Assessment of Participatory Ground Water& Crop Planning

By

Surendra Kumar Singh

Dissertation submitted for the partial fulfillment of the

MBA Rural Management

Academic year, 2018-2020

The IIHMR University, Jaipur

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CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled, **"Assessment of Participatory Groundwater & Crop Planning"**, submitted by "**Shri. Surendra Kumar Singh**, **Enrollment Number :043"** under the supervision of **Prof. Ms. Anuradha Srinivasan Palanichamy**, for award of MBA in Rural Management of the University, carried out during the period from 20th February 2020 to 20th June 2020, embodies my original work & has not formed the basis for the award of any degree, diploma associateship, fellowship titles in this or any other institute or other similar institute of higher learning;

Place : Jaipur (SURENDRA KUMAR SINGH) **Date : 22nd June 2020**

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As a matter of gratitude, I would like to thank and elaborate on how each person or group contributed in my research without their support, this research couldn't have been completed.

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Chapter 01: About the Organization

1.1 About the Organization:

Vikas Sahyog Kendra evolved from a larger campaign on water resources and a Drought Proofing Campaign (Sukha Mukti Abhiyan) in Palamu District, in the early nineties. The Campaign was anchored by *Pani Chetna Manch,* a forum of NGOs, social activists, researchers, engineers and scientists. Most founder members of VSK were associated with Sukha Mukti Abhiyaan. This program was implemented in the entire Palamau district between 1992 to 1996 by tripartite partnership of district administration, village community (Pani Panchayat) and *Pani Chetna Manch*. Over this period the Manch constructed 140 water-harvesting structures in 125 villages, as a large-scale demonstration of local water management as an effective alternative to the building of large dams. The Manch also provided technical and social support to the forest department in the construction of water harvesting structures. Pani Chetna Manch transformed into Vikas Sahyog Kendra as a registered organization in 1997. Since its formal registration as a non-profit Society in 1997, VSK has been working in three districts – Palamau, Latehar and Garhwa that constituted the erstwhile Palamau district.

VSK works with a mix of rights based approach with development initiatives to secure access to natural resources, public investments and welfare benefits that contribute to livelihoods of Adivasis and Dalits. The approach comprises organizing and capacitating the primary stakeholders into common interest groups, establishing their specific advocacy forums at multiple levels to collectively access resources and provide technical support.

It also works in realizing the wage entitlements provisioned under the MGNREGA, getting food entitlements under public distribution system, securing entitlements under various welfare programs and supporting in development of natural resources based livelihoods. VSK has networks with various civil society networks like Revitalizing Rainfed Agriculture Network, Right to Food, Right to Life with Dignity, Jharkhand Van Adhikar Manch, NREGA consortium, NREGA Watch.

1.1.1 Organizational Mission: Enabling the vulnerable & voiceless communities to assert rights and develop their capacity;

1.1.2 Organizational Vision: Creation of a society based on justice & free from poverty and exploitation;

1.2 Professional Portfolio, Approach & Strategy:

VSK works with both right based and livelihood enhancement approaches. For sustainability of work the focus is on institution building of the people. The ideals of democracy, transparency and accountability are installed in these institutions of the people or CBOs. Through implementation of various activities the focus is also on model building as a case for policy advocacy. Some of the strategies used are listed below:

- Preparation and implementation of plan based on management of natural resource including water, forest, sustainable agriculture and livestock;
- Making science and technology simple and accessible so that the marginalized communities can derive benefit out of it;
- Preparation of participatory development plan which is based on long-term sustainability;
- Creating a centre for research and study for environmental conservation and promotion with the use of various IC materials;
- Capacity building of people from marginal communities for their active participation;
- Bringing transparency and accountability in operation of public welfare schemes by using means like social audit and public hearing;
- Preparation and implementation of plan based on improvement of health, education, nutrition and sanitation;

- Proving training to rural communities, govt. and non-govt. organizations on issues of development, technology, environment etc;
- Organization building of women, labor and farmers and networking with other like minded organizations for better accessibility of resources and services;
- Providing support in formation of Producer Company, cooperative etc. for the purpose of value addition of the produce;
- Improving reach of people for their access to various social security schemes and services;
- Providing legal aid on issues related to protection of human rights and welfare of the people;
- Creating a concept of proof for pro-people's policy and advocacy relating to it. Working for promoting equal rights of women in the society;

1.3 Present Activities / Initiatives:

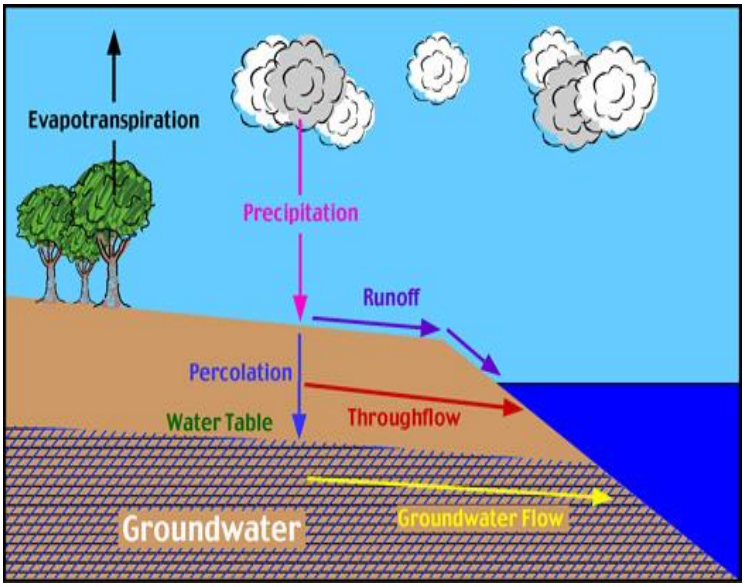
We work for the livelihood enhancement of marginal communities through natural resource management especially from land, forest and water. We also work for entitlement guarantee, especially from government schemes and services. Our prime activities include 1) Water resource management. Through this activity we develop participatory village development plans with special focus on water. We also work on monitoring and advocacy for construction of water harvesting structures through MGNREGA and other line departments. We work on data collection and research analysis with respect to rainfall, ground water level, soil moisture etc. This analysis is shared with community members which is used for crop water budgeting. We work for 2) Land resource development and augmentation. Through this activity we promote non-pest and non-chemical management-based practices. We also work for 3) promotion of sustainable agriculture practices. Through this various agronomic and improved agriculture and nutrition based practices like millets and vegetable kitchen garden is promoted. We also work for 4) promotion of income generating allied activities including livestock health specially of goat and backyard poultry and fisheries in inland water bodies. We work towards 5) Farmers' institution building. As part of this we are promoting the Farmer Producer Organization (FPO) and the farmer's club. We also work for 6) ensuring rights, entitlement and improvement of the local governance system. As part of this we work for strengthening the Gram Sabha and better implementation of government social security schemes and services including Forest Rights Act & MGNREGA;

Chapter 02: Outline of the Project / Dissertation & Methodology

2.1 Background & Introduction: Ground water is the main component of human life in case of drinking and other lifelines activities like irrigation, domestic and industries. Due to rapidly expansion of urban, industrial and agricultural water demands the groundwater keeps its own fundamental importance along with that due to the global warming and unbounded water use the groundwater has also become the matter of great concern. Only 3% of the Earth's water is freshwater. Most of it in icecaps and glaciers (69%) and groundwater (30%), while all lakes, rivers and swamps combined only account for a small fraction (0.3%) of the Earth's total freshwater reserves. Various studies have estimated the impact of groundwater depletion on global sea levels. Dutch scientists claim groundwater depletion adds about 25 percent to projected rates of sea-level rise, making it the largest contributor from land to sea-level rise other than the melting of the Greenland and Antarctic ice sheets. It is about a 1mm rise in sea level. 23 million cubic kilometers of groundwat.er held globally. According to a 2010 Nature report 80% of the world's population live in areas with threats to water security and 50% of the world's population relies on groundwater for drinking water. 40% of global food production now relies on irrigation with groundwater. Since 1960, groundwater extraction has increased by over 300%;

2.2 Rationale & Objectives of the Study: (a) To estimate the water availability in different water bodies, (b) Based on water availability prepare the water budgeting and calculate the water;

2.3 Groundwater & its Attributes:



When rain falls to the ground surface, some of it flows along the surface to form streams or lakes, some of it is used by plants, some evaporates and returns to the atmosphere, and some percolates into the ground. Imagine pouring a glass of water onto a pile of sand. Where does the water go? The water moves into the spaces between the particles of sand. In the similar fashion the portion of water percolates down below ground surface and forms groundwater. Ground-water is water that is found underground in the cracks and spaces in soil, sand and rock. The portion of the area below ground surface where groundwater is stored in--and moves slowly through--layers of soil, sand and rocks called aquifers. Aquifers typically consist of gravel, sand, of different sizes or mixture of sand and travel in alluvial areas. In hard rock areas weathered parts of rocks at shallow depth and fracture and joined parts at deeper depth form aquifers. These materials are permeable because they have large connected spaces that allow water to flow through. The speed at which groundwater flows depends on the size of the spaces in the soil or rock and how well the spaces are connected.

Due to some specific reasons the groundwater has depleted to the unexpected level and which brought adverse effects to the community. The following are the reasons-

1. Tremendous population growth of the country
2. Change in the lifestyles
3. Over extraction of the groundwater for irrigation

4. Saltwater intrusion
5. Groundwater pollution

2.4 Groundwater Depletion & Climate-Change:

Under a warming atmosphere, precipitation rates are predicted to increase, particularly in the tropics. Projected shifts in the timing of rainfall itself (e.g. changes to seasonal patterns) will result in more variable river discharge and soil moisture.

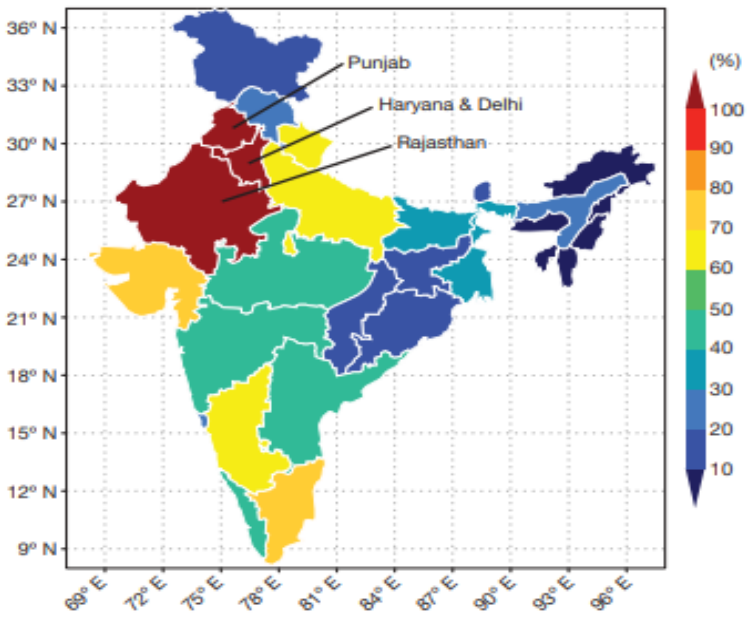
River discharge changes will impact on in-year freshwater shortages and the risk of flooding whereas soil moisture changes threaten food security through reduced crop yields. Projected changes in the geographic distribution of average rainfall are substantial but remain highly uncertain for most of the world. Many current reports point to inadequacy of modelling techniques in not being able to draw firm predictions of future impact. Strategies to adapt to more variable freshwater resources will, in many environments, increase dependence on groundwater. Few climate impact models consider how climate variability and change affect groundwater recharge and the sustainable development of groundwater despite its central role in enabling adaptation in domestic and agricultural water sectors.

2.5 Groundwater Depletion Environmental Effects:

The following are common effects:

Land subsidence - the collapse of land from lack of structural support (from the water that is being depleted). Reduction of water volume in streams, lakes and wetland environments. Plants and animals that depend on streams and lakes for food, water and habitat are adversely affected - reducing biodiversity

Deteriorating water quality. Crop production decreases from lack of water availability (40% of global food production relies on groundwater). Groundwater depletion interrupts the 'natural' water cycle putting disproportionately more water into the sea.



2.6 Ground-water depletion & Socio-economic Effects:

Many countries are over-pumping aquifers as they struggle to satisfy their growing water needs, including each of the big three grain producers— China, India, and the United States. These three, along with a number of other countries where water tables are falling, are home to more than half the world's people. Nearly half of our food comes from the warm, dry parts of the planet, where excessive groundwater pumping to irrigate crops is rapidly shrinking the porous underground reservoirs called aquifers.

Vast swaths of India, Pakistan, southern Europe, and the western United States could face depleted aquifers by mid-century, a recent study finds—taking a bite out of the food supply and leaving as many as 1.8 billion people without access to this crucial source of freshwater. Computer simulation models predicted that California's agricultural powerhouses—the Central Valley, Tulare Basin, and southern San Joaquin Valley, which produce a plentiful portion of the nation's food—could run out of accessible groundwater as early as the 2030s. India's Upper Ganges Basin and southern Spain and Italy could be used up between 2040 and 2060. And the southern part of the Ogallala aquifer under Kansas, Oklahoma, Texas, and New Mexico could be depleted between 2050 and 2070.

Farming has mushroomed across arid regions like these in the past half century. With scarce rains and few rivers and lakes, they depend on water pumped up from underground. Since 1960, excessive pumping has already used up enough groundwater worldwide to nearly fill Lake Michigan. With climate change and population growth, future groundwater use will soar.

A 2015 study based on satellite observations showed that most of the world's largest aquifers—21 out of 37—are being drained faster than they can refill. "A number of studies point to the overuse of groundwater and the tremendous risk that our water and food security are under," says water scientist Jay Famiglietti of the NASA JET Propulsion Laboratory, who led the satellite study. "The problem is, we don't know how much groundwater is left." The cost of water to the consumer rises. This is due to the water table lowering so more energy is needed to pump further down. Once the depth of extractable water falls below 300 feet, it becomes uneconomical for most companies to recover.

2.7 Definition & the Concept Participatory Groundwater Management (PGWM):

Participatory Groundwater Management (PGWM) is a collaborative program between Community and partner NGOs across India to build a sustainable model for groundwater management. Groundwater is a common pool resource (CPR) by definition, but its management seldom reflects CPR principles. PGWM is an aquifer-based and community-centric approach that has emerged as an alternative for managing groundwater as a common pool resource. The current, conventional knowledge base on groundwater has little space to fill the existing gaps between what is desired in practice and policy and the academic pedagogy of groundwater. This major challenge is addressed in the program by enabling the local communities to take informed decisions about water use, cropping patterns and crop water management through water budgeting.

2.8 PGWM Principles & Practice:

- Groundwater is a common pool resource.
- Use an aquifer-based understanding for groundwater management.
- Groundwater management must be understood across different uses.
- The units of groundwater management should be aquifers, watersheds and habitations.
- Groundwater management requires long term engagement.
- Management should catalyse community action.
- Groundwater management should integrate formal and peoples' knowledge

2.9: PGWM : Intervention Aspects

The PGWM approach focuses on a scientific understanding of the resource, building capacities of local communities and defining usage priorities. It demonstrates that groundwater management is based on effective partnerships with institutions and local communities. It aims for a sustainable and equitable management of groundwater resources by promoting a shift in controls by states to management by user groups, and moving from attending to crises after they occur to averting them. Such an approach leads to redefining the scope of public investments, technologies, access to resources, production systems and markets. It provides an alternative and acknowledges the way forward. A typical PGWM program design is built on three pillars: Action Research, Capacity Building and Advocacy. Put together, these pillars play a vital role in making PGWM a holistic model.

2.10 Steps taken by the Central Government to control water depletion and promote rainwater harvesting / conservation.

2.10.1 Hon'ble Prime Minister has written a letter to all sarpanchs on 08.06.2019 regarding the importance of water conservation and harvesting and exhorted them to adopt all appropriate measures to make water conservation a mass movement;

2.10.2 Creation of a new Ministry of Jal Shakti for dealing with all matters relating to water at one place in an integrated manner;

2.10.3 The National Water Policy (2012) has been formulated by Department of Water Resources, RD & GR, inter-alia, advocates rain water harvesting and conservation of water and highlights the need for augmenting the availability of water through direct use of rainfall. It also, inter-alia, advocates conservation of river, river bodies and infrastructure should be undertaken in a scientifically planned manner through community participation. Further, encroachment and diversion of water bodies and drainage channels must not be allowed and wherever, it has taken place, it should be restored to the extent feasible and maintained properly;

2.10.4 In compliance to the decision taken by the Committee of Secretaries, an 'Inter-Ministerial Committee' under the Chairmanship of Secretary(WR, RD & GR) has been constituted to take forward the subject of 'Push on Water Conservation Related Activities for Optimum Utilization of Monsoon Rainfall';

2.10.5 DoWR, RD &GR has circulated a Model Bill to all the States/UTs to enable them to enact suitable ground water legislation for its regulation and development, which includes provision of rain water harvesting. So far, 15 States/UTs have adopted and implemented the ground water legislation on the lines of Model bill;

2.10.6 Central Ground Water Authority (CGWA) has issued directions under Section 5 of "The Environment Protection Act, 1986" for mandatory Rain Water Harvesting / Roof Top Rain Water Harvesting for all target areas in the Country including UTs. While granting 'No Objection Certificate (NOC)' for drawing ground water, CGWA insists for mandatory rain water harvesting as per the guidelines issued;

2.10.7 Central Ground Water Board (CGWB) under DoWR, RD & GR has also prepared a conceptual document entitled "Master Plan for Artificial Recharge to Ground Water in India" during the year 2013, which envisages construction of 1.11 crore rain water harvesting and artificial recharge structures in the Country at an estimated cost of Rs. 79,178 crores to harness 85 BCM (Billion Cubic Metre) of water, in an area of 9,41,541 sq.km by harnessing surplus monsoon runoff to augment ground water resources;

2.10.8 Besides, CGWB has taken up Aquifer Mapping and Management programme during XII Plan, under the scheme of Ground Water Management and Regulation. The Aquifer Mapping is aimed to delineate aquifer disposition and their characterization for preparation of aquifer/area specific ground water management plans with community participation. The management plans are shared with the respective State Governments for taking appropriate measures;

2.10.9 Department of Water Resource, RD&GR has instituted National Water Awards to incentivize good practices in water conservation and ground water recharge;

2.10.10 Mass awareness programmes (Trainings, Seminars, Workshops, Exhibitions, Trade Fares and Painting Competitions etc.) are conducted from time to time each year under the Information, Education & Communication (IEC) Scheme of DoWR, RD & GR in various parts of the Country to promote rain water harvesting and artificial recharge to ground water;

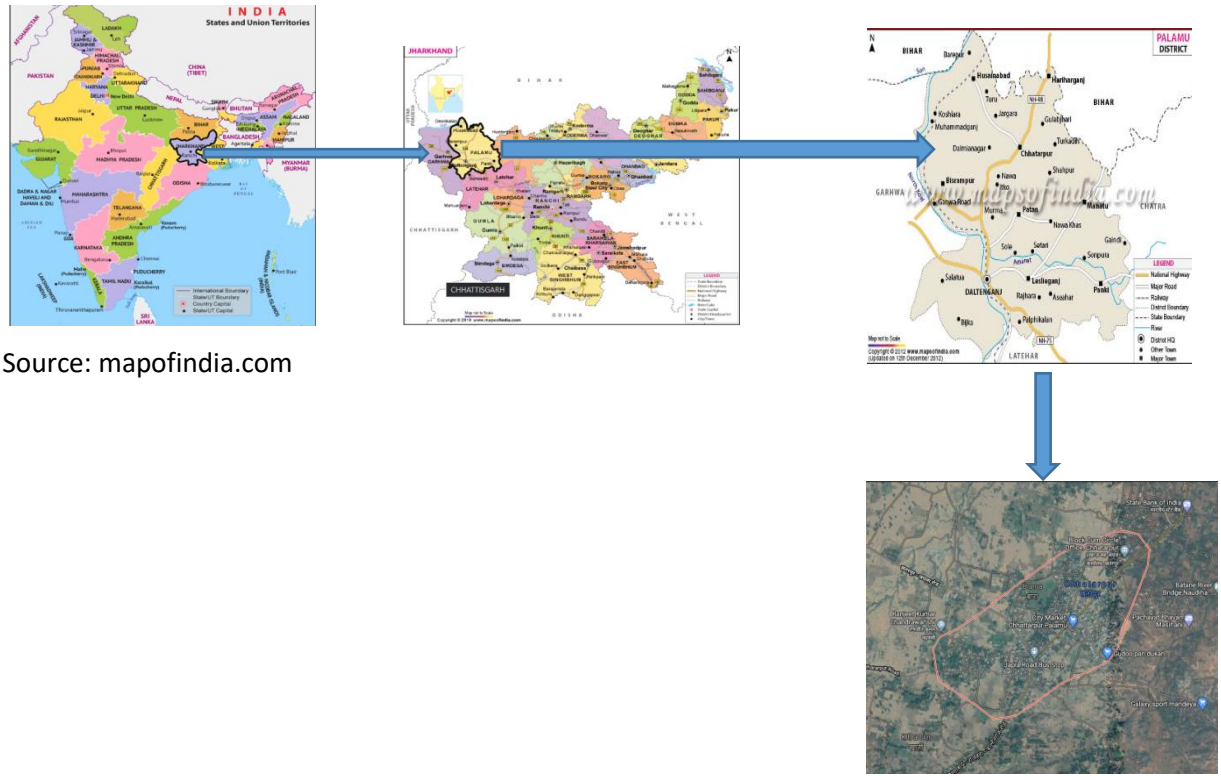
2.10.11 The Ministry of Rural Development in consultation and agreement with the Department of Water Resources, RD & GR and the Ministry of Agriculture & Farmers' Welfare has developed an actionable framework for Natural Resources Management (NRM), titled "Mission Water Conservation" to ensure gainful utilization of funds. The Framework strives to ensure synergies in Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), erstwhile Integrated Watershed Management Programme (IWMP) now PMKSY-Watershed Development Component and Command Area Development & Water Management (CAD&WM), given their common objectives. Types of common works undertaken under these programmes/schemes are water conservation and management, water harvesting, soil and moisture conservation, groundwater recharge, flood protection, land development, Command Area Development & Watershed Management;

2.10.12 Department of Land Resources is currently implementing 8214 watershed development projects in 28 States covering an area of about 39.07 million ha. under the Watershed Development Component (WDC) of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) principally for development of rainfed portions of net cultivated area and culturable wastelands. The major activities taken up under the WDC-PMKSY, inter-alia, include ridge area treatment, drainage line afforestation, soil and moisture conservation, rain water harvesting, horticulture, and pasture development etc;

2.10.13 Ministry of Housing & Urban Affairs has released Model Building Bye-laws, 2016 which recommends Rainwater Harvesting for all types of Building with plot size 100 sq.m or more. Barring the States/UT of Sikkim, Mizoram and Lakshadweep, all the States have incorporated the provisions in their respective building bye laws. The plans submitted to the local bodies shall indicate the system of storm water drainage along with points of collection of rain water in surface reservoirs or in recharge wells. Further, all building having a minimum discharge of 10,000 litre and above per day shall incorporate waste water recycling system. The recycled water should be used for horticultural purposes;

2.10.14 Government of India has approved Atal Bhujal Yojana (Atal Jal), a Rs. 6000 Crore Central Sector Scheme, for sustainable management of ground water resources with community participation in water stressed blocks of Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh;

Chapter 03: Background of the Study Area



Source: mapofindia.com

Profile of the Chuchrumanr Village:

3.1 Background: Chuchrumanr village is located 15 km from the Chhatarpur block. This village, which comes under Palamu district of Jharkhand (24.291703°, 84.231834°) , is a tribal dominant. A total of 110 households reside in this village and the population is around 609 individuals, with almost equal ratio of Male & Female. This village is locally famous for the resourceful and pictorial Matkhani check dam. The major livelihood options of the households and its average annual remuneration are given below:

Table 1.0 : Socio-Economic Data

S.No	Name of Occupation	No. of HH involved	Average Annual Income
1	Agriculture	110	12264
2	Farm based labor	15	20000
3	Seasonal migration	60	31850
4	Daily based labor	35	70000
5	Goat rearing	69	2609
6	Non-timber Forest Produce	40	24000

3.2 Socio-economic Information : The village has a total population of 609 people of which male and female population are 295 and 314 respectively, which reside in 102 households. Around 97.04% of the total

population Scheduled Tribe communities. Male literacy in the village is 66.81% whereas the literacy rate among women stands at 43.25%. Majority of the people reside in the northern part, particularly the Charkutba tand, Purab Tola, Karjivabel tand, Hartangi peepar and Pathal gadhi. The major economy of the villagers is generated from agricultural activity, however, many households practice goat rearing, dairy rearing. Although the migration in the village is less but few villagers migrate out of the village as labours; either agriculture laborers or non-agricultural laborers.

DEMOGRAPHIC SNAPSHOT OF CHUCHRUMANR

- **Total number of houses- 102**
- **Total population- 609**
- **Total male- 295**
- **Total female- 314**
- **Male literacy- 66.81%**

3.3 Land-Use Pattern: The data for the land use/ land cover was collected with the help of participatory rural appraisal i.e. after collective meeting and discussion with the villagers and support from the staff of 'Vikas Sahyog Kendra (VSK)'. The below figure shows the major land use- land cover of village Chuchrumanr and also the extent of acreage of respective land use classes. The major part of the village comes under agriculture area (149.9 Ha) followed by forest with an area of 11 Hectares. The village has non agriculture land of 6 hectares where community resides. Apart from this, all other classes of land use is not present in the village. The land use pattern in Chuchrumanr conforms to the pattern of classification of land use as recommended by the Ministry of Agriculture, Government of India. The details on land use classification is given as annexure 1 at the end of the report.

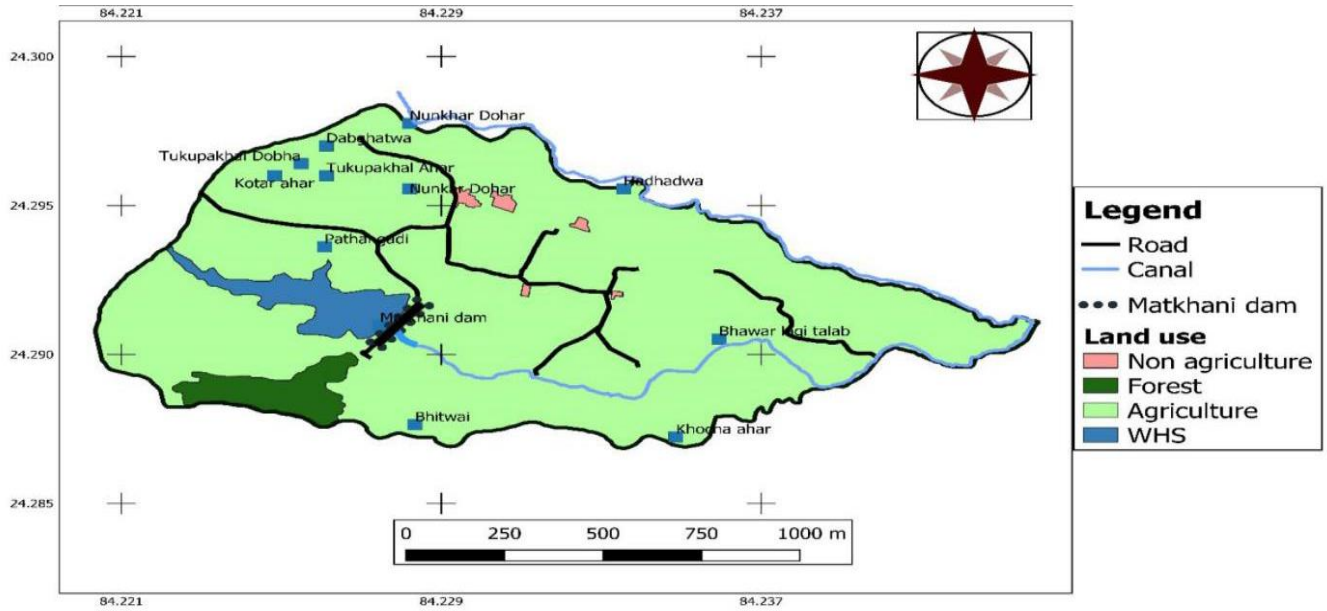


Illustration : Land-Use Map of Chuchrumanr Village (2019)

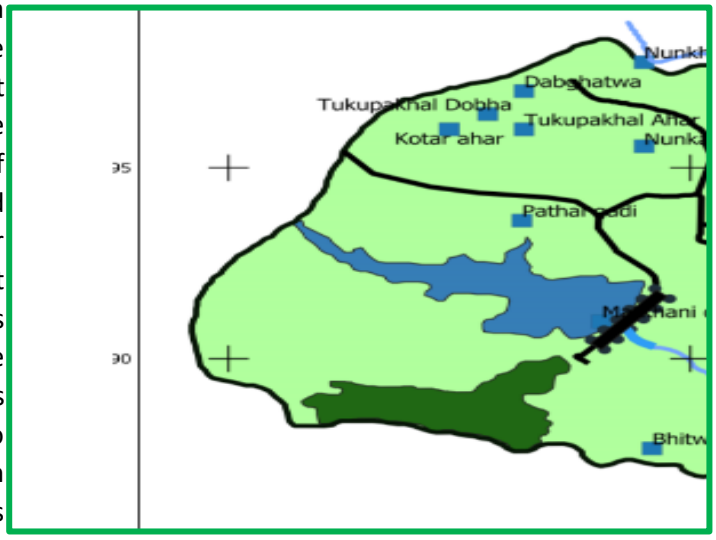
Source: *Document on NRM Planning Chuchrumanr*

Table 2.0 : land-use Pattern, Chuchrumanr

Land use/ Land cover	Area (in Hectares)	Percentage (%) (out OF TOTAL)	Hamlet (in which present majorly)	Remarks
Forest	11	6.5	Forest	Includes all land classes as forest.
Agriculture	149.9	89.8	All hamlets except forest and mountains	Includes the net sown area.

Non-Agriculture	6	3	Chuchrumanr Abadikhass	Includes all land occupied by the buildings, roads and water.

3.4 Forest: Forest contributes to 6.5 % of the area out of total area(167 ha) of the village and the location is south to Matkhani Dam. Although forest provides immese ecosystem services to th evillage and villagers indirectly but the villagers of churchumanr are not dependent on the forest and NTFP (Non Timer Forest Products) for their livelihood generation. However the villagers collect Non Timber Forest Product (NTFP) that includes Mahua, Tendu Patta which gives additional income for their livelihood. Interestingly, the villagers prepares liqour from Mahua flowers and also prepares household level dishes by mixing them with rice flour as their dietary use. From the seeds of Mahua (locally called Dori), they extract oil at local level which is used for cooking purposes;



Source: *Document on NRM Planning, Chuchrumanr*

3.5 Agriculture: Agriculture covers about 89.8% area of the village. Out of 149.9 Ha of the net sown area, Not even 1% of the agriculture land is irrigated; More than 99.9% of the land is un-irrigated. The major crops that are cultivated are Maize *(Zea mays*), Paddy (*Oryza sativa*), Mustard (*Brassica*), Chickpea, Horse- gram (Macrotyloma uniflorum), Pigeonpea (Cajanus cajan) and vegetables. Table 3 shows the major crops preferred and cultivated by the villagers. (Table 3 is arranged on the priority of crop cultivated by the villagers);

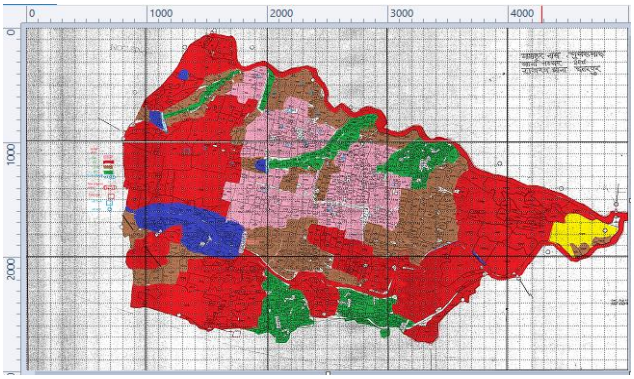
Table 3. 0: Agricultural Crops Vs Patch Name

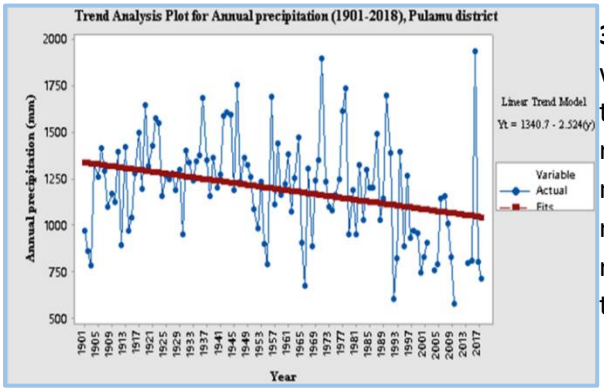
S. No.	Crops cultivated	Extent	Patch Name (in which cultivated)
01	Maize *(Zea mays)*	Moderate	Gulali tand, Bhaira tand, Gulali Dohar, Bhitwai Tand, Chor tekba tand, Bhal dohar, Lakad Dhari, Pach bighwa, Pathal gadi, Kharab Dohar
02	Paddy *(Oryza sativa)*	Large	Nauka Dohar, Bhal Dohar, Mahtwain Dohar, Jamun Dohar, Jhariba Dohar, Satbahini, Karamboha Dohar,Pachiari Dohar, Chamar Dohri
03	Arhar *(Cajanus cajan*)	Moderate	Sahaedibad, Charmuhan, Jharaewa, Iguniya tamr,Bhudiya neem, Baskatia, Kusma tamr, Titki mahur
04	Kulthi *(Macrotyloma uniflorum)*	Limited	Iguniya tamr, Kusma tamr, Titki mahur

3.6 Soil: The village has mainly 4 types of soil, namely; Sandy, Murrum, Black, Clay soil. Where, Murrum soil is largely present in Gulali tand, Bhaira khad, Barba Tola, Pathal Gadi and Pach bighawa patches. The Black soil is present in Jhariba dohar, Jamun dohar, chamar dohar patches. The remaining patches are either covered by sandy loam or clay soil.

3.7 Land Type in Chuchrumanr Village

Table 4.0: Land Type Vs Area;		
S. No	**Type of Land**	**Area in Hectare**
1	Bari(Pink)	30.53
2	Tanr(Red color)	83.25
3	Chaur(Soily)	32.04
4	Jah(Green)	18.42



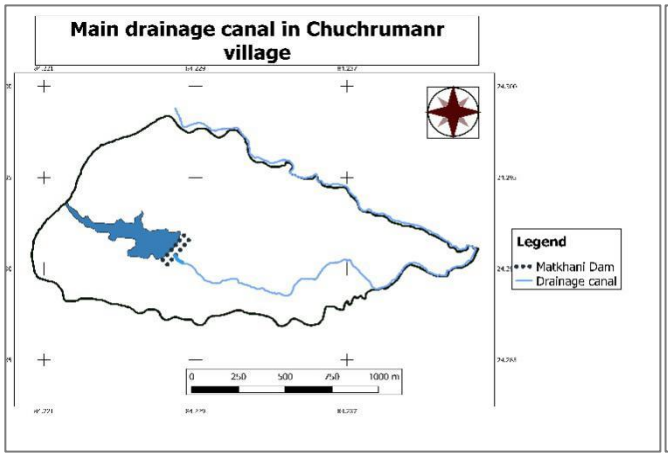


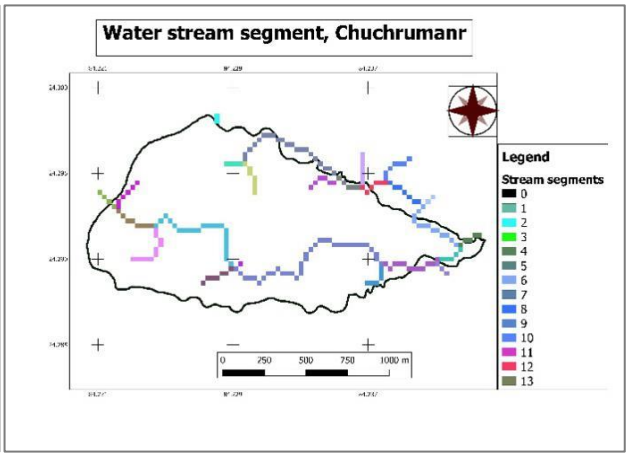
3.8 Rainfall: Churchumanr comes in the Pulamu district, which is a zone that receives monsoon rains during June to September. The district receives an annual average rainfall of 1091mm, 85% of which occurs between the months of June to October and 15% occurs in the remaining 7 months. However, as the figure 3 shows, the rainfall tends to follow a decreasing trend. The rainfall trend analysis is done from the year 1901-2018.

Figure 1 Rainfall Trend Analysis,

Source: *Document on NRM Planning, Chuchrumanr*

3.9 Drainage: The main stream flowing across Chuchrumanr village is east to west flowing, there are two main stream lines that could be highlighted as blue drain lines, as shown in the figure below; first is the stream arriving from Sohrani patch which is present in Central east position of the village, at high elevation. Second stream arrives from the central west side of the village particularly from the Murta Dhodha ahar. Both of these streams flow across the village from south towards north and exits as an inflow for Chuchrumanr village in the north. In Chuchrumanr village all the canals and streams are intermittent streams, i.e. during the wet season, the water table is above the streambed and there is contribution of the base flow to the stream flow. However, during the dry season, the water table drops to a level lower than that of the streambed and dries up.



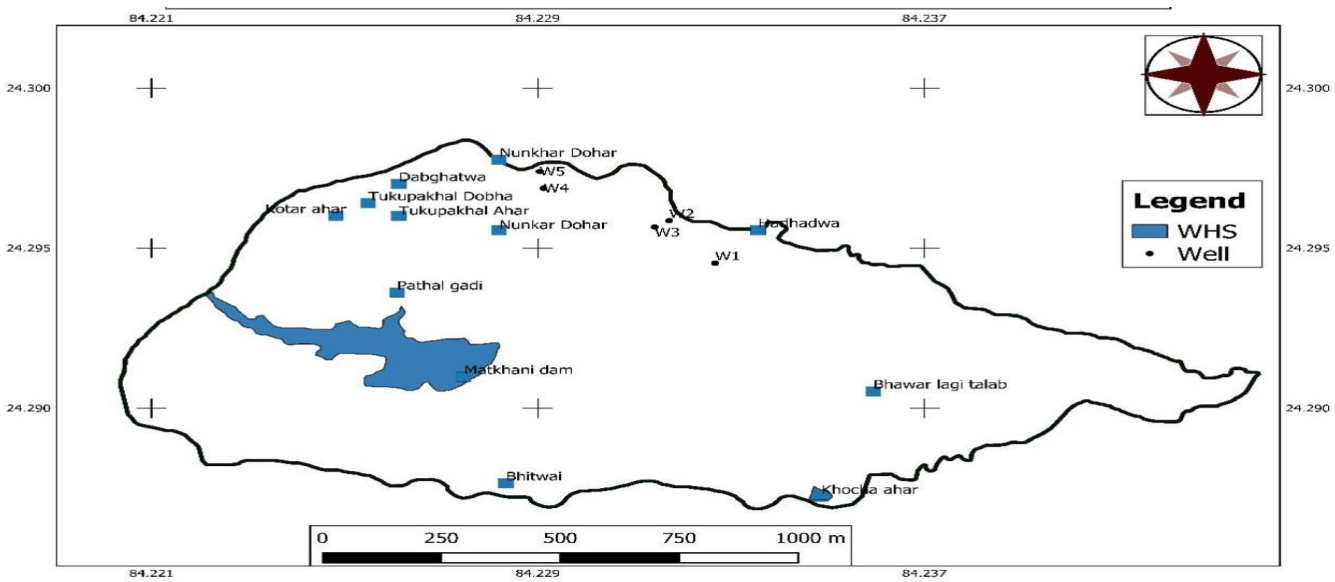


Source: NRM Plan, Chuchrumanr (2019)

3.10 Water Harvesting Structures : At present, there are 12 major water harvesting structures present in the village including the Matkhani Dam which is the biggest water harvesting structure. The below table depicts the name of the water bodies (in local language), and their coordinates where the approximate potential storage capacity of the structures ranges from 182.8-307200 m^3;

Table 5.0: Details of Rain-Water Harvesting Structures

Sl. No.	Name of the Water Harvesting Structure	Latitude (° E)	LONGITUDE (° N)	Remarks
1	Hadhadwa	24.295566	84.233556	❖ All the structures except Matkhani dam were found to be completely dry at the time of visit. ❖ The structures retain water only during monsoon season.
2	Nunkhar Dohar	24.297767	84.228201	
3	Kotar ahar	24.296009	84.224822	
4	Dabghatwa	24.297008	84.226118	
5	Bhitwai	24.28765	84.228338	
6	Khocha ahar	24.287237	84.234864	
7	Bhawar lagi talab	24.290525	84.235942	
8	Pathal gadi	24.293619	84.226082	
9	Pathal gadi 2	24.226201	84.22429	
9	Tukupakhul Dobha	24.296407	84.22549	
10	Tukupakhul Ahar	24.296009	84.226118	
11	Nunkar Dohar	24.295566	84.228201	
12	Matkhani	24.291060	84.227857	Has the largest water holding potential and was found to retain some quantity of water during the visit.



Rain-Water Harvesting Structures in Chuchrumanr Village

Source: *Document on NRM Planning, Chuchrumanr*

3.11 Ground Water: The ground water of the region varies according to the different seasons; the ground water level in the month of June varies from 4.5-11m bgl (Below ground level). This reading has been estimated by taking the average of the amount of water in the 23 well that were analyzed;

Chapter 04: Literature Analysis & Case Study

Participatory Groundwater Management (PGWM) is a collaborative program to build a sustainable model for groundwater management. Groundwater is a common pool resource (CPR) by definition, but its management seldom reflects CPR principles. PGWM is an aquifer-based and community-centric approach that has emerged as an alternative for managing groundwater as a common pool resource. While, the current, conventional knowledge based on groundwater has little space to fill the existing gaps between what is desired in practice and policy and the academic pedagogy of groundwater. This major challenge is addressed in the program by enabling the local communities to take informed decisions about water use, cropping pattern and crop water management through water budgeting;

Table 6.0: PGWM Principles & Practice:
01. Groundwater is a common pool resource; 02. Use an aquifer-based understanding for groundwater management; 03. Groundwater management must be understood across different uses; 04. The units of groundwater management should be aquifers, watersheds & habitations; 05. Groundwater management requires long term engagement; 06. Management should catalyze community action; 07. Groundwater management should integrate formal and peoples' knowledge;

4.1 Approach to Participatory Ground-Water Management: The PGWM approach focuses on a scientific understanding of the resource, building capacities of local communities and defining usage priorities. It demonstrates that groundwater management is based on effective partnerships with institutions and local communities. It aims for a sustainable and equitable management of groundwater resources by promoting a shift in controls by states to management by user groups, and moving from attending to crises after they occur to averting them. Such an approach leads to redefining the scope of public investments, technologies, access to resources, production systems and markets. It provides an alternative and acknowledges the way forward;

4.2 Case-Study of Sectoral Practices in "Ground-Water Management":

Case-Study 01: Borewell Pooling: Reducing Telangana Farmers' Burdens Substantially
For farmers in Telangana, borewell drilling was proving to be a very expensive way to extract groundwater. Several farmers were unable to repay the loans they had taken for drilling, leaving them worried and anxious about their future. Under a PGWM project – Karavu Kavacham (the Drought Shield Program), an experiment was conducted with five borewells and five farmers in a single watershed. The outcome of the experiment was introduction of the concept of borewell pooling wherein borewell farmers shared water with non-borewell farmers. A water grid was created by connecting the wells through a long pipeline with several outlets to reduce wastage by seepage and evaporation. Water conservation was an immediate outcome, financial condition of the farmers improved and drinking water was made available throughout the year;

Case-Study 02 : Training the Local Talent, to become Para-Hydrogeologists
Capacity building is one of the key areas PGWM focuses on. In a span of three years, a cadre of hundreds of para-hydrogeologists has been built. These professionals are chosen from groups of local youth, government staff and local NGO staff who work on the ground. They learn, among other aspects of PGWM, how to make groundwater and aquifer maps. Additionally, extensive training programs spanning over weeks are conducted for management and decision-making officials of organisations, networks, governments, technical assistants, watershed assistants of IWMP (the Government's Integrated Watershed Management Program) and more. In Gujarat alone, in three years 1815 people have been trained and made ready to work on

groundwater management. Helping a water-stricken village in Maharashtra achieve drinking water security. In the drought prone village of Randullabad in Satara district of Maharashtra, a three year long watershed development project undertaken with PGWM principles brought the village back from the brink of drinking water scarcity crisis to becoming to a water-sufficient village. The project involved recharge of regional aquifers, geological mapping, testing of water quality and establishing usage protocols for drinking and irrigation. Drilling of borewells was banned and 90% of wells in the village were used on a sharing basis as farmers took turns to irrigate their lands. Groundwater recharge and discharge areas were demarcated. As a result of these interventions, groundwater levels have improved and local water structures have been revived. The impact of the program is seen in improved kharif productivities, improvement in irrigation and water use efficiency, improved equitability particularly for farmers and improved drinking water security;

Case Study 03: Strategic Initiatives in the Public-Sector: PGWM as recommended in the 12th Five Year Plan by the Planning Commission:

As a result of concerted advocacy at the national level, the 12th Planning Commission Report of the Government of India recommended PGWM. Participatory principles have also been incorporated into the Central Groundwater Board's National Aquifer Mapping Program (NAQUIM). PGWM is also one of the key programs that is building capacities of personnel working on the Government of India's Integrated Watershed Management program (IWMP). Other collaborations include integration of PGWM in NABARD-funded watershed projects, implementing guidelines for water management for the National Rural Drinking Water Program (NRDWP) and National Rural Employment Guarantee Act (NREGA), collaborations with state governments, NGOs, private foundations, corporate agencies and institutions;

Case-Study 04: Field Practices in "Ground Water Management"

01. 1972: Pani Panchayat is a system of equitable distribution of water through a people's council started by Vilasrao Salunke in the village of Naigaon, which lies in the severely drought prone region of Purandhar Taluka in Pune. Today, Pani Panchayats can be found all over the state of Maharashtra;
02. 1975: Anna Hazare's model of watershed management in Ralegan Siddhi in Maharashtra has been a successful program that has had many followers. Under this program so far, 48 nulla bunds (a crop irrigation system that involves creating lateral trenches to retain water), five cement check dams and 16 Gabion structures have been constructed;
03. 1985: Rainwater harvesting initiative led by Rajendra Singh of Tarun Bhagat Sangh in Alwar District, the semi-arid area close to the Thar Desert built over 8600 johads (rainwater storage tanks that collect and store water throughout the year) and other water conservation structures that brought water back to over 1000 villages and revived five rivers in Rajasthan;
04. 1995: Under the Maharashtra Government's Adarsh Gaon Yojana, the Hivre Bazaar watershed program became a model to follow. Spearheaded by Popat Pawar, 52 earthern bunds, two percolation tanks, 33 loose stone bunds and nine check dams have been built under this program;
05. 2000s: The Andhra Pradesh Farmer Managed Groundwater System (APFAMGS) project encouraged farmers to collect local water data and make collective resource use decisions. APFAMGS has been implemented in 638 habitations clustered into 63 habitations across seven drought-prone districts of Andhra Pradesh, through nine partner NGOs till 2010;
06. Other ongoing participatory approaches include:

- Foundation for Ecological Security takes a micro watershed unit for water balance and planning groundwater use along with communities in Rajasthan, Madhya Pradesh & Andhra Pradesh;
- Advanced Center for Water Resources Development and Management (ACWADAM) and Samaj Pragati Sahayog in Madhya Pradesh are working on knowledge-based, typology-driven aquifer-management strategies similar to those of Pani Panchayats;
- The use of a water budgeting tool known as the Jal Chitra by Barefoot College in Tilonia, Rajasthan;

4.3 Literature Study on Participatory Ground-Water Management: While, most mainstream approaches such as watershed development programs have mainly focused on augmenting groundwater recharge, the number and range of watershed programs continue to increase since the 1980s; some reports suggest Government of India has invested over US$500 million1 per year for rehabilitation of watersheds. In watershed programs, the onus is on 'treatment' of watersheds rather than any consideration of aquifers. Groundwater problems, even in excellent watershed programs have emerged parallel to the programs. As farmers dig-and-drill on the back of such programs, with the notion of unlimited augmentation within underlying aquifers, the very purpose of public investment lies defeated.

Also the analysis of various literature specific to several groundwater approaches indicate failure owing to: (a) A lack of understanding of the importance of scale in groundwater resources, (b) Neglect of the magnitude of diversity - geological, climatic and socio-economic factors that govern groundwater resources, (c) The focus is mostly on supply augmentation without regulating demand, (d) A lack of understanding of groundwater as a 'common pool resource', (e) Missing policy and regulations on groundwater, (f) Failure to demystify the science of groundwater management, & (g) Due priority not given to drinking water;

The approaches adopted so far lack a comprehensive understanding of groundwater resources & decentralized approaches that give rise to an engaged and well-informed participation by all stakeholders and communities. There is a need to bring about a fresh paradigm of looking at groundwater management – that includes supply augmentation, demand management and resource-based interventions. To achieve this, participatory approaches that involve communities become key;

4.4. Mixed Approaches towards "Participatory Ground-Water Management":

While the approaches adopted so far were towards solving only part of the problem, the stated methods indicate their strengths & focus towards conserving the source;

Table 7.0 : Approaches in "Participatory Ground-Water Management"

Water-shed Approach Strong Focus;	Conserving the Resource;	Drinking-water Pilots;	Crop-water budgeting;
Incidental to the Approach;	Recharging the Resource;	Some focus Strong;	Very Strong Focus;
A Strong Focus on the Source;	Source based Interventions;	A Strong Focus on the Source;	Mainly Livelihood Focused;
Seldom;	Monitoring Water-levels & Quality;	A Strong Focus;	A Strong Focus;
Water-budgeting is sometimes undertaken;	Water Budgeting, at Village Level;	Water-budgeting seldom under-taken;	Hydrological units – mainly water-sheds;

Since ground-water is an invisible common pool resource, it brings with it a set of complexities about who uses and who provides. When a potential user overuses groundwater for personal consumption, it leads to a situation where it decreases the availability of water for a community. Similarly dilemmas arise about who develops and manages the water and who uses it because with a common pool resource it becomes difficult to exclude users.

4.5 "Participatory Methods" & Its Outcomes / Impacts in "Ground-Water Management"

While "Participation" is the development concept, that brings a discipline into this process of management, it aims at bringing users together to arrive at mutually-agreed decisions on usage and recharge.

Simultaneously, it builds in an ethos of self-regulation and sustainable use of groundwater to be followed by all. The plethora of studies indicate the lessons from various programmes cross India

The findings of the research on **"Institutionalising Groundwater Management: A Tale of Three Participatory Models in Andhra Pradesh"** by M. Srinivasa Reddy, V. Ratna Reddy, R.V. Rama Mohan (May, 2012) portrays that, (a) The social regulation approach works better for sustainable groundwater management when compared to the knowledge intensive approach, & (b) Encouraging water sharing between well owners and others would result in achieving the twin objectives of conservation and improved access with equity;

Amrtha kasturi Rangan's research (January 27, 2016), portrays that, (a) there is annual extraction of water is 230 cubic kilometer from the groundwater in India, (b) also there is unregulated water extraction in 60% districts leading to water scarcity & distress, & (c) PGWM programme has been tested which increase the Ground water level, improved productivity;

The **"Economic Impact of Participatory Groundwater Management: A Case Study on Andhra Pradesh Farmer Managed Groundwater Systems Project",** by Kolla Sravanthi, Stijn Speelman* and K B Umesh (December 2015), highlights that, (a) Community-level institutions have become more assertive in the management of local resources has significantly increased on farm employment, but there is no significant impact on the net farm income, on crop diversification and water use;

Based on the above research focused articles & its literature review we find that there is unregulated water extraction due to which there is water scarcity and water stress. In India ground water is the main source of water so it necessary to utilize the ground water in more rational way. Also it was found that the Participation of Community to manage the water resources the community level institution has become more assertive and significant in case of water use and change in the crop pattern;

While the various literature studies, case study & analysis of pre-existing research has enable the refinement of the scope of the study, categorically, the dissertation places thrust on the estimation of water in the Mathkhani Dam, the wells in Chuchrumanr Village, and based on the water availability, design social awareness & advocacy initiatives along with good practices in water use & change in crop pattern so that adaptation could be developed even after the rainy season & without reaching a level of water scarcity. Also decision support mechanism to support the maximum sown area towards priority irrigation management could be practiced towards effectiveness & efficacy of water-utility;

Chapter 05: Outline of the Research Methodology, Data Analysis & Synthesis

While the research towards undertaking this study has been designed in such way so as to the three research segments viz., (a) Data Collection, (b) Measurement of the data, analysis & synthesis towards evolving the need / capacity related projects and techniques, along with practices that shall coincide with the field scenarios;

Qualitative Research Design: This enabled to determine the relationship between collected data & observation based on the mathematical Calculation(calculation of water in Mathkhani Dam and 23 numbers of wells);

5.1 Research Methodology: Per the project's scope, the calculation of the water in the Mathkhani Dam for the surface water and in the wells for ground water, is pivotal along with the knowledge on the water requirement of the house holds for different purposes. Therefore, the research methods, including experimental methods, questionnaires, informal interviews, focus group discussion & field observation were undertaken with the following objectives;

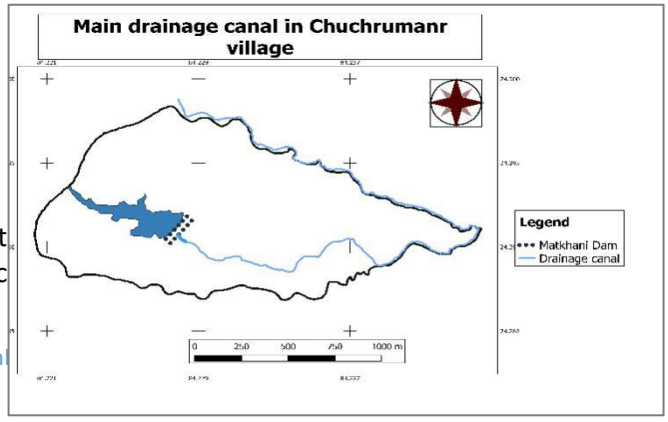
5.2 Objectives Towards Data Analysis, Synthesis & Scoping:
The specific objectives of the study encompassed towards, (a) Estimation of water available in the Mathkhani Dam for surface water & in the wells for ground water, (b) Estimation of the water budget of House Holds for irrigation, Drinking, Livestocks, & other domestic uses, & (c) In case of water deficit, to undertake social advocacy to rational use water and change in crop pattern;

The basic "Research Questions" that were circumscribed along achieving the study objectives are, (a) How the crops are irrigated in the post rainy season? & (b) What all kinds of crops grown in the Chuchrumanr Village?

Table 8.0: Methodology Adopted For Mapping Primary Data;

S. No	Types of Methods	Purposes
01.	Experimental	To calculate the water in the Mathkhani Dam & Wells arnd recharge and Discharge potential of the well
02.	Questionnaires	To know the crop pattern and use of watter source in off season
03.	, Interview	To know the indigenous way of water use
04.	focus group discussion	To know the local solution of meeting the requirement of water deficit
05.	Observation	To know all the life line activities in the Chuchrumanr Village

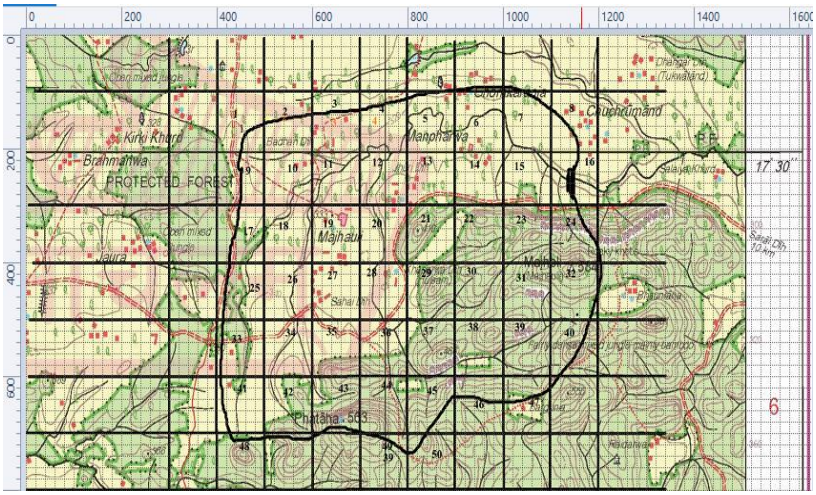
5.3 Methodology Adopted For Mapping Secondary Data:
The secondary data was obtained using the Bhuvan Portal & Google earth Pro to calculate area. Accordingly, the calculation of water of different water bodies are stated below:



5.3.1 About Mathkhani Dam
Mathkhani Dam is the Main source of Surface water at the time of visit and the rest of the water bodies werec

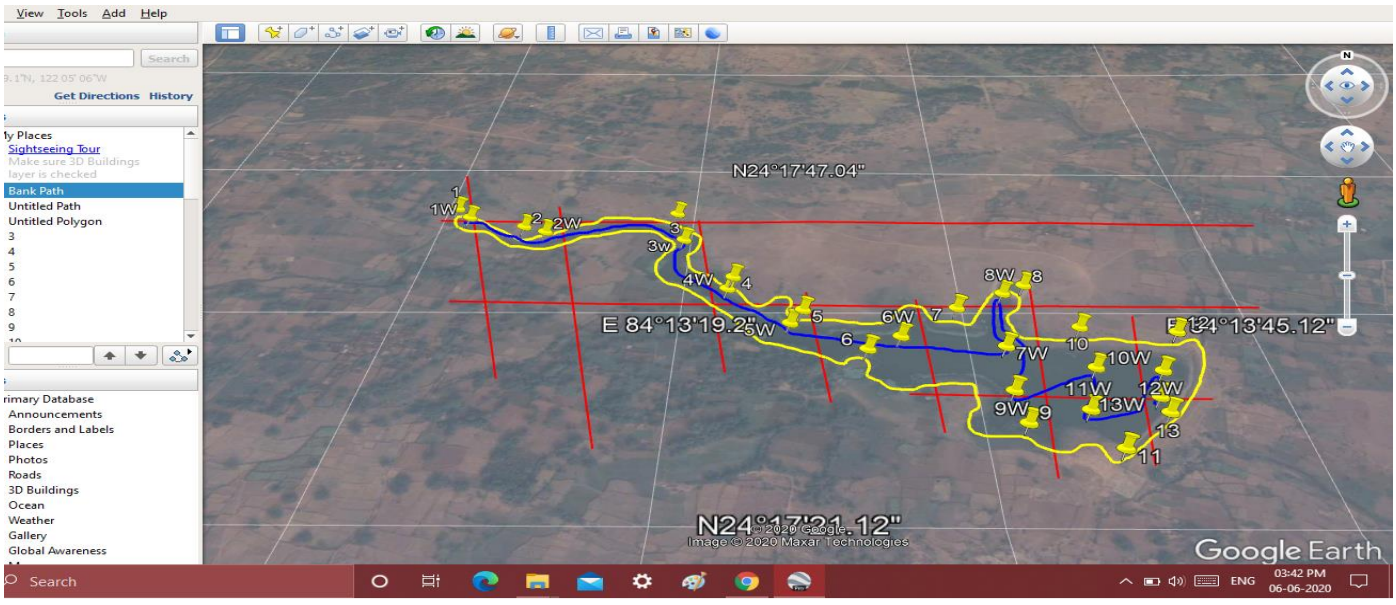
dry. It is South west side of Chuchrumanr Village . The total Submerggence area of the Mathkhani Dam is almost 9.5 hectares and the maximaus depth was at the time of visit was about 3 meters near at the Dam. The Mathkhani Nala Drains from South west to East in the Chuchrumar Village.

5.3.2 Catchment Area of Mathkhani Dam



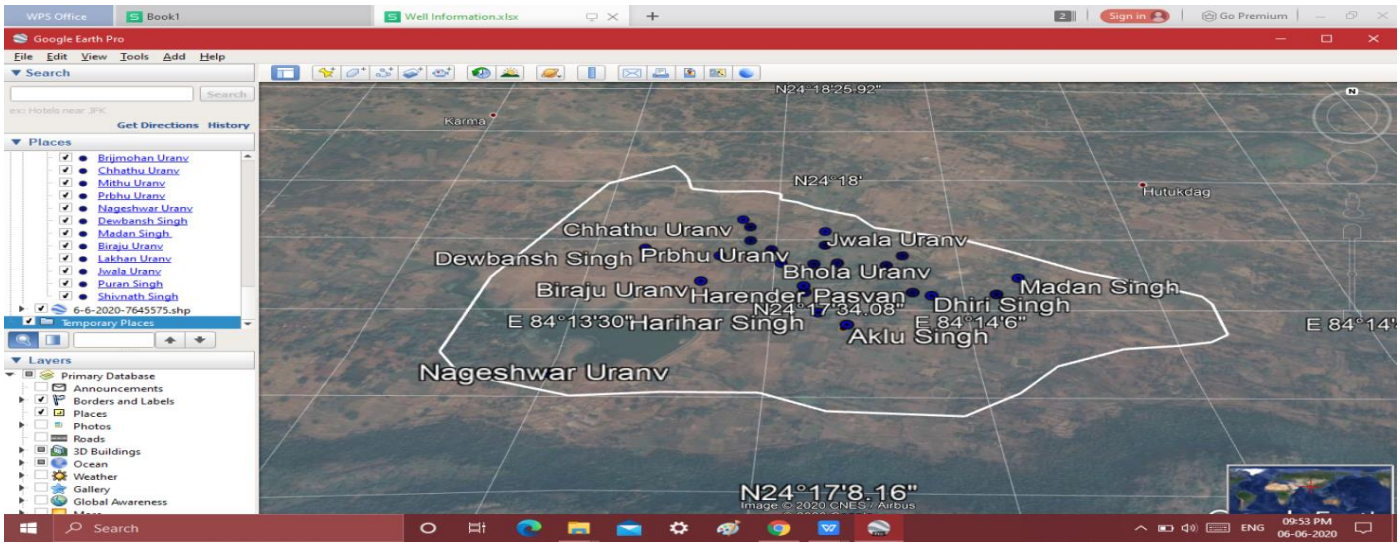
The most deep pont in the map is the Mathkhani Dam and this Dam draines the water of about 1028.25 hectares which includes the following Villages:
The average annual rrainfal of near and Catment area recieves748 in 2017, 482.5 in 2018,528.3in 2019 and in 2020 till may 124 im milli meter. The catchment area of Mathkhani dam recieves approx average annual rainfal 500 mm. In such way this area is rich in rainfall.

Water available in Mathkhani Dam : To calculate the water in Mathkhani Dam , the GIS was used using Bhuvan Portal and Google Earth Pro to mark the boundary of the Mathkhani Dam , also to find the average depth the Google Earth Pro was used.
The complete process & steps of measuring water in Mathkhani Dam is stated in the Annexure



Technical Findings: The total water available in Hectare-meter is 14.0098;

Illustration : Water calculation in 23 wells of Chuchrumanr



The 23 number of well brought under study and to calculate the volume which is as follows:
Total Volume of the Water in the well: 603093.0836 liters
The details of metrics are mentioned in annexures of the report;

5.4 Water-Budgeting:

Based on the information of the water availability in surface and ground both, the next steps towards calculation of the water requirement in every house holds pertaining to different segments such as irrigation, drinking, livestocks and other categories, that shall be the basis for water budgeting exercise;

5.4.1 Agriculture & Mapping of Crop-Cycle:

Table 9.0 : Agriculture & Mapping of Crop-Cycle;

Name of Crop	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Wheat	Irrigation	Irrigation	Harvesting	Harvesting		____	_____	_____	___	Ploughing, Seed Snowing /Pesticide	Irrigation After 21 Days, 90mm water required, Weed out	Irrigation Pesticide
Gram	Weed Out	Harvesting	Harvesting	___	___	____	-____	_____	____	Ploughing Snowing Period	Snowing Period	Weed Out
Masur	Weed Out, Irrigation	Harvesting	Harvesting	_____	___	____	_____	_____	____	Ploughing, Snowing Period	Snowing Period	Weed Out, Irrigation
Mustard	_____	Harvesting	Harvesting	_____	___	_____	_____	_____	___	Snowing Period	_____	____

Arhar	_____	Harvesting	Harvesting	____	___	Ploughing, Snowing Period, Compost	Ploughing, Snowing Period, Compost	Weed out	____	Weed out	_____	_____
Maize	_____	_____	_____	_____	___	Ploughing	Snowing period, Compost	Snowing Period, Compost	Weed Out	_____	Harvesting	Harvesting
Kulthi	_____	_____	_____	_____	__	_____	_____	Ploughing, Snowing	Weed out	_____	Weed out	Harvesting
Paddy	_____	_____	_____	____	___	Ploughing,	Snowing	_____	Weed out	Harvesting	Harvesting	____
Till	_____	____	_____	____	___		Snowing	_____	____	Harvesting	_____	____

5.4.2 Water Requirement of Crops Land-wise Upper/Middle/Lower Region:

(a) Upper-land Region:

Table 10.0 : Water Requirement in the Upper-land Region

Name of crop	Water requirement	Growing Period	Water fulfillment due to RF	Water Deficit
Lentil (Masur)	425mm	125-130	51.43	373.57
Maize	525 mm	120	51.43	473.57
Arhar	420	150-200	51.43	368.57
Kulthi	420	120	51.43	368.57

Total Upper-land is 83.25(Tanr) hectares and the average water deficit approximately 400mm;

(b) Middle-land Region:

Table 11.0 :Water Requirement in the Upper-land Region

Wheat	500mm	90	51.43	448.57
Gram-	400mm	130-135	51.43	348.57
Mustard	400mm	90	51.43	348.57
Rice	1250mm	110	51.43	1198.57

Total Middle land (Bari) is 30.53 hectares and the average water deficit is 440 mm.

Total land in water deficit is (upper-land+ middle-land) (83.25+30.53)=108.78 hectares on an average (400+440)/2= 420 mm. So we have water deficit 108.78x420 hectare-milimeter But the net shown area is only. And we have water available in Mathkah I Dam 14.0098 Hectare-meter;

Live-stocks Water Requirement

Total no of livestocks is=400and the water requirement in a day 155 liters a day
Total water requirement by 400 livestocks 400x155=62000liters
House hold water requirement

Table 12.0 : Live-stocks Water Requirement

No of HH	Animal	No of animals	Water requirement in liter
45	Ox	124	38
62	Cow	28	41
5	Buffalo	5	65
64	Goat	63	7
15	Pig	20	4.5
40	Poultry	160	.250

Table 13.0 : Water Requirement Wrt Individuals

Total no. of Individuals	Water Requirement (LPCD)
609	117

Water requirement in a day by all number of human 609 x 117 = 71,253 Liters;

Table 14.0: Overall Water Requirement:

S. No	Sectors in Need:	Requirement:	
01.	Irrigation	108.78x420 hectare-mm	45,687.6 Hectare-mm
02.	Livestock's	400x155=62000liters	Total in liter 133,253
03.	HH	609x117=71,253liters	

Table 15.0 : Comparison between Water Availability & Water Requirement:

Water Available in Mathkhani Dam	Water requirement in irrigation
14.0098Hectare-meter or 14.0098x100x100=140098 Hectare-mm	45,687.6 Hectare-mm

Table 16.0 : Water Available in Well for Domestic-Use Vs. Water Requirement

Water Available in Well for Domestic-Use	Water Requirement
603093.0836 liters	133,253 liters

Summary of Field Based Findings / Observations:

While Mathkhani Dam is the source of surface water for irrigation in the off rainy season, in case of Horticulture the well water is used for irrigation & mainly the Rainfed crops are sown as farmers have less facilities such as solar pumps & diesel pumps, to lift the water from the Mathkhani Dam and their own wells;

Chapter 06: Recommendations & the Way Forward

Based on the secondary data, field analysis of scoping the "Participatory ground water Management" at the Chuchrumanr Village for about three months in field and office too, and further analyzing various methodologies it was obvious that majority of the families dependent on the agriculture activities. Although there is surface water in the Mathkhani Dam & adequacy of ground water in the wells, but there is less use of water as they are less facilitated to lift the water from the wells as well as from Mathkhani Dam excepting few canals that sprawls upto the middle of the village.

Furthermore, the quantity of water available in the Mathkhani dam is about 14 hectare metre, against the required quantum of 45 hectare meters. i.e In the current scenario, even if even then if half of the agriculture land is sown even then there would be water deficits. Therefore, the logical management option would be towards strategizing water body linkages, pasture-wise so that the water can be availed at that very pocket of land;

In case of Households water needs and for live stocks the water in the well is sufficient, however it cannot be let to dry or to deplete the water table, and henceforth maintenance of wells should be carried out periodically. Since, it has been observed that the recharge rate is normal & well functioning at Chuchrumanr, maximum amount of water can be extracted for utilities other than drinking & live stocks;

Besides these logical assessment in consultation with field officers, experts , the proposed **"Participatory Ground-Water Management"** plan for Chuchrumanr will serve as a role model for environmental stewardship by providing community leadership in the area of natural resources management, resource protection and civic education.

Table 17.0 : Agriculture & Livestock based Livelihood

Categories	Problems	Solutions
Agriculture		
	- The existing water harvesting structures have decreased in depth due to excess siltation, causing drastic reduction in the potential water holding capacity of the structures. Thus, these don't suffice the irrigation demand of the community; - There are very few number of wells, used for irrigation, in the village; - Due to lack of proper canal structural intervention the water from the water harvesting structures, particularly Matkhani Dam to Gohdi Ahra to Dhan ki ber (canal of 1200ft) does not reach many agricultural fields in the village and does not benefit the villagers at its potential;	- Improving water harvesting structures (Includes pond renovation); - New farm ponds and new wells can be constructed to conserve rainwater and also for improving ground water; - Canal renovation and extension of 1200ft additionally can irrigate additional 20-30 % (approx..) of the agricultural area of the village.
Livestock		

	- Scarcity of drinking water during dry season; - Lack of availability of fodder due to water scarcity;	- One or two sources of water, such as panchayat well and Matkhani dam can be used for fulfilling the livestock's' water demand; - Fodder plantations can be carried out to meet the fodder demand during lean season.

Table 18.0 : Water Requirement of HH

House holds	The wells get dry also the water table goes down in the summer seasons so the people are in less households use of water	The wells should be maintained in condition, they should be cleaned time to time.

However, this is taking into consideration just the agricultural requirement, & this quantity is exclusive of domestic and livestock water demand within the village;

While the prime purpose of this Natural Resources Management Plan is to provide the communities of village Chuchrumanr with the knowledge, methods and tools necessary for participatory NRM planning and to mobilize the community to preserving their local natural resources and the environment, the scope of the plan is to bring together the various elements of existing plans and best management practices to create an achievable set of actionable innovative practice relating to the protection of those natural resources inside the village boundary of Chuchrumanr.

The recommendations include creating: (a) The Enabling Environment 1. Policies – setting goals for water use, protection and conservation. (b) Institutional Roles : i.e. Towards creating an organizational framework – forms and functions, institutional capacity building – developing human resources, community partnership models & (c) Management Instruments;

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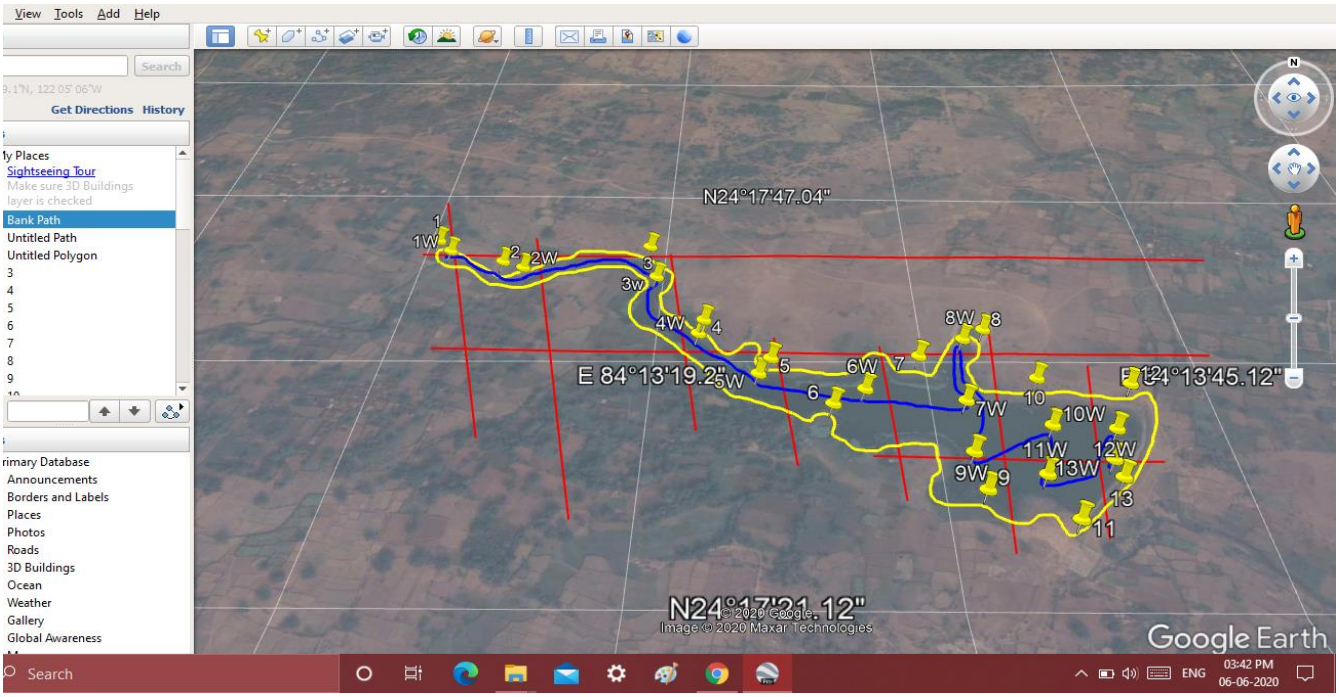
Annexures

Annexure 01: Calculation of Water in Mathkhani Dam

(a) The yellow pin are points with same name to calculate the difference in height and multiply the relevant area with so that the water could be calculated;



(b) The Height of the Water on the Bank of the Mathkhani Dam

No. of	Area in	Data on the Bank			
Squares	Hectare	PIN no.	Coordinate		Height from sea level
	1square=0.028h		Latitude	Longitude	Sea level(integer)
2	0.056	1	24°17'42.23"N	84°13'6.71"E	316.2
13	0.364	2	24°17'40.59"N	84°13'10.48"E	315.25
30	0.84	3	24°17'41.79"N	84°13'18.19"E	314.12
12	0.336	4	24°17'36.14"N	84°13'21.35"E	315.3
20	0.56	5	24°17'33.51"N	84°13'24.66"E	316
65	1.82	6	24°17'30.64"N	84°13'27.48"E	318
85	2.38	7	24°17'33.70"N	84°13'31.71"E	314
5	0.14	8	24°17'35.45"N	84°13'35.05"E	315
25	0.7	9	24°17'26.02"N	84°13'33.69"E	315
60	1.68	10	24°17'32.29"N	84°13'37.05"E	314
70	1.96	11	24°17'24.62"N	84°13'37.25"E	313
25	0.7	12	24°17'31.96"N	84°13'41.33"E	313
15	0.42	13	24°17'26.73"N	84°13'39.58"E	312

(c) Height of the Water in the drainage other than Bank of the Dam

Data in the water					water in
PIN no.	Coordinate		Height from sea level	Height	hectare meter
	Latitude	Longitude	Sea level(integer)	Difference in mete	
1W	24°17'41.40"N	84°13'7.52"E	316	0.2	0.0112
2W	24°17'40.08"N	84°13'11.65"E	315	0.25	0.091
3W	24°17'39.41"N	84°13'18.72"E	314	0.12	0.1008
4W	24°17'35.18"N	84°13'21.13"E	315	0.3	0.1008
5W	24°17'32.51"N	84°13'24.08"E	315.5	0.5	0.28
6W	24°17'31.55"N	84°13'28.99"E	317	1	1.82
7W	24°17'30.90"N	84°13'33.55"E	313.3	0.7	1.666
8W	24°17'34.83"N	84°13'33.97"E	314	1	0.14

9W	24°17'27.97"N	84°13'33.43"E	314.6	0.4	0.28
10W	24°17'29.56"N	84°13'37.20"E	311	3	5.04
11W	24°17'26.86"N	84°13'36.37"E	312	1	1.96
12W	24°17'29.37"N	84°13'40.02"E	310	3	2.1
13W	24°17'27.68"N	84°13'39.44"E	311	1	0.42

Note: Total no of square= 345	
Approx. area under Mathkhani Dam is =9.5 hectare	
Value of 1 square is approx. = 0.028 hac	

Accordingly, the water calculated is 14.0098 hectare metre

Annexure: 02 Calculation of water in the well

(a) Comprehensive List of Wells & Its Attributes

Name of Owner	Coordinate		water width	Well Radius	Circular area	Volume Cubic	Volume in
	Latitude N	Longitude E	in meter	in Meter	of the well(m*m)	meter	liter
Dhiri Singh	24.293207	84.234147	5.7912	1.524	7.29288864	42.23457669	42234.57669
Aklu Singh	24.291856	84.231943	1.6764	1.524	7.29288864	12.22579852	12225.79852
Harihar Singh	24.292394	84.231227	7.1628	1.2192	4.66744873	33.43200176	33432.00176
Basnt Singh	24.298696	84.234301	2.7432	1.524	7.29288864	20.00585212	20005.85212
Harender Pasvan	24.300064	84.231337	2.1336	1.524	7.29288864	15.5601072	15560.1072
Hrigopal Singh	24.295236	84.233497	2.7686	2.286	16.40899944	45.42995585	45429.95585
Syamdev Singh	24.294863	84.232995	3.429	1.524	7.29288864	25.00731515	25007.31515
Suresh Pasvan	24.294835	84.231762	2.8448	1.524	7.29288864	20.7468096	20746.8096
Parmeshwer Uranv	24.294808	84.23118	2.8702	1.524	7.29288864	20.93204897	20932.04897
Sarju Uranv	24.295251	84.228613	2.794	1.524	7.29288864	20.37633086	20376.33086
Bhola Uranv	24.294779	84.230141	5.1054	1.524	7.29288864	37.23311366	37233.11366
Brijmohan Uranv	24.296881	84.229221	2.159	2.286	16.40899944	35.42702979	35427.02979
Chhathu Uranv	24.297311	84.228978	2.5908	1.524	7.29288864	18.89441589	18894.41589

Mithu Uranv	24.295983	84.229303	2.9718	1.524	7.29288864	21.67300646	21673.00646
Prabhu Uranv	24.295845	84.231383	3.6576	2.286	16.40899944	60.01755635	60017.55635
Nageshwar Uranv	24.289872	84.225015	2.8702	2.286	16.40899944	47.09711019	47097.11019
Dewbansh Singh	24.295594	84.226509	1.397	1.524	7.29288864	10.18816543	10188.16543
Madan Singh	24.299141	84.236277	2.4384	1.524	7.29288864	17.78297966	17782.97966
Birju Uranv	24.28983	84.225069	2.8448	1.524	7.29288864	20.7468096	20746.8096
lakhan uranv	24.295527	84.229928	2.5654	1.524	7.29288864	18.70917652	18709.17652
Jwala Uranv	24.29655	84.231449	2.7432	2.286	16.40899944	45.01316726	45013.16726
Puran Singh	24.288115	84.248129	0.6096	1.0668	3.573515434	2.178415008	2178.415008
Shivnath singh	24.293301	84.235831	0.6096	2.286	16.40899944	10.00292606	10002.92606
Kamta Singh	24.29308	84.22982	0.6096	1.0668	3.573515434	2.178415008	2178.415008

Total Volume of the Water in the well: 603093.0836 liters

(b) Mapping the Recharge & Discharge Potential of the Well**:**

Towards mapping the recharge & discharge, the potential amount, pumping test has been executed & the following results were achieved;

Owner Name	Water volume	Starts time	Ends time	minutes spend
Aklu Singh	12236.92299	10:43	11:47	64
Basant Singh	20024.0558	13:40	15:49	129
Puran Singh	2180.397188	14:04	14:25	21

Extraction(Lt.)/second	Extraction(l)/minutes	Time taken	Extra time taken	Water recharged in extra time	Rate of recharge

3.33	199.8	61.24586082	2.754139181	550.2770085	8.598078257
3.75	225	88.99580357	40.00419643	9000.944196	69.77476121
6	360	6.056658854	14.94334115	5379.602812	256.1715625

(c) The comprehensive checklist for data mapping pertaining to water in Mathkhani Dam

(i) Catchment Area:

S. No	Activity	Comment
01.	Marking of watershed area on Revenue map	
02.	Counting the square	
03.	Counting the incomplete square	

Total Calculated area_____

(ii) Storage Calculation:

S. No	Activity	Comment / Parameter		
1	Marking of submergence area on revenue map			
2	Identification of Top point through GPS	Height	Longitude	Latitude
3	Identification of base point through GPS	Height	Longitude	Latitude
4	Identification of the Point of water level through GPS	Height	Longitude	Latitude
5	Identification of point of UP Stream through GPS	Height	Longitude	Latitude

Finding Slop

1. Up stream_____

2. Down stream_____

3. Total Volume of the Dam _____

(iii) Base Flow Calculation:

S. No	Activity			comment
01.	Point of identification	Longitude	Latitude	

02.	Depth			
03.	Width			
04.	Speed			

(iv) Base flow of

1. Location-1 _____
2. Location-2_____
3. Location-3 _____

The draft template mapping the crop pattern is stated in the table below:

Composite Template-01

S. No	Plot No	Area(Acre)	Land Type				Ownership			
			Agriculture	Barren	Forest	Pasture	GM	Morgage	Raiyat	Share

Composite Template-02

Crop									Risk Zone		
Kharif (Jun-Oct)			Rabi(Nov-Apr)			Zaid(Mar-Jul)			Low	Moderate	High
Crop	Irr. Source	Freq.	Crop	Irr. Source	Freq.	Crop	Irr. Source	Freq.			

Annexure:03

Community Service : Case Study during Covid-19 of Chuchrumanr Village

Ab to gharhi ne kuchh karela padtai…(Now we have to search a livelihood option at home itself…) – Voices of Chuchrumanr village

Chuchrumanr village is located 15 km from the Chhattarpur block. This village, which comes under Palamu district of Jharkhand, is a tribal dominant. A total of 110 households reside in this village and the population is around 609 individuals, with almost equal ration of Male and Female. This village is locally famous for the resourceful and pictorial Matkhani check dam. The major livelihood options of the households and its average annual remuneration are given below:

S. No	Name of Occupation	No. of HH involved	Average Annual Income
01.	Agriculture	110	12264
02.	Farm based labor	15	20000
03.	Seasonal migration	60	31850
04.	Daily based labor	35	70000
05.	Goat rearing	69	2609
06.	Non-timber Forest Produce	40	24000

Agriculture is the primary occupation of the villagers from Chuchrumanr. It is primary done for fulfillment of household food security. A total of around 167 acres of village land is under agricultural cultivation. The major crops sown are Grains and Pulses. Kitchen garden based vegetable cultivation is done in around 60 odd households. Goat rearing and Non-timber Forest Produce (NTFP) is another source of key income. As epicted in above table, season migration is adopted by members of 60 household. While surveying the households and having a discussion with few elderly members of the village, we found out that 24 individuals from 19 households had migrated to cities and were presently trapped and stranded due to the lockdown imposed. These individuals were working as laborer in factories and building construction site in Gujrat, Telangana, Andhra Pradesh, Maharashtra, New Delhi and Rajasthan. Some of the households are involved in daily wage earnings at the nearly stone crunchers quarry sites. Few households are also earning by breaking stones boulders in their farm or common lands and its sale to the quarry site, where various sizes of stone chips are being prepared.

The lockdown has forced the shutdown of all quarry sites. The present situation has not only stopped the earnings of all the daily wage based and migrant workers, but it has pushed them into a world of uncertainty with tremendous worries about their future livelihood ptions.Pitamber Singh, who was earlier working in a factory in Maharashtra (Raygarh district), is one of the lucky individuals who managed to return home before lockdown was imposed. He has a family of ten members and in spite of having land he is

forced to adopt migration. He said that "Maharashtra se mahine-mahine khat pit ke mota-moti 16-17 hazar bhej dev hali…lekin ab kaise hotai…ab to gharhi ne kuchh karela padtai" (From Maharashtra, I used to work hard and used to send home 16 to 17 thousand monthly…but what will happen now…now we have to search a livelihood option at home itself).

The villagers of Chuchrumanr realize and discuss the need to focus on agriculture and allied activities. But their hopes are dimmed with the recent experiences of agricultural losses incurred due to hail stone pelting. They also recall the incidences of dry spell and low productivity. When asked about the reason of these occurrences, they say the climate has changes over the year. When discussed about the scope of income earnings through livestock rearing, they feel that the market has slow down and doubt whether they will be able to get the right price for their goats and poultry. The reduced production of Mahua flower this year has also disheartened the farmers. On discussing the plans for the upcoming agricultural Kharif season, the major worries of the farmers are that of purchase of seeds. Earlier the dependence of the farmers on market seeds was less, but now with rising trend of market labeled packet seeds the traditional seeds is almost out of existence. It is estimated that in the next Kharif season, 70 households of Chuchrumanr village will require Rs. 41000 for purchase of 7.3 quintal of paddy seeds. Around Rs. 40000 will be required by 60 households for purchase of 2.6 quintal of Maize. We also estimated that due to the lockdown and the resulting closure of income from seasonal migration and daily wage earnings, Chuchrumanr will have an economic loss of more than one lakhs rupee. The impact of Corona virus is not only restricted to economic sphere, but it has spilled its effects on the social life of the village. People fear to gather together. There are various rumors about the spread of the disease, most of which doesn't have any logic and are also flavored with a communal angle. All the marriages of young couples have been postponed. The villages fear that if marriages will be conducted in the winter season, the expenses will increase. The members of girl's family fear that alliance with the male side will be disrupted due to the change in decision or hike in dowry price. On the whole the situation is quite grim at Chuchrumanr village. We were relieved to hear that the PDS machinery has started providing ration to the card holders. In these situations, the villagers expect Vikas Sahyog Kendra to support them for strengthening their livelihood options. They are hopeful that the Farmer Producer Organization (FPO) will provide them support in terms of availability of seed, procurement and marketing of stock. They are also hopeful that MGNREGS work will be re-opened in the village.