake	
Water Treatment	Field	Provision for conventional water treatment plant / filter	
Ownership of delivery point	Field	public / private / both	For situations such as a well in each house
No of public delivery points under asset	Field / office of implementing agency	how many public delivery points are created, if applicable	A public well can be treated as representative of GW source
No of private delivery points under asset	Field / office of implementing agency	how many private delivery points are created, if applicable	All private wells need not have separate entry. They indicate that households rely on ground water
Scheme Type	AAP column 15	For water coverage or to tackle water quality issue	
Funtionality agenda	96 columns 14B, 14C	perennial / seasonal	
no of habitations touched	NRDWP, Format B22, Column: HabCovered	how many habitations benefit from this asset	
implementing agency	NRDWP, Format B22, Column: ImplementingAgency		
Completion date	NRDWP, Format B22, Column: DateofCompletion	Date of completion of asset, if applicable	
Commissioned date	NRDWP, Format B22, Column: DateofCommissioning	Date of commissioning of asset, if applicable	
O&M agency	GP	Agency responsible for handling O&M of the asset, if applicable	
O&M handover date	GP / office of implementing agency	The proposed date of handover of the asset by O&M agency, if applicable	
Active Status	Field	Alive or permanently failed	

* An asset is defined as a vessel that provides water for extraction and use

Table 4. Attributes of Asset

Source:

A source is the natural source through which water can be availed. The sources can be groundwater, river, ponds, rainwater.

Source represents the supply of water that can be utilized to meet the demand.

Source	Source of information	Description
Type	Field	river / lake / dam
Name	Field	
Water availability	Field / GP office	perennial / seasonal
Quality Affected?	Field / GP office	contaminated / potable / seasonal variation
Quality problem	Field / GP office	Arsenic / Fl / NO3 / Chlorine / hardness / TDS / Fe / Sulphates / Coliform Organism / Faecal Ecoli
Source failed?	Field	yes / no

Table 5. Attributes of Source

Sustainability Structures:

Sustainability structures are artificial structures created with the purpose of ensuring availability of water at all times. The structure can be created with the intension of recharging groundwater, increasing quantity of water in surface water sources, storing water in sealed structures so that it can be utilized in water stressed months. Along with the purpose of sustainability structures, their usage may differ. Some structures would provide water for consumption, some would enhance the water sources, some would achieve both.

Examples of sustainability structures are village ponds with or without plastic sheets, percolation tanks, contour trenches, rain water harvesting systems etc.

sustainability structure	Source of information	Description
structure type	field	pits and trenches / check dams / percolation tanks / point source recharging / dugwells / injection / skimming wells / traditional water body / rooftop
structure id / name	field	
water storage capacity	field	small / medium / large : based on area (eg < 10sqm, 10-25sqm, >25sqm)
no of such structures	field	
latitude	field	
longitude	field	
completion date	field	
is operation required?	field	eg for solar power based systems
is maintenance required?	field	eg annual desilting
recharge for source?	field	does an existing asset directly benefit from recharge by this structure?
independent sustainability structure?	field	does it recharge GW in general, irrespecitve of an existing asset?
season of accumulating water	field	monsoon / post-monsoon / pre-monsoon
season of retaining water	field	monsoon / post-monsoon / pre-monsoon / never
season of recharging groundwater	field	monsoon / post-monsoon / pre-monsoon / never
accumulated water available for domestic use	field	yes / no
season of using accumulated water	field	monsoon / post-monsoon / pre-monsoon / never
accessible to animals?	field	yes / no

Table 6. Attributes of Sustainability Structures

Watershed:

Watershed is the geographic area that can be identified as a unit which is demarcated with ridge line such that the rainfall falling within its boundary joins a drain exiting the watershed from a single point. Watershed has its own characteristics such as slope gradient, soil/rock type, rainfall, drainage network etc. These characteristics affect the water availability in the watershed.

Watershed	Source of Information	Description
micro-watershed	WRIS	identifier
mini-watershed	WRIS	identifier
sub-watershed	WRIS	identifier
watershed	WRIS	identifier
sub-catchment	WRIS	identifier
catchment	WRIS	identifier
basin	WRIS	identifier
water resource region	WRIS	identifier
average annual rainfall	WRIS	
slope gradient	computation	slope gradient can give the speed of runoff
permeability	GSDA	permeability value (k) for the strata of watershed
boundary	computation	GIS polygon feature, from DEM
area	computation	GIS attribute, from DEM

Table 7. Attributes for watershed

3.7.2 Relationships

While the other relationships in the ERD are but the mappings of foreign keys, the two relationships that are important are between asset and habitation.

(Asset) <u>is created for</u> (habitation)

The assets can be meant to be utilized by multiple habitations. When an asset is created, various attributes regarding the relationship between asset and habitation gets finalized. For example, the service delivery capacity of asset for a particular habitation etc. These attributes are unlikely to change, unless augmentation or re-structuring works are taken up for the asset. Thus, this relationship represents a static data, that need not be collected too frequently.

Asset	habitation	provision *	Source of information	Description
(Many)	(Many)	habitation	field	habitation that is benefited from asset
		asset	field	asset
		distance of delivery point from habitation	field	in meters, zero if inside habitation
		elevation difference	field	in meters, zero if inside habitation
		provision for LPCD during functional period	field / GP office	applicable for piped water supply scheme
		provision for treatment during functional period	field / GP office	conventional treatment plant / filter / chlorination
		treatment needed at delivery point?	field / GP office	is the source of water quality affected?
		* This table gives a static relationship between asset and habitation that remains constant for fair amount of time		

Table 8. Attributes for (asset) <u>is created for</u> (habitation) relationship

(Asset) is <u>functional for</u> (habitation)

Functionality of asset can be seasonal and temporal. Thus, even though an asset is created for an habitation, it doesn't guarantee water delivery through that asset. For the monitoring purposes, this data needs to be collected periodically. It is recommended that this data be collected monthly.

Asset	habitation	is functional for*	Source of information	Description
(Many)	(Many)			
		Functional	field only	(yes / with problems / defunct / out of season)
		functional for how many days of month	field only	
		LPCD delivered	field only	the day of visit can be taken as a representative
		no of households served	field only	this data needs to be gathered by a local in-charge person or by a small FGD
		used for	field only	drinking / washing / cattle
		did the households depend on any other asset?	field only	yes / no. Data needs to be gathered by a small FGD
		was water treatment done?	field only	only when any treatment mechanism is provided and recommended
		how was the quality of water served	field only	irrespective of whether the treatment was done, was the quality good?
		was there a water sample taken for lab testing?	field only	is the water tested?
		* This table serves as regular monitoring tool. Ideally monthly entries should be made for each habitation as seasonality plays a big role in water supply.		

Table 9. Attributes for (asset) is functional for (habitation) relationship

This ERD proposes to make data storage more insightful and concise, so that high priority actions, long term planning etc. can be aided with the help of database.

To help into the data collection for this dataset, following questionnaires are suggested.

3.8 Questionnaires

The first questionnaire collects information regarding assets in a particular habitation. This survey can be carried out once in a year, or data can be updated as and when an asset is created or augmented. The recommended period for yearly survey is the month of February/March, as it becomes easy to understand water stress during that period.

	GP:		Asset 1	Asset 2
	Village:			
	Habitation:			
1	Source Type (Ground water / surface water)			
2	Asset Type (Public standpost / Domestic connection / HP / well / river / Tanker)			
3	Source Name (Name of river / lake / dugwell / scheme / identifier of handpump etc)			
4	Provision for Water Treatment Plant / Filteration / Chlorination			
5	Is the asset public or private?			
6	If both, how many connections? (Public , Private)			
7	Is there a problem of quality in groundwater / surfacewater because of which this scheme was designed? (Is this scheme made to serve the coverage or the quality problem?)			
8	Is the scheme designed for year round use or just seasonal? (months?)			
9	How many habitations are touched by this scheme?			
10	Who is the implementing agency?			
11	When was the scheme completed?			
12	When did the scheme start functioning?			
13	Who handles the operation & maintenance of the scheme?			
14	How many years will the above agency handle the operation and maintenance of scheme?			
15	Is there a VWSC in the village?			
16	Is there any provision for handing over the O&M to VWSC?			

Table 10. Questionnaire for assets

In this questionnaire, the location and elevation of each asset is to be collected, along with location and elevation of delivery points, if away from the asset.

Second questionnaire is for regular monitoring. It is recommended that this questionnaire be administered every month in the best case, or every quarter at the minimum, so that any necessary information can reach administration early, and in time.

GP:	**Asset name:**
Village:	**Latitude of delivery point:**
Habitation:	**Longitude of delivery point:**

1 Distance of asset from habitation in meters

2 Elevation difference in asset and habitation

3 Public contribution collected from each household in habitation

4 Provision of LPCD to habitation (during the functional period)

5 What is the provision for water treatment (during the functionality period)?

	1	2	3	4	5	6
Functionality	**Jun-14**	**May-14**	**Apr-14**	**Mar-14**	**Feb-14**	
Functional (yes / with problems / defunct / out of season)						
Functional for how many days of month						
LPCD delivered						
no of Households served						
Was water used for drinking / washing or cattle feeding?						
Was it enough water for these households?						
If provision for treatment, done or not?						
How was the quality of water served?						

Table 11. Questionnaire for monitoring

The third questionnaire is created to gather useful information about the sustainability structures. As explained in previous section, sustainability structures can be created for various purposes and can have different contributions. Thus, it is important to know the purposes and contribution of the structures, even if qualitatively. This questionnaire is recommended to be carried out in the month of January, so as to see if the sustainability structures are functioning properly. If a structure is seen to be defunct in this period, possible measures to assure water availability in summer could be applied in time.

GP: watershed id:

Village: rainfall:

Habitation:

							Primary source of informatio
1	Structure type						villager
2	Structure name / identifier						villager, if applicable
3	Completion date						villager / GP office
4	is operation required?	yes	no				villager
5	is maintenance required?	yes	no				villager / GP office
6	Does it strengthen an existing asset directly?	yes	no				villager
7	Does it recharge watertable independently of any existing asset?	yes	no				villager
8	Dimension of the structure (if applicable), in sq meter	small (<10 sqm)	medium (10 - 25 sqm)	large (> 25sqm)			villager
9	how many such structures are made in the area(habitation)?						villager
10	location of structures (Latitude, Longitude)	Lat:	Long:				villager
11	season of accumulating water	monsoon	post monsoon	pre-monsoon			villager
12	season of retaining water	monsoon	post monsoon	pre-monsoon	never		villager
13	season of recharging groundwater	monsoon	post monsoon	pre-monsoon	never		villager
14	accumulated water available for domestic use?	yes	no				villager
15	season of using accumulated water	monsoon	post monsoon	pre-monsoon	never		villager
16	accessible to animals?	yes	no				villager

Table 12. Questionnaire for sustainability structures

It needs to be emphasized that creating an effective questionnaire does not solve the lacunae in data gathering. There is no excuse to gathering correct and good quality data from the field.

Chapter 4 A Sample GIS Interface

Availability and access to water is highly dependent on the geography. Terrain and the hydrogeology can play an important role in planning. This aspect can be best captured by using GIS interface for data analysis. GIS interface can show the spatial relationship between water demand, water supply assets and water sources. The aspect of longitudinal distance as well as elevation difference can be captured through GIS representation, without losing the sight of other natural or administrative parameters. This chapter gives a protocol for creating a GIS interface and analyses the usefulness of the product.

This chapter demonstrates-

1. Creating base layers for GIS interface
2. Demonstration of regional view with example of a mini-watershed
3. Demonstration of local view with example of a village

4.1 Creating base layers for GIS interface

The GIS interface should reflect geographical as well as administrative attributes in a single view. The base layers for interface consist of geographical attributes, that serve as backdrop for data analysis at later stage. In this sample prototype, watershed, contours and surface water bodies are captured in the base layers.

The following datasets were used for creation of GIS interface-

Table 1. Datasets used for creation of GIS interface

Sr No	Dataset	Agency	Product	File identifier	remark
1	Digital elevation map	Bhuvan	Cartosat-1 (CartoDEM version 1)	cdne43b	Tiff file
2	Taluka boundary map	MRSAC	thane files	Taluk0_polygon	shapefile

3	village boundary map	MRSAC	thane files	Village_polygon	shapefile
4	watershed boundary map	MRSAC	thane files	Watershed0_polygon	shapefile
5	Drainage map	MRSAC	thane files	Drainp0_polygon	shapefile

Keeping in mind the scope of the project, it was decided to create GIS interface for a mini watershed. The MRSAC maps for Thane district were used for selecting a study area. These MRSAC maps were obtained from GISE lab in the department of Computer Science and Engineering (CSE) of IITB.

4.1.1 Study area

Watershed is defined at Soil and Land Use Survey of India as-

'A natural hydrologic entity governed by the terrain topography from where runoff is drained to a point.' (Soil and Land Use Survey of India, 2014)

Thus, watershed is a general term and does not have specifications regarding its size or area. In India, various institutes have classified watersheds differently. The classification followed by MRSAC is as given by Soil and Land Use Survey of India. For more details about classification of watersheds as per Soil and Land Use Survey of India, see Annexure.

The demarcation of watersheds in Shahapur block is as follows-

Table 2. Demarcation of watersheds in Shahapur block

Watersheds in Shahapur	
Region	Arabian Sea
Basin	Sharavati to Tapti
Catchment	Savitri to Tapti
Subcatchment	Tansa to Kalak, Bhatsal to Tansa
Watershed	Bhatsal, Kalu, Ulhas, Vaitarna

As per the MRSAC maps, Shahapur has 4 watersheds. The four watersheds are further divided into sub-watersheds, mini-watersheds and micro-watersheds as follows –

Table 3. Sub, mini and micro watersheds in Shahapur

	Sub watersheds	Mini watersheds	Micro watersheds
Bhatsal	WF 30	7	25
Kalu	WF 33, WF 34, WF 35	4	23
Ulhas	WF 28	3	24
Vaitarna	WF 24	4	26

For the purpose of this study, A mini watershed in Kalu watershed, identified as 'WF-33/02' was chosen. This mini watershed consists of 20 micro-watershed.

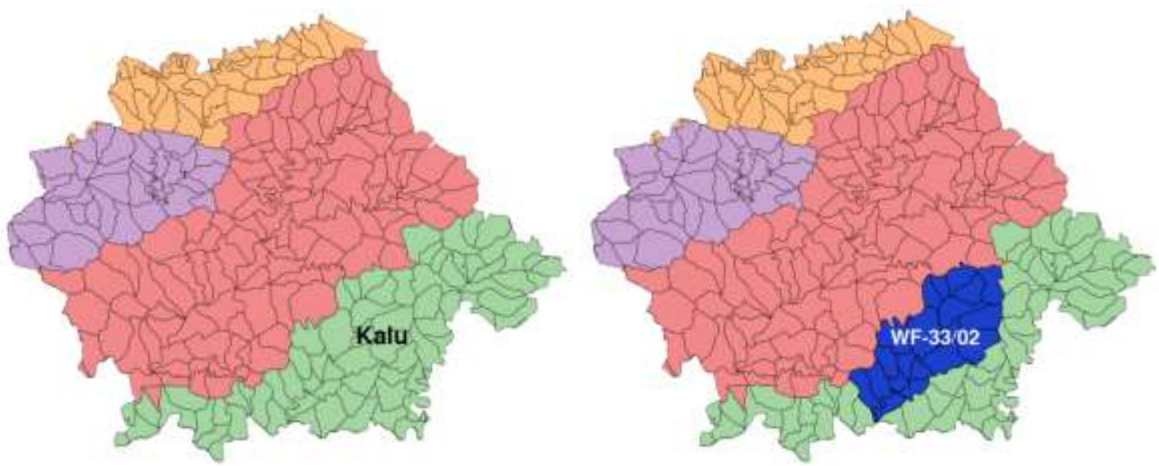


Fig 16. Kalu Watershed and mini-watershed of studyin Shahapur Block

Fig 17. Kalu mini-watershed WF-33/02

Once the area was fixed for preparing interface, the procedure started with DEM taken from Bhuvan.

4.1.2 Generating watershed maps

For generation of watershed maps of the study area, Digital Elevation Map (DEM) was taken from Bhuvan [Bhuvan]. See annexure for downloading DEM fromBhuvan.

Create a new project in Quantum GIS (QGIS). Then open the DEM into project by selecting 'Add Raster Layer' from Layer menu.

i. Stylize DEM

Initially the DEM may be in Grayscale and look as follows-

Fig 18. DEM in Grayscale

Go to Layer Properties and in the 'Style' tab, select Pseudocolor for color map for visual details.

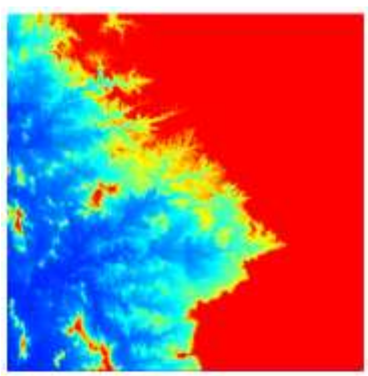


Fig 19. DEM in Pseudocolor

Make sure that the image is saved in Co-ordinate Reference System (CRS) WGS 84, EPSG:4326.

ii. Import DEM in GRASS

Install GRASS for QGIS. Create a GRASS database and mapset.

Using 'Import Loaded Raster' module in GRASS, import the DEM (cdne43b) into grass (say, 'cdne43b_grass')

iii. Generate maps of basins and stream-segments

Using the module 'Watershed Analysis' (r.watershed) in GRASS and cdne43b_grass as input map, generate

a. map of basin with 5000 cells draining into each basin
b. map of stream segments with 1000 cells draining into each basin

The maps would look as follows:

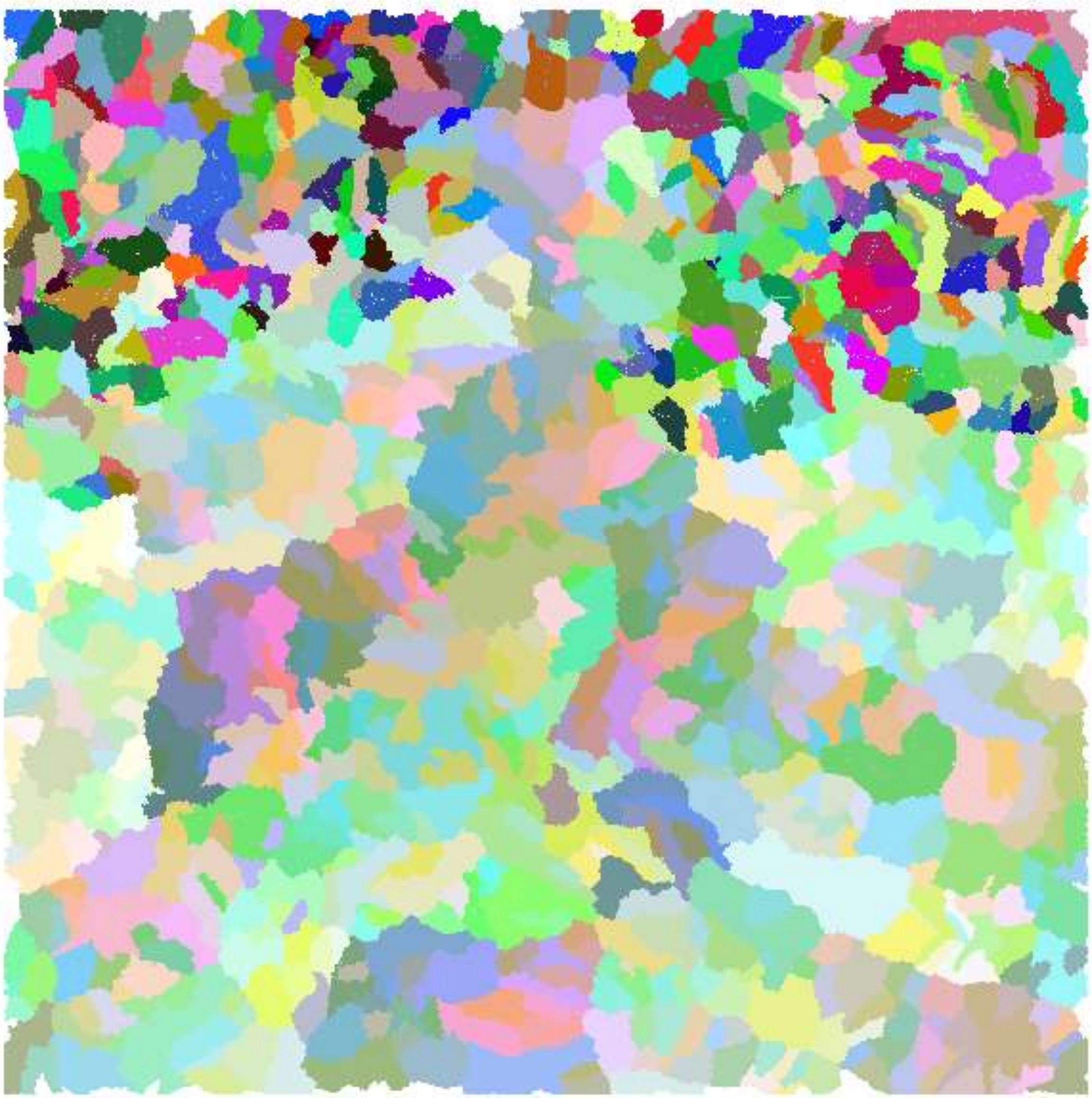


Fig 20. Basins map generated through GRASS with 5000 no of cells as size of basin

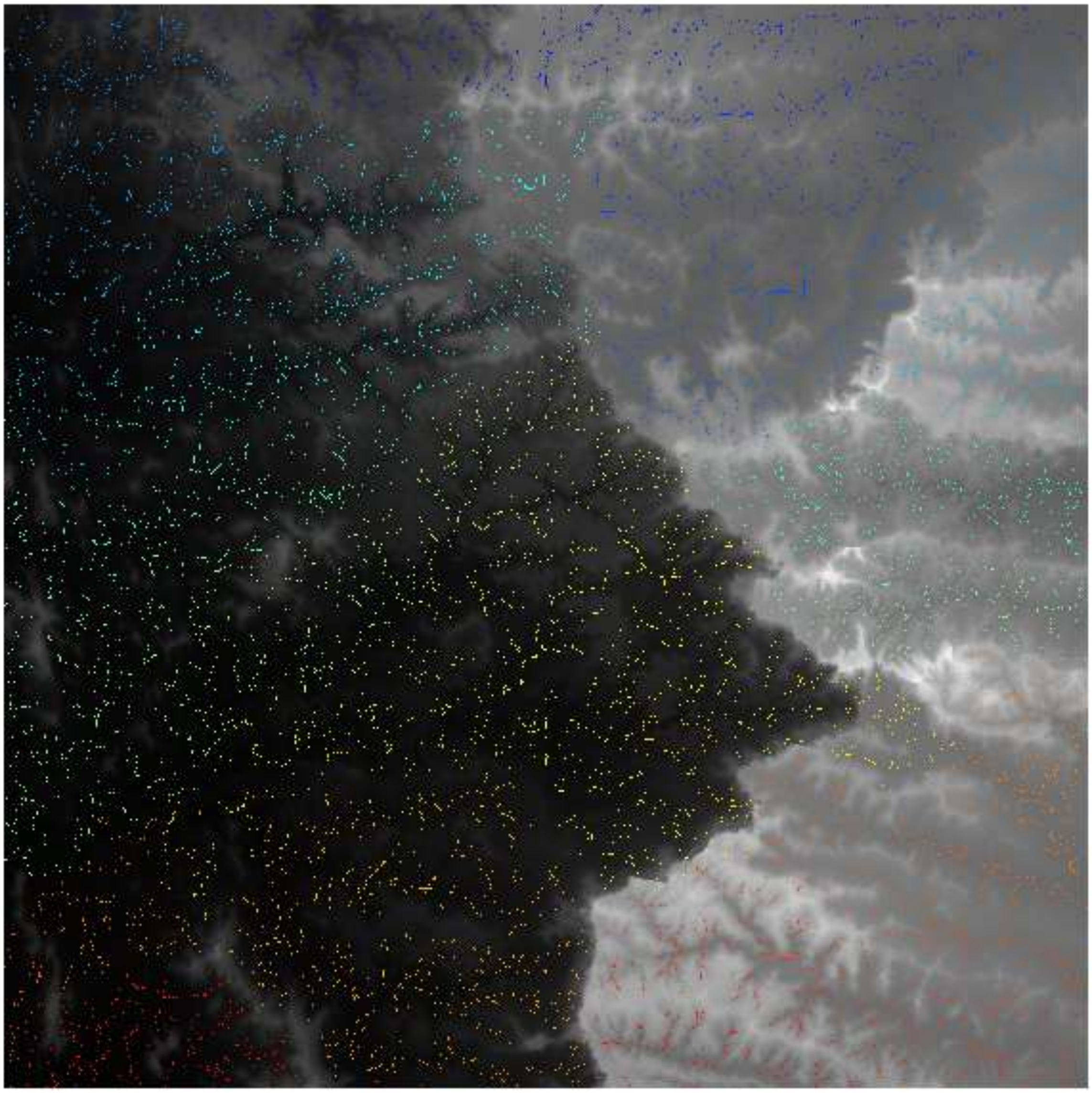


Fig 21. Stream segments (drainage) generated through GRASS with 1000 no of cells as basin size

iv. Convert watershed maps into shapefiles

This can be done by using module 'Convert raster to vector lines' (r.to.vect.line) for stream segments (drainage) and 'Convert raster to vector area' (r.to.vect.area) for basins. See Annexure 3 for details of procedure.

Then load the vector maps in QGIS using ‘view output’ and use ‘save as’ for exporting them to shapefile. Select CRS as WGS 84:EPSG4326.

Fig 22. Final drainage map obtained by vectorizing GRASS output

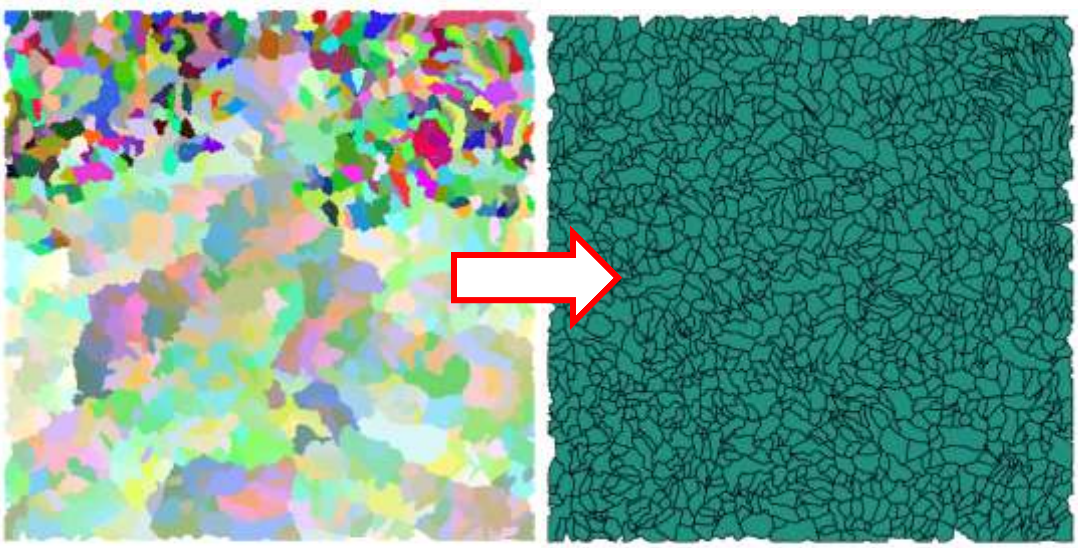


Fig 23. Final watershed map obtained by vectorizing grass output

v. Generate contour map through GRASS

Obtain a contour map by using the GRASS module ‘create vector contour from raster at specified steps’ (‘r.contour’). Use cdne43b_grass as input raster map. Specify the steps interval to be 15. Save the loaded map as shapefile with CRS WGS-84. Thus, a contour map for the DEM will be obtained as following-

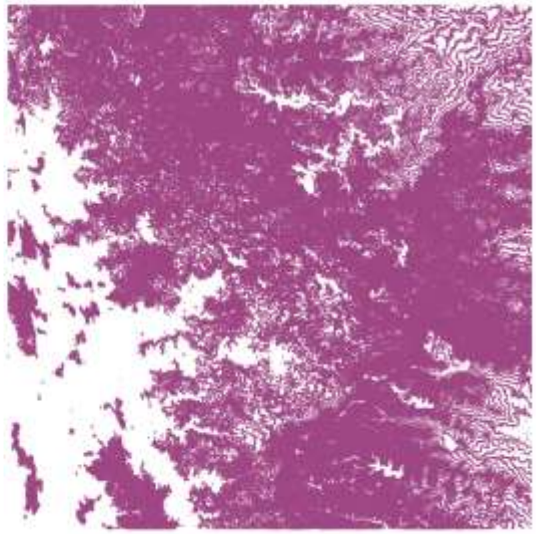
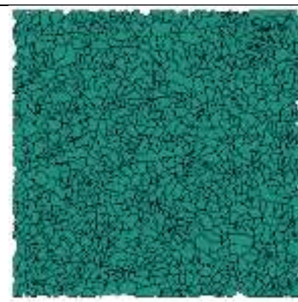
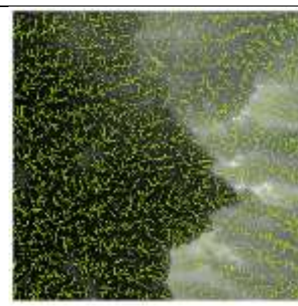


Fig 24. Contour lines shapefile at interval of 15m obtained through GRASS

Table 4. Table summarizing basic shapefiles of watershed maps

Basins: "basins_map.shp", with 5000 cells draining into each basin	
Drainage: "drains_map.shp" with 1000 cells draining into each basin (only the lines in the picture)	
Contours: "contours.shp" with 15m as step interval, initial elevation taken as 0.	

4.1.3 Using generated watershed maps and MRSAC maps to create GIS interface

Now that the watershed maps are ready, the interface for Kalu mini watershed can be created. For this, the three shapefiles created in above step will be used along with MRSAC maps.

First, load MRSAC map for watershed polygon ‘watershed0_polygon.shp’ as mentioned in table 1.

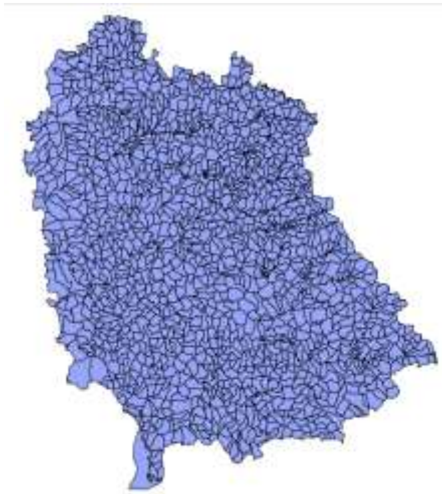


Fig 25. Thane watershed polygon map from MRSAC

Select the micro-watershed WF-33 and mini-watershed 02 from the Attribute Table of this shapefile.

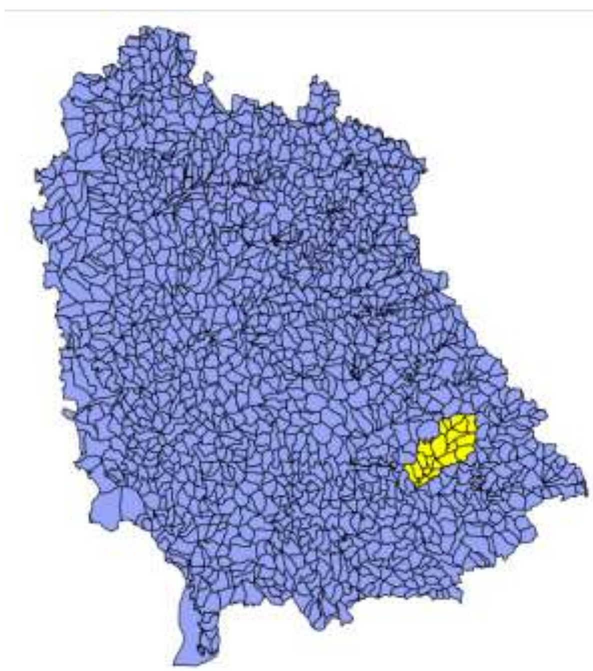


Fig 26. Thane watershed with selection of Kalu mini watershed 'WF-33/02'

Save the selected area as new shapefile named 'Kalu-watershed-MRSAC.shp, with the CRS as WRS 84. Thus, the map of Kalu watershed will be obtained.

Fig 27. Kalu watershed map from MRSAC

Now, increase the transparency of 'basins_map.shp' obtained in previous step, put it above the 'Kalu-watershed-MRSAC.shp' layer and select the common area with the help of the tool 'Select features by freehand' tool on QGIS toolbar. Save the selected area as new shapefile, say, 'Kalu-watershed-GRASS.shp'.This will ensure that the naturally drawn watersheds from DEM are selected without cropping or clipping their natural boundaries.Following watershed layer will be obtained.

Fig 28. Kalu watershed obtained through GRASS

Now, load the drainage map from MRSAC ‘drainp0_polygon.shp’. Clip it with ‘Kalu-watershed-GRASS.shp’ to obtain drainage map for kalu watershed region. Repeat the same procedure for drainage map obtained with GRASS in previous step (‘drains_map.shp’). The drainage map of MRSAC gives the water bodies in the region and the drainage map of GRASS gives the first order, second order and third order drains in the region.

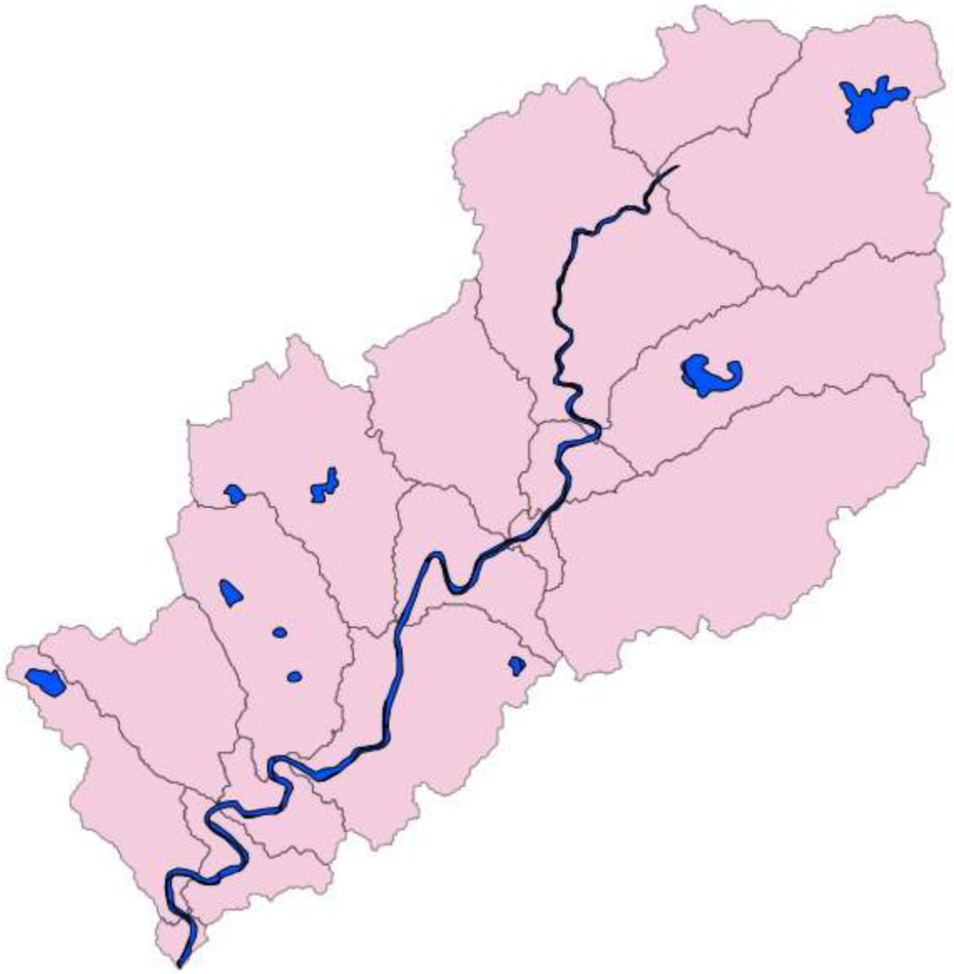


Fig 29. Kalu drainage MRSAC showing water bodies in the region

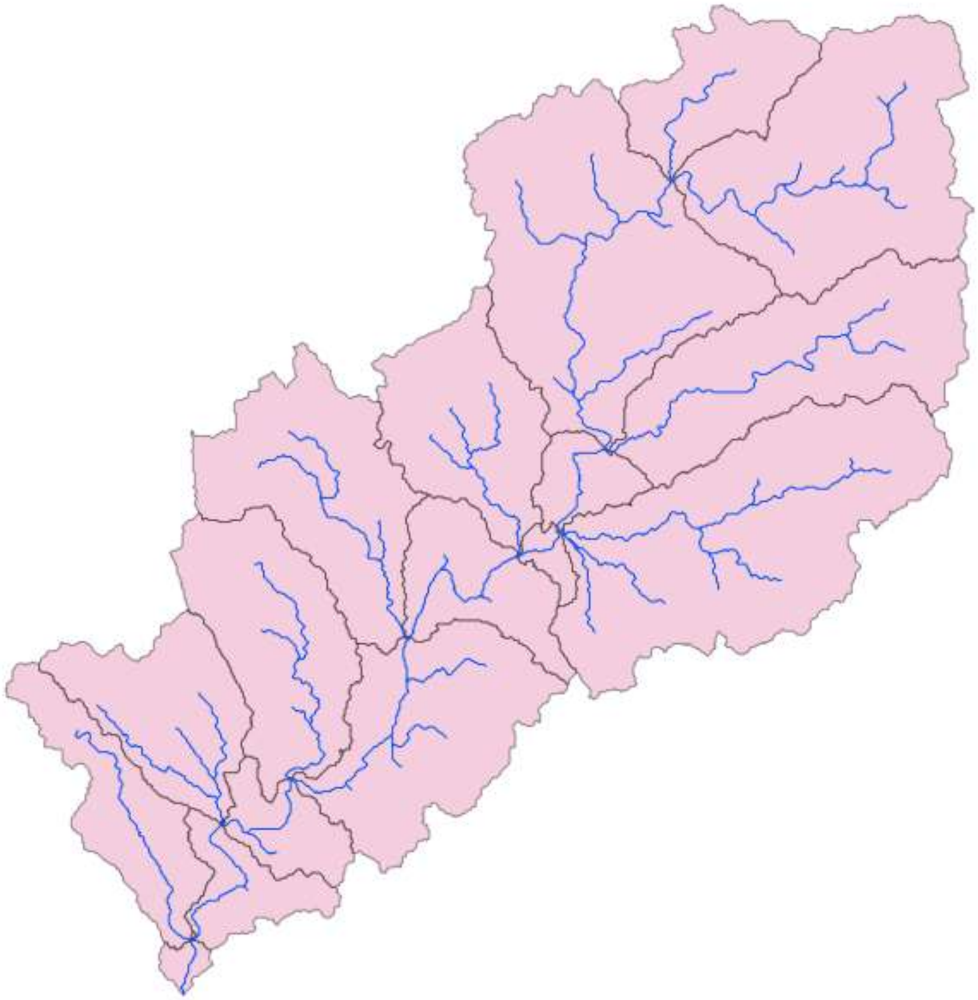


Fig 30. Kalu drainage GRASS showing first, second and third order streams

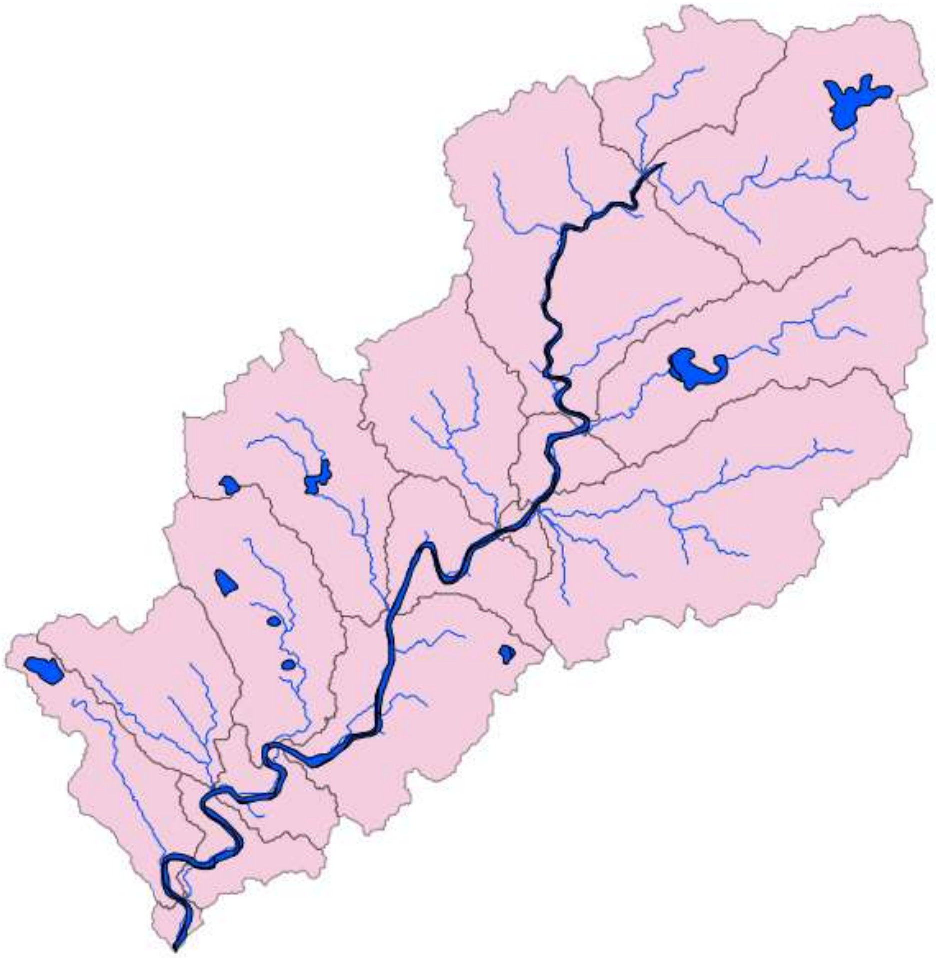


Fig 31. Kalu watershed surface water bodies and drains

Now load the contour map on the screen to obtain the watershed interface for the Kalu mini watershed region.

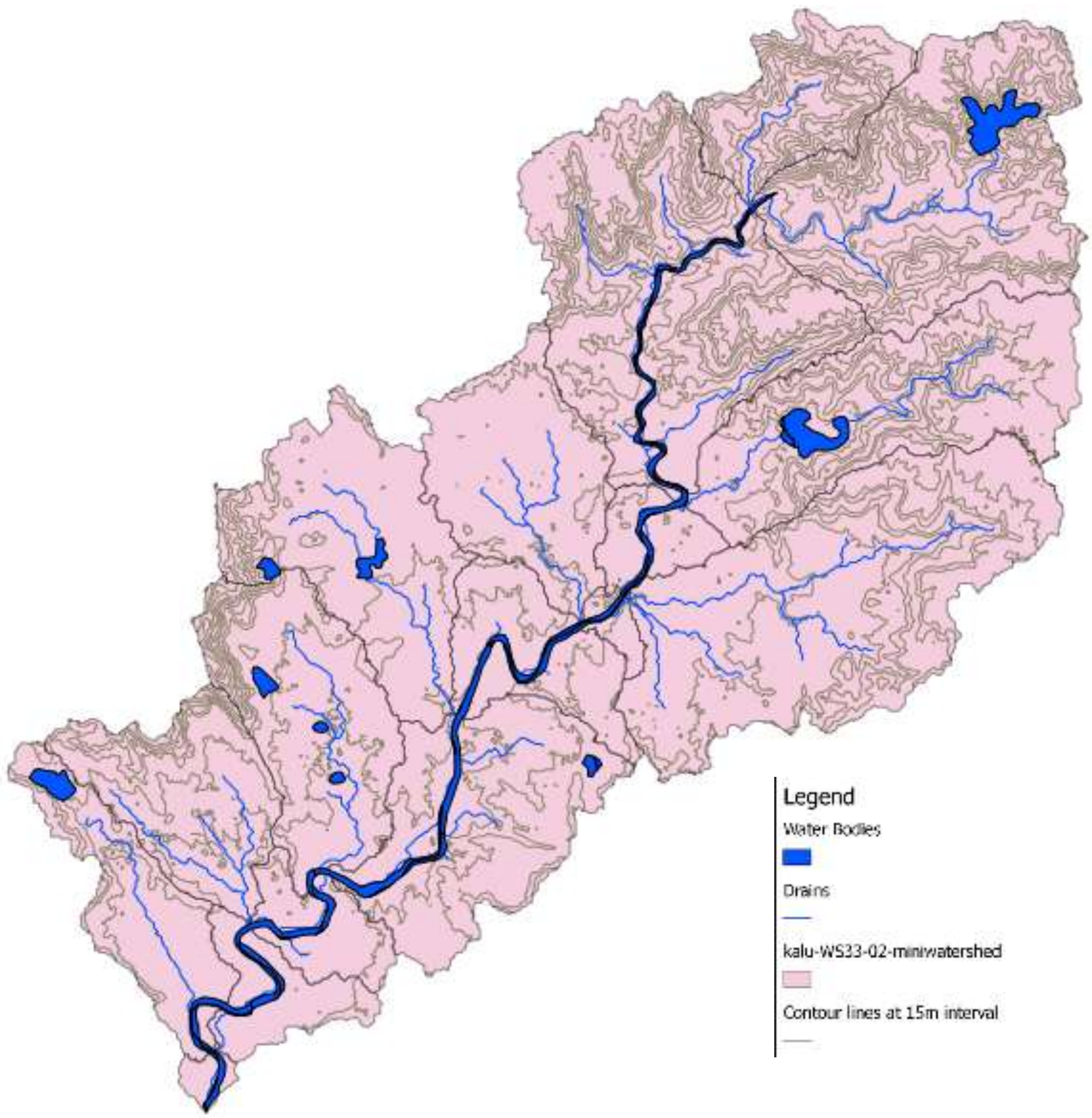


Fig 32. Watershed interface for Kalu mini watershed 'WF-33/02'

The above figure gives the basic watershed interface for the study region. This process can be used for obtaining watershed interface for other regions or larger regions as well.

The Kalu mini-watershed obtained here has area of 126 sq km, with a main drain of 23km, which is tributary of Kalu river and two dams, namely Adivali dam (live capacity 2.03MCM) at lower elevation and Kharade dam (live capacity 2.054MCM) at higher elevation. The contour lines are relative, starting with zero, and go up to 180m in this watershed.

Now that the basic watershed interface is ready, next section shows the demonstration of how this interface can be used for data representation.

4.2 Demonstration of regional view through Kalu mini-watershed

After creating the geographical base layers, the administrative attributes such as habitations, assets etc can be brought in GIS to start data analysis. For the regional view, habitations in the villages of Kalu mini-watershed were marked on top of the geographic base layers.

i. Locate habitations falling under mini-watershed boundary

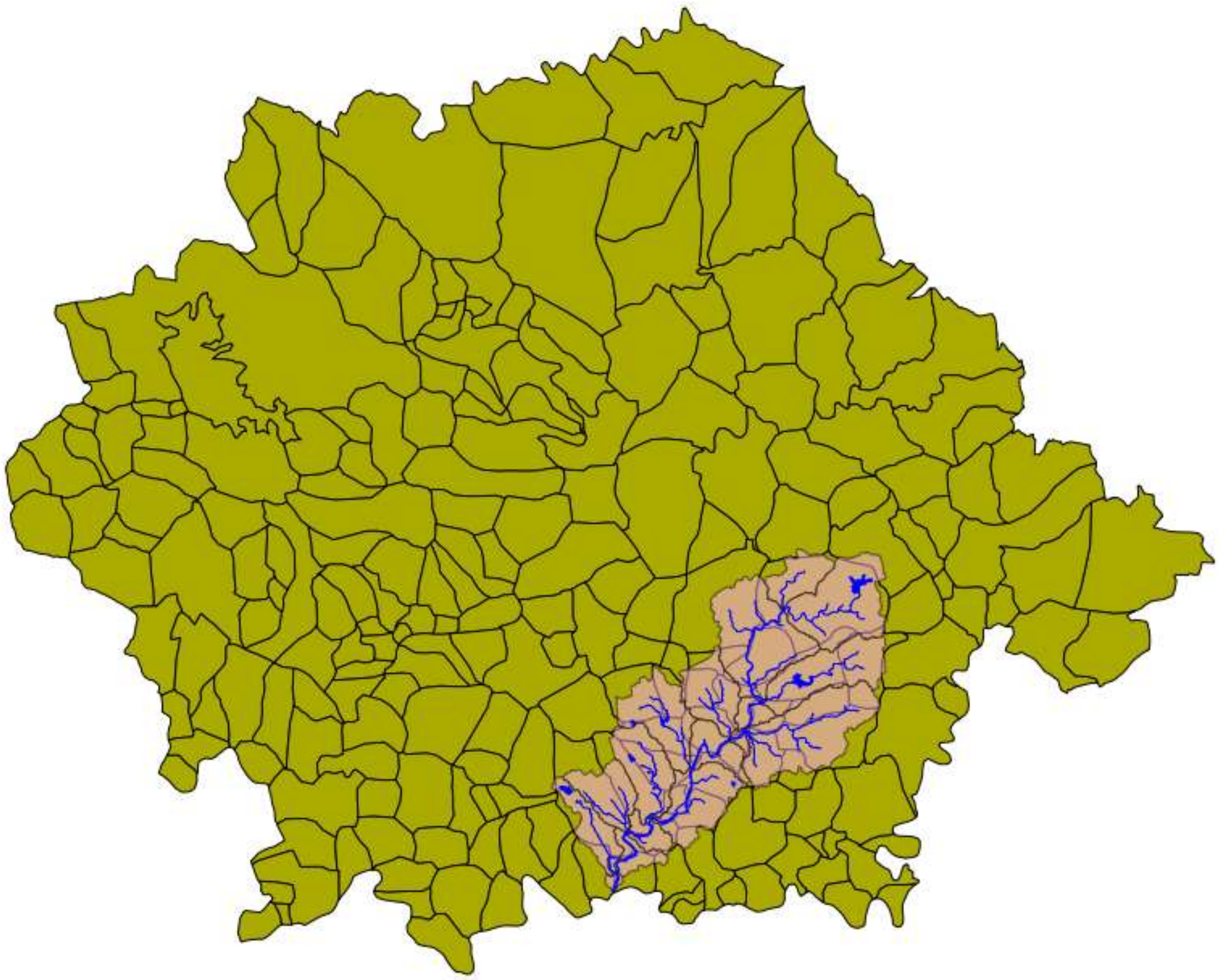


Fig 33. MRSAC villages shapefile superimposed by Kalu mini-watershed

Open the village shapefile from MRSAC. Superimpose the Kalu mini-watershed boundary on this village shapefile. With the help of select features tool, select the villages and save them as the village layer for Kalu mini-watershed.

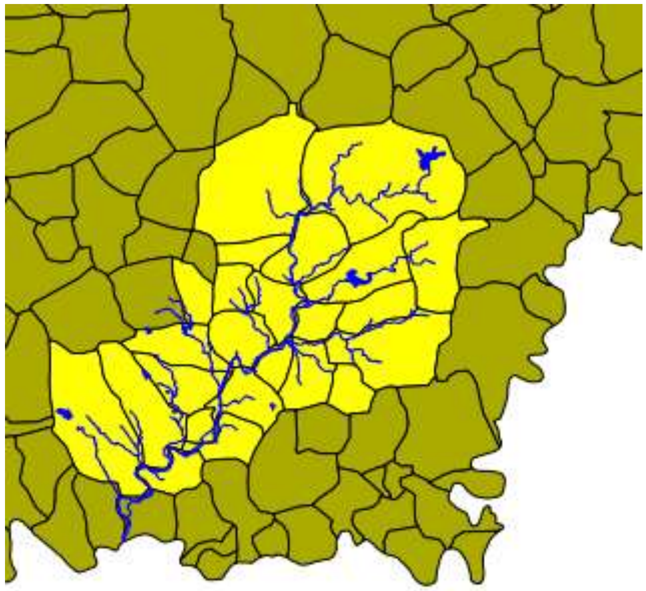


Fig 34. Select the villages in watershed and save as village shapefile

Once this file is saved, name of villages can be retrieved from attribute table of the new village shapefile. Now, list of all habitations from these villages can be obtained by visiting NRDWP web portal. Thus, a list of all possible habitations falling in the watershed can be obtained.

Now for each village, try to map exact location of each of the habitations in that village using Google Earth. Here, the habitations were located with the help of National GIS - Map Viewer (National GIS Web Portal, 2014). It is stressed that no official record of geo-location of all habitations was found for Shahapur block. Thus, the regional analysis is based on partial data. However, it would be good enough to demonstrate the use of GIS interface.

Now, among the habitations, few would fall outside the actual geographic boundary of the watershed. In this analysis, such habitations have been removed from map.

After exporting these habitations as a shapfile, following view of the Kalu mini-watershed can be obtained:

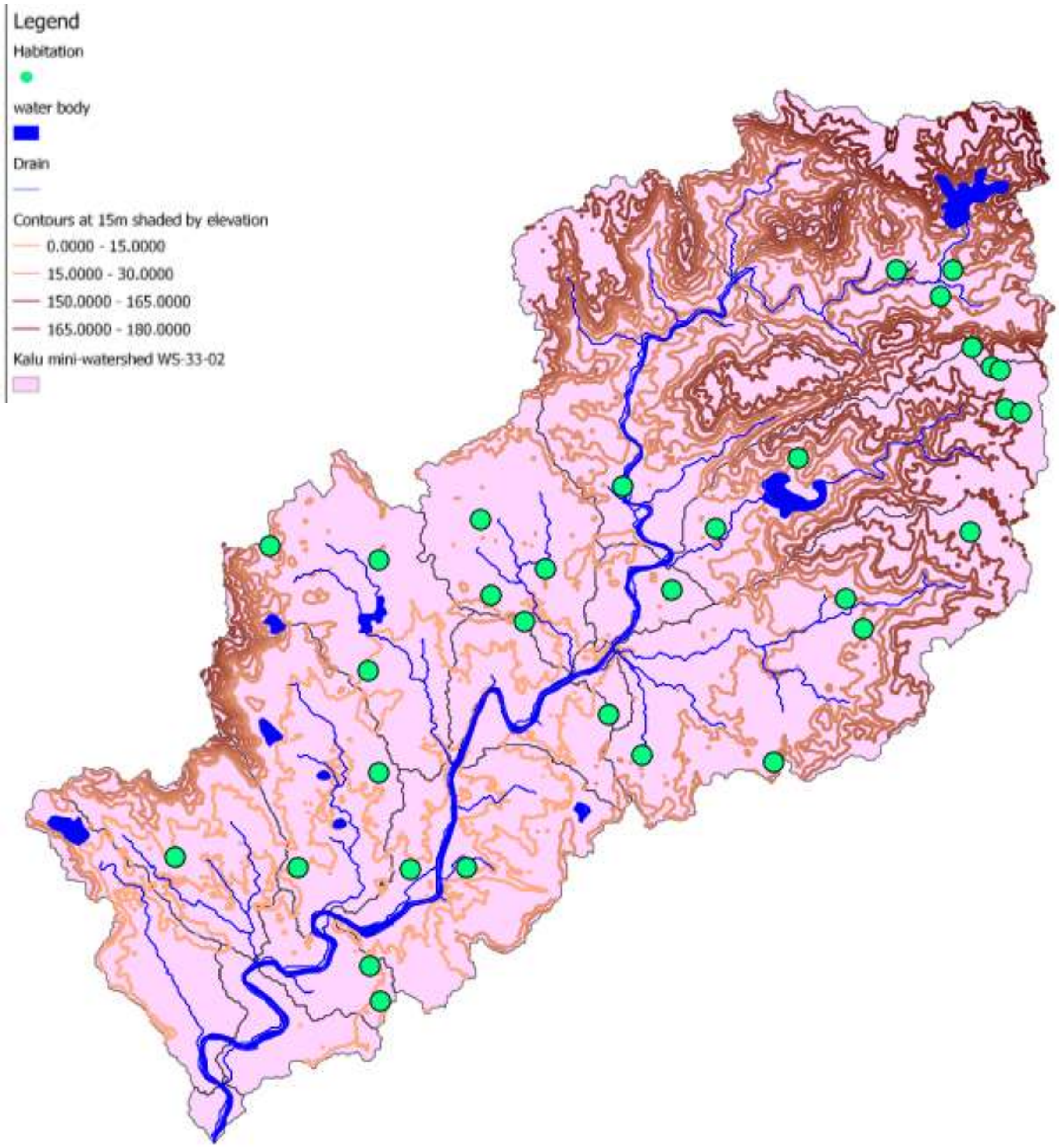


Fig 35. Habitations inside Kalu mini-watershed boundary

Maximum of 60 habitations are located in Kalu mini-watershed. Out of them, 32 habitations were located through the National GIS Web Portal.

ii. Obtain habitations falling below each contour line

This step obtains shapefiles for habitations falling below each contour line. Thus, we can get details of habitations located below a certain elevation.

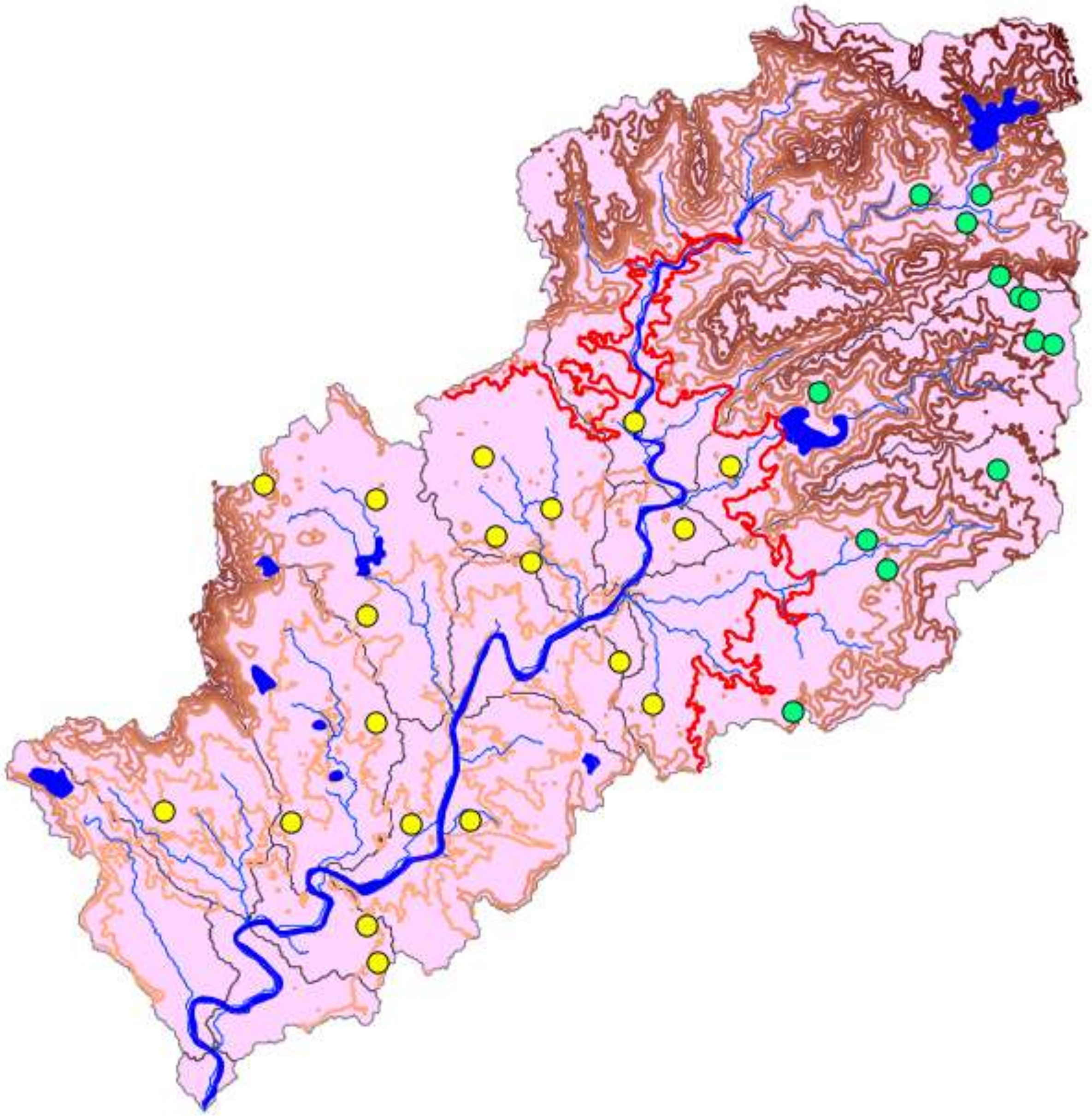


Fig 36. Capturing habitations below elevation 45m (relative)

In fig 33, the red contour is 45 m elevation contour, and the yellow points are habitations falling below that contour. The selected habitations can be saved as a new shapefile. In similar way, shapefiles for cumulative habitations from 15m to 180m are obtained.

It can be seen that the habitations on top right are separated from rest of the watershed by high slope gradient.

iii. Plotting graph of cumulative demand with respect to elevation

Once the list of habitations is obtained and separated by elevations, their respective population can be obtained from NRDWP web portal and a graph of cumulative population with respect to relative elevation can be plotted as shown in figure below-

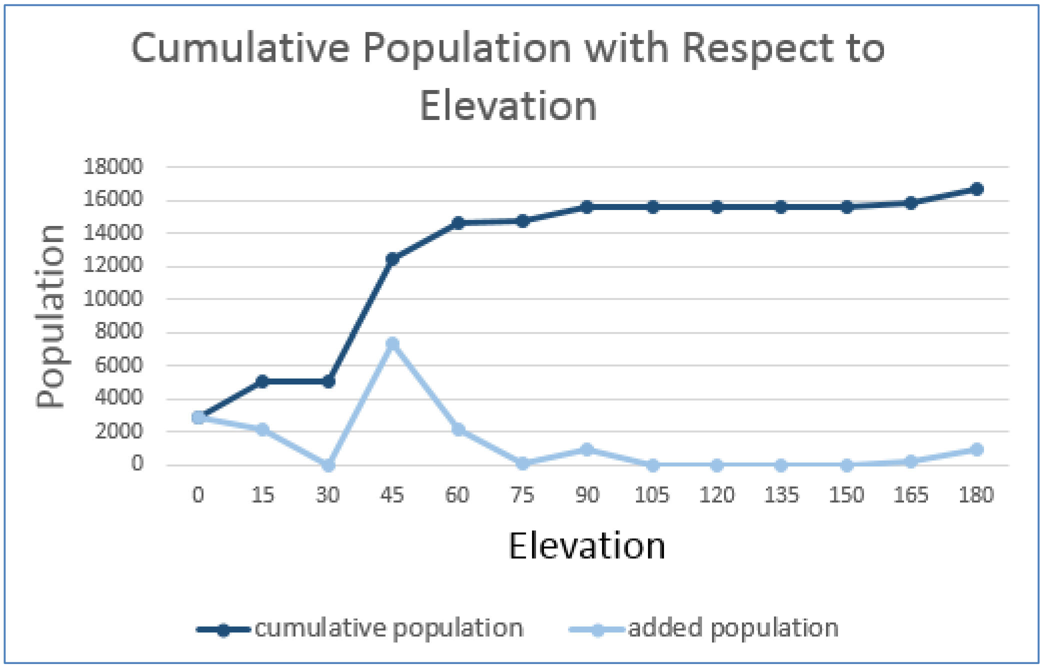


Fig 37. Graph of cumulative population with respect to elevation

Thus, it can be seen that around 93% of the population resides below relative elevation of 90m. Now, if the plot of water demand for the population with the norm of 55 LPCD is plotted for demand of one year, following graph is obtained. Here, the demand lines represent the cumulative demand by total population (blue line) and cumulative demand by SC/ST population (orange bar). The vertical green bars represent the water available in two dams in the watershed, here, the length of green bar shows sum of drinking water quota and balance water of the dams in million cubic meters per year. Thus, it can be seen that there is available surface water in the watershed to serve majority of the habitation. The graph also reveals that the population at high elevation are mostly SC/ST category. It also shows that it would be costly (per capita cost) to provide these high elevation habitations through surface water of the dams as the population to be served at that elevation level is quite small.

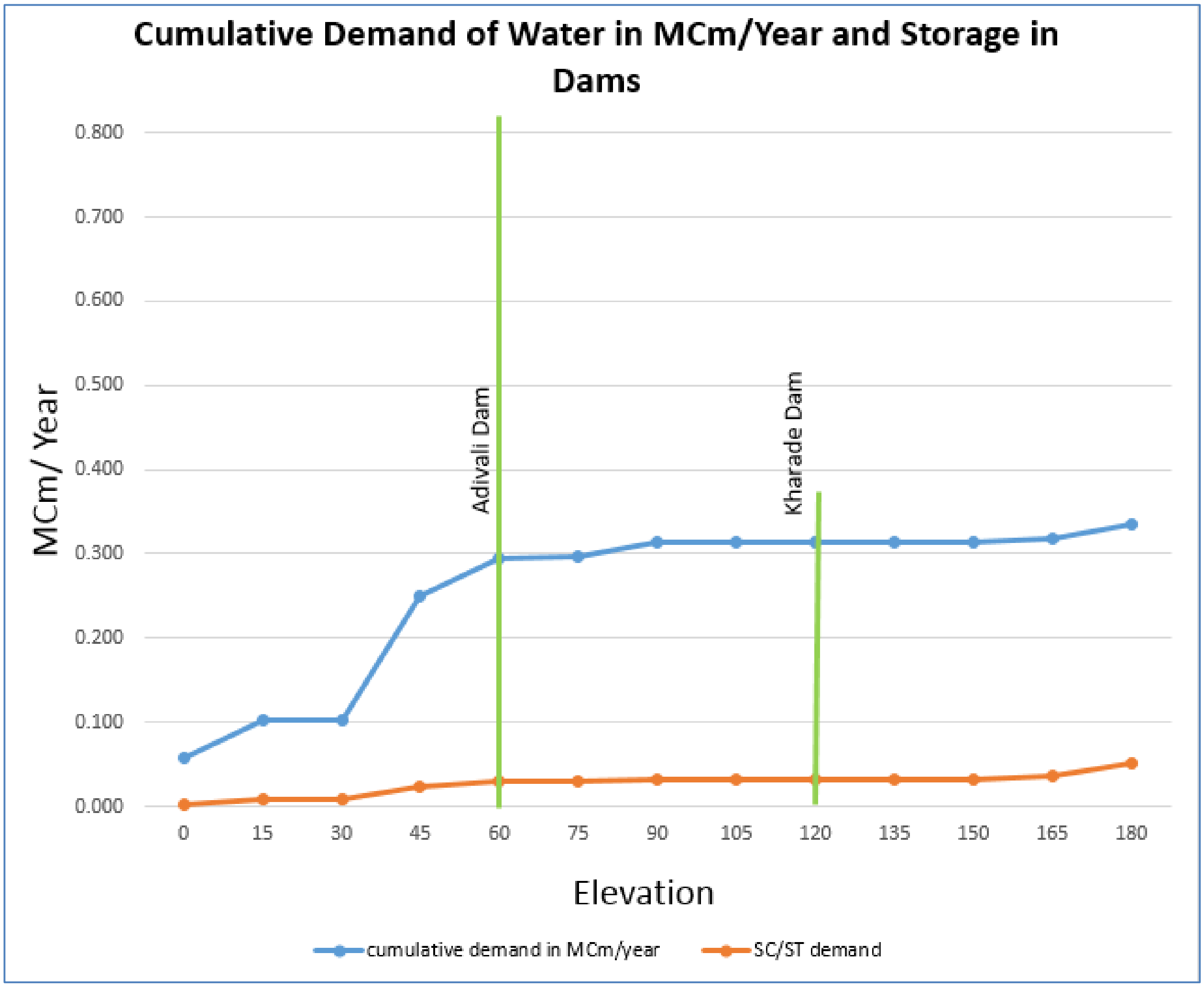


Fig 38. Cumulative water demand in Kalu mini-watershed and available surface water

Further, if we mark habitations using groundwater source and habitations using surface / rainwater water source, following map is obtained, which shows heavy use of groundwater in this region.

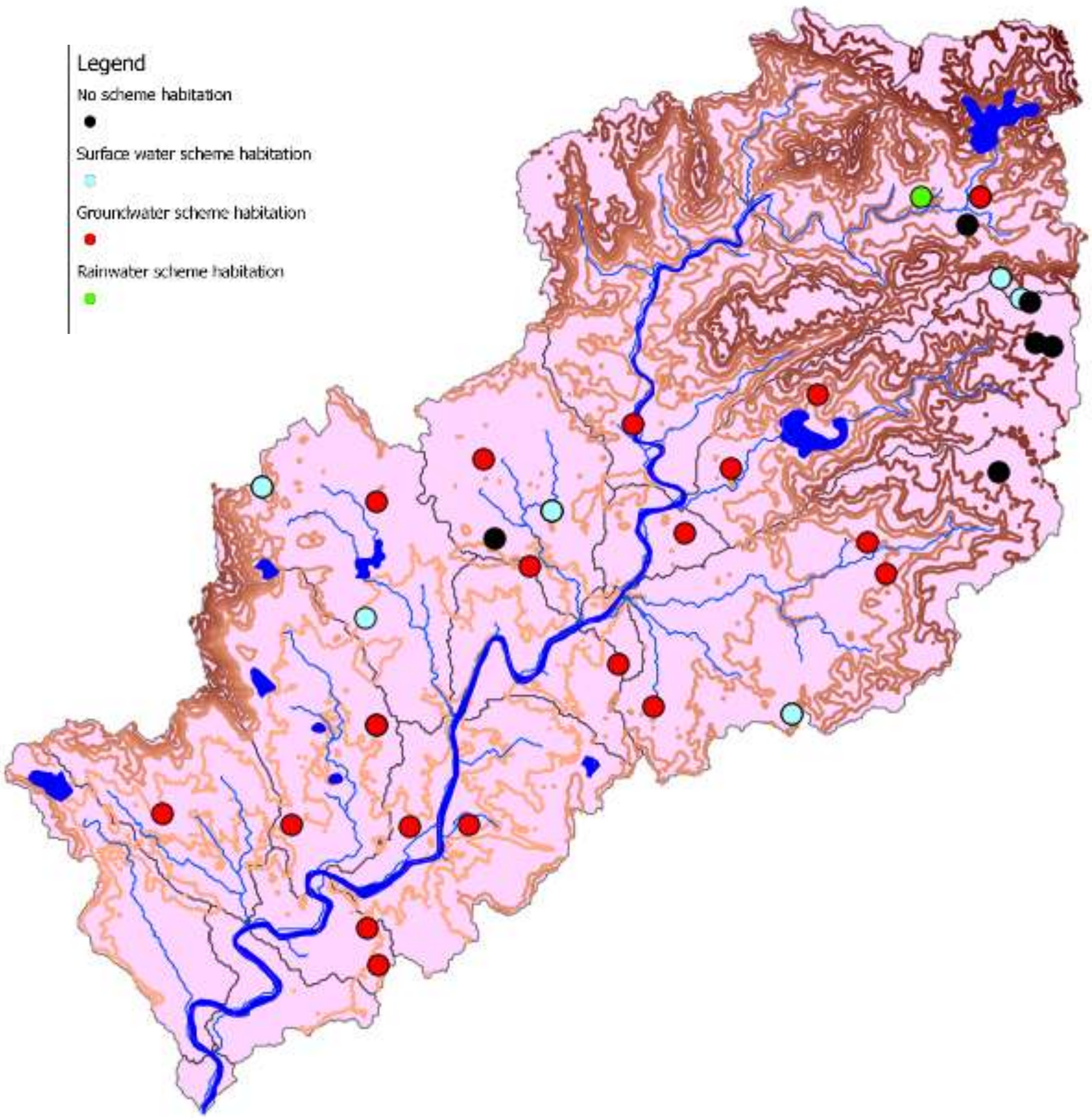


Fig 39. Habitations using different water sources for drinking water schemes

From the graph and maps, it can be concluded that the surface water available in Adivali and Kharade dams can be used to reduce dependency on groundwater for majority of habitations of this region. Again, it can be seen that the habitations with no schemes are mostly located on the top right side, with maximum elevation. Thus, once again, it is reflected that these remote habitations need to be dealt with differently.

In this example, the habitations on top right corner belong to Ambekhor village, which relies on tanker for the summer months. Thus, Ambekhor village was taken for study of local view in the GIS interface.

4.3 Demonstration of local view with example of Ambekhor village

To demonstrate the use of GIS interface in data analysis, details regarding drinking water situation in the village of Ambekhor (Gram Panchayat: Manekhind) are represented in the interface and various aspects of the water supply to the village are explained. The details about the field visit to Ambekhor village can be found in Annexure. The village boundary is extracted from MRSAC village polygon map.

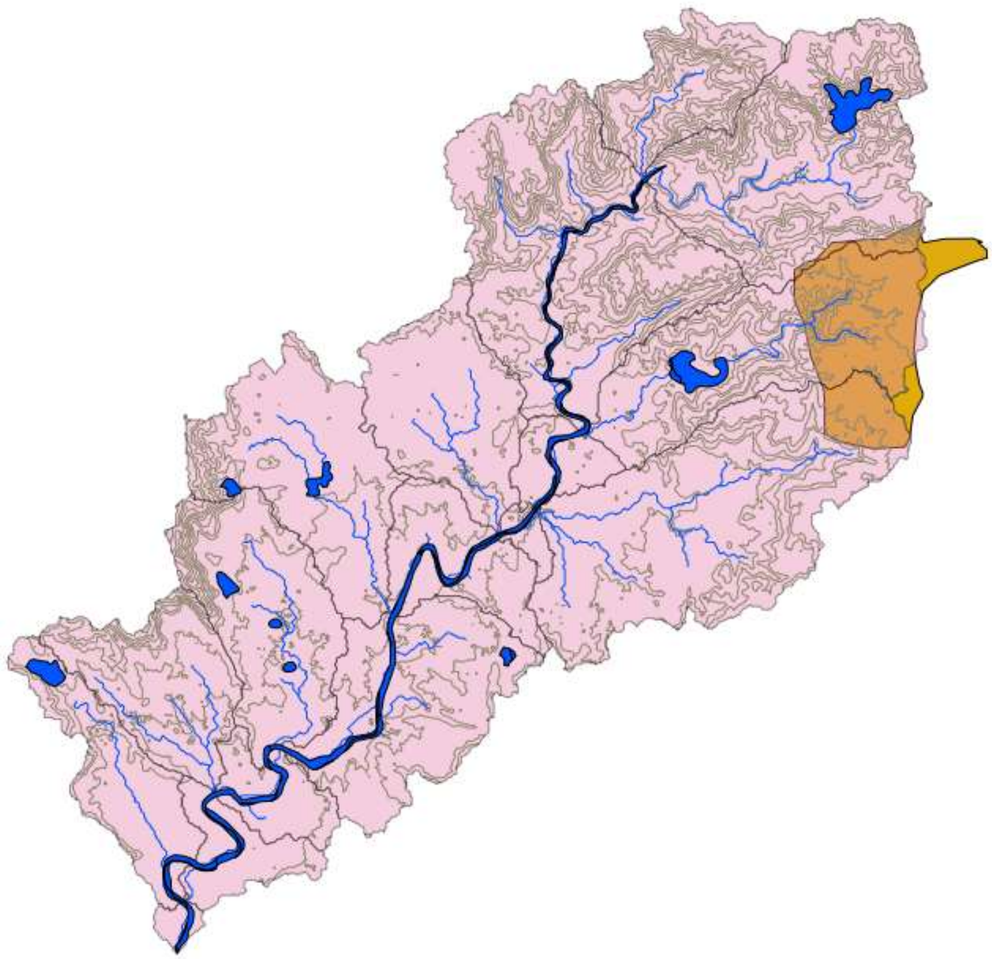


Fig 40. Ambhekor boundary in Kalu mini watershed

The above figure shows the boundary of Ambhekor village and its location in the mini watershed of Kalu. As can be seen, this village lies on the ridge of the watershed.

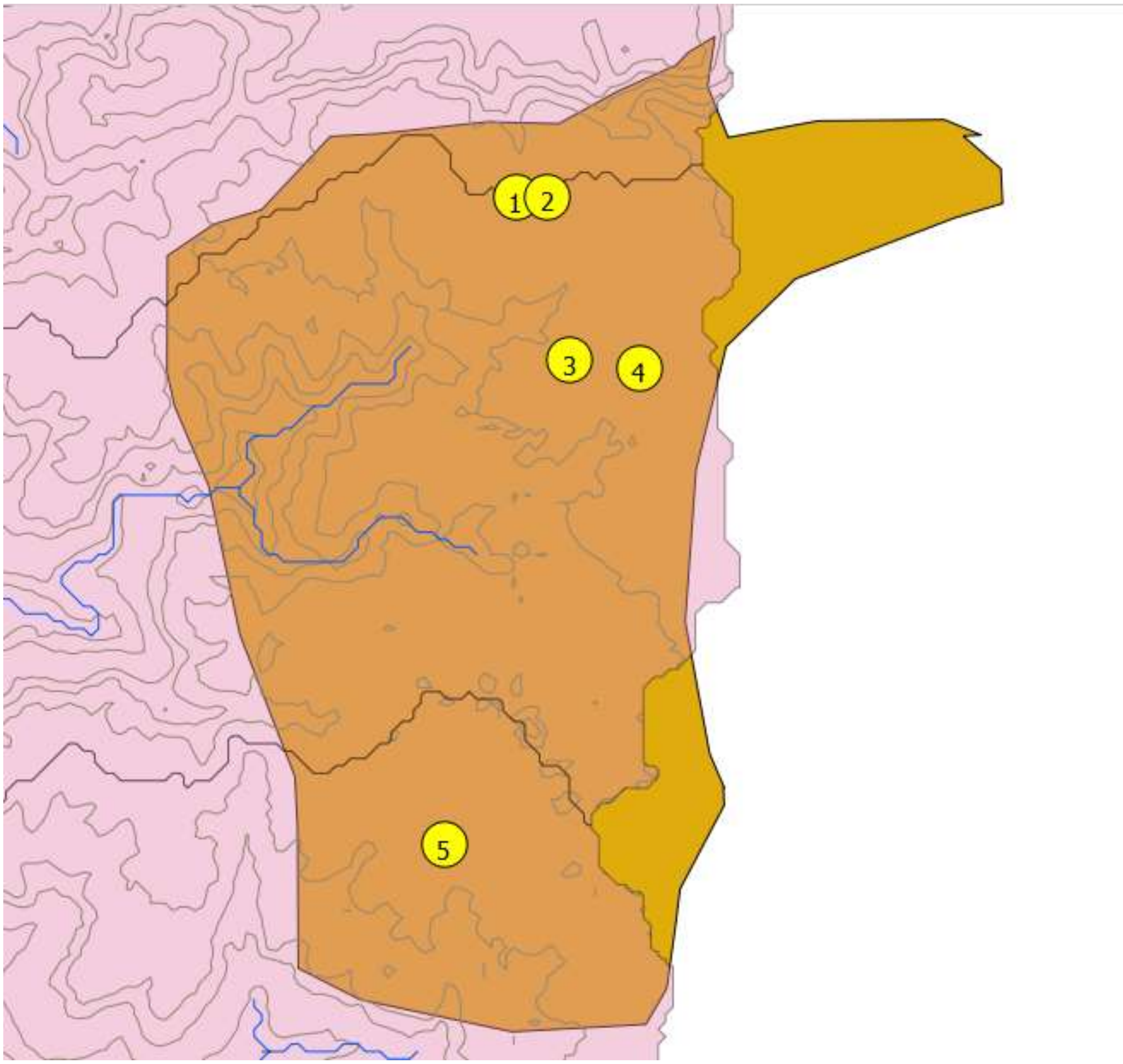


Fig 41. Five habitations of Ambhekor village

The picture shows the position of five habitations in the village which are namely,

1. Balyachiwadi (24 households)
2. Kavtewadi (30 households)
3. Ambekhor (38 households)
4. Sakharwadi (20 households)
5. Kubhaichiwadi (105 households)

Habitations 1 and 2 are closely located followed by habitations 3 and 4. Habitation 5, Kubhaichiwadi, is quite isolated from rest of the habitations in the village.

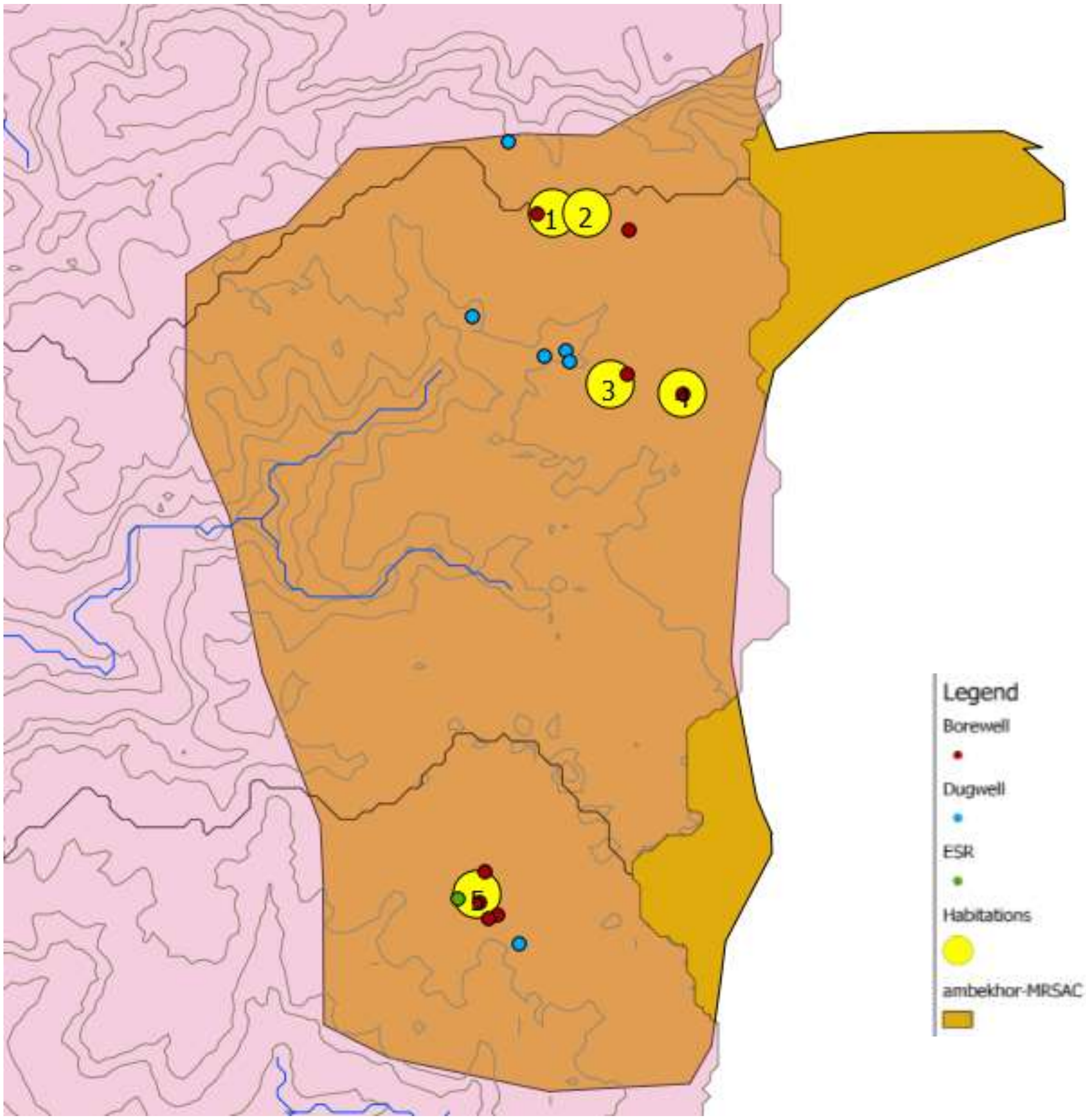


Fig 42. Assets located around each habitation

The dug wells have been represented as blue dots whereas bore wells have been represented as brown dots. The green dot in habitation 5 represents an ESR. This view gives an idea of source structures or delivery points located around each habitation. For instance from above image it is easy to know that bore wells are more in habitation five whereas dug wells are more near habitation 3. It is interesting to note that there is a ridge line between habitation 5 and rest of the habitations.

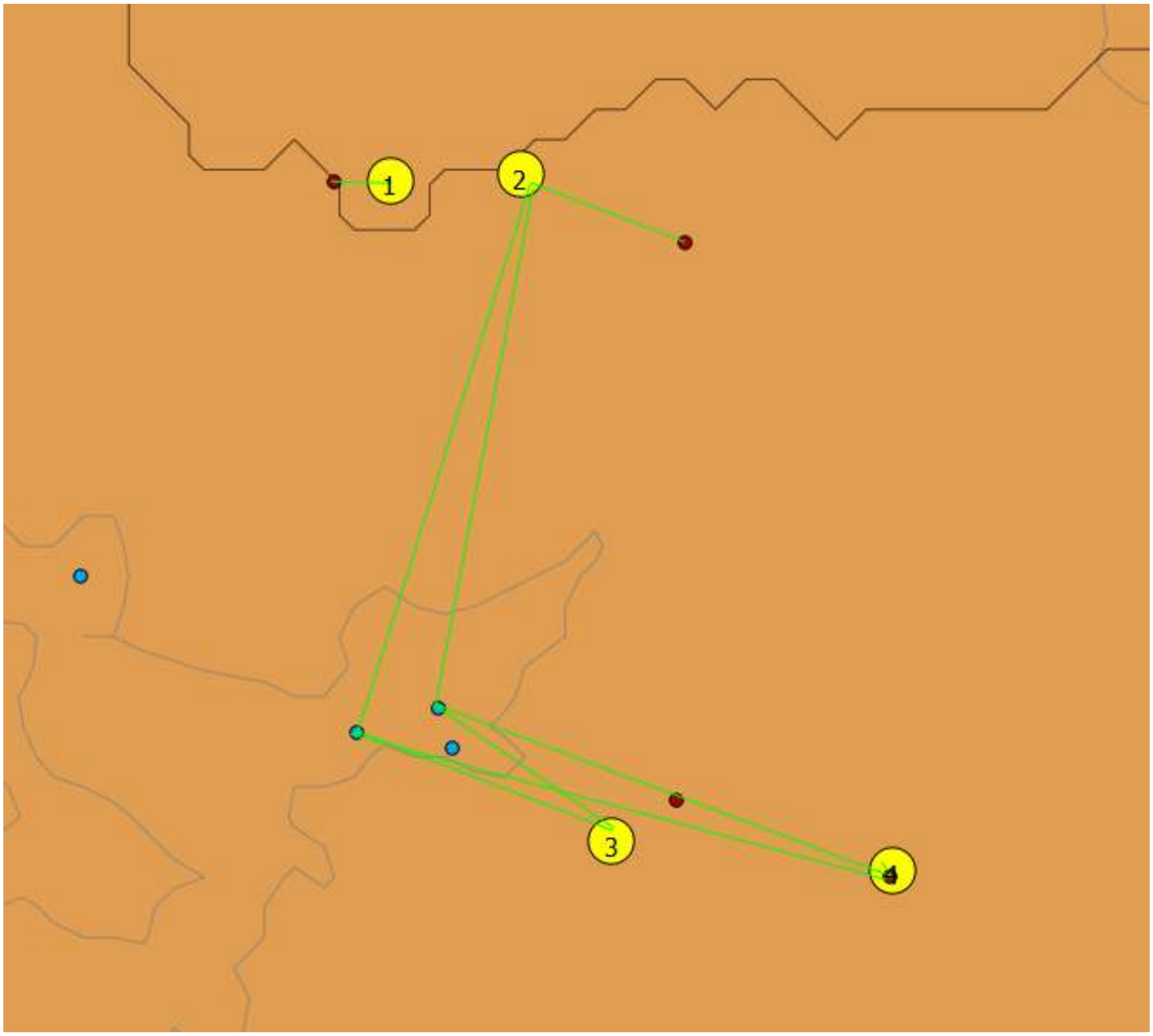


Fig 43. Fig. Utilization of Dug and Bore wells during July (Habitation-1,2,3 and 4)

The utilization pattern of sources is represented as green line. This scenario is during the month of July, when rains have already fallen for few days. Here, habitations 1 is dependent on bore well, habitations 2, 3 and 4 are mostly utilizing dug well. It can be seen that the water assets are closely located to the habitations and hence there is no element of drudgery involved. There is only one contour line separating habitations 3 & 4 from the dugwells. This means the elevation difference is not much.

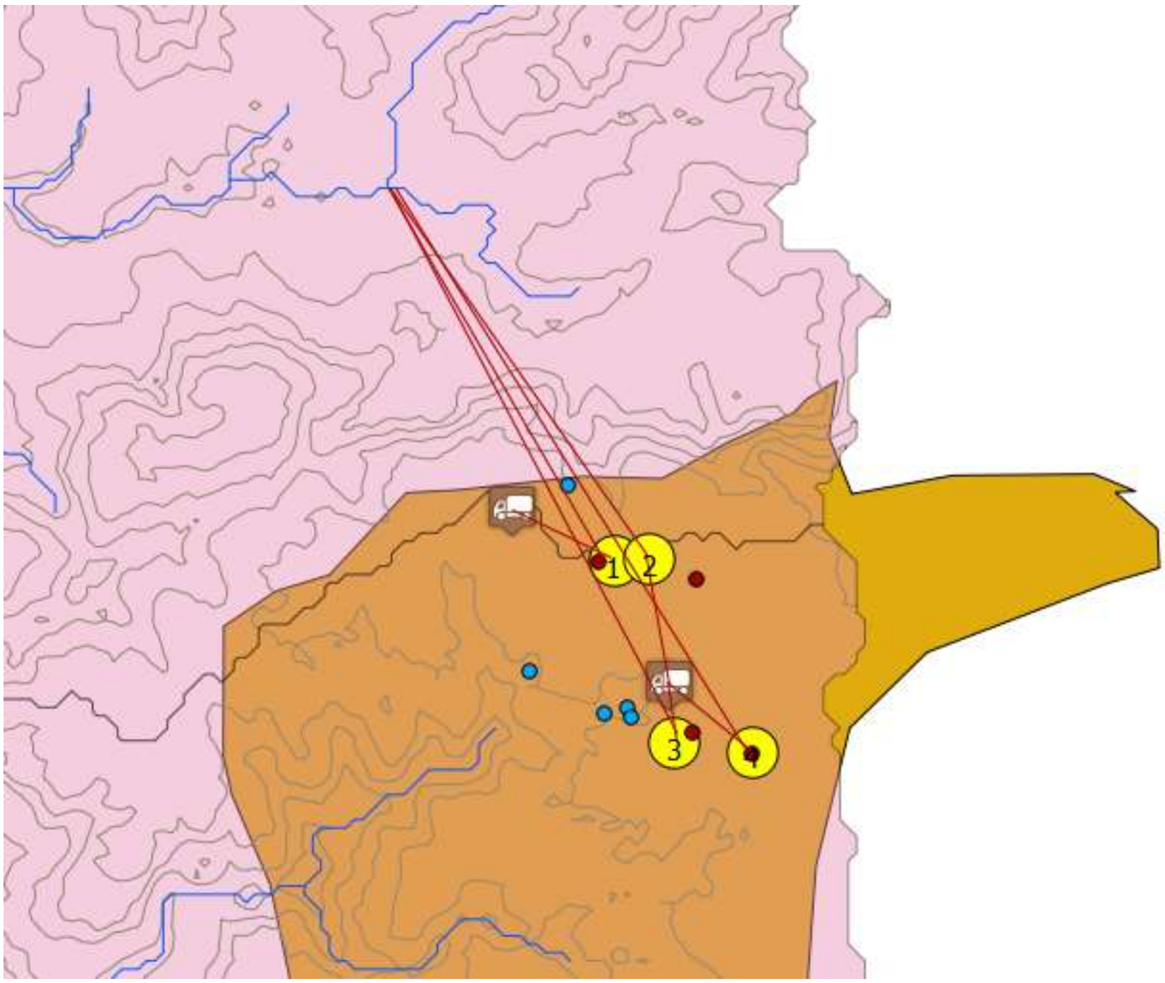


Fig 44. Fig. Utilization of wells, tankers and drains during May (Habitation -1,2,3 and 4)

The utilisation of source during summer month of May is totally different. All the habitations suffer from water shortage and have to shift to a different source which is three kilometers away. This source is a spot on Kharade river, 3 km away from the habitations. It is utilized for washing cloths and providing water to cattle. For driking purpose, villagers have to depend on tanker water which is depicted in the picture above. Thus, this picture clearly shows that there is drudgery involved in summer months.

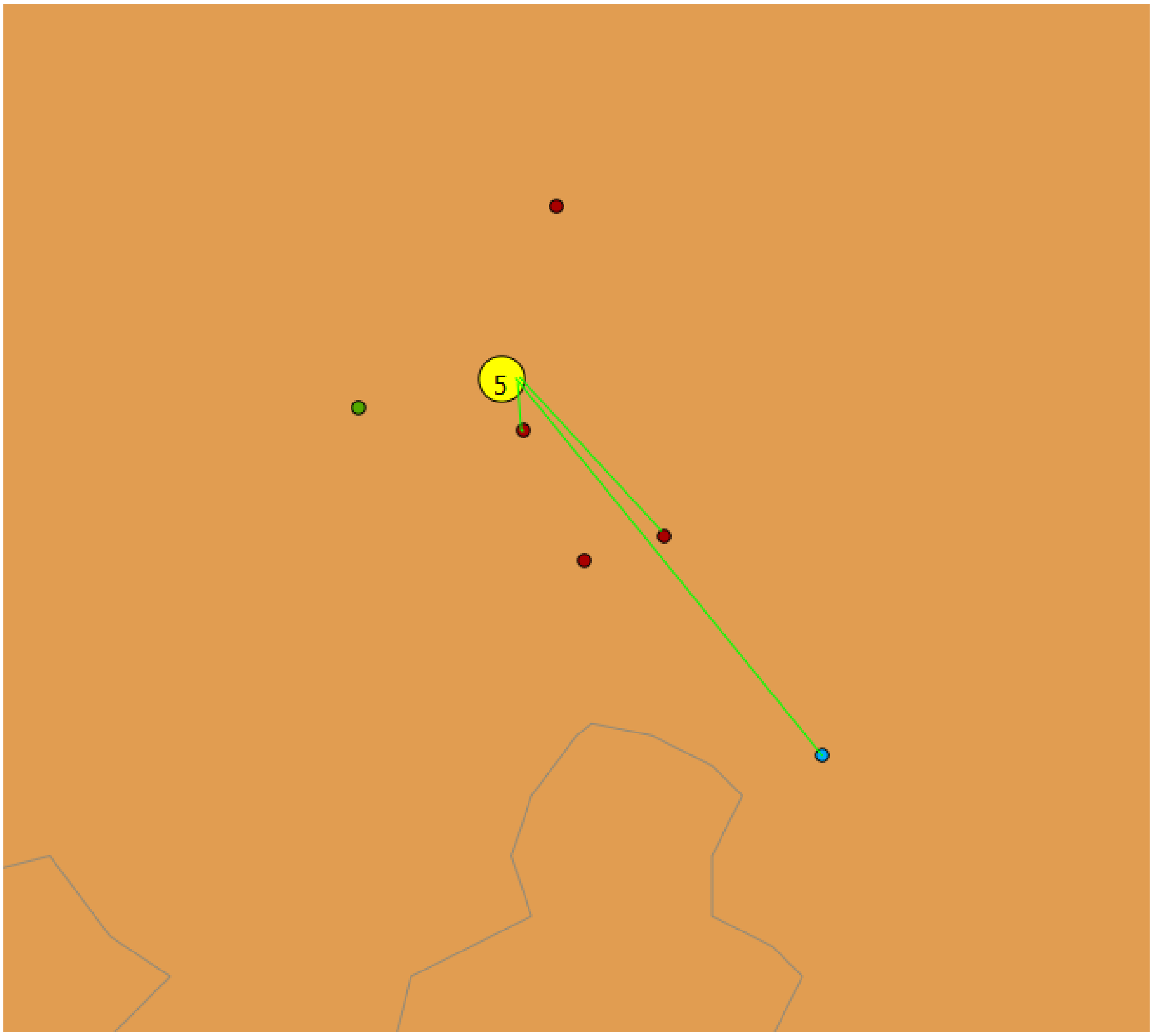


Fig 45. Utilization of dug and bore wells during month of July (Habitation-5)

In a similar fashion habitation 5 is utilizing both dug and bore well water during the month of Monsoon. It is stressed that the Elevated Service Reservoir (ESR) is not functional, which can be seen by lack of line connecting the ESR to the habitation.

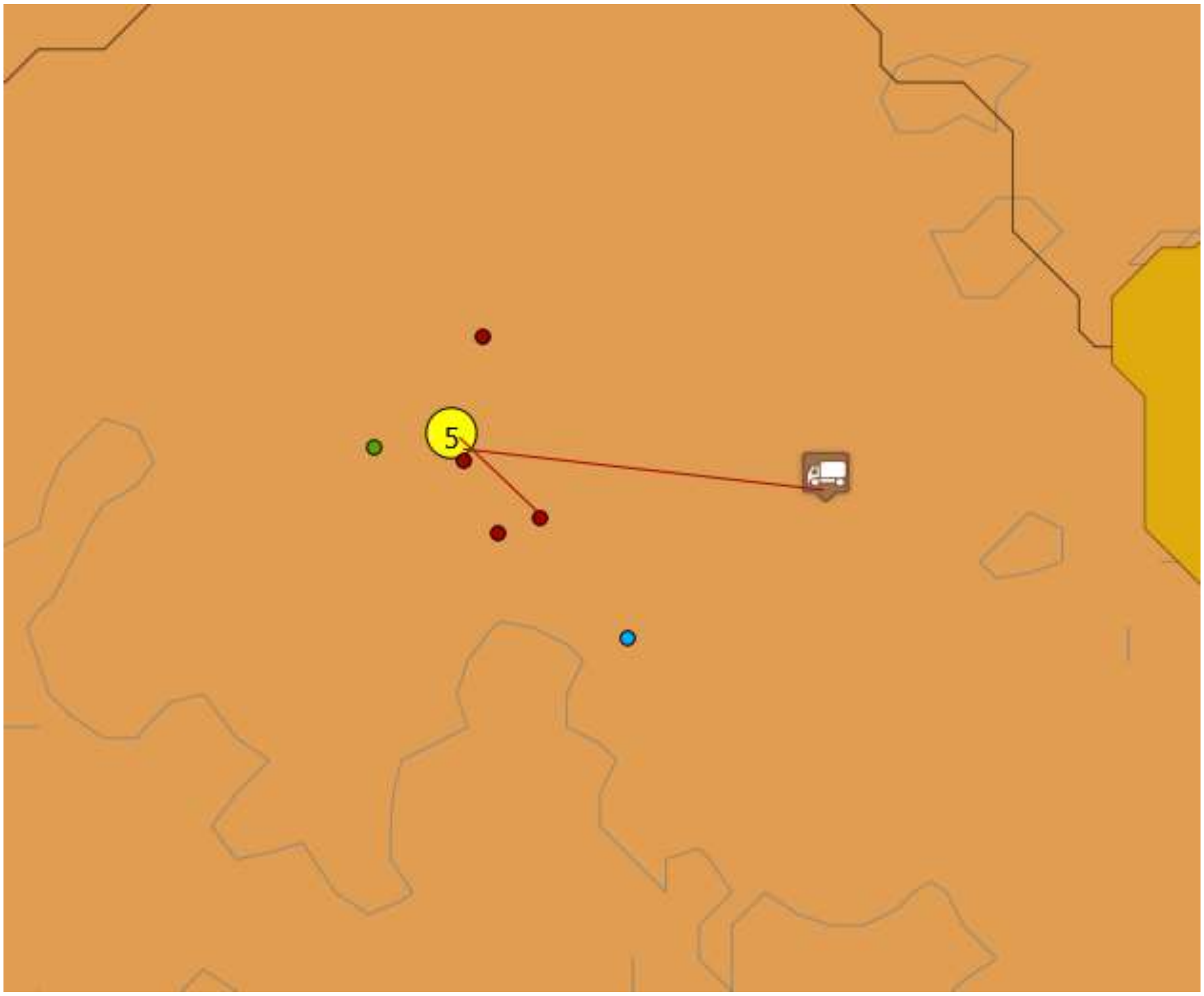


Fig 46. Utilization of wells and Tanker during the month of May (Habitation-5)

Habitaiton 5 is also in need of tanker water during the month of May. However, the borewell in this habitation is perennial. Again, note that there is a ridge line separating this habitation from other habitations. This shows how the two neighboring watersheds have different behavior of groundwater.

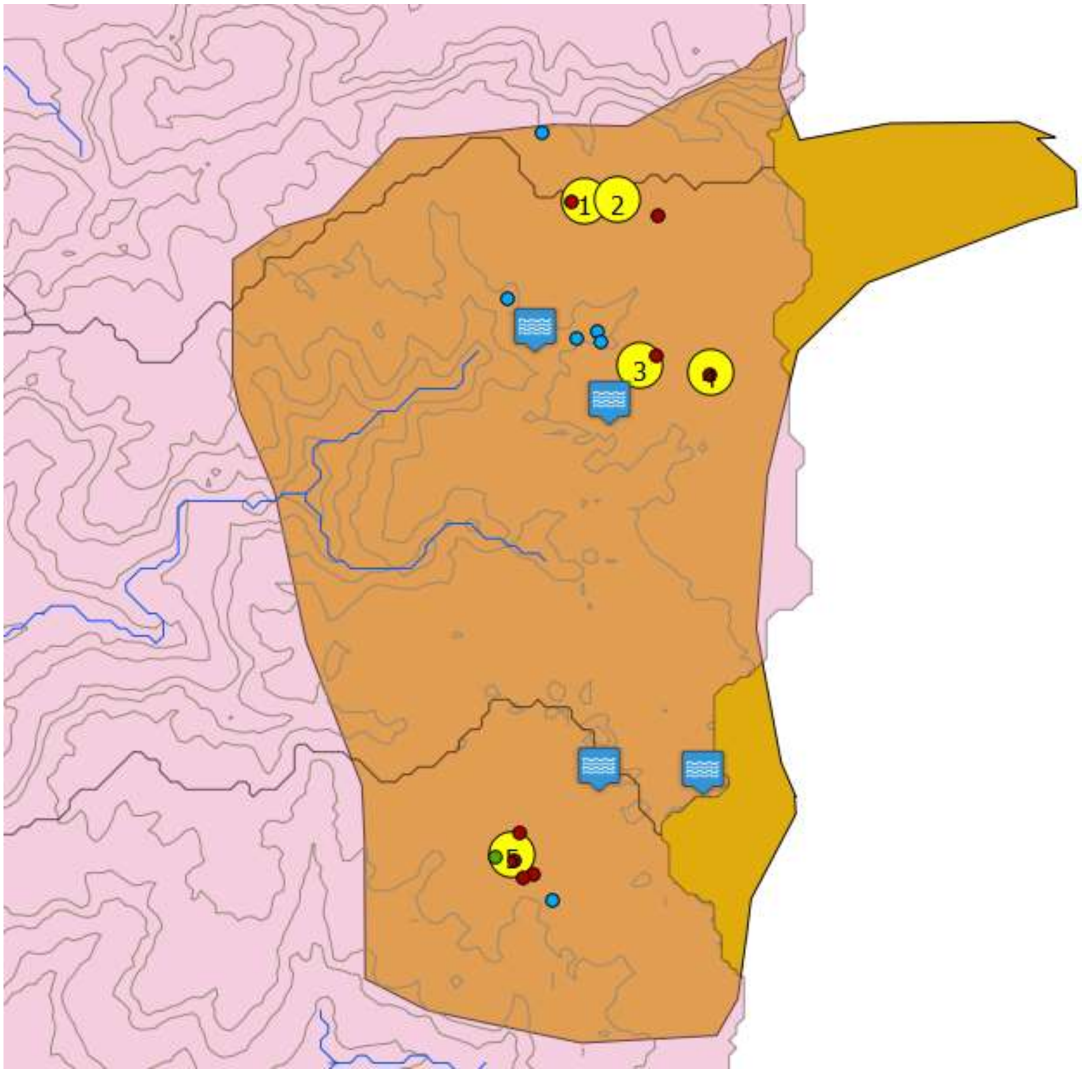


Fig 47. Sustainability structures in Ambhekor

The various water sustainability structures have been depicted by blue symbol.

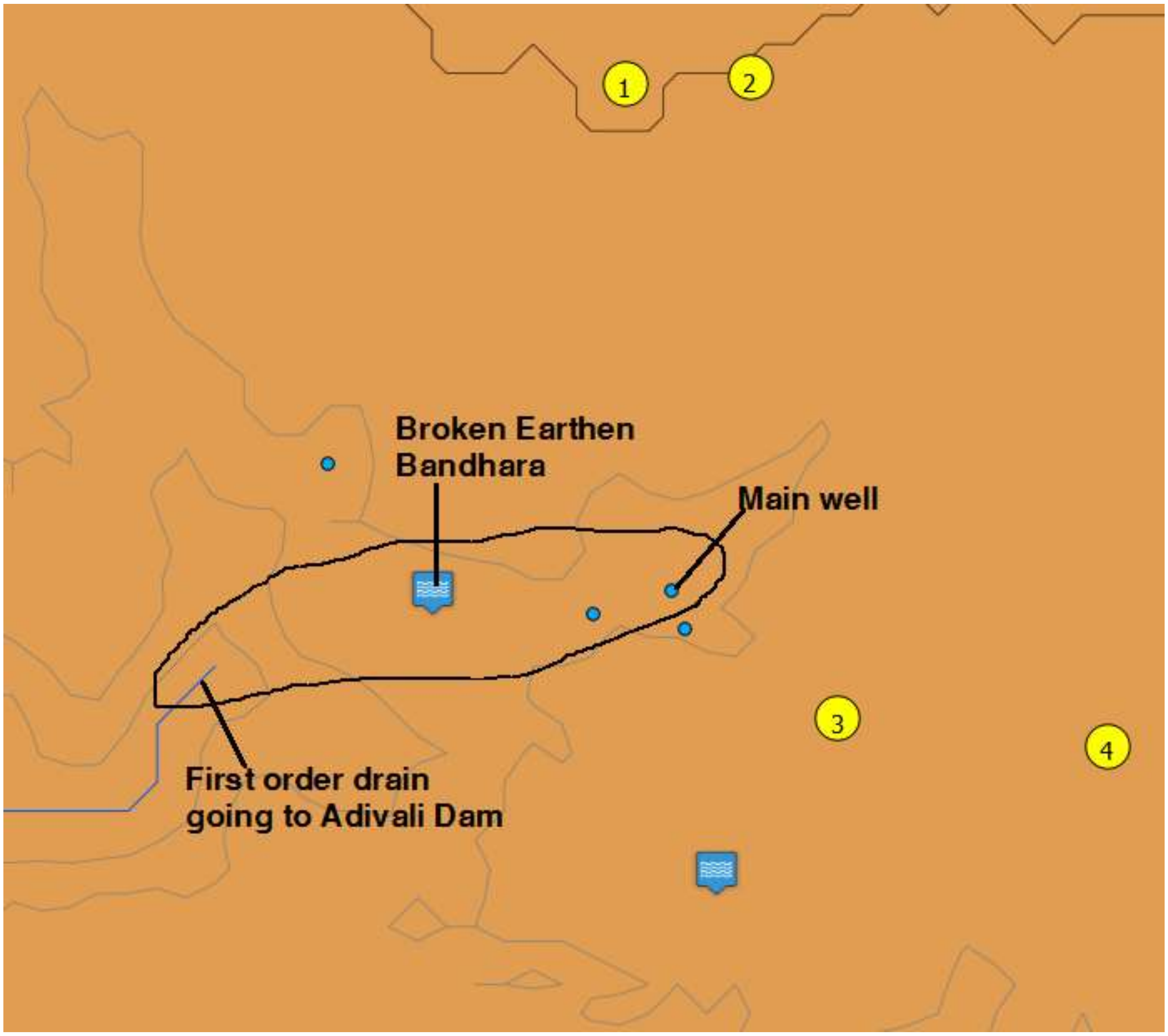


Fig 48. The link between drain, broken earthen bandhara and main well

Fig 49. The link between drain, broken bandhara and main well as seen in Google Earth

The link between main well of the village, broken earthen bandhara and a first order drain going to Adhivali dam can be seen from the GIS. The main well is situated in the first order drain. As the earthen bandhara has broken down, there is a chance of intervention on this drain to strengthen the main well and see if it can become perennial. This detail of water assets is very hard to obtain without going to the field, if pictorial data representation is not used.

Thus, the GIS interface has the capacity to show information that goes beyond summarizing statistics in a pictorial format. The geographical elements can be used to gain much better understanding of the current situation in any locality. This single village view shows spatial relationship between habitations and water assets, delivery points, captures seasonality, drudgery and also aids in figuring out possible local intervention to deal with problems faced by the habitation.

4.4 Conclusions from sample prototype of GIS interface

From the two examples in this chapter, it can be seen that GIS interface is capable of meeting the design objectives which were expected from it as a knowledge tool. Recalling from previous chapter, the GIS interface was expected to do the following-

i. To help in assisting the implementers and planners at District and Taluka level to take better decisions at regional as well as local levels to ensure –
    a. Immediate water security such as drought mitigation
    b. Short term water security such as five year perspective plans
    c. Long term water security, such as restoring the water balance in the region through strategic utilization of source and ground water resources and watershed development etc.
ii. To share a common picture of ground reality between administration and public
iii. To aid in holistic understanding of demand-supply scenario in a region

With respect to the first objective of assisting implementers and planners, the example of Ambekhor village illustrates need of draught mitigation for the village, along with plausible solution repairing the broken bandhara for accumulation of surface water and help in increasing water table for the main well. The regional example also illustrates that available surface water bodies can be used to reduce dependency on groundwater sources in watershed, thus enhancing reliable water supply. The regional example gives this insight that the isolated habitations at the extreme elevations need special attention with respect to

a. Scheme with high per capita cost or
b. Focus on creating local surface water bodies at those elevations or
c. Focus on watershed interventions to increate water table of the area

Thus, the first design objective is met to a significant extend by this knowledge tool.

As this interface is graphical, and fairly easy to understand, it can be used to be shared as common platform between administration and public, so that the public can verify and rectify the representation of ground reality in their habitation/village.

As this interface captures geographic, social and administrative attributes and the demand-assets-supply attributes collectively, it can aid in holistic understanding of the demand-supply scenario in the region.

From the example of Ambekhor village, it can be seen that the GIS interface captures the elements of seasonality and drudgery.

Chapter 5 Conclusion and Future Work

5.1 Conclusion

The learnings of this project are that data handling creates significant difference in how a particular goal is achieved. Properly monitored data can prove important in assessing planning for the goal. In the context of Thane district and particularly Shahapur block, lacunae were found in monitoring and planning process. Monitoring is neglected at the local level. Whereas planning is only done for finances. Both these lacunae fail to plan for water as a resource, for achieving drinking water security. Because of neglecting regional planning, the datasets do not capture seasonal fluctuations in water supply and comfortable access to water for all.

To bring the geographical and regional element into the planning and monitoring process, it is proposed that a visual GIS interface be incorporated in data analysis. The GIS interface has potential to reveal information regarding equity, drudgery and seasonality, which are otherwise hard to capture. By using GIS for regional analysis, efficient and sustainable solutions can be unearthed, thus providing for intermediate and long term planning for water security. Through the example of Ambekhor village, it can also be seen that possible local interventions can be suggested by studying the habitation / village in GIS interface.

As the local view of GIS interface is easy to understand, it can serve as a common platform between implementers, decision makers and beneficiary groups.

It is also suggested that regular surveying of habitations should be taken up seriously, and a simplified questionnaire should be created to make it feasible. The primary task of this questionnaire would be to monitor seasonal fluctuations. Current database does not capture sustainability structures well. Thus, a new questionnaire and table format is recommended for adoption.

It can be concluded from this project, that while the data handling system has come a long way with the publically accessible data and visual summarizations through GIS, the tools can be sharpen much more to increase efficiency in the administrative system and aid the decision-makers. This project provides one example of such attempt. It is recommended that more studies should be done from this perspective and the outcomes of studies should be fed into existing system to make it more efficient and effective.

5.2 Future work

1. Taking up more pilot studies with GIS interface to make the interface more robust
2. Exploring alternative approaches of data collection and management for a feasible monitoring mechanism
3. Enhancing GIS interface further so that it can facilitate discussions between various agencies such as water supply, water resources, forestry, agriculture department etc.

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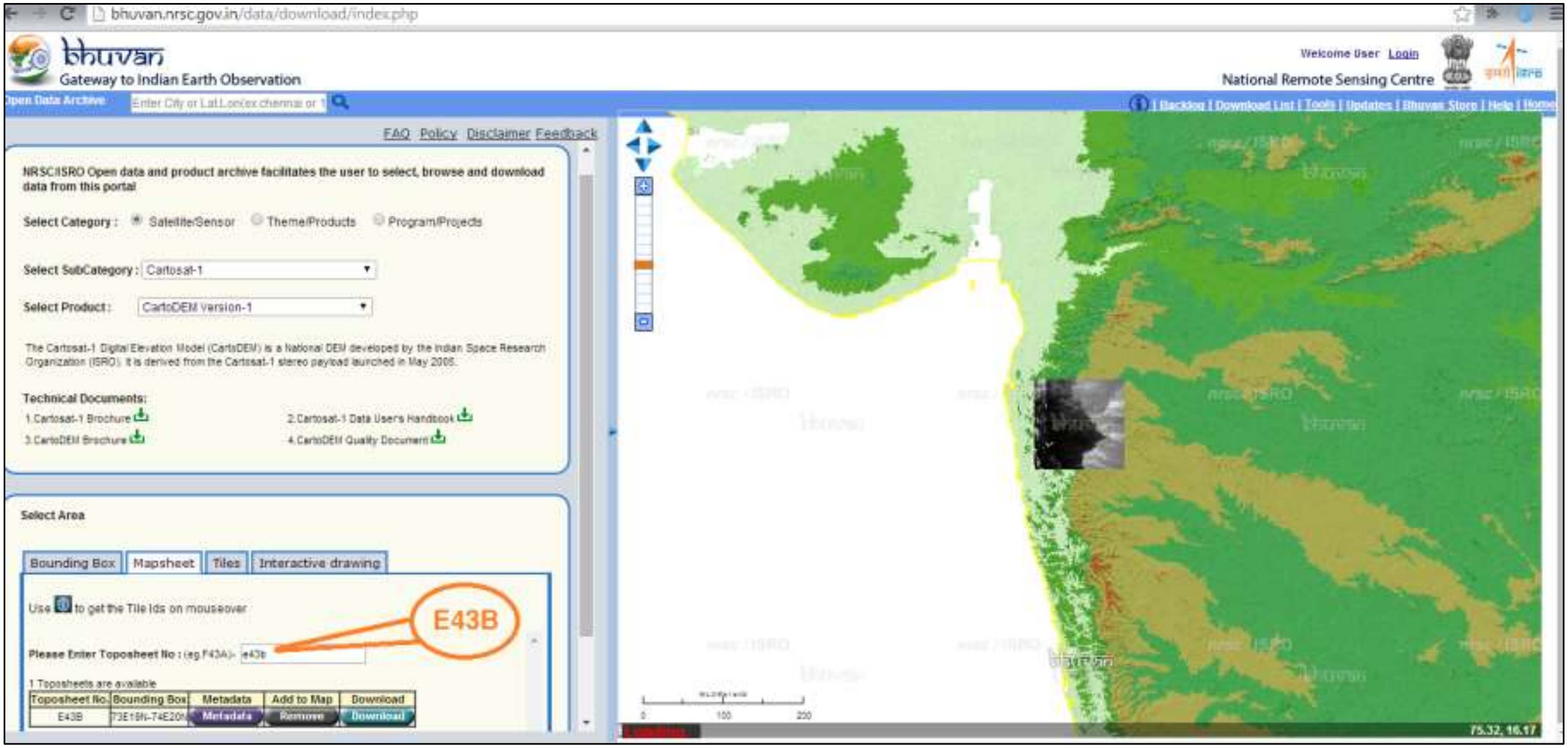
Annexure 1:

Getting DEM for Shahapur block from Bhuvan



Annexure 2:

Classification of watersheds as per Soil and Land Use Survey of India

Watershed is defined at Soil and Land Use Survey of India as-

'A natural hydrologic entity governed by the terrain topography from where runoff is drained to a point.'

Thus, watershed is a general term and doesn't not have specifications regarding its size or area. In India, various institutes have classified watersheds differently. The classification followed by MRSAC is as given by Soil and Land Use Survey of India [SLUSI]:

Water Resource Region: India is divided in six water resource regions as per Soil and Land Use Survey of India. Each region has multiple river basins.

Basin: Basins may refer to individual basin of one big river, such as Krishna, or combined basins of smaller rivers.

Catchment: Each basin further has catchments, demarking the tributaries of a basin

Sub-catchments: Sub-catchments cover the small tributaries of the catchment

Watersheds: Watersheds are hydrological units of the smallest size in a macro system. While it is further divided into sub-watershed, mini-watershed and micro-watershed, the smaller units are generally not considered for analysis at the national / state level. As Shahapur block has high fluctuations in terrain, these smaller units become important in the current case study of Shahapur block.

The rough areas of each of these units as given by Soil and Land Use Survey of India in following table:

S. No.	Category of Hydrologic Units	Size Range (ha)	Average Size (ha)
1.	Water Resource Region	270,00,000-1130,00,000	5,50,00,000
2.	Basins	30,00,000-300,00,000	95,00,000
3.	Catchments	10,00,000-50,00,000	30,00,000
4.	Sub-catchments	200,000-10,00,000	7,00,000
5.	Watersheds	20,000-300,000	1,00,000
6.	Sub-watersheds	5,000-9,000	7,000

S. No.	Category of Hydrologic Units	Size Range (ha)	Average Size (ha)
7.	Micro-watersheds	500-1,500	1,000

Table 5. Average sizes and ranges of hydrological units in India

Annexure 3:

Generating watershed from DEM using GRASS

In GRASS tools, select the module 'import loaded raster' (r.in.gdal.qgis). Select DEM (cdne43b) as loaded layer and give a suitable name for output raster map (eg cdne43b_grass). Press Run and View Output when the process is successfully completed.

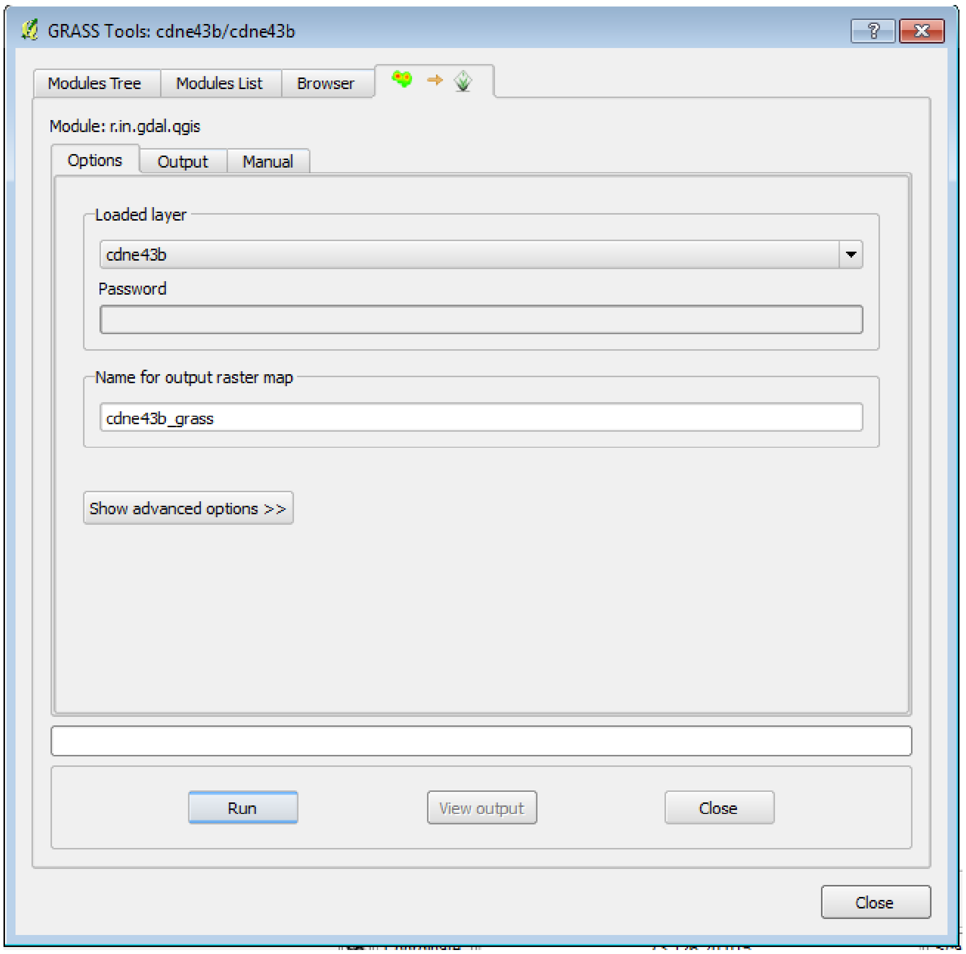


Fig 50. Importing DEM in GRASS

Now select the module 'Watershed Analysis' (r.watershed). Choose the cdne43b_grass as Input map.

The field "Minimum size for each basin (no of cells)" uses the specified no of cells in catchment of watershed to calculate the watershed boundaries. Set no of cells to be 5000. This number needs to be arrived at by trial and error. The smaller the number, higher number of watersheds would be created.

Then provide names for each of the four maps that would be generated. These four maps would be-

Stream segments: streamsegments5000 (This will give the drains in the watershed)

Unique label for each watershed basin: basins5000 (This will give the sub-basin polygons for watershed)

The rest two maps can be generated as per requirement.

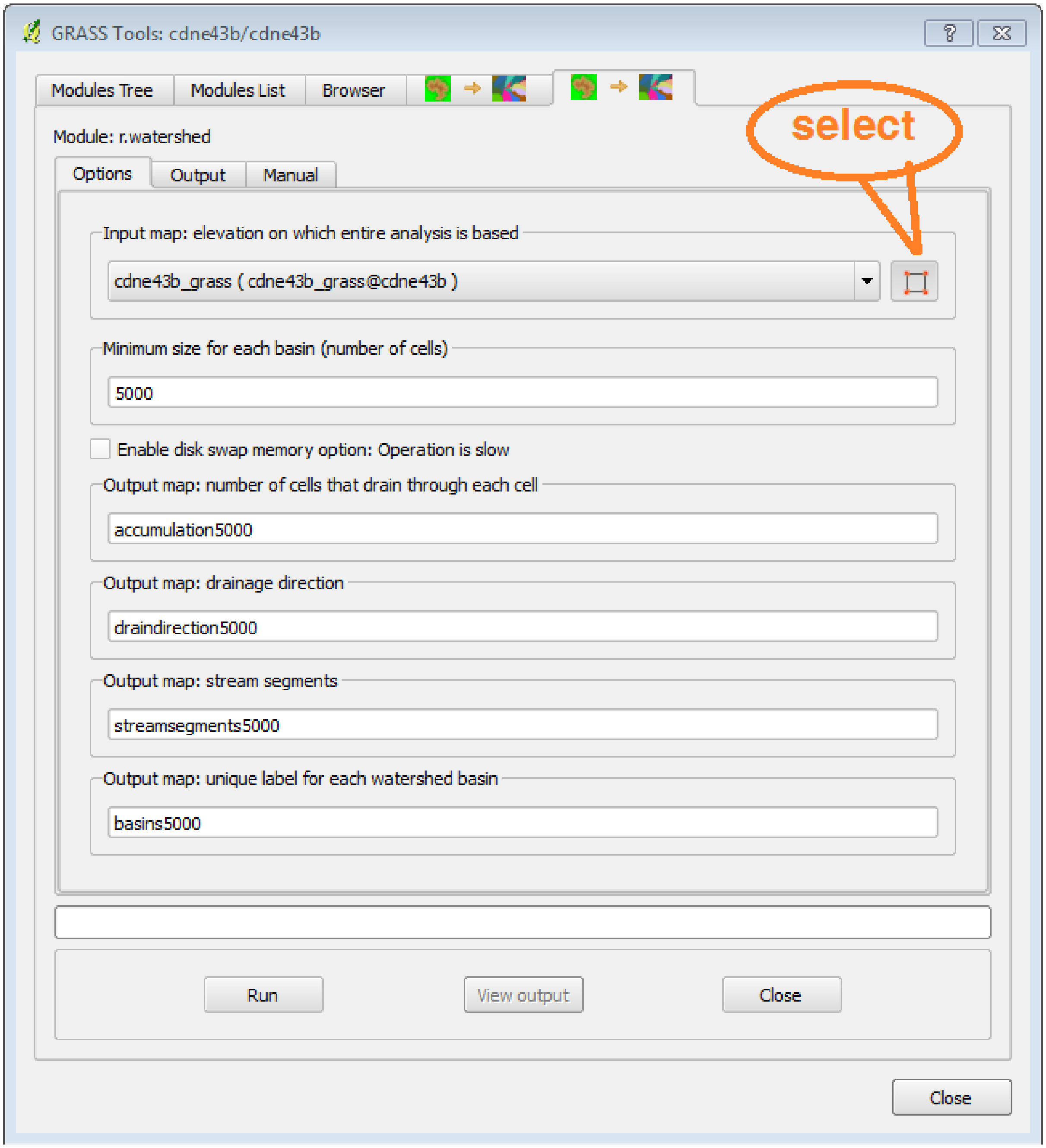


Fig 51. Choosing parameters for 'watershed analysis' module

This operation would take some time. After successful completion, click on view output. It will add four maps to the QGIS browsing list.

The maps would look as follows:

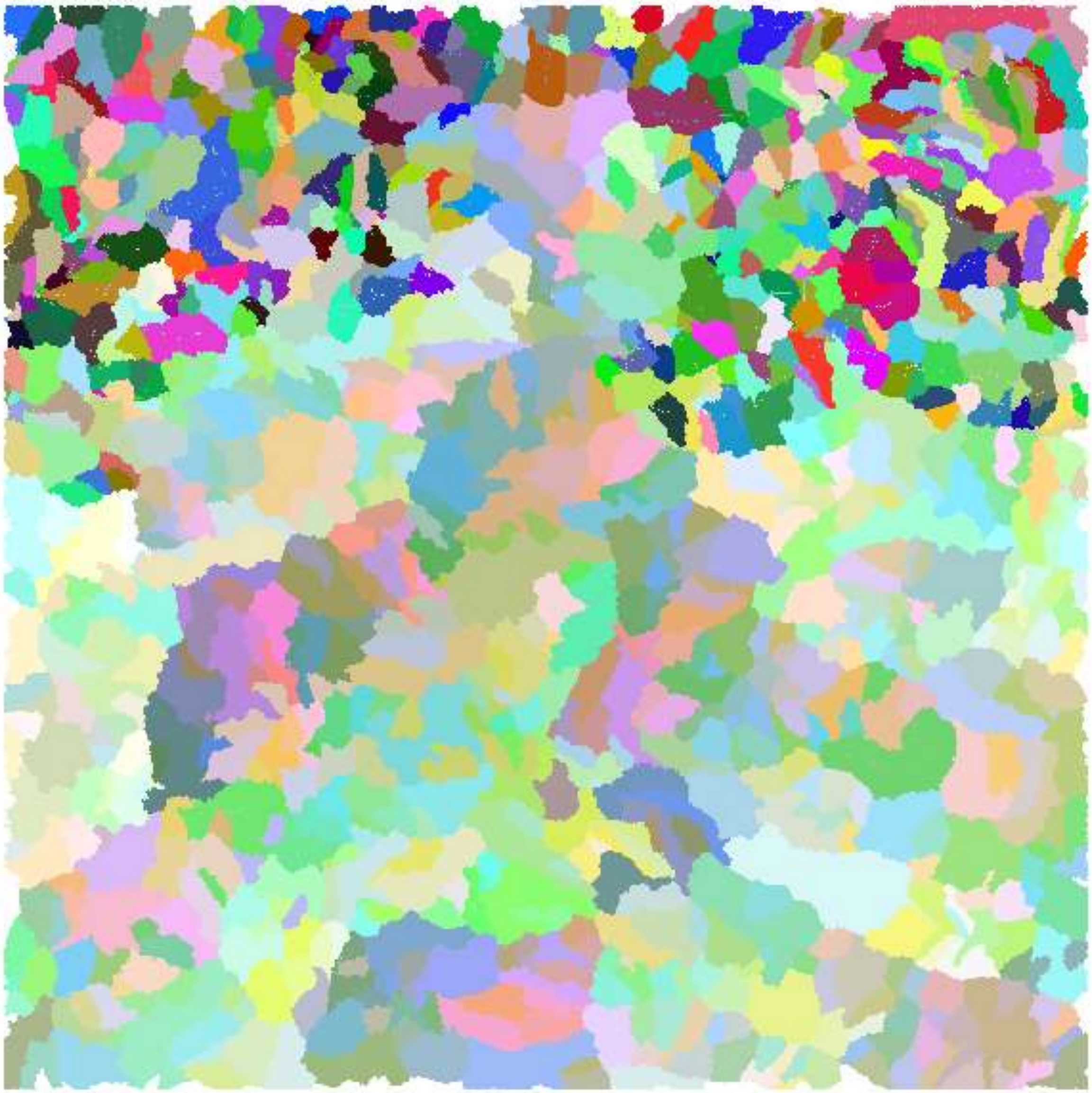


Fig 52. Basins map generated through GRASS with 5000 no of cells as size of basin

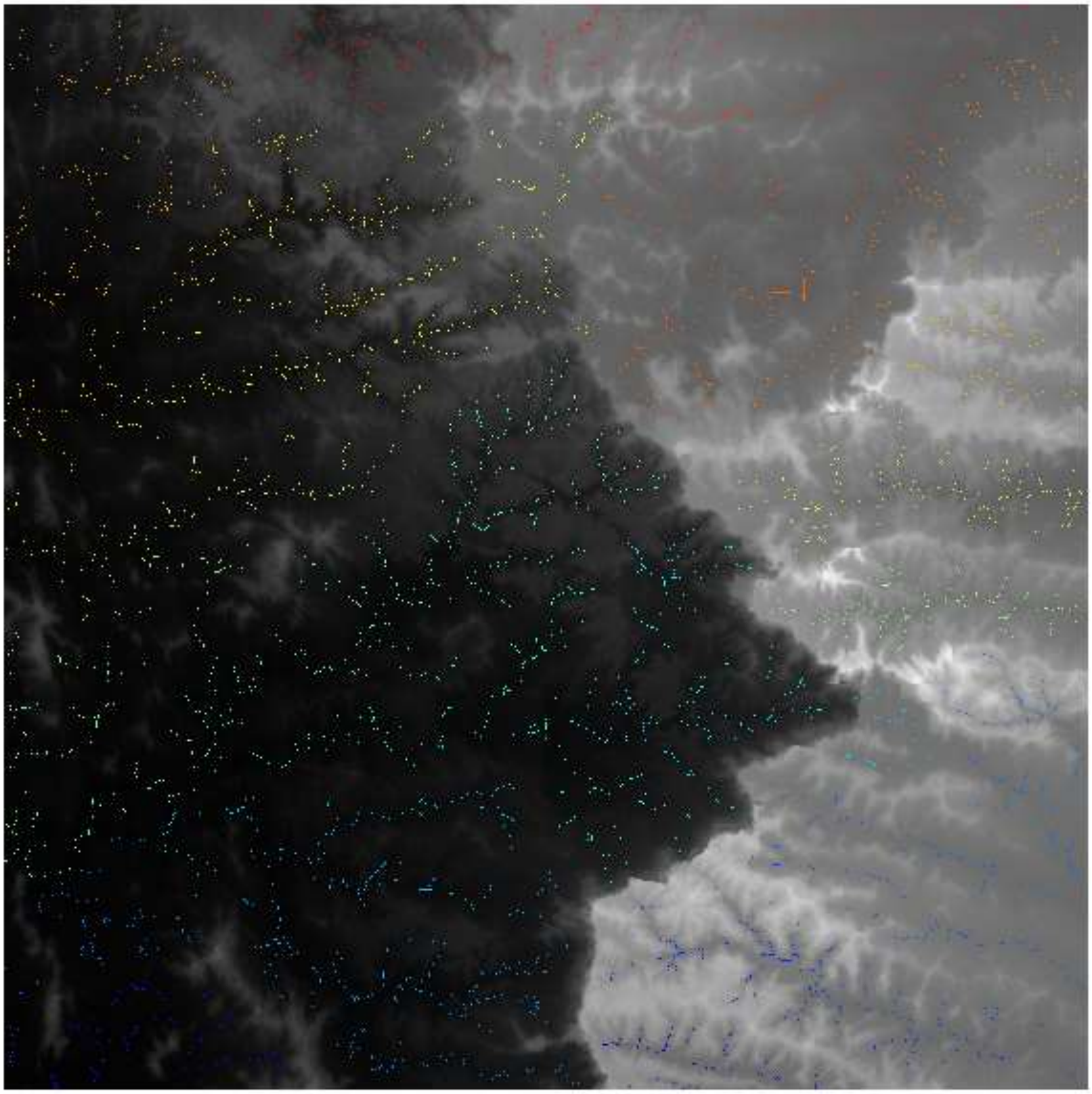


Fig 53. Stream segments generated through GRASS with 5000 no of cells as basin size

Repeat the module of r.watershed to generate maps with 1000 cells draining into the basin. This will capture even the smaller stream segments. The output for the same will look as follows-

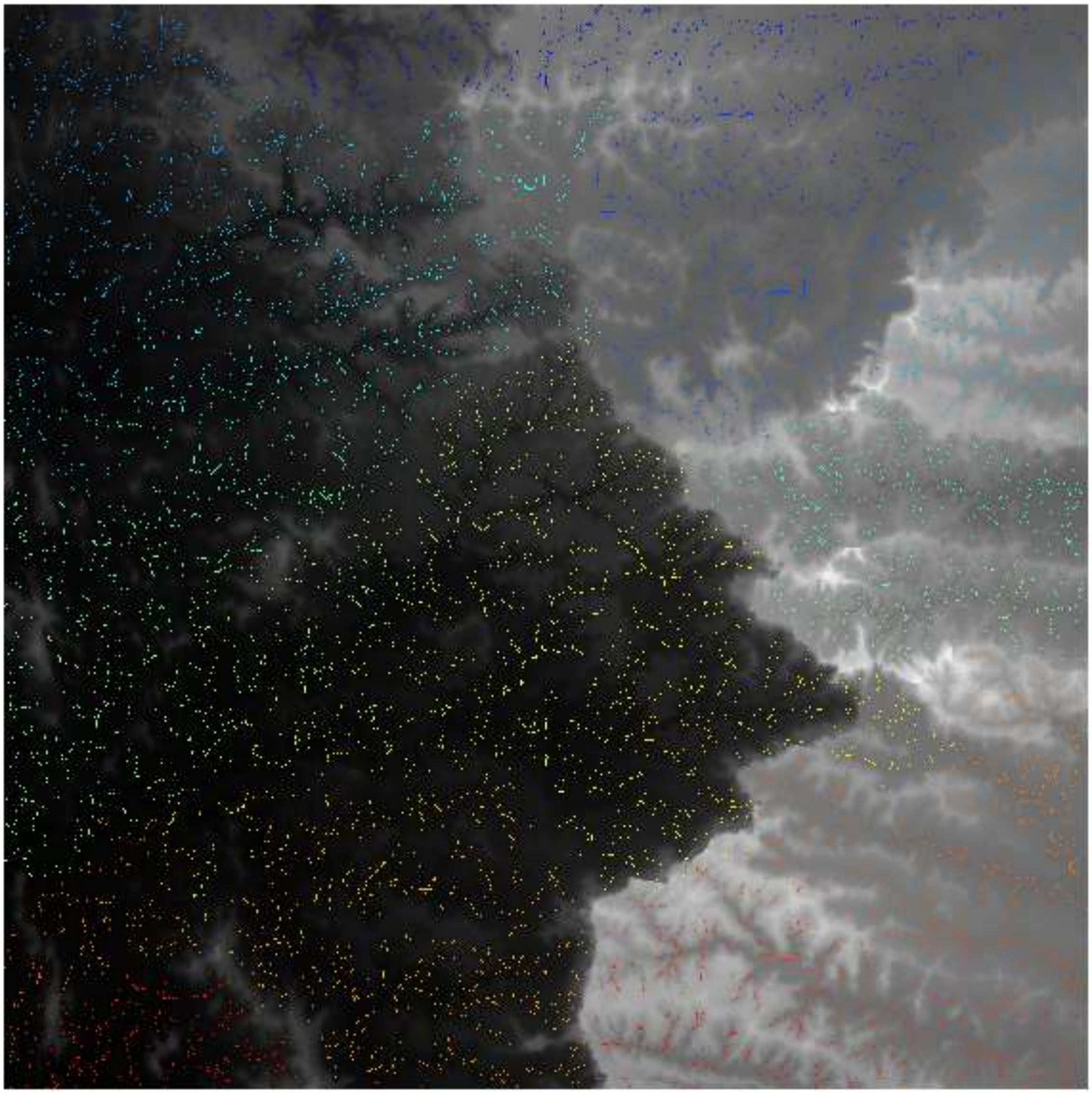


Fig 54. Stream segments generated through GRASS with 1000 no of cells as basin size

Annexure 4:

Involved Players and Their Roles

Many government departments, offices and agencies are directly involved in rural drinking water supply for Maharashtra.

Rural Water Supply Department (RWSD): Rural water supply department (ZP) is the main agency that handles implementation of rural drinking water supply schemes. RWSD (ZP) comes under the Water Supply and Sanitation Department of Government of Maharashtra.

The executive engineer heads this department with a team of deputy engineers and section/junior engineers in district as well as sub-division and taluka offices situated in blocks. RWSD reports to the Chief Executive Officer in ZP. The organizational chart for RWSD is given in Fig 55(Mishra, MTP 1 report on Drinking Water Security, 2012).

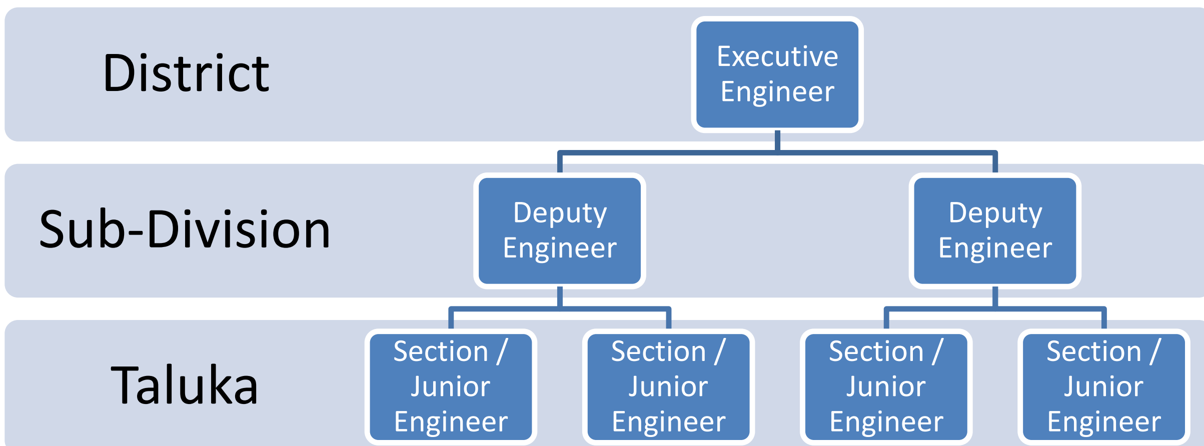


Fig 55. Organizational Structure of Rural Water Supply Department (ZP)

MJP: Maharashtra Jeevan Pradhikaran (MJP) is one of the two technical bodies of Water Supply and Sanitation Department of Government of Maharashtra. It was founded in 1976 through Maharashtra Water Supply and Sewerage Board Act and came to be known as Maharashtra Jeevan Pradhikaran in 1997.MJP specializes in technical expertise for large water supply schemes. Hence, regional rural water supply schemes and schemes exceeding ₹ 5 Cr are carried out by MJP.

MJP has central office in Mumbai and Navi Mumbai. This office is headed by Chief Executive Officer of MJP. MJP also has field offices throughout the state. The field offices have five zonal chief engineers. MJP also has Research and Training Centre in Nashik that has primary responsibility of training skilled staff for running the completed schemes for longer duration.(MJP, 2008)

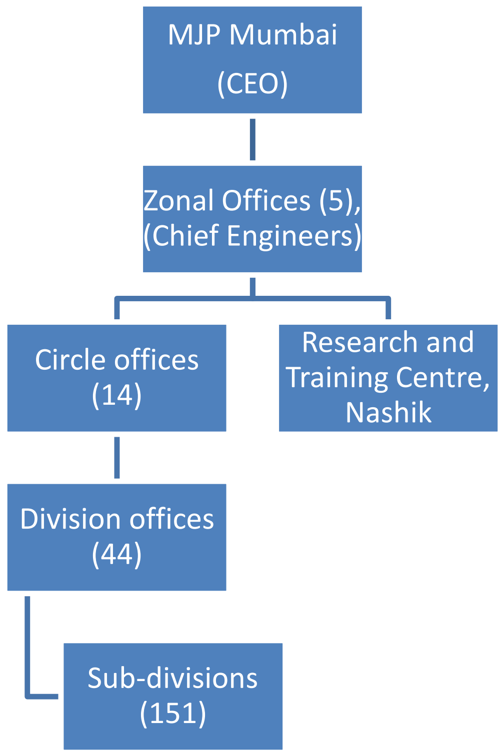


Fig 56. Organizational Structure of MJP(MJP, 2008)

RWSD and MJP segregate the water supply schemes among themselves according to the financial cost of the scheme, and take charge of the lifecycle of the scheme.

GSDA: Groundwater Survey and Development Agency is the other technical body of Water Supply and Sanitation Department, Government of Maharashtra. It was established in state in 1972. It has been given all responsibility regarding groundwater development in Maharashtra. GSDA is also mandated to carry out periodic groundwater surveys for various purposes, such as drought prediction, status of groundwater etc. GSDA has the responsibility of source testing and approval for a new scheme and sustainability component of NRDWP. (Source: Website of GSDA) The organizational structure of GSDA is shown in Fig 57

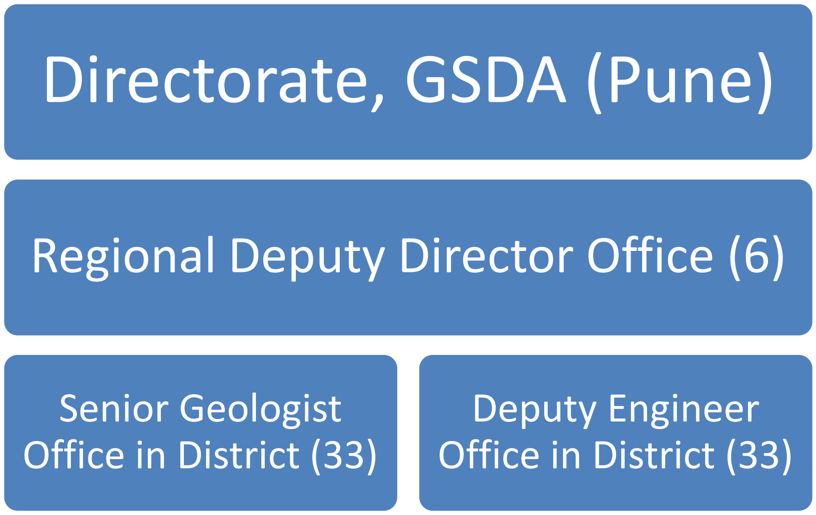


Fig 57. Organizational structure of GSDA(GSDA, 2013)

The responsibility of sustainability of NRDWP is given to GSDA for the state of Maharashtra. Due to the hard-rock and poor storage capacity of aquifers in Thane district, creating water percolation structures does not help in ensuring water availability during the summer months. Thus, GSDA focuses on creating rain water harvesting structures in the form of water tanks. These tanks are locked after monsoon and opened during the two months of summer. (source: interview with Senior Geologist, GSDA Thane)

These tanks are independent of the other water supply schemes that may be existing in the habitation/village. There are other sustainability jobs that are taken up, which include well deepening, de-siltation and so on, when the source delivery level falls. As per NRDWP guidelines, each water supply scheme should have a component of sustainability built into it. The Senior Geologist informed us that they have proposed 12 such schemes in Thane, where the sustainability structures or measures will be taken up with the new water supply schemes right from start. (Source: Senior Geologist, Thane, GSDA)

Apart from developing sustainability structures, GSDA also carries out surveys for groundwater assessment in state. There are two kinds of surveys taken up. One is a three yearly survey for assessing groundwater status. Second is an annual survey that is used for early prediction of drought-prone areas for upcoming summer so that appropriate authorities could take up proper mitigation measures. This annual survey is called Possible Scarcity Report. The scarcity report by GSDA, Thane district released in 2013 concludes that Thane has sufficient drinking water for the entire year.(GSDA T. , October 2013) This study is carried out in the month of October, just after the monsoon. Thane has ample water in that season due to heavy rains. Nevertheless, because of the poor quality aquifers of Thane, this groundwater vanishes before summer and then the hilly parts of the district face acute water shortage. While GSDA is aware of this characteristic behaviour of groundwater in Thane, they follow the standard procedure and publish the report in October without considering the seasonal changes. Now, even as this year's report predicts the availability of water in Thane throughout the year, it also states a disclaimer that the situation may differ in summer months. (Source: Interview with Senior Geologist, GSDA, Thane) Thus, this study does not help in taking up mitigation measures, and does not serve much purpose.

Minor Irrigation:

During the study, it was found that the irrigation structures are used as source of drinking water supply. Irrigation structures are classified as per the size of their command area. Structures till 2000 Hectares fall under minor irrigation structures whereas those above 2000 Hectares fall under major irrigation structures. Here we have explored the role of Minor Irrigation offices in rural drinking water supply schemes.

The Water Resources Department (formally the Irrigation Department) and Water Conservation Department have three Minor Irrigation sub-departments between them: MI Zilla Parishad, MI local and MI state. These sub-departments are hosted in the state departments as follows-

Table 6. Division of micro-irrigation structures according to departments

Sub-department	Size of command area of micro-irrigation structure	Department
MI ZP	Under 100 Hectares	Water Conservation Department
MI Local	101 - 250 Hectares	Water Conservation Department
MI State	251-2000 Hectares	Water Resource Department

Both these departments are primarily responsible for water for irrigation. These constructed water storages have 15% reservation for drinking purposes by default. The drinking water supply agencies can avail this 15% water for their drinking water supply schemes by paying a standard water tariff. When needed, a request can be made to purchase more than 15% water for drinking water supply from Water Conservation Department or Water Resource Department.

Gram Panchayat and VWSC: Village Water and Sanitation Committee is standing committee of Gram Panchayat that raises the demand for drinking water supply scheme and owns it on behalf of the villagers. This demand is forwarded through the PRI hierarchy starting from Gram Panchayat, until its inclusion in Annual Action Plan for the district.

Jal-Surakshak and Gramsevak:

As discussed in last chapter, special attention is given under NRDWP for water quality monitoring and surveillance. The WSSD has given detailed instructions in the Government Resolution dated 30th March 2011 for this activity. According to this GR, the *Jal-Surakshak* (Village Water Supply Worker)should perform water quality tests using Field Test Kits (FTKs). Biological contamination should be checked at least 4 times in test labs, and chemical contamination should be checked each year. Testing for chlorine should be done every day at difference places in the village.(WSSD, Government Resolution, 2011)

Jal-surakshak is mandated to attend training in PHC and is expected to work along with Multipurpose Worker (MPW) in the Gram Panchayat.

The Gramsevak is supposed to gather water quality data from Jal-surakshak and submit it to Block Development Officer (BDO) at Panchayat Samiti every month. The BDO is then supposed to submit the combined report from all Gram Panchayat within the Taluka further up. This data helps in identification of quality-affected habitations. It is made available on the website of NRDWP through the support offices.(WSSD, Government Resolution, 2011)

The staff at DWSM informed us during an interview that there is no problem in quality of water in Shahapur Taluka.

WSSO, DWSM and BRC:

NRDWP secures 5% funding for support activities for the core programme. These support activities are-

- Support for awareness creation and training activities
- Support for water quality testing (training as well as infrastructure)

- Providing hardware and software support for MIS

These support activities are routed through Water and Sanitation Support Organization (WSSO) in Maharashtra. District Water and Sanitation Mission (DWSM) at district level and Block Resource Centres (BRCs) at Taluka level support WSSSO. The BRC and DWSM are given dual responsibilities of M&E of schemes and IEC for the programme. They are supposed to look after various other schemes, such as National Rural Health Mission (NRHM), National Rural Employment Guarantee Scheme (NREGS) and others that share common interests with NRDWP. However, due to multiple responsibilities given to these offices without clear instructions and training, they face confusion over their role, responsibilities and authority. (Source: interview with staff at BRC in Shahapur Panchayat Samiti, interview with staff at DWSM in Thane Collectorate)

Annexure 5:

District Planning Committee (DPC)

74th Amendment to the Constitution mandated and eventually lead to formation of District Planning Committee (DPC from now on) in districts of every state. According to the amendment, every state had to make provisions for composition, process of filling seats and functions of DPC. In this line, Planning Department of Maharashtra Government issued a GR on 1st June 1999, with instructions for composition and functions of DPCs.

According to this GR, DPCs should contain 30 to 50 members depending on the population of district. DPCs have special invitees, nominated members and ex-officio members along with elected members. This committee is headed by Guardian Minister of the district and the collector of district will is appointed the secretary of DPC.

Type of Membership	Total Number of members	Remark
Ex-officio Members	6	
Guardian Minister of district		Chairperson
President, ZP		
CEO, ZP		
District Collector		Member secretary
Representative of Statutory Development Board for district		
Division Commissioner of district		
Nominated Members	0-4	
Elected Members	24-40	At least 4/5th of the DPC
Special Invitees		Members of Parliament, Members of Legislature of Maharashtra
Total Members of DPC	30-50	As per district population

The main functions of DPC are (Government Resolution, 1999) –

i. To consolidate annual plans prepared by various Panchayat Samitis and Municipalities

ii. To create five year plan for district based on five year plans of Panchayat Samitis and Municipalities

iii. To take overview of progress of district action plan and monitoring the execution

iv. To submit the district action plans to State Planning Department for approval

According to the report on Status and Functioning of DPCs released by PRI in 2009, the eleventh five year plan was supposed to be made through consolidation of such district plans. However, this did not happen due to non-functioning / non-existing DPCs in several parts of the country.(PRAI, November 2009) (refer Introduction, page 6). Later, a manual for integrated district planning was created in 2008 to guide the states regarding procedures for preparing district plans. Among the core arguments to support the case of district planning, one is that the optimum outcomes could be achieved if resources are converged with the help of increased local horizontal communication (refer Foreword, page iii). The other argument is that this institutional change would allow for increased and more sustainable access to basic services. In light of the huge and increasing investments made by Central Government on provision of basic services in the form of Centrally Sponsored Schemes, Central Government believes that the support from Panchayati Raj Institutions (PRIs) and district level administration would help in better service delivery [refer section 1.2, page 4].(Manual for Integrated District Planning, 2008)

While it is expected that through formation and working of DPC, District development planning would take place with communication between various departments and sectors, this does not seem to be the case in reality. The Maharashtra District Planning Committees (Constitution and Functions) Act 1998 states that the functions of DPC in Maharashtra would be to 'consider and consolidate the District Action Plans prepared by the panchayats and Municipalities in district and to prepare draft district plan as a whole.' Along with this, DPC is supposed to prepare draft five year plan and perspective plan for the district. Even the subsequent government resolutions by Maharashtra Government expand on the concept of consolidation of individual district level plans for presenting it to the state government. Thus, the emphasis seems to be on doing the *financial distribution* instead of planning of schemes for optimum designing.(Government Resolution, 2008)

There is a provision made for innovative schemes via DPC budget that allows for schemes that are locally conceived for catering district specific needs. These schemes, however, are not to exceed

4.5% amount of the district budget. (Government Resoultion, 2010) It needs to be further noted, that apart from the 1999 GR (Government Resolution, 1999), which mentions five year planning, no subsequent GR makes any comment about how such plan is to be made.

2.1.1 Composition of District Planning Office, Thane

The Planning Branch at district level supports District Collector for district planning. This branch is headed by the District Planning Officer (DPO). The organizational structure of planning branch in (Thane) is as follows-

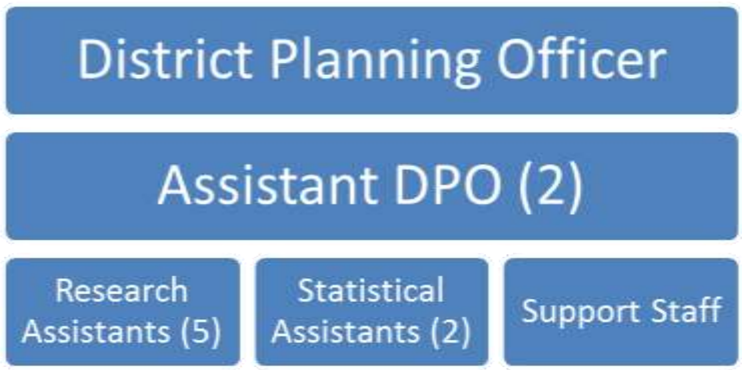


Fig 58. Organizational chart of DPO office in Thane (Source: Interview of Assistant DPO, Thane by Mr Vishal Mishra and Mr Aditya Khebudkar)

The duties entrusted with the District Planning Office is to converge following into one District Action Plan for upcoming financial year:

i. Annual action plans received from line departments
ii. Annual plan for MLAs local development funds
iii. Annual plan for MPs local development funds

Apart from these duties, if a department requests for additional finances for coming financial year, DPO takes the responsibility of forwarding the request to State Planning Department and then State Planning Department seeks sanction of the fund from State Ministry. (Source: Interview of Assistant DPO, Thane by Mr. Vishal Mishra and Mr. Aditya Khebudkar)

The DPO office consolidates the action plans. It also keeps minutes of the meetings of DPC meetings. These minutes of meetings include discussions regarding three points. First is to take an overview and status update of action items from last DPC meeting. Second is approval of Annual Action Plans (AAPs) by various departments by DPC and the Guardian Minister. Third point is to hear and consider requests from people’s representatives for new works to be carried out in next financial year. In the meeting of DPC carried out in Thane Collectorate on 18th October 2013, out of these three points, the approval of AAPs was given hardly 10 minutes of discussion time. The committee assumed that the members have read the proposed AAPs beforehand and no further discussion is required for sanctioning the requested budget. Major emphasis of the DPC meeting was on grievances and/or requests by people's representatives. The staff of concerned line departments were expected to give a reply to such grievances on the spot and corresponding action items were jotted down in minutes of meetings. The duration of meeting of Thane DPC was 5 to 6 hours. (Source: 3rd DPC meeting in the year 2013-14, 18th October 2013, Collectorate, Thane)

From these evidences, it could be said that planning still focuses on finance distribution as far as the District Action Plans are considered.

Thus, as far as the provisions are concerned, while the need to bring the element of regional planning is acknowledged, there is little consideration given to planning for increasing efficiency of service delivery.

To summarize, because of the legislature, DPCs have been materialized and thus the basic infrastructure for district level planning is in place. One could think that this space could be utilized to introduce planning for service rather than just budgets. But any such intervention would need significant changes in the structure and functioning of DPC, and especially DPO. According to the 1999 GR (Government Resolution, 1999), DPC is not supposed to meet for more than four times every year. Which means DPC has to cover all departments and rural, urban sectors within these four meetings. This further indicates that DPC is not expected to be a space for regional resource planning, but a mere grievance and budgetary planning space at district level.