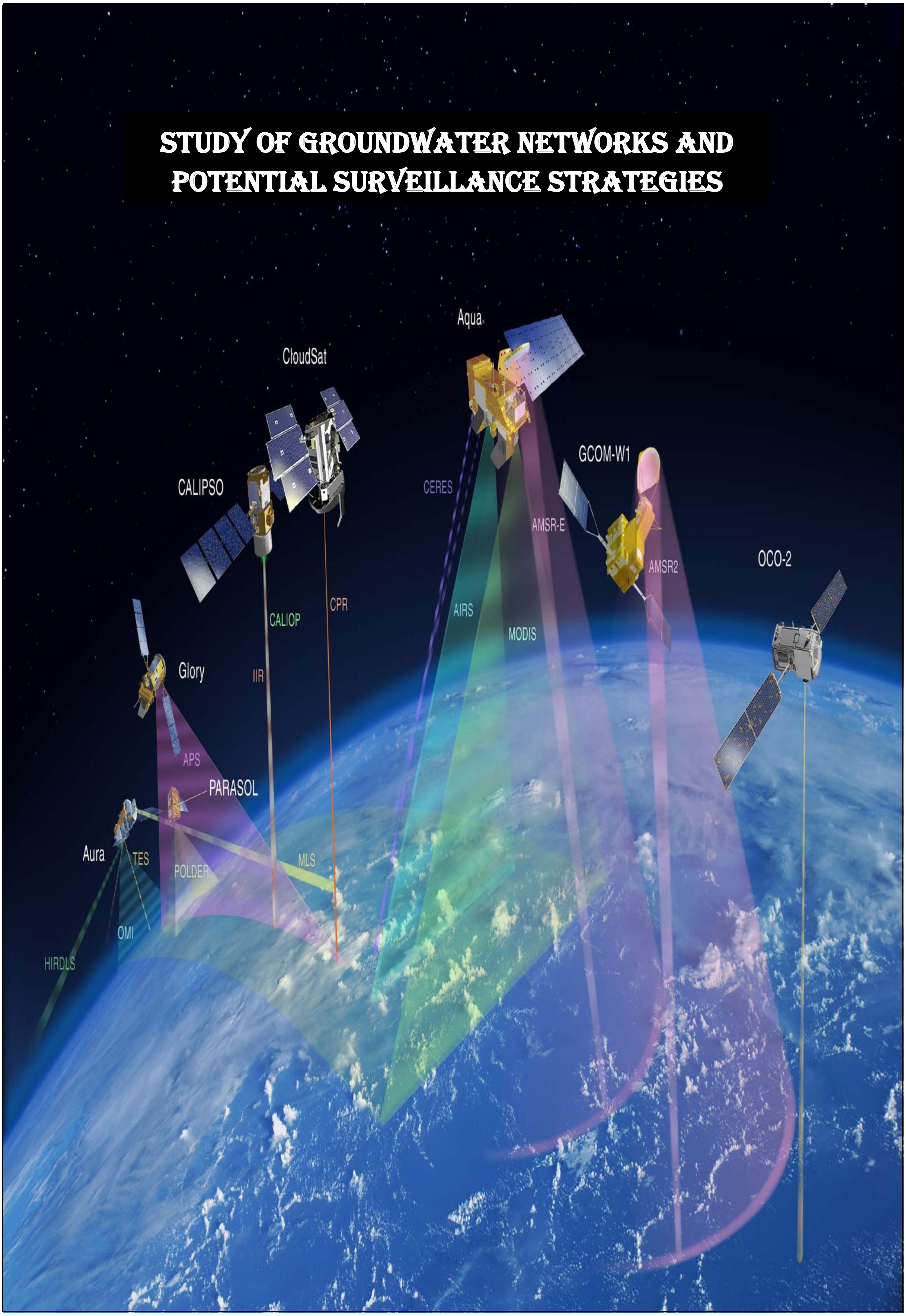
STUDY OF GROUNDWATER NETWORKS AND POTENTIAL SURVEILLANCE STRATEGIES



ACKNOWLEDGEMENT

This year has been an extremely informative journey for, my friend and me. We would like to extend our gratitude to **Dr**. **Jyoti M. Divecha** (Head of Department) for entrusting upon me these invaluable projects. The journey of the study at the department and the projects gave me immense insight into the world of analytics. We are very thankful to **Mr. Agniva Das(sir),** and **Mr. Shrey Pandya(sir)** my internal guide for their incomparable affection during my projects works. Documentation is heart of project, so we take opportunity to express my heartfelt thanks to all my dear friends who support and encourage my project partner and me to complete our documentation successfully. These projects have been the outcome of ideas of combination of ideas suggestions and contribution of many people. We express our gratitude to **Mr. Agniva Das(sir)** and **Mr. Shrey Pandya(sir)** for their immense support and timely help and for their incomparable affection during our project work. Our project is dedicated to all the people whom we met, took guidance interviewed and something from them. At this occasion, we want to grab this opportunity to acknowledge our sincere thanks to all of them while submitting.

Mr. Rajendra Jadhav (AS12)

Mr. Shreyash Chavanke (AS16)

Mr. Swejit Pawar (AS20)

Place: V.V.Nagar, Anand

Date:

A

PROJECT REPORT

(PS04CAST23)

ON

"Study Of Groundwater Networks And Potential Surveillance Strategies"

PROJECT GUIDE

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MR. SHREY PANDYA SIR

DEPARTMENT OF STATISTICS,

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VALLABH VIDYANAGAR , ANAND – 388120

BATCH : 2020 – 2022

SUBMITTED BY

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M.SC. APPLIED STATISTICS (SEMESTER IV)

CERTIFICATE

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Place: Vallabh Vidyanagar

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ABSTRACT

The present study focuses on the assessment of Groundwater in Vadodara City. Water resources are natural resources of water that are potentially useful. Uses of water include agricultural, industrial, household, recreational and environmental activities. Ground water is water in a river, lake or fresh water wetland. Ground water is naturally replenished by precipitation and naturally lost through discharge evaporation, evapotranspiration and groundwater recharge. Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. In Current study we will be using the satellite images provided by BHAUVAN and Google earth pro to estimate the water cover in Vadodara city. Statistical and geostatistical analyses were performed on satellite data in Qgis to estimate the area of statistics. For this we use statistical tools like Supervised classification and maximum likelihood classification. Results from the study is we determined the area of statistics.

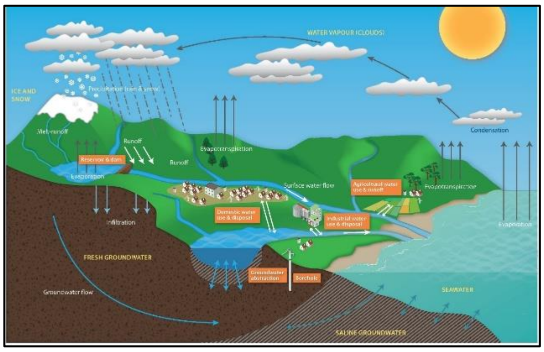
Objective

1. Different types of Data capturing technique.
2. Simulating aquifer forming using clustering techniques.
3. Estimation of groundwater using satellite images

INTRODUCTION:

Groundwater

Groundwater is fresh water (from rain or melting ice and snow) that soaks into the soil and is stored in the tiny spaces (pores) between rocks and particles of soil. Groundwater accounts for nearly 95 percent of the nation's fresh water resources. It can stay underground for hundreds of thousands of years, or it can come to the surface and help fill rivers, streams, lakes, ponds, and wetlands. Groundwater can also come to the surface as a spring or be pumped from a well. Both of these are common ways we get groundwater to drink. About 50 percent of our municipal, domestic, and agricultural water supply is groundwater**.**



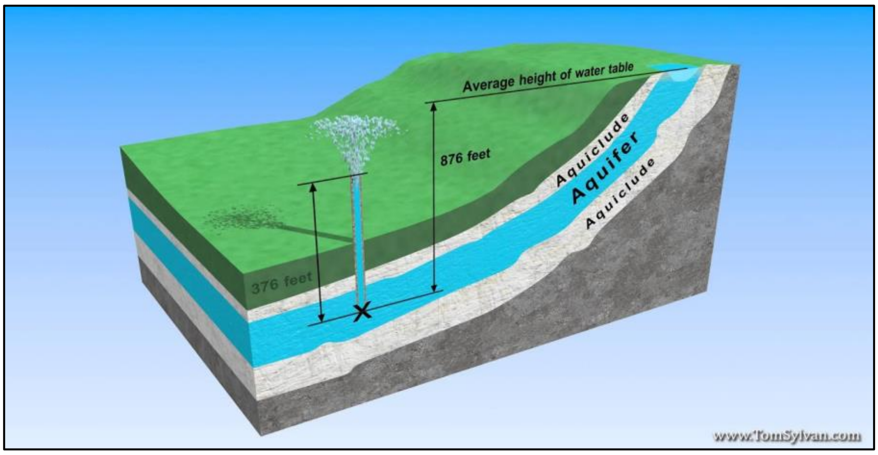
How does the ground store water?

Groundwater is stored in the tiny open spaces between rock and sand, soil, and gravel. How well loosely arranged rock (such as sand and gravel) holds water depends on the size of the rock particles. Layers of loosely arranged particles of uniform size (such as sand) tend to hold more water than layers of rock with materials of different sizes. This is because smaller rock materials settle in the spaces between larger rock materials, decreasing the amount of open space that can hold water. Porosity (how well rock material holds water) is also affected by the shape of rock particles. Round particles will pack more tightly than particles with sharp edges. Material with angular-shaped edges has more open space and can hold more water.

Groundwater is found in two zones. The unsaturated zone, immediately below the land surface, contains water and air in the open spaces, or pores. The saturated zone, a zone in which all the pores and rock fractures are filled with water, underlies the unsaturated zone. The top of the saturated zone is called the water table (Diagram 1). The water table may be just below or hundreds of feet below the land surface.

Aquifer :-

Where groundwater can move rapidly, such as through gravel and sandy deposits, an aquifer can form. In an aquifer, there is enough groundwater that it can be pumped to the surface and used for drinking water, irrigation, industry, or other uses. For water to move through underground rock, pores or fractures in the rock must be connected. If rocks have good connections between pores or fractures and water can move freely through them, we say that the rock is permeable. Permeability refers to how well a material transmits water. If the pores or fractures are not connected, the rock material cannot produce water and is therefore not considered an aquifer. The amount of water an aquifer can hold depends on the volume of the underground rock materials and the size and number of pores and fractures that can fill with water. An aquifer may be a few feet to several thousand feet thick, and less than a square mile or hundreds of thousands of square miles in area. For example, the High Plains Aquifer underlies about 280,000 square miles in 8 states— Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming.



NDVI (Normalized Difference Vegetation Index)

Normalized Difference Vegetation Index (NDVI) quantifies vegetation by measuring the difference between near-infrared (which vegetation strongly reflects) and red light (which vegetation absorbs).

NDVI always ranges from -1 to +1. But there isn't a distinct boundary for each type of land cover.

For example, when you have negative values, it's highly likely that it's water. On the other hand, if you have an NDVI value close to +1, there's a high possibility that it's dense green leaves. But when NDVI is close to zero, there aren't green leaves and it could even be an urbanized area.

NDVI is the most common index that analysts use in remote sensing. But how do you calculate it? What do NDVI values represent? How do Earth scientists use NDVI?

How do you calculate NDVI?

As shown below, Normalized Difference Vegetation Index (NDVI) uses the NIR and red channels in its formula.

NDVI = (NIR – Red) / (NIR + Red)

How do we use NDVI?

We see several sectors using NDVI. For example, in agriculture, farmers use NDVI for precision farming and to measure biomass.

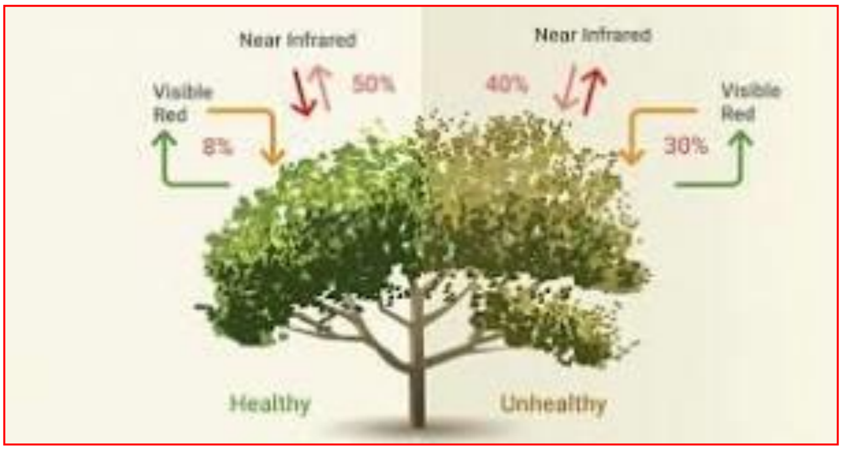
Whereas, in forestry, foresters use NDVI to quantify forest supply and leaf area index.

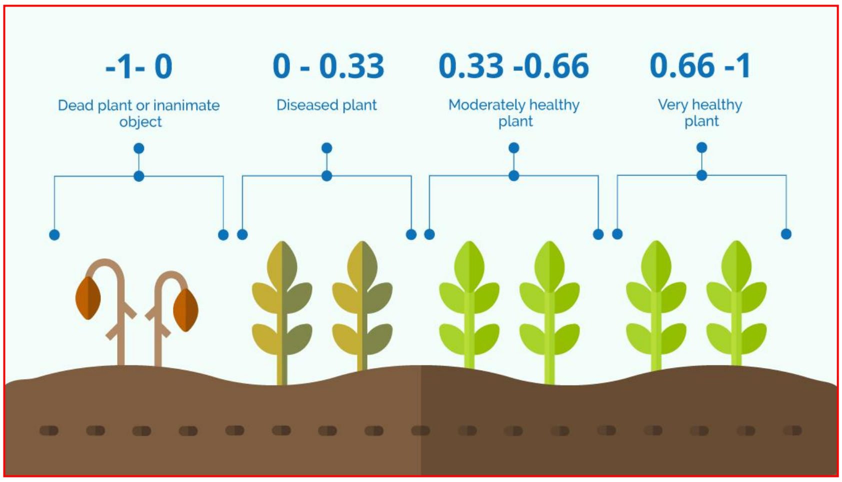
Furthermore, NASA states that NDVI is a good indicator of drought. When water limits vegetation growth, it has a lower relative NDVI and density of vegetation.

In reality, there are hundreds of applications where NDVI and other remote sensing applications is being applied to in the real world.

How is NDVI calculated?

How To Calculate NDVI? NDVI is calculated with the following expression: **NDVI = (NIR-Red) / (NIR+Red)**, where NIR is near-infrared light and Red is visible red light. There's a great number of free online GIS tools that allow you to instantly calculate NDVI.





What is the NDVI?

NDVI or greenness index is an indicator that shows the greenness, density and health of vegetation in each pixel of a satellite image.

It has been one of the most widely used vegetation indices in remote sensing since its introduction in the 1970s, and digital agriculture is one of the industries that takes most advantage of it.

Thus, this index is suitable for estimating vigor throughout the crop cycle based on how plants reflect certain ranges of the electromagnetic spectrum. It allows to know its current state, which can then be compared with another temporal image to observe its evolution over

NDWI: The water index and how to use it.

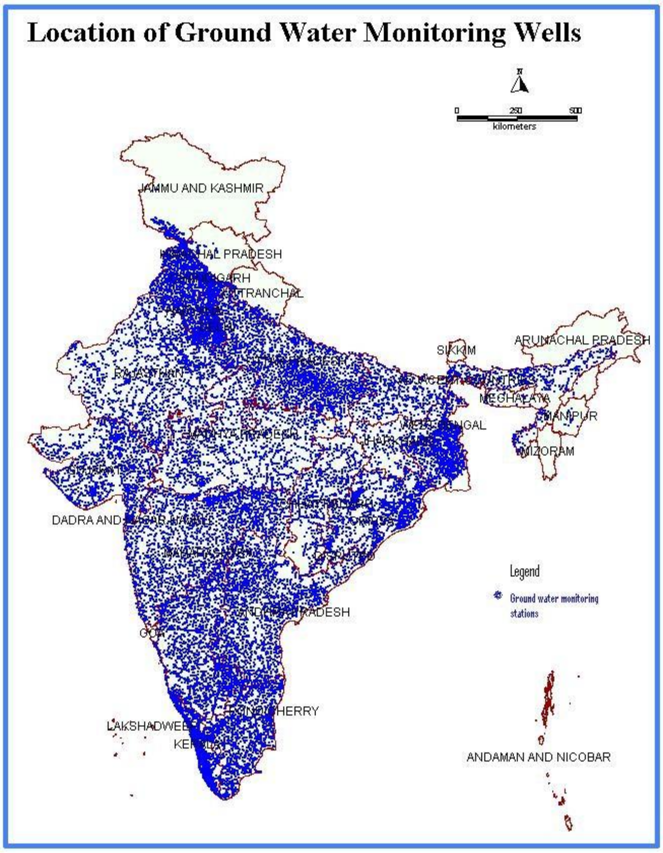
The **NDWI**, Normalized Difference Water Index, is used to monitor crop water status. It is used to observe the water status of the crop, identify moisture deficit and saturation in the crop. This index uses green and near infrared bands of satellite images. NDWI can improve water information efficiently in most cases. It is sensitive to soil accumulation and results in overestimation of water bodies. NDWI products can be used in conjunction with NDVI change products to assess the context of apparent change areas.

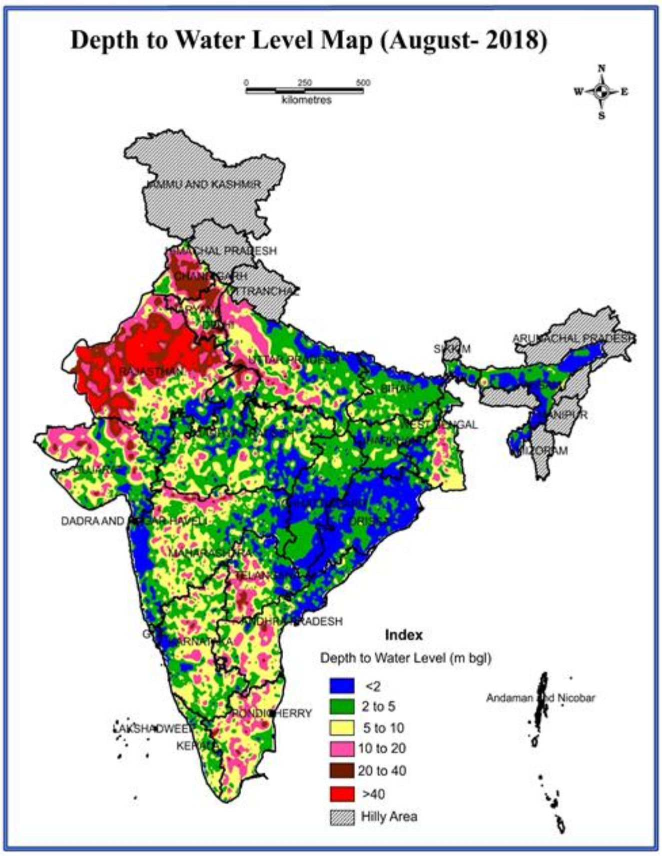
$$\mathbf{NDWI=(NIR-SWIR) / (NIR+SWIR)}$$

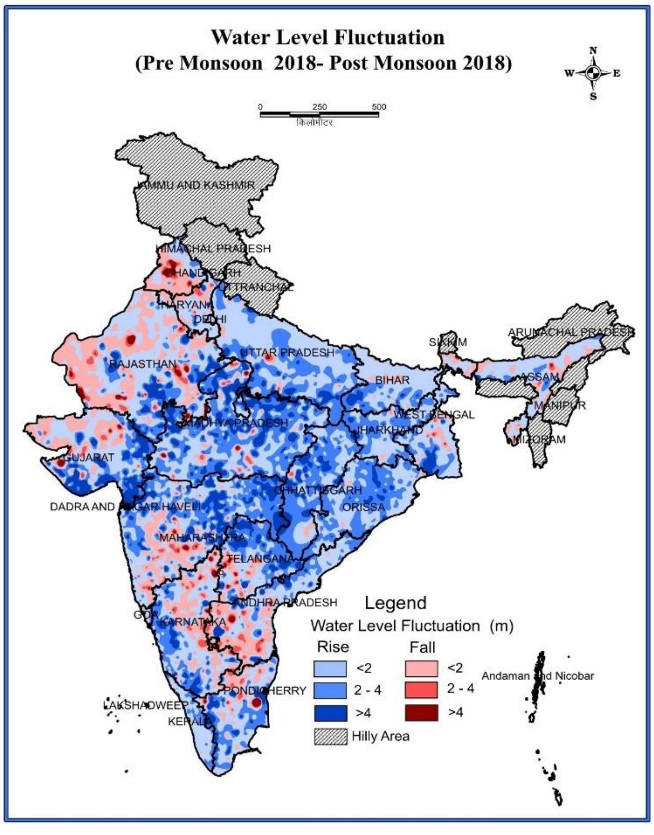
How is the NDWI used?

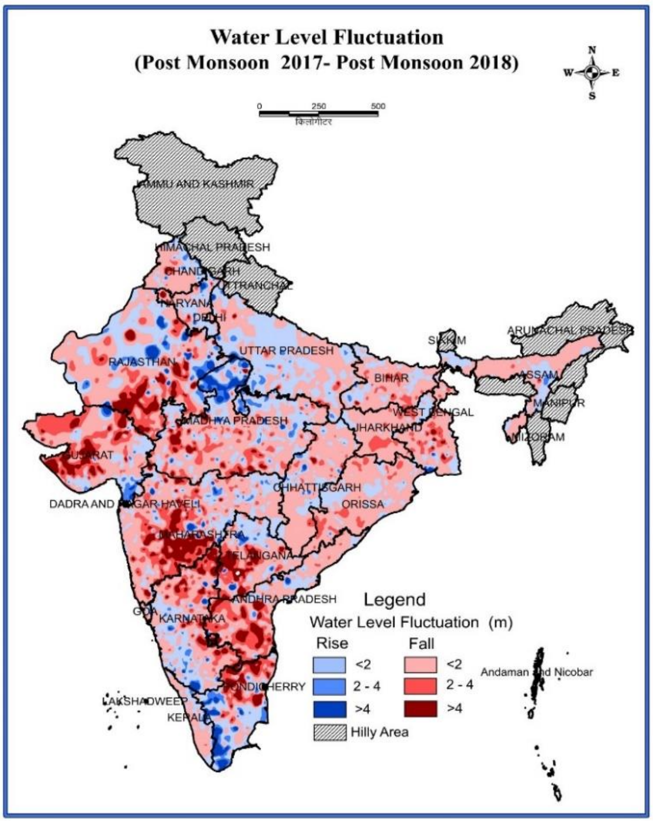
As with other indices, the values obtained for NDWI range from -1 to 1, where high values correspond to high plant water content and coverage of a large part of the plant and low values represent low vegetation water content and sparse cover.

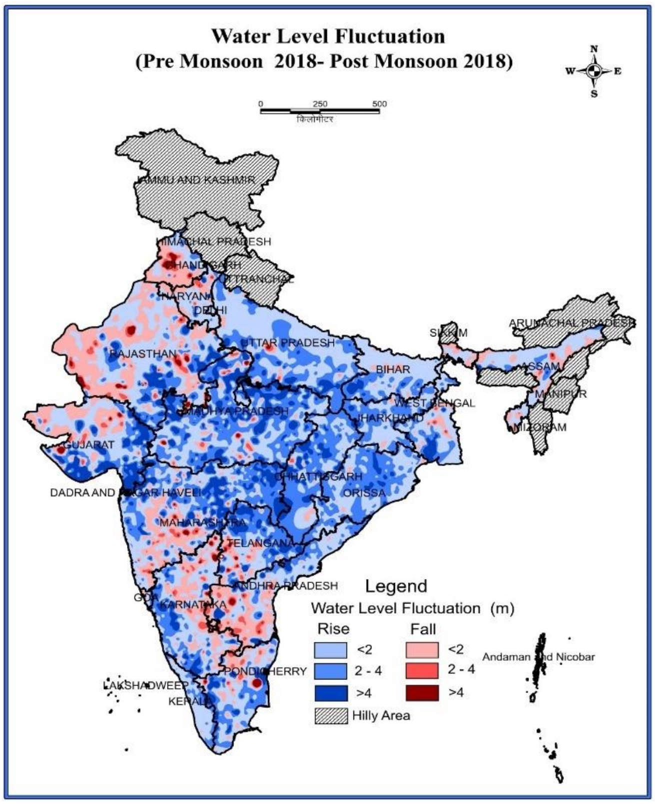
- **India data of Ground water, wells, rainfall**



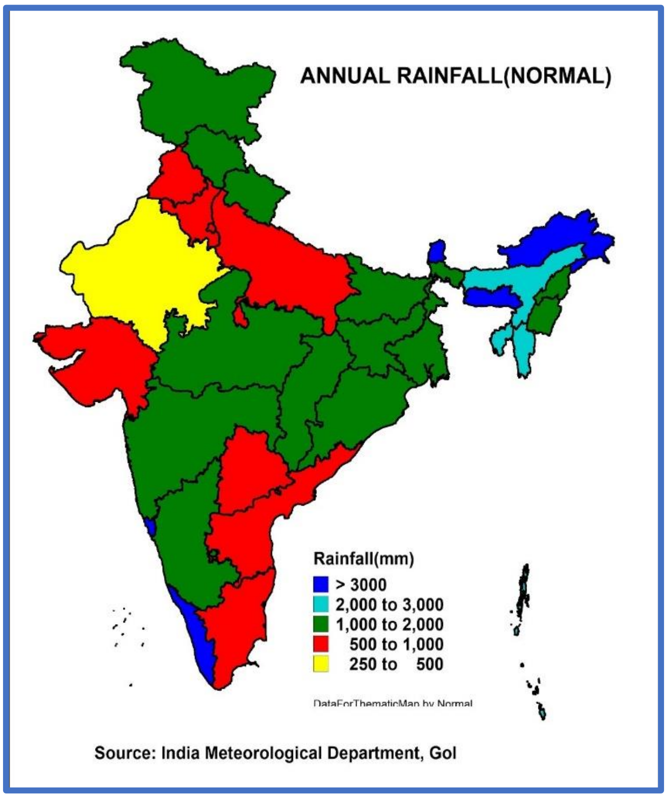


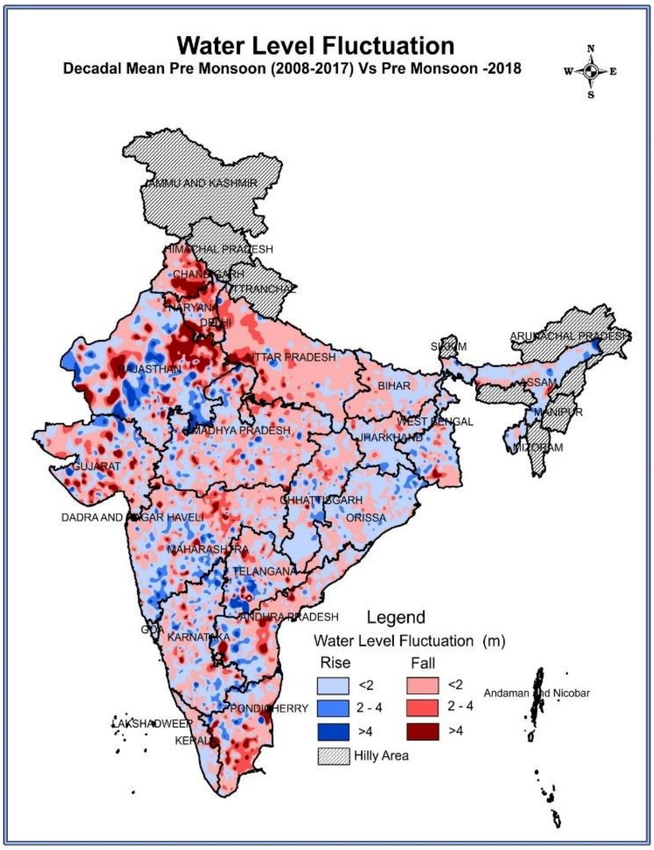





Water Level Fluctuation
(Pre Monsoon 2018- Post Monsoon 2018)
0 250 500
किलोमीटर
N
W E
S
JAMMU AND KASHMIR
HIMACHAL PRADESH
CHANDIGARH
UTTRANCHAL
HARYANA
DELHI
RAJASTHAN
UTTAR PRADESH
SIKKIM
ARUNACHAL PRADESH
BIHAR
ASSAM
WEST BENGAL
MANIPUR
JHARKHAND
MIZORAM
MADHYA PRADESH
GUJARAT
CHHATTISGARH
ORISSA
DADRA AND NAGAR HAVELI
MAHARASHTRA
TELANGANA
ANDHRA PRADESH
GOA
KARNATAKA
PONDICHERRY
LAKSHADWEEP
KERALA
Andaman and Nicobar
Legend
Water Level Fluctuation (m)
Rise
Fall
<2
2 - 4
>4
Hilly Area

•


ANNUAL RAINFALL(NORMAL)
Rainfall(mm)
> 3000
2,000 to 3,000
1,000 to 2,000
500 to 1,000
250 to 500
DataForThematicMap by Normal
Source: India Meteorological Department, GoI


Water Level Fluctuation
Decadal Mean Pre Monsoon (2008-2017) Vs Pre Monsoon -2018
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JAMMU AND KASHMIR
HIMACHAL PRADESH
CHANDIGARH
UTTRANCHAL
HARYANA
DELHI
RAJASTHAN
UTTAR PRADESH
SIKKIM
ARUNACHAL PRADESH
BIHAR
ASSAM
WEST BENGAL
MANIPUR
JHARKHAND
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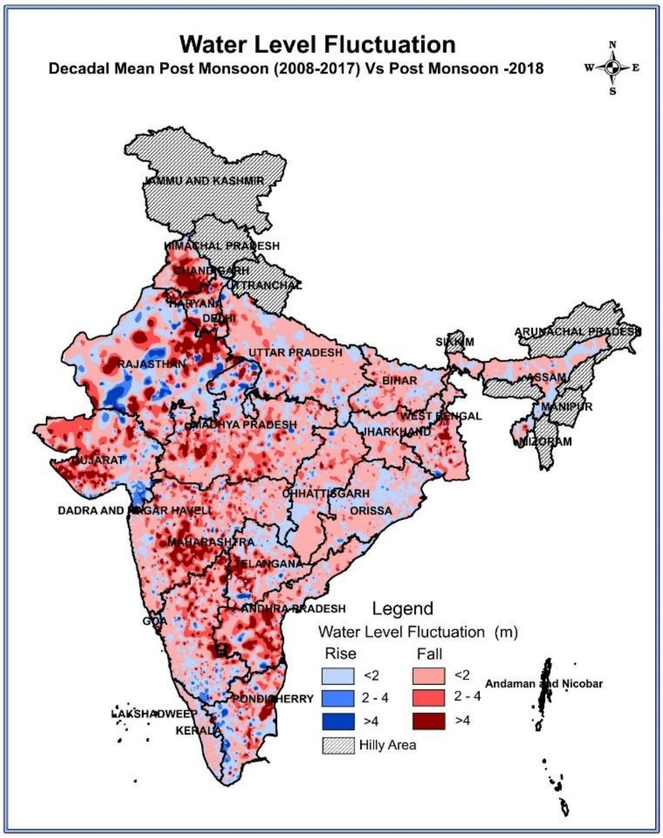
LAKSHADWEEP
KERALA
Andaman and Nicobar
Legend
Water Level Fluctuation (m)
Rise
Fall
<2
2 - 4
>4
Hilly Area


Water Level Fluctuation
Decadal Mean Post Monsoon (2008-2017) Vs Post Monsoon -2018
N
W E
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JAMMU AND KASHMIR
HIMACHAL PRADESH
CHANDIGARH
UTTRANCHAL
HARYANA
DELHI
RAJASTHAN
UTTAR PRADESH
SIKKIM
ARUNACHAL PRADESH
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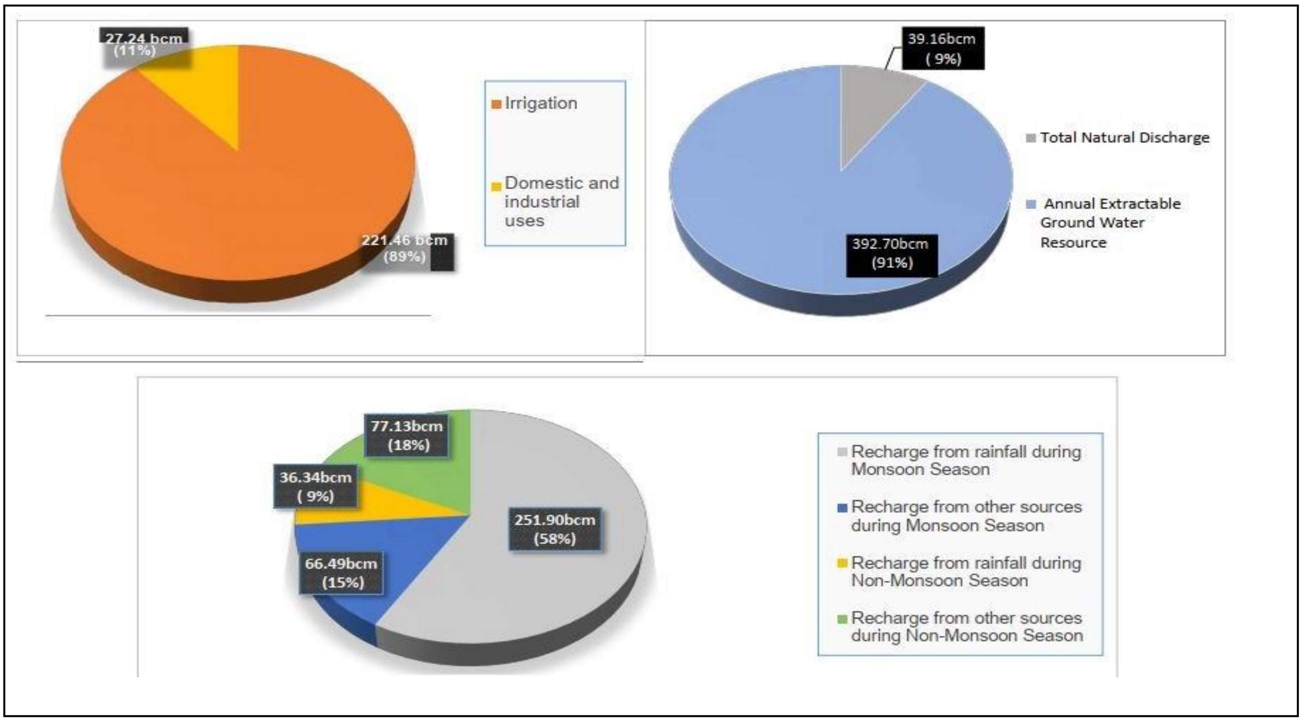
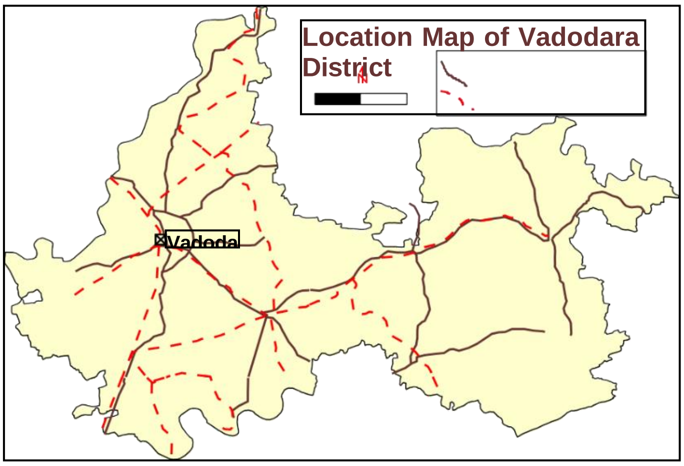
ANDHRA PRADESH
GOA
PONDICHERRY
LAKSHADWEEP
KERALA
Andaman and Nicobar
Legend
Water Level Fluctuation (m)
Rise
Fall
<2
2 - 4
>4
Hilly Area

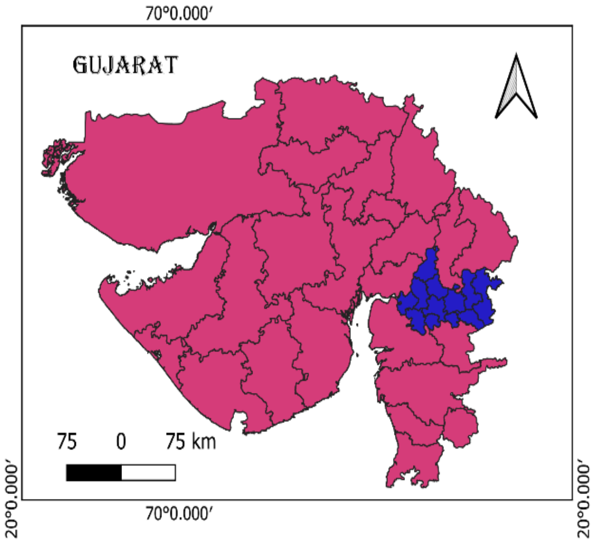
study area and geological information:

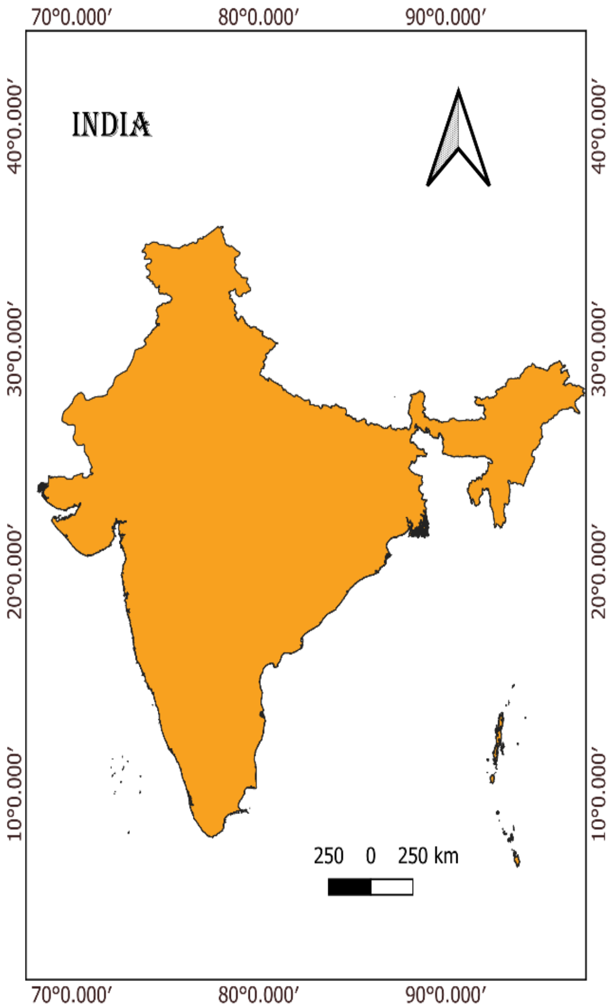


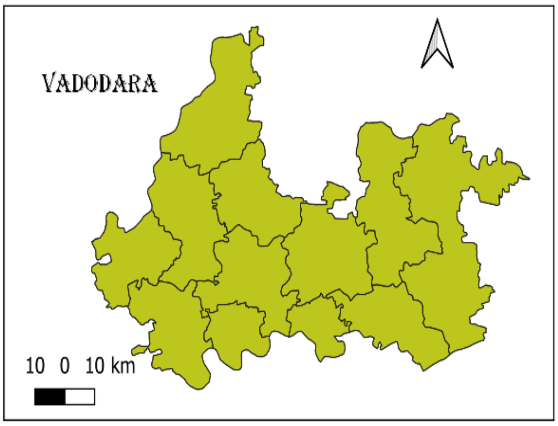
Source	Irrigated Area (Hectares)		
	Net	MTO *	Gross
Tanks	3,642	523	4,165
Canals	4,073	745	4,818
Lift & Flow Irrigation	2,283	238	2,521
Total Surface Water	**9,998**	**1,506**	**11,504**
Govt. Tube Wells	19,029	3,086	22,115
Pvt. Tube Wells	71,705	6,867	78,572
Dug Wells	99,076	24,593	123,669
Total Ground Water	**189,810**	**34,545**	**224,355**
Total Irrigated Area	**199,808**	**36,052**	**235,860**



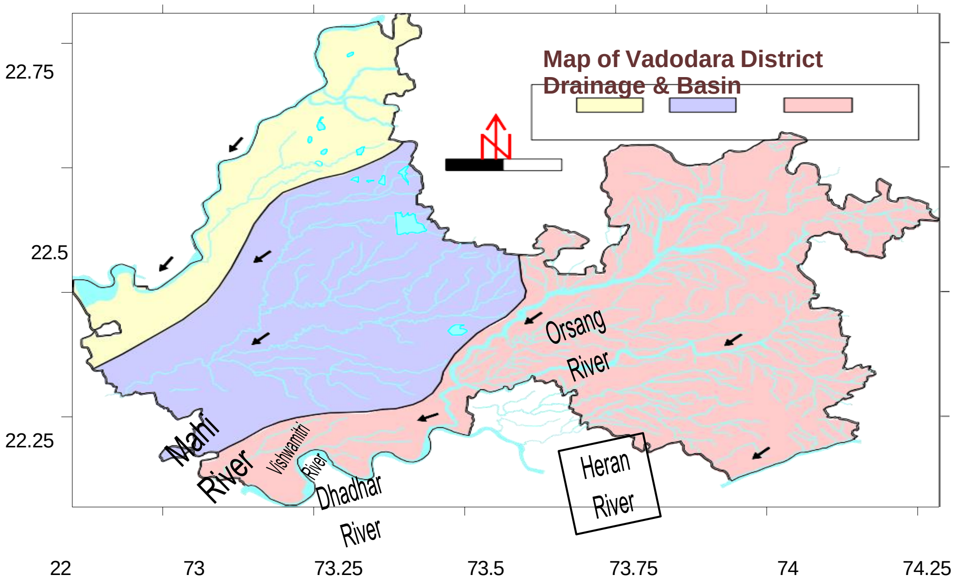
STUDY AREA :-



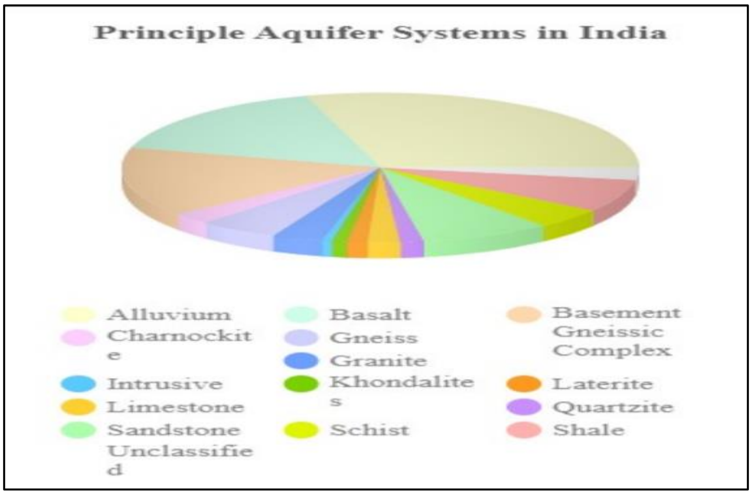


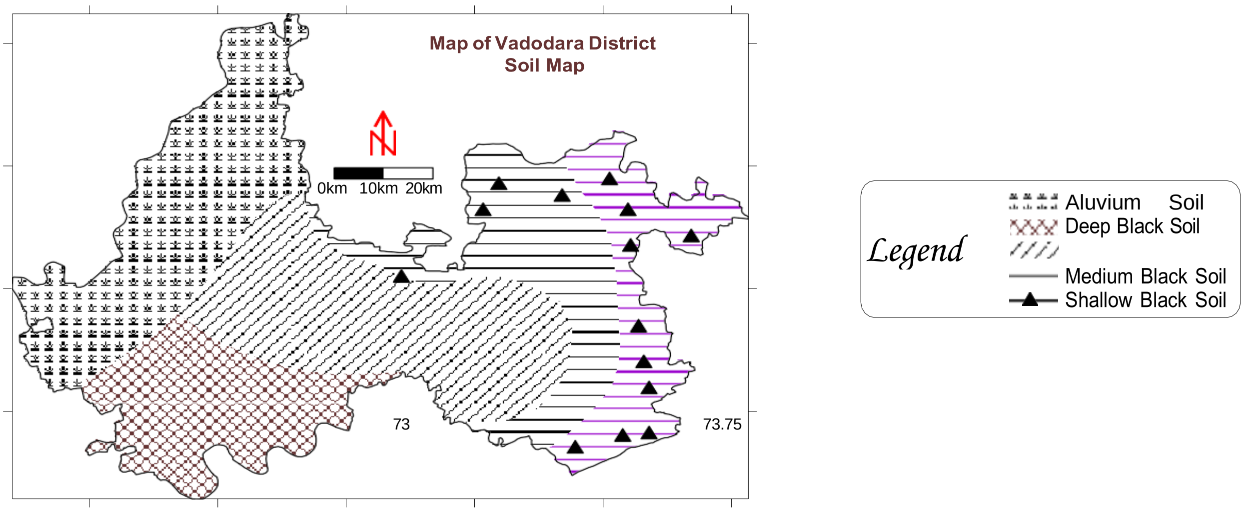


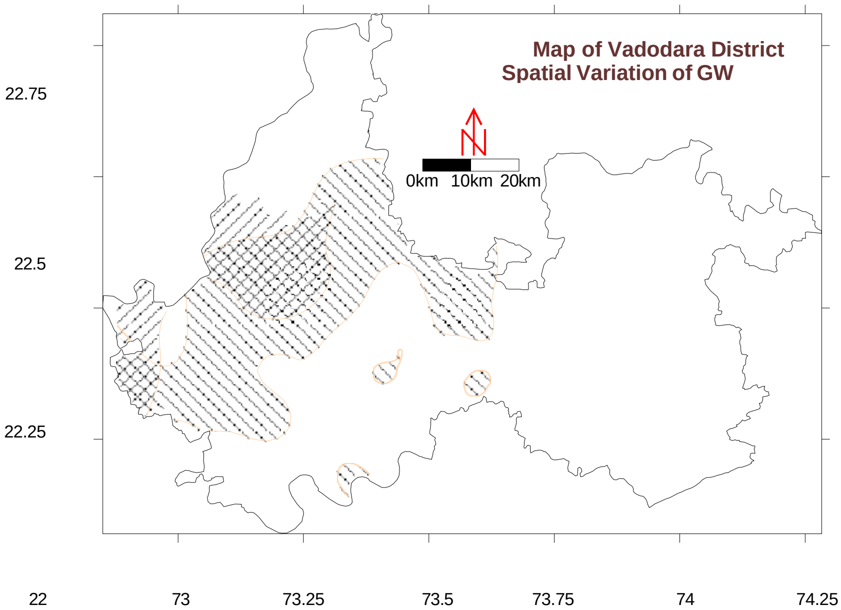
Drainage & Basin Map of Vadodara District



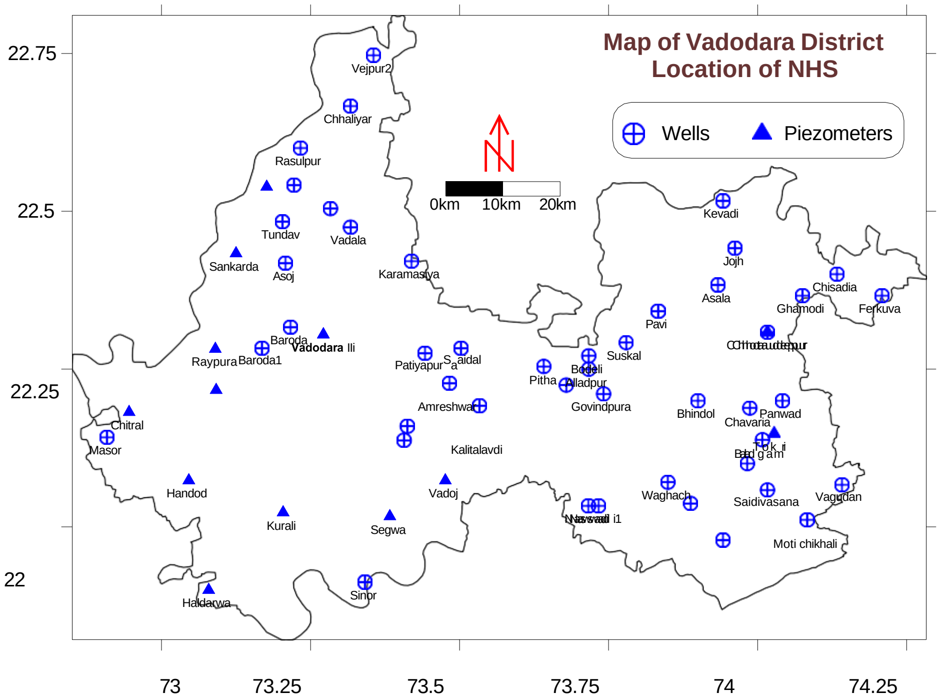
- **Soil Map of Vadodara District :**







Map showing location of NHS



<u>Indian water resource information system: -</u>

National Water Informatics Centre (NWIC) was set up by the Government of India on 28th March, 2018 to act as a central repository of updated water data and allied themes. The establishment of centre has been approved by the Cabinet on 06.04.2016 for timely and reliable water resources data acquisition, storage, collation & management and to provide tools for informed decision making for management of water resources of the country. It is created as a subordinate office under Ministry of Jal Shakti, Department of Water Resources, RD & GR and the office is located in New Delhi.

Objectives of NWIC:

Collection of available data from varied sources, generate new database, organize in standardized GIS format and provide scalable web-enabled information system.

Maintaining, updating, collating and disseminating water data and information.

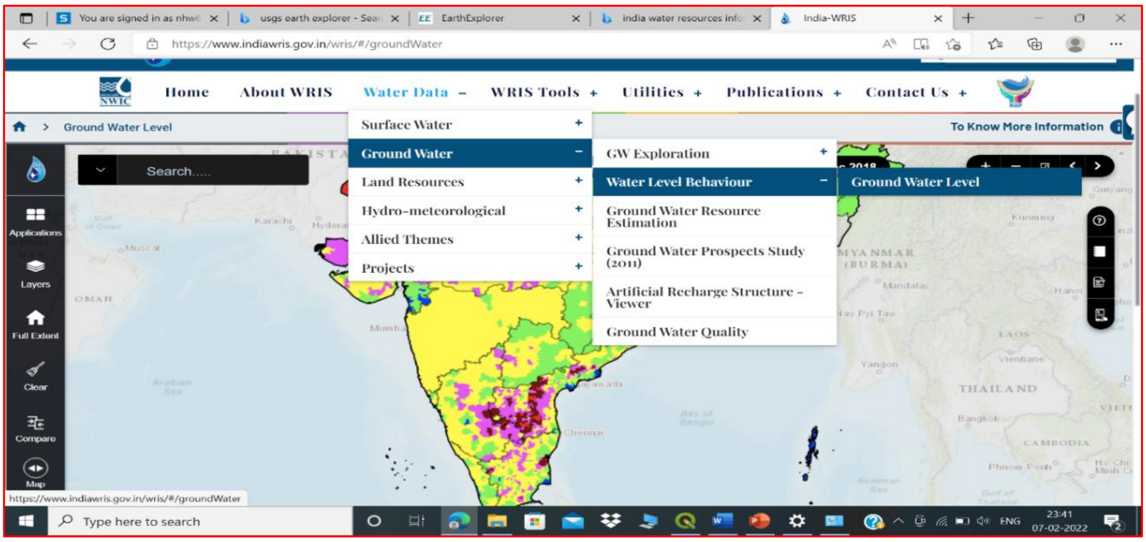
Sharing of hydro-meteorological data amongst central and state government organisations and other stakeholders of water & general public.

Provide tools to create value added maps by way of multilayer stacking of GIS database so as to provide integrated view to the water resources scenarios.

Collaborate with national/ international research institutes and Provide technical support to organizations dealing with water emergency response for hydrological extremes.

- **<u>Steps for getting latitude and longitude of every water stations:</u>**

  Path: water data ⟶ water level behaviour ⟶ ground water level



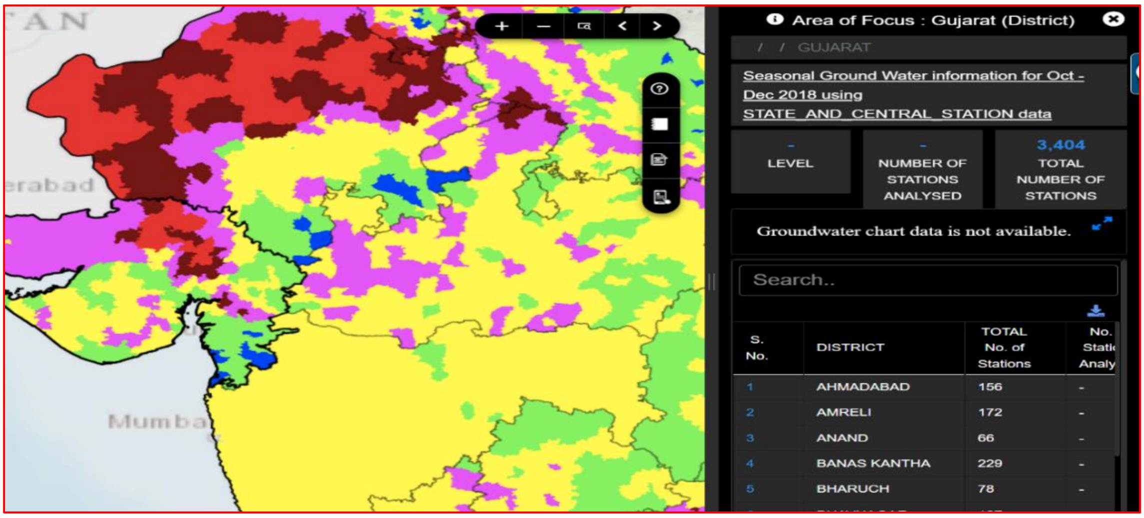
Steps:

1. Click on nation -> India.

2. Then select state -> Gujarat.

3. Select district-> Vadodara.

4.Then click on the water stations of which we want latitude and longitude .



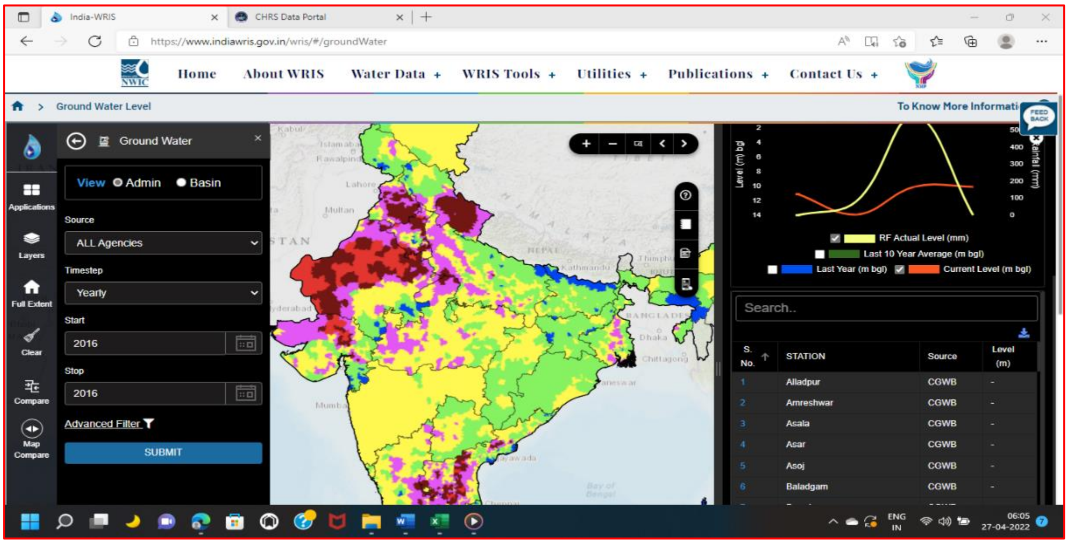
satation	latitude	longitude	level(metres)
Alladpur	22.25	73.7167	6.4
Amreshwar	22.2278	73.4833	3.35
Asala	22.3833	73.9333	4.88
Asar	22.2036	74.0106	17.0106
Baladgam	22.1375	74.0083	5.53
Bhindol	22.2	73.9	5.27
Bodeli	22.2708	73.7167	3.58
Chavaria	22.1875	73.9875	12.3
Chella Karamsiya Pz	22.3967	73.4322	1.22
Chhaliyar	22.6667	73.3167	23.9
Chhota udepur	22.3083	74.0167	2.26
Chisadia	22.4	74.1333	0.3
Chitral PZ_II	22.1819	72.9458	24.96
Chitral Pz-I	22.1819	72.9458	27.63
Chota udepur	22.3083	74.0167	8.36
Devat (thadgam)	22.1	73.9833	4.8
Ferkuva	22.3667	74.2083	0.15
Ghamodi	22.3667	74.075	1.43
Ghayaj ii	22.2333	73.0542	19.48
Govindpura	22.2111	73.7414	2.2
Handod1	22.0736	73.0458	29.8
Handod2	22.0736	73.0458	28.07
Jojh	22.4417	73.9625	6.95
Juna samalya	22.5042	73.2833	2.65
Kaprali	21.9792	73.9417	10.53
Karamasiya	22.4208	73.4194	13.2
Kevadi	22.5167	73.9417	3.23
Kosindra Pz-I	22.1467	73.7556	2.72
Makni	22.225	73.6792	8.65
Masor	22.1417	72.9083	12.95
Moti chikhal	22.0111	74.08333	6.4
panwad	22.2	74.0417	0.8
Patiyapura	22.275	73.4417	3.64
Pavi	22.3417	73.8333	3.71
Pitha	22.2542	73.6417	1.36
Rasulpur	22.6	73.2333	5
Raypura I	22.2819	73.0903	17.4
Saldal	22.2833	73.5028	0.57
Saidivasana	22.0583	74.0167	1.85
Sankarda	22.4389	73.1222	33.88
Sankarda1	22.4389	73.1222	29.16
Sankheda	22.5389	73.175	32.175
Segwa chouki ii	22.0083	73.3833	37.7
Segwa chowki I	22.0083	73.3833	28.76
Sengpur	22.0375	73.8875	4.25
Sinor	21.9125	73.3417	26.05
Suskal	22.2017	73.7702	8.13
Tukri	22.1472	74.0278	6.1
Tundav	22.4833	73.2028	8.7
Vadodara I	22.3047	73.2717	19.89
Vadodara ii	22.3047	73.2717	13.76
Vadodara_Kevada Bag	22.2933	73.1983	8.08
Vadodara_ONGC	22.2092	73.2128	16.14
Vadodara_Sama	22.3425	73.2006	0.6
Vadshala Pzi	22.1681	73.1604	28.3
Vadshala Pz-II	22.1681	73.1604	14.36
Vadtalav Pz	22.2586	73.7839	19
Vagudan	22.0667	74.1417	6.93
Vega	22.1594	73.4125	7.28
Vejpur1	22.7417	73.3542	26.2
Vejpur2	22.7472	73.2556	0.6
Waghach	22.0708	73.85	9.95
Waghodia Pz	22.3639	73.3769	6.43
Wankaner2	22.5389	73.175	25.6

- **<u>Process for getting water level data of individual station of every year</u>**

Water Data -> Ground Water -> Ground level Behaviour -> Ground Water Level

Steps:-

- Source :- All agencies
- Timesteps :- Yearly Start(----) , Stop(-----)
- Submit
- Area Of Focus:- INDIA / GUJARAT / VADODARA / (All station)
- Download



Data:

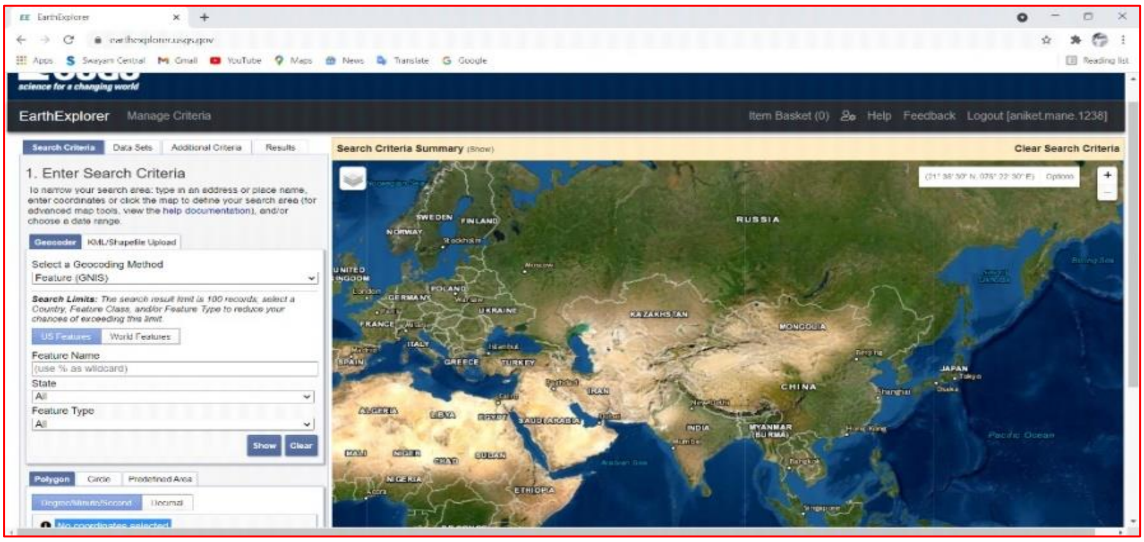
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alladpur	6.7	8.2	8.33	5.7	8.7	10.37	10.43	6.4	10.43	10.43
Amreshwar	4.35	4.75	3.97	7.1	4.07	3.73	3.35	4.04	1.97	1.45
Asala	11	10.93	11	11.6	12.5	12.22	12.5	8.06	4.2	4.4
Asar	17.2	17.7	18	17.2	17.2	13.1	17.2	11.51	9.64	11.9
Baladgam	13	13	13	13	13	13	13	10.81	12.12	13
Bhindol	8.28	10.75	9.52	1.55	6.98	3.42	9.56	10.75	6.01	5.58
Bodeli	1.98	1.48	2.8	8.79	6.1	7.28	7.28	6.2	1.41	1.41
Chavaria	12.3	12.3	12.3	12.3	12.3	12.3	12.3	9.21	9.21	12.3
Chella Karamsiya Pz	3.73	1.84	1.84	2.6	3.46	3.58	2.5	5.12	2.07	1.65
Chhaliyar	20.75	13.25	26.6	14.3	22.7	23.7	23.9	27.38	24.71	25.45
Chhota udepur	6.9	5.98	4.77	6.79	8.02	8.72	10.2	10.42	4.42	4.9
Chisadia	11.88	11.88	11.88	11.88	11.88	11.88	0.3	0.3	11.88	11.88
Chitral PZ_II	26.4	26.41	25.8	24.7	25.9	25.63	24.96	26.13	24.85	21.2
Chitral Pz-I	26.02	27	25.46	23.8	25.72	25.65	24.48	27.09	44.32	24.12
Chota udepur	2.08	9.85	2.08	2.08	2.08	8.36	8.36	8.36	3.14	2.33
Devat (thadgam)	10.21	9.87	9.3	11.7	11.7	10.27	11.7	9.11	5.33	5.33
Ferkuva	8.01	9.7	8.47	15.3	7.15	6.33	7.9	9.12	8.35	4.1
Ghamodi	8.96	8.15	2.55	0.8	9.08	8.32	9.09	9.15	4.82	5.65
Ghayaj ii	29.5	29.15	18.66	21.33	18.55	25.12	21.3	29.53	24.02	22.4
Govindpura	5.72	5.43	6.19	11.11	8.52	7.87	7.85	8.11	3.67	4.7
Handod1	32.1	32.21	29.46	29.51	29.6	29.3	29.8	29.8	29.31	29.05
Handod2		31.87	31.87	31.87	27.21	27.21	28.07	32.22	34.49	29.02
Jojh	13.42	13.42	9.73	13.42	13.42	13.42	13.42	11.72	7.97	8.1
Juna samalya	12.55	12.03	10.84	4.7	11.35	11.05	16.65	14.02	10.05	12.4
Kaprali	7.5	7.5	4.73	7.5	7.5	4.06	10.53	10.53	10.53	5.6
Karamasiya	11.25	12.78	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
Kevadi	6.65	6.86	5.53	13	8.02	6.42	7.5	7.61	4.6	5.35
Kosindra Pz-I	3.21	0.93	0.93	1.2	2.48	4.84	2.72	2.72	2.15	2.9
Makni	9.21	10.59	8.37	10.25	8.22	10.75	10.75	10.77	10.77	9.7
Masor	13.04	10.72	11.28	5.7	15.83	14.34	12.95	12.95	12.95	9.45
Moti chikhali	3.15	3.3	3.6	1.85	6.4	3.49	6.4	6.4	3.08	3.2
Panwad	14.7	14.85	9	3.46	15.3	9.78	10.25	9.77	6.37	7.38
Patiyapura	7.4	8.5	12.21	28.36	11.75	8.11	8.07	9.42	5.8	5.2
Pavi	4.41	4.34	4.65	15.7	4.97	4.7	4.42	6.85	4.95	4.5
Pitha	8.26	8.63	5.71	11.82	9.46	9	10.51	7.44	5.27	4.92
Rasulpur	5.4	4.92	2.15	12.7	4.28	4.28	5	5	5	5
Raypura i	15.5	35.7	30.42	24.37	30.64	15.52	17.4	36.42	26	34.1
Saidal	3.32	3.08	3.56	0.78	3.4	2.84	2.76	3.05	1.3	0.36
Saidivasana	6.7	6.7	2.75	6.7	6.7	6.7	5.5	6.61	2.45	3.45
Sankarda	29.35	31	19.26	30.03	19.47	27.23	32.04	48.72	48.72	26.1
Sankarda1	29.4	28.99	27.59	29.51	28.99	27.7	29.16	29.16	27.05	21.48
Sankheda	33.2	29.8	22.46	25.48	22.18	28.03	32.17	37.9	37.9	26.4
Segwa chouki ii	38.67	39.2	27.46	36.76	27.32	42.87	37.7	50	37.8	37.8
Segwa chowki I	39.1	39.1	41.55	29.44	41.15	36.09	29.05	49	37.1	35.6
Sengpur	9.7	9.64	8.9	4.55	7.64	11.75	11.1	11.31	6.56	6.3
Sinor	23.2	25.2	22.21	14.7	21.65	24.67	26.05	25.12	25.12	22.1
Suskal	3.79	7.64	4.11	18.6	18.6	18.6	8.13	8.13	4.36	4.36
Tokri	18.57	3.17	8.14	3.53	8.34	29.32	6.1	6.1	2.42	2.42
Tundav	16.35	17.13	15.2	3.7	14.56	9.72	10.9	15.03	4.88	4.6
Vadodara I	22.3	25.4	22.32	13.62	22.27	16.52	13.74	27.92	12.57	6.1
Vadodara Ii	8.18	8.18	5.34	5.31	5.3	6.42	7.5	8.36	4.41	12.5
Vadodara_Kevada Bag	10.4	10.6	8.1	10.1	10.6	10.13	8.98	9.55	3.55	4.1
Vadodara_ONGC	14.9	15.3	17.2	14.6	15.23	13.66	16.14	13.12	4.18	5.4
Vadodara_Sama	3.9	17.1	4.6	3.96	17	3.57	3.57	3.96	0.35	3.7
Vadshala Pzi	31.3	17.43	17.43	20.33	20.33	11.6	23.9	24.58	19.8	12.2
Vadshala Pz-II	12.3	12.14	14.36	14.36	14.36	14.36	15.39	14.36	14.36	14.36
Vadtalav Pz	11.61	17.43	17.43	19.45	6.8	13.86	19	16.63	4.92	6.7
Vagudan	6.93	6.93	6.6	6.93	6.93	6.93	6.93	6.27	5.87	6.93
Vega	5.88	6.05	5.46	14.05	6.2	7.11	7.28	7.66	4.55	5.45
Vejpur1	1.9	1.9	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2
Vejpur2	2.53	2.15	2.88	11.7	2.3	2.45	2.15	3.45	1.12	1.9
Waghach	9.95	9.95	2.97	9.95	9.95	9.95	9.95	9.95	9.95	9.95
Waghodia Pz	6.71	4.92	4.92	5.83	8.53	10.54	6.43	9.92	3.52	3.52
Wankaner2	40.2	42.3	44.8	45.07	40.3	36.97	25.6	25.6	25.6	25.6

United States Geological Survey (USGS):

The United States Geological Survey (USGS, formerly simply Geological Survey) is a scientific agency of the United States government. The USGS is a bureau of the United States Department of the Interior; it is that department's sole scientific agency. The organization's work spans the disciplines of biology, geography, geology, and hydrology. The USGS is a fact-finding research organization with no regulatory responsibility.

Steps for getting sentinel-2 data in USGS:

* Open https://earthexplorer.usgs.gov/ and login.
* You will get window like.



Find your area of interest and select points for polygon. Showed in figure: -

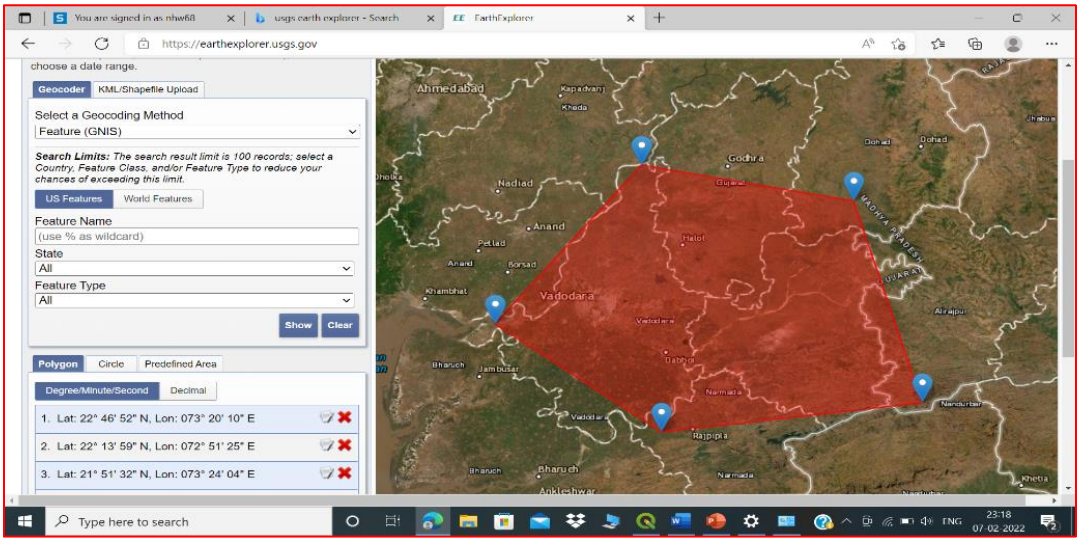
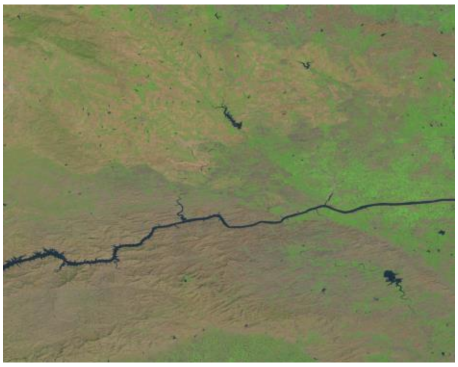
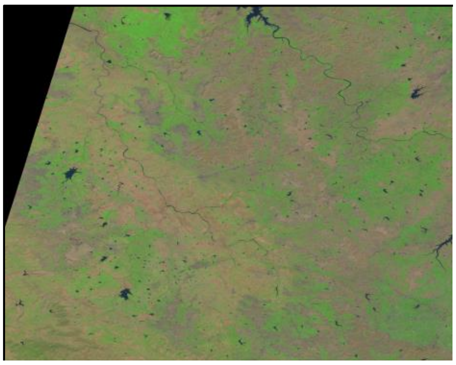
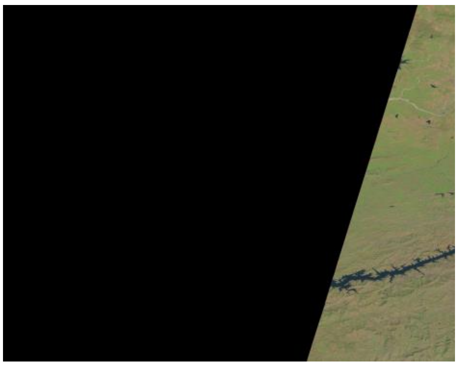


_Image Of USGS:-





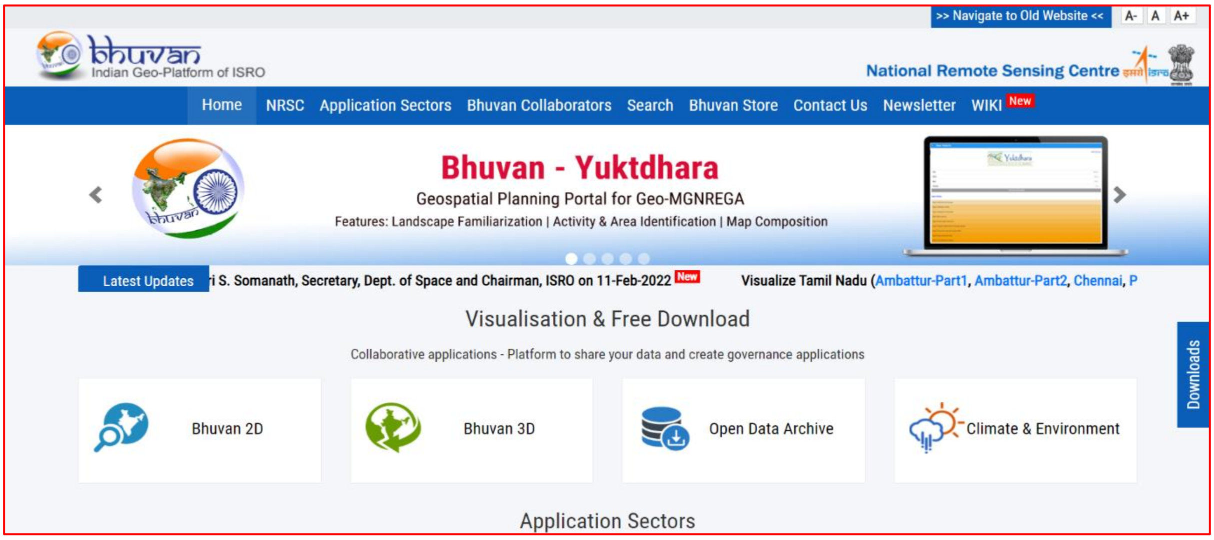


Observation: - The images taken from USGS website were not clear and suitable for the project requirement as shown in the above pictures.

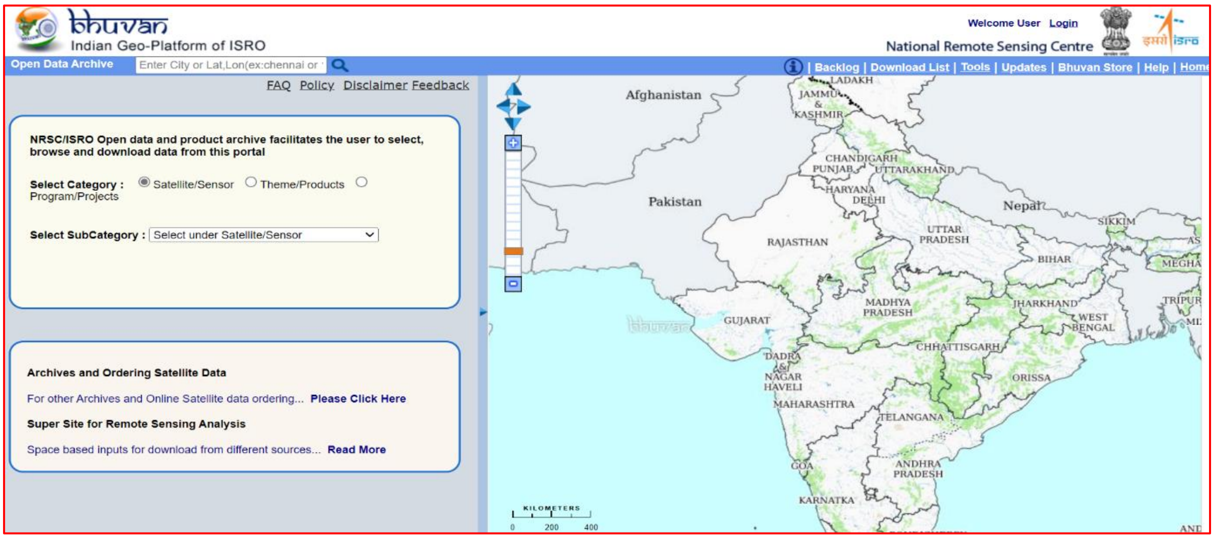
Hence, we switched to BHUVAN website where we found the clear and suitable images as per the requirement of the project.

BHUVAN :-

Bhuvan, (lit: Earth), is an Indian web based utility which allows users to explore a set of map based content prepared by Indian Space Research Organization . The content which the utility serves is mostly restricted to Indian boundaries and is offered in 4 regional languages. The content includes thematic maps related to disasters, agriculture, water resources, land cover and also processed satellite data of ISRO.[2] Bhuvan is known for its association with various sections of Government of India to enable the use of Geospatial technology. Bhuvan has since its inception enabled Indian government to host public geospatial data as Information layers for visualisation and public consumption

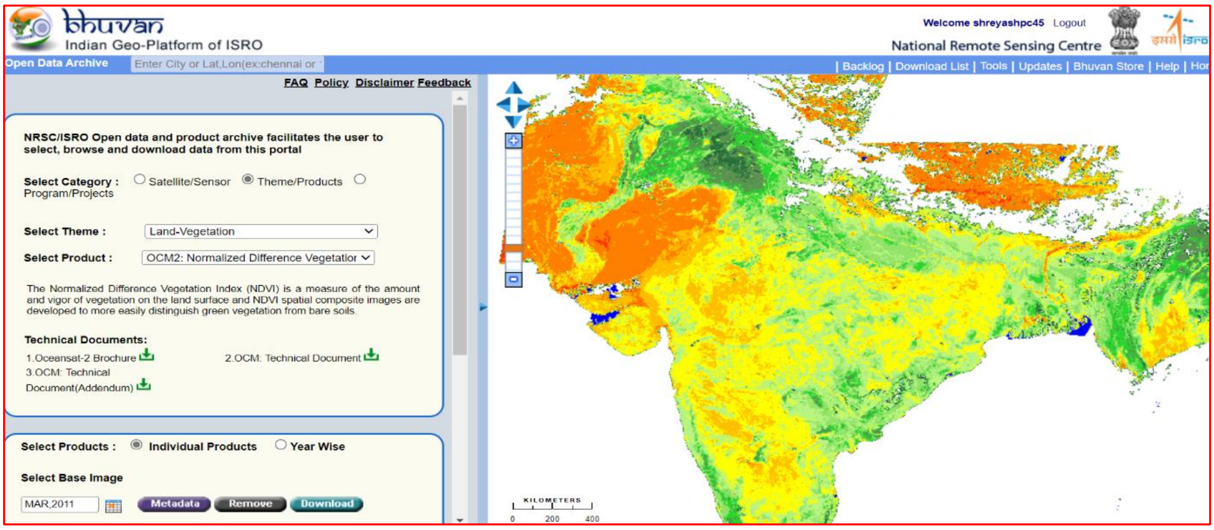


BHUVAN -> Open Data Archive -> Go to new tab



Steps For Download BHUVAN Image :-

1. Select Category :- Theme/ Product
2. Select Theme:- Land Vegetationation Index-Local coverage
3. Select Product :- Year Wise Select Year :- (------)
4. Select Monthly data :- Download.

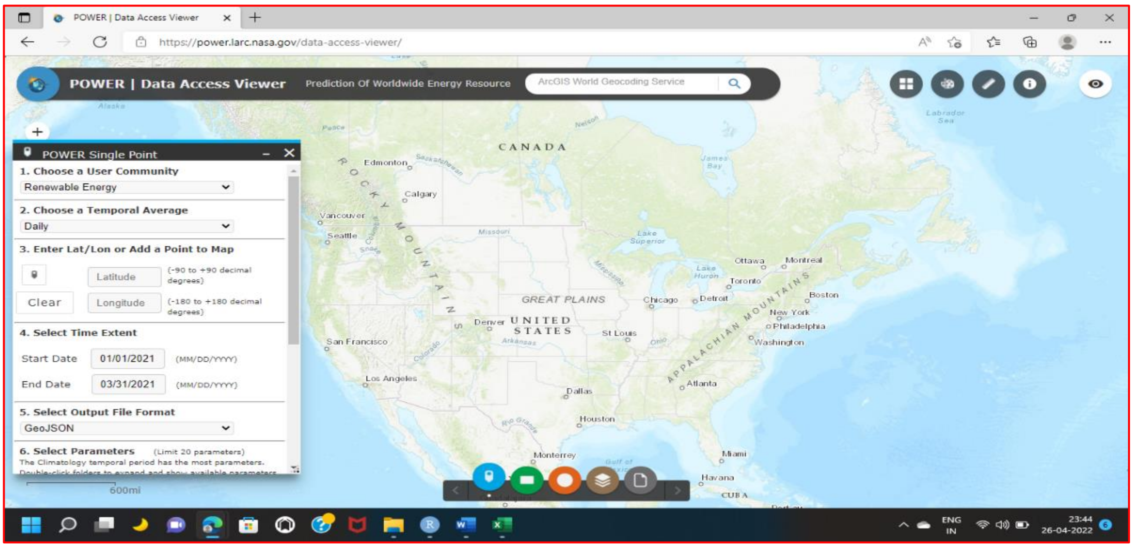


- **POWER || DATA ACCESS VIEWER**
- **Process to download temperature data :**

The POWER Data Access Viewer (DAV) Web Mapping Application contains geospatially enabled solar, meteorological, and cloud related parameters formulated for assessing and designing renewable energy systems. The POWER DAV is a responsive widget based application which runs on all devices (PC, laptop, tablet, smartphone) and all platforms (Apple, Android, and Windows). This design provides users with access to POWER data in the office or in the field. The POWER Data Archive is made available through a series of services that are extensible and integral beyond the web mapping application. POWER provides various text, tabular, geospatial datasets, and files which users can download and/or integrate into custom software and applications for further processing, analysis, and visualization.

POWER DAV leverages the ArcGIS APIfor JavaScript and is built upon the Web App Builder for ArcGIS framework. This integral framework provides the tools and interface for developing custom applications and widgets for geospatial data interaction, sub setting, geoprocessing, and analysis.

This guide provides an introduction to the POWER DAV Web Mapping Application.



Renewable energy:- energy that is generated from natural processes that are continuously replenished. This includes sunlight, geothermal heat, wind, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed.

steps:-

- Choose a User Community :- Renewable energy
- Choose a Temporal Average:- Monthly & annual
- Enter Lat/Lon or Add a Point to Map:- Latitude ----- Longitude ------
- Select Time Extent:- Start Year--- End year-----
- Select Output File Format:- CSv.
- Select Parameters:-
  - Ps (Surface Pressure (kPa))
  - TS (MERRA-2 Earth Skin Temperature (C))
  - QV2M(Specific Humidity at 2 Meters (g/kg))
  - WS2M(Wind Speed at 2 Meters (m/s))
  - ALLSKY_SFC_SW_DWN (All Sky Surface Shortwave Downward Irradiance (kW-hr/m^2/day))
  - CLRSKY_SFC_SW_DWN (Clear Sky Surface Shortwave Downward Irradiance (kW-hr/m^2/day))
- Submit And process

DATA

PARAMETER	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
PS	2011	99.66	99.5	99.31	99.03	98.86	98.38	98.44	98.49	98.82	99.37	99.55	99.59	99.08
PS	2012	99.68	99.51	99.36	99.05	98.87	98.53	98.41	98.59	98.86	99.39	99.52	99.57	99.11
PS	2013	99.75	99.56	99.42	99.07	98.74	98.42	98.32	98.69	98.86	99.27	99.67	99.7	99.12
PS	2014	99.85	99.51	99.48	99.21	98.91	98.57	98.52	98.77	99.02	99.46	99.62	99.76	99.22
PS	2015	99.88	99.62	99.53	99.13	98.88	98.57	98.61	98.89	99.06	99.47	99.58	99.82	99.25
PS	2016	99.8	99.64	99.43	99.12	98.81	98.61	98.57	98.62	99.01	99.33	99.67	99.75	99.19
PS	2017	99.77	99.69	99.32	99.1	98.85	98.58	98.54	98.67	99.03	99.21	99.55	99.75	99.17
PS	2018	99.61	99.6	99.33	99.05	98.79	98.46	98.43	98.66	99.15	99.47	99.64	99.82	99.17
PS	2019	99.91	99.71	99.46	99.11	98.96	98.58	98.48	98.59	98.88	99.45	99.61	99.81	99.21
PS	2020	99.79	99.74	99.44	99.2	98.87	98.61	98.51	98.44	98.85	99.13	99.7	99.68	99.16
TS	2011	20.11	24.76	29.68	34.76	36.57	35.28	28.61	26.79	26.19	25.88	25.81	22.83	28.11
TS	2012	20.02	23.1	28	34.37	36.62	34.11	29.52	27.6	26.32	25.62	22.9	23.53	27.65
TS	2013	21.14	25.32	29.31	33.73	37.15	29.98	26.66	26.07	26.91	24.85	22.03	20.72	26.99
TS	2014	20.45	23.28	29.26	34.35	37.6	36.95	31.11	27.15	26.44	26.15	25.77	21.14	28.32
TS	2015	20.4	25.26	28.76	33.47	37.67	32.46	28.94	27.55	27.86	27.74	27.18	22.26	28.3
TS	2016	22.54	25.65	31.01	34.36	37.69	35.49	29.27	26.91	26.78	25.13	22.91	22.37	28.34
TS	2017	21.8	25.66	29.85	33.77	37.8	33.41	27.63	26.94	27	26.55	24.54	21.75	28.06
TS	2018	22.58	26.36	30.56	34.97	37.62	35.43	28.12	26.5	26.19	28.26	26.6	20.86	28.66
TS	2019	19.79	23.5	28.85	35.43	36.88	34.87	29.01	26.62	26.58	24.94	23.11	19.91	27.46
TS	2020	19.36	24.28	28.18	35.48	38.19	31.46	29.3	27.35	27.15	25.5	22.53	21.97	27.56
QV2M	2011	4.21	5.13	4.39	6.29	12.82	16.72	19.29	20.08	18.92	14.1	8.91	5	11.35
QV2M	2012	4.21	3.11	3.6	7.75	12.02	17.15	18.92	19.04	18.98	14.22	7.75	5.68	11.05
QV2M	2013	3.6	5.68	4.7	8.24	11.47	19.53	20.45	19.29	19.04	15.56	10.13	6.71	12.08
QV2M	2014	6.35	6.04	6.35	7.39	10.38	15.32	18.25	19.47	18.68	14.04	9.58	4.76	11.41
QV2M	2015	5.92	5.43	7.26	10.25	11.17	17.88	18.92	19.1	17.4	12.76	7.87	3.3	11.47
QV2M	2016	4.27	4.58	5.8	7.93	12.82	15.87	18.98	19.29	18.19	13.79	6.71	4.46	11.11
QV2M	2017	4.7	4.21	4.64	7.57	11.29	18.49	19.35	19.35	18.74	12.76	6.77	5.98	11.17
QV2M	2018	4.21	4.64	5	7.39	11.23	16.97	19.47	18.8	16.72	10.62	5.98	3.85	10.44
QV2M	2019	3.11	4.52	4.88	7.02	10.93	16.85	20.08	19.84	20.26	16.6	14.04	9.7	12.39
QV2M	2020	6.71	5.19	6.9	7.39	10.8	18.74	20.2	20.45	19.84	15.5	9.95	7.75	12.51
WS2M	2011	2.06	1.95	2.12	1.98	4.06	4.64	3.47	3.02	2.29	1.4	1.89	1.77	2.55
WS2M	2012	2.04	2.2	2	2.45	3.66	4.74	3.99	3.22	2.31	1.51	2.16	2.1	2.7
WS2M	2013	2.34	2.29	2.02	2.29	3.83	3.48	3.68	3.34	2.23	1.39	1.82	1.74	2.54
WS2M	2014	2.12	2.05	2.02	1.98	3.19	5.12	3.95	2.78	1.87	1.3	1.55	2.16	2.51
WS2M	2015	1.98	1.84	2.01	2.8	3.45	3.92	4.83	2.94	2.02	1.37	1.52	1.95	2.55
WS2M	2016	1.62	1.94	1.83	2.44	3.96	3.98	3.74	3.48	2.04	1.27	1.71	1.98	2.5
WS2M	2017	1.94	1.94	2.02	2.94	3.51	3.87	4.09	2.98	1.5	1.32	1.67	2.09	2.49
WS2M	2018	1.71	1.79	1.81	2.3	3.39	4.74	3.87	3.59	2.11	1.48	1.63	2.01	2.54
WS2M	2019	2.12	2.22	1.98	2.2	3.48	3.88	3.86	3.42	2.1	1.59	1.54	2.2	2.55
WS2M	2020	2.16	2.06	2.2	2.29	3.23	3.11	3.03	3.54	1.44	1.29	1.85	1.84	2.34

ALLSKY_SFC_SW_DWN	2011	4.98	5.58	6.72	7.08	7.32	5.23	3.94	3.54	4.49	5.59	4.84	4.46	5.31
ALLSKY_SFC_SW_DWN	2012	4.68	5.62	6.57	6.98	7.47	6.14	3.92	3.69	4.22	5.44	4.79	4.44	5.33
ALLSKY_SFC_SW_DWN	2013	4.56	5.35	6.48	7.16	7.49	4.92	3.29	3.74	4.72	5.1	4.65	4.25	5.14
ALLSKY_SFC_SW_DWN	2014	4.15	5.24	6.56	7.32	7.44	6.49	4.31	4.65	4.44	5.45	4.64	4.37	5.42
ALLSKY_SFC_SW_DWN	2015	4.41	5.41	6.14	6.82	7.51	5.55	3.96	4.22	5.09	5.39	4.53	4.51	5.29
ALLSKY_SFC_SW_DWN	2016	4.55	5.35	6.27	7.07	7.17	5.87	3.74	3.43	4.98	4.95	5.01	4.64	5.25
ALLSKY_SFC_SW_DWN	2017	4.48	5.59	6.73	7.5	7.37	5.87	3.59	3.98	4.76	5.35	4.6	3.65	5.28
ALLSKY_SFC_SW_DWN	2018	4.65	5.18	6.42	7.2	7.37	5.86	3.44	3.6	5	5.61	4.72	4.36	5.28
ALLSKY_SFC_SW_DWN	2019	4.76	5.4	6.65	7.28	7.64	5.98	4.39	3.42	3.56	4.87	4.19	3.85	5.16
ALLSKY_SFC_SW_DWN	2020	4.43	5.44	6.25	7.24	7.66	5.51	4.99	3.4	4.63	5.28	4.59	4.09	5.29
CLRSKY_SFC_SW_DWN	2011	5.06	5.72	6.91	7.3	7.66	6.83	6.54	6.63	6.27	5.66	4.87	4.48	6.16
CLRSKY_SFC_SW_DWN	2012	4.84	5.83	6.89	7.35	7.67	7.24	6.47	6.5	6.13	5.53	4.78	4.53	6.15
CLRSKY_SFC_SW_DWN	2013	4.75	5.59	6.83	7.37	7.71	6.85	6.93	6.68	6.18	5.61	4.65	4.33	6.13
CLRSKY_SFC_SW_DWN	2014	4.51	5.61	6.74	7.44	7.64	7.4	6.82	6.58	6.13	5.58	4.68	4.54	6.14
CLRSKY_SFC_SW_DWN	2015	4.72	5.63	6.63	7.13	7.69	7.14	6.71	6.59	6.18	5.44	4.61	4.63	6.09
CLRSKY_SFC_SW_DWN	2016	4.76	5.69	6.66	7.45	7.6	7.26	6.79	6.72	6.09	5.57	4.98	4.7	6.19
CLRSKY_SFC_SW_DWN	2017	4.67	5.74	6.81	7.62	7.66	7.2	6.94	6.49	6.01	5.63	4.61	4.2	6.13
CLRSKY_SFC_SW_DWN	2018	4.72	5.49	6.58	7.34	7.58	6.9	6.56	6.21	6.32	5.61	4.75	4.41	6.04
CLRSKY_SFC_SW_DWN	2019	4.82	5.59	6.78	7.46	7.78	7.16	6.6	6.49	6.1	5.49	4.58	4	6.07
CLRSKY_SFC_SW_DWN	2020	4.62	5.51	6.64	7.41	7.82	6.99	7.05	6.7	5.85	5.49	4.62	4.26	6.08

Description of the data :

Variables :-

PS (Surface Pressure (kPa))

TS (MERRA-2 Earth Skin Temperature (C))

QV2M (Specific Humidity at 2 Meters (g/kg))

WS2M (Wind Speed at 2 Meters (m/s))

ALLSKY_SFC_SW_DWN (All Sky Surface Shortwave Downward Irradiance (kW-hr/m^2/day))

CLRSKY_SFC_SW_DWN (Clear Sky Surface Shortwave Downward Irradiance (kW-hr/m^2/day))

PRE (PRE Monsoon NDVI Colour Image as per Year (in colour code 1:10))

POST (POST Monsoon NDVI Colour Image as per Year (in colour code 1:10))

Rainfall (Rainfall In pre year/ station)

Water level (Water that collects or flows beneath the Earth's surface)

- **PS(Surface Pressure (kPa)) :-**

Climatology:- The average of surface pressure at the surface of the earth.

Monthly & Annual :- The average of surface pressure at the surface of the earth.

- **TS(Earth Skin Temperature (C)) :-**

Climatology**:-** The average temperature at the earth's surface.

Monthly & Annual: The average temperature at the earth's surface.

- **QV2M(Specific Humidity at 2 Meters (g/kg)):-**

Climatology:- The ratio of the mass of water vapor to the total mass of air at 2 meters (kg water/kg total air).

Monthly & Annual:- The ratio of the mass of water vapor to the total mass of air at 2 meters (kg water/kg total air).

- **WS2M (Wind Speed at 2 Meters (m/s)) :-**

Climatology:- The average of wind speed at 2 meters above the surface of the earth.

Monthly & Annual:- The average of wind speed at 2 meters above the surface of the earth.

- **ALLSKY_SFC_SW_DWN (All Sky Surface Shortwave Downward Irradiance):-**

Climatology:- The total solar irradiance incident (direct plus diffuse) on a horizontal plane at the surface of the earth under all sky conditions. An alternative term for the total solar irradiance is the "Global Horizontal Irradiance" or GHI.

Monthly & Annual:- The total solar irradiance incident (direct plus diffuse) on a horizontal plane at the surface of the earth under all sky conditions. An alternative term for the total solar irradiance is the "Global Horizontal Irradiance" or GHI.

- **CLRSKY_SFC_SW_DWN(Clear Sky Surface Shortwave Downward Irradiance (kW-hr/m^2/day)):-**

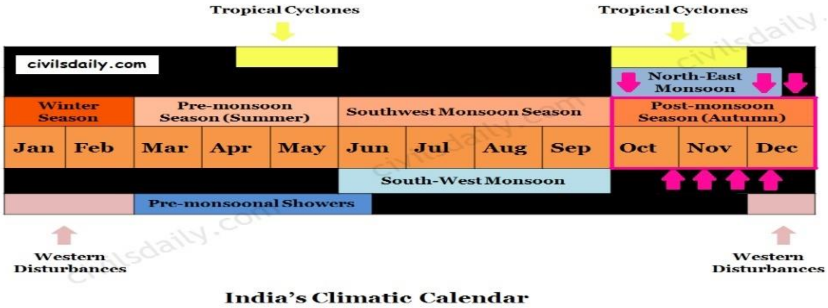
Climatology:- The total solar irradiance incident (direct plus diffuse) on a horizontal plane at the surface of the earth under clear sky conditions. An alternative term for the total solar irradiance is the "Global Horizontal Irradiance" or GHI.

Monthly & Annual:- The total solar irradiance incident (direct plus diffuse) on a horizontal plane at the surface of the earth under clear sky conditions. An alternative term for the total solar irradiance is the "Global Horizontal Irradiance" or GHI

Water level (Water that collects or flows beneath the Earth's surface) :A line corresponding to the surface of the water when the vessel is afloat on an even keel; often painted on the hull of a ship.

- **PRE (PRE Monsoon NDVI Colour Image as per Year (in colour code 1:10)) :-**

The season of pre-monsoon takes place from March to May. It is also called **summer rain**. The intensity of these pre-monsoon showers can be in the form of light showers to heavy and persistent rain Complete Answer: Mango shower is the name which is given to describe the occurence of pre-monsoon rainfall.



- **POST (POST Monsoon NDVI Colour Image as per Year (in colour code 1:10)) :-**

The months of October-November form a period of transition from the hot rainy season to the dry winter conditions.

The withdrawal of the south-west monsoon and the onset of north-east monsoon are both gradual phenomenon. They take place almost at the same time and tend to merge. This explains the popularity of the phrase "**Retreating Monsoon**".

CHRS DATA PORTAL

Building Global Capacity for Forecast and Mitigation of Hydrologic Disasters through the development of means to extend the benefits of space and weather agencies' vast technological resources, which are untapped, into applications that can assist hydrologists and water resource managers worldwide and through equitable access to relevant information

Objective:-

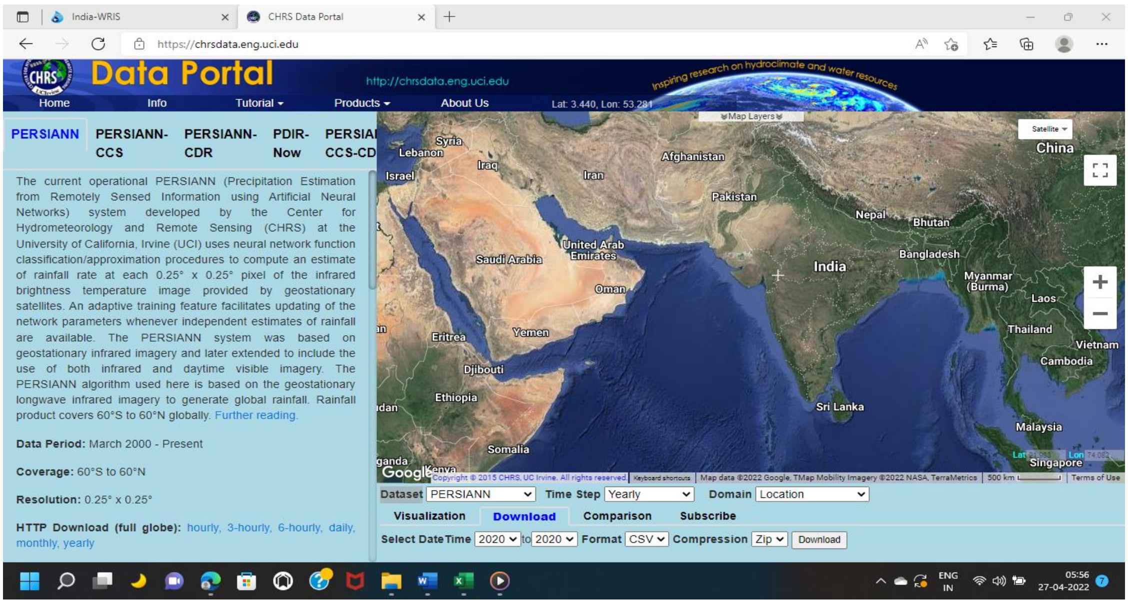
Improve hydrologic prediction through development and refinement of hydrologic models and use of advanced observations, particularly from remote sensing sources

Develop mathematical algorithms capable of estimating precipitation both from space-based and in-situ observations at spatial and temporal resolutions relevant to hydrologic applications, particularly in the semiarid environments

Develop decision support tools for generating and evaluating a variety of hydro-meteorologic and hydro-climatologic information required by the water resources management community

Contribute to the education of well trained hydrologists and water resources engineers responsive to the growing needs of public and private sectors at the state, national and international levels.

- **process of finding rainfall data :**



Steps:-

- 1 Dataset :- PERSIANN
- 2 Time Set :- Yearly
- 3 Domain :- Location (Latitude:- ____ , Longitude:-____)
- 4 Data Set Time:- (-------)TO (--------)
- 5 Format:- CSV.
- 6 Compression :- Zip
- 7 Download

PERSIANN SYSTEM:-

The Current operational PERSIANN (Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks) system uses neural network function classification/approximation procedures to compute an estimate of rainfall rate at each 0.25° x 0.25° pixel of the infrared brightness temperature image provided by geostationary satellites. An adaptive training feature facilitates updating of the network parameters whenever independent estimates of rainfall are available. The PERSIANN system was based on geostationary infrared imagery and later extended to include the use of both infrared and daytime visible imagery. The PERSIANN algorithm used here is based on the geostationary longwave infrared imagery to generate global rainfall. Rainfall product covers 50°S to 50°N globally

Data:

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alladpur	503.2	465.85	684.17	398.53	657.48	580.32	556.74	445.01	1607.87	892.38
Amreshwar	467.29	468.24	719.16	395.37	618.81	585.33	593.44	428.42	1645.25	875.99
Asala	558.1	535.3	627.15	460.45	629.6	663.9	562.53	510.77	1664.53	934.08
Asar	633.58	465.04	687.06	462.86	664.17	631.2	494.03	484.37	1597.72	947.13
Baladgam	633.58	465.04	687.06	462.86	664.17	631.2	494.03	484.37	1597.72	947.13
Bhindol	552.85	479.92	680.61	418.97	669.16	613.14	518.58	460.05	1703.76	924.05
Bodeli	496.83	503.33	641.65	453.47	589.11	656.32	627.71	502.12	1754.48	922.79
Chavaria	552.85	479.92	680.61	418.97	669.16	613.14	518.58	460.05	1703.76	924.05
Chella Karamsiya Pz	498.32	498.91	667.84	474.81	564.64	637.27	614.43	484.14	1615.55	862.83
Chhaliyar	545.46	544.93	636.94	520.51	471.66	722.29	605	562.35	1657.6	885
Chhota udepur	621.59	524.71	684.43	470.56	634.1	696.01	546.31	508.87	1652.25	1032.81
Chisadia	621.59	524.71	684.43	470.56	634.1	696.01	546.31	508.87	1652.25	1032.81
Chitral PZ_II	468.72	466.53	734.11	373.62	510.33	527.84	624.5	423.67	1919.87	871.97
Chitral Pz-I	468.72	466.53	734.11	373.62	510.33	527.84	624.5	423.67	1919.87	871.97
Chota udepur	621.59	524.71	684.43	470.56	634.1	696.01	546.31	508.87	1652.25	1032.81
Devat (thadgam)	552.85	479.92	680.61	418.97	669.16	613.14	518.58	460.05	1703.76	924.05
Ferkuva	621.59	524.71	684.43	470.56	634.1	696.01	546.31	508.87	1652.25	1032.81
Ghamodi	621.59	524.71	684.43	470.56	634.1	696.01	546.31	508.87	1652.25	1032.81
Ghayaj ii	442.04	479.65	733.78	382.09	550.4	557.2	605.92	421.65	1790.55	862.35
Govindpura	503.2	465.85	684.17	398.53	657.48	580.32	556.74	445.01	1607.87	892.38
Handod1	442.04	479.65	733.78	382.09	550.4	557.2	605.92	421.65	1790.55	862.35
Handod2	442.04	479.65	733.78	382.09	550.4	557.2	605.92	421.65	1790.55	862.35
Jojh	558.1	535.3	627.15	460.45	629.6	663.9	562.53	510.77	1664.53	934.08
Juna samalya	545.46	544.93	636.94	520.51	471.66	722.29	605	562.35	1657.6	885
Kaprali	544.95	426.81	733.22	391.14	674.24	546.64	512.4	431.17	1594.63	948.67
Karamasiya	498.32	498.91	667.84	474.81	564.64	637.27	614.43	484.14	1615.55	862.83
Kevadi	602.44	578.83	643.4	449.86	541.11	776.72	637.26	555.01	1706.82	1025.35
Kosindra Pz-I	552.85	479.92	680.61	418.97	669.16	613.14	518.58	460.05	1703.76	924.05
Makni	503.2	465.85	684.17	398.53	657.48	580.32	556.74	445.01	1607.87	892.38
Masor	468.72	466.53	734.11	373.62	510.33	527.84	624.5	423.67	1919.87	871.97
Moti chikhali	633.58	465.04	687.06	462.86	664.17	631.2	494.03	484.37	1597.72	947.13
Panwad	633.58	465.04	687.06	462.86	664.17	631.2	494.03	484.37	1597.72	947.13
Patiyapura	498.32	498.91	667.84	474.81	564.64	637.27	614.43	484.14	1615.55	862.83
Pavi	558.1	535.3	627.15	460.45	629.6	663.9	562.53	510.77	1664.53	934.08
Pitha	496.83	503.33	641.65	453.47	589.11	656.32	627.71	502.12	1754.48	922.79
Rasulpur	544.58	546.28	672.64	509.84	459.15	652.45	615.29	540.27	1578.81	820.18
Raypura i	495.66	512.08	715.68	459.36	521.28	605.11	633.92	475.3	1599.74	823.33
Saidal	496.83	503.33	641.65	453.47	589.11	656.32	627.71	502.12	1754.48	922.79
Saidivasana	633.58	465.04	687.06	462.86	664.17	631.2	494.03	484.37	1597.72	947.13
Sankarda	495.66	512.08	715.68	459.36	521.28	605.11	633.92	475.3	1599.74	823.33
Sankarda1	495.66	512.08	715.68	459.36	521.28	605.11	633.92	475.3	1599.74	823.33
Sankheda	544.58	546.28	672.64	509.84	459.15	652.45	615.29	540.27	1578.81	820.18
Segwa chouki ii	467.29	468.24	719.16	395.37	618.81	585.33	593.44	428.42	1645.25	875.99
Segwa chowki I	467.29	468.24	719.16	395.37	618.81	585.33	593.44	428.42	1645.25	875.99
Sengpur	552.85	479.92	680.61	418.97	669.16	613.14	518.58	460.05	1703.76	924.05
Sinor	476.71	428.3	745.61	337	609.01	499.07	545.17	384.3	1410.15	907.49
Suskal	558.1	535.3	627.15	460.45	629.6	663.9	562.53	510.77	1664.53	934.08
Tokri	633.58	465.04	687.06	462.86	664.17	631.2	494.03	484.37	1597.72	947.13
Tundav	495.66	512.08	715.68	459.36	521.28	605.11	633.92	475.3	1599.74	823.33
Vadodara I	498.32	498.91	667.84	474.81	564.64	637.27	614.43	484.14	1615.55	862.83
Vadodara Ii	498.32	498.91	667.84	474.81	564.64	637.27	614.43	484.14	1615.55	862.83
Vadodara_Kevada Bag	495.66	512.08	715.68	459.36	521.28	605.11	633.92	475.3	1599.74	823.33
Vadodara_ONGC	495.66	512.08	715.68	459.36	521.28	605.11	633.92	475.3	1599.74	823.33
Vadodara_Sama	495.66	512.08	715.68	459.36	521.28	605.11	633.92	475.3	1599.74	823.33
Vadshala Pzi	442.04	479.65	733.78	382.09	550.4	557.2	605.92	421.65	1790.55	862.35
Vadshala Pz-II	442.04	479.65	733.78	382.09	550.4	557.2	605.92	421.65	1790.55	862.35
Vadtalav Pz	558.1	535.3	627.15	460.45	629.6	663.9	562.53	510.77	1664.53	934.08
Vagudan	633.58	465.04	687.06	462.86	664.17	631.2	494.03	484.37	1597.72	947.13
Vega	467.29	468.24	719.16	395.37	618.81	585.33	593.44	428.42	1645.25	875.99
Vejpur1	545.46	544.93	636.94	520.51	471.66	722.29	605	562.35	1657.6	885
Vejpur2	545.46	544.93	636.94	520.51	471.66	722.29	605	562.35	1657.6	885
Waghach	552.85	479.92	680.61	418.97	669.16	613.14	518.58	460.05	1703.76	924.05
Waghodia Pz	498.32	498.91	667.84	474.81	564.64	637.27	614.43	484.14	1615.55	862.83
Wankaner2	544.58	546.28	672.64	509.84	459.15	652.45	615.29	540.27	1578.81	820.18

ArcGIS:

ArcGIS is a geographic information system (GIS) for working with maps and geographic information maintained by the Environmental Systems Research Institute (Esri). It is used for creating and using maps, compiling geographic data, analyzing mapped information, sharing and discovering geographic information, using maps and geographic information in a range of applications, and managing geographic information in a database. The system provides an infrastructure for making maps and geographic information available throughout an organization, across a community, and openly on the Web.

Pros of ArcGIS:

1. **The power-The power that this platform provides is the first and the most important benefit.** Most users like the power it offers for spatial analysis and the data. There have been a couple of improvements in the latest version. The latest version includes the most popular data analysis python libraries.

2. **It has a tool for almost anything you could think of doing**. This is another benefit that users are talking about. The platform has compelling tools that can help you in all dimensions. It has “smart maps” which offers a lot of functionalities.

3. **The software has preset** of tools-Everyone would agree that ArcGIS is a very powerful tool with a stipulated of tools. Though it takes some training and playing around to learn the whole thing.

4. This software has an excellent reputation and experience in GIS software. This is the reason why this is an excellent and competitive computerized geographic analysis.

5. **Advanced statistical tools**-The software has a couple of advanced statistical tools that are much helpful in the whole process.

6. **Effective handling of a large amount of vector data**. The software will correctly and effectively handle a large amount of vector and raster data. This is another thing that makes this software merely the best.

7. Has applications for publishing web maps for the public. These applications make reporting easy and very fast.

8. **Most of its features, specifically the ArcMap, are easier to navigate**. The best thing about this is that there are a couple of tutorials on YouTube. There are also many books in the software to make your work easier.

Cons of ArcGIS:

1. **Price-**The first con to spot is the price. The standard licenses are scary high.

2. **ArcGIS online search from a pro is limited**. The software is regarded as less flexible than the traditional ArcGIS server. This is examined in terms of hosting services and mapping capacities,

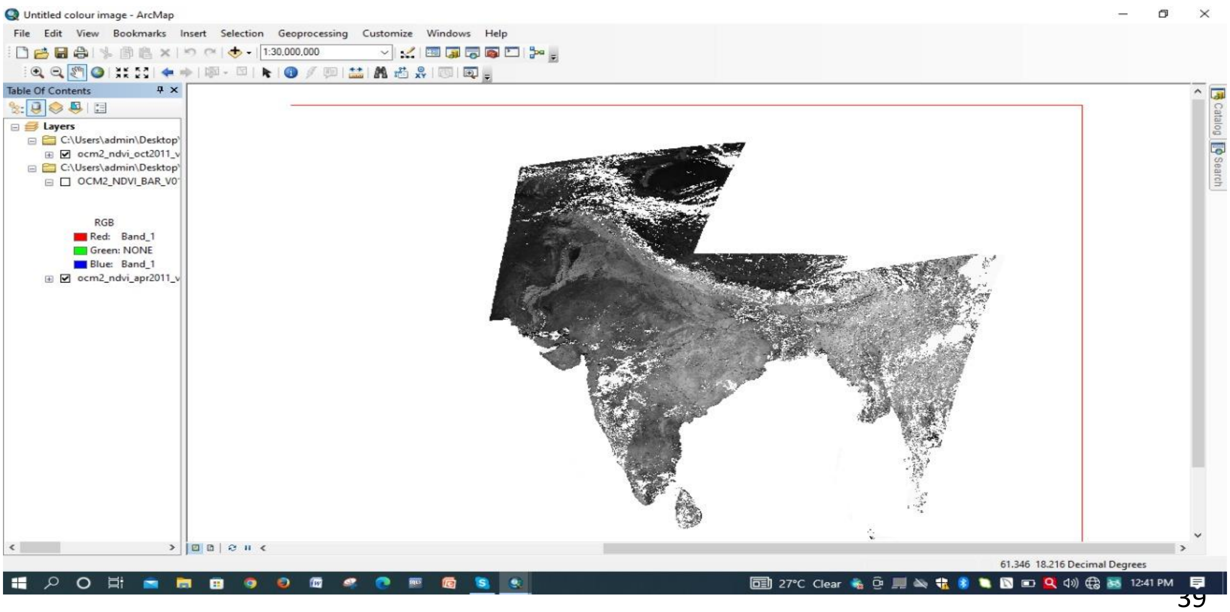
3. **You will not get all the features before paying for a premium subscription**.

4. **Esri products are presented as the only solution to the problem.** I think using Programming solutions and using FOSS can save you a lot of money and time. Learning the Esri products can as well be very difficult.

5. **Customer care may ignore some bugs and issues**. The reality is that this software has a significant market share, and for that reason, they will not be very wary of any complains or issues by a single customer.

6. **You can wait for a long time for the software to open**. This is another con that makes a lot of people think this software is not highly reliable. You will have to wait for a long time for it to open after you launch.

7. **The interface is not very friendly**. Though, this is not a big issue compared to the features the software hosts. Though, sometimes it can be very hard to know where the specific tools

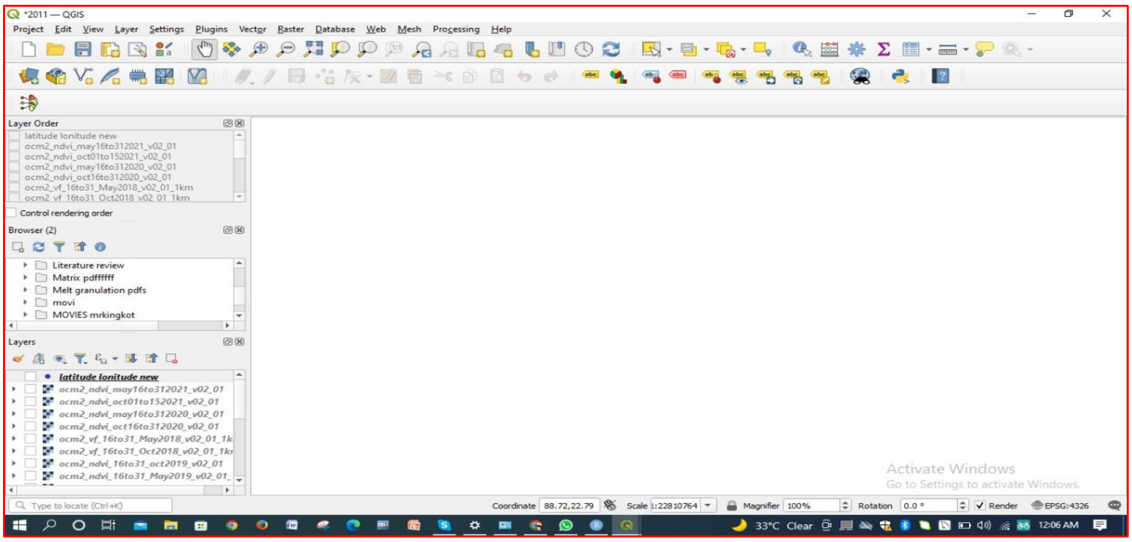


- **<u>QGIS (Quantum Geographic Information System):-</u>**

QGIS is a free and open-source cross-platform desktop application that supports viewing, editing, and analysis of geospatial data. Also, for composing and exporting graphical maps. QGIS supports both raster and vector layers. QGIS supports shapefiles, coverages, personal geodatabases, dxf, MapInfo, Post GIS, and other formats.

What is QGIS software used for?

QGIS functions as geographic information system (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps. QGIS supports both raster and vector layers; vector data is stored as either point, line, or polygon features.



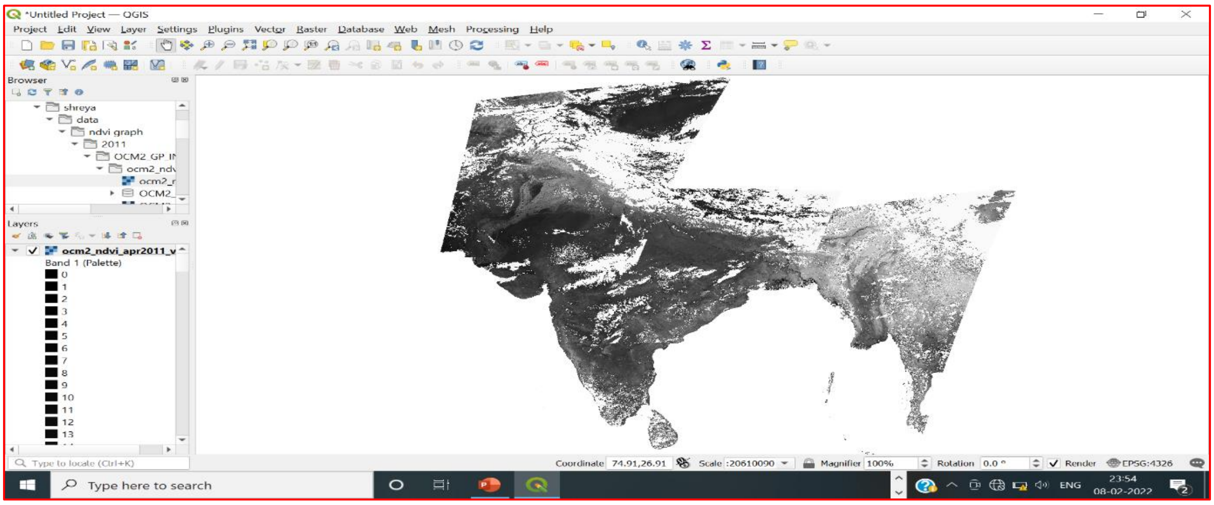
Pros of QGIS:

- ✓ Its Free to use-QGIS is one of the applications of its sort that is completely free to use. However, it comes with some features and core plugins that will provide basic usability.
- ✓ Allows users to View and Overlay vector and raster data– The benefit is that this application will help you view and overlay two types of data which is Vector and Raster data. To add on that, it allows you to do this in many different projections.

- ✓ The application has a surfeit of usable features-Some of these useful features include vector analysis, geometry tools, sampling, and geo-processing.
- ✓ It's more versatile than ArcGIS. The fact that this platform is Mac and Linux friendly makes it one of the best out there for the versatility.

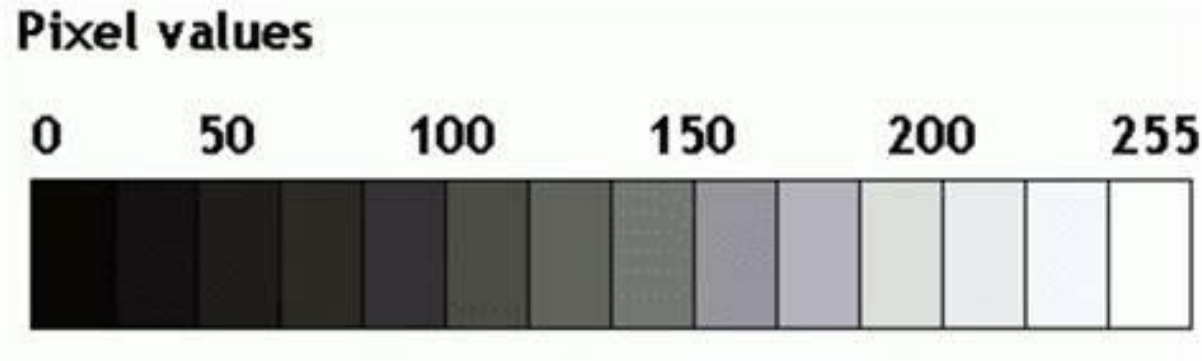
Cons of QGIS:

- ✓ It is less Beginner Friendly-To some extent, most people think that this application is confusing to beginners.
- ✓ The platform takes a lot from ArcGIS. If closely checked, you will realize that QGIS takes a lot of computing power from ArcGIS.
- ✓ It lacks a proper online tutorial. The fact that there are no proper tutorials and online help makes this application hard to use.
- ✓ Labeling Interface is complicated-The interface allows users to manually add the labels to relevant items because it's overly complicated.
- ✓ It takes a lot of time to learn-This is a platform that will consume a lot of your time in order to understand it fully.



Pixel:

In digital imaging, a pixel, or picture element is a smallest addressable element in a raster image, or the smallest addressable element in an all-points addressable display device; so, it is the smallest controllable element of a picture represented on the screen. A pixel consists of Red, Green, Blue (RGB) color subpixel each having values ranging 0 to 255 (8 bit).



Calculation of total number of pixels:

The number of Pixels would be equal to the number of rows multiply with number of columns.

Total number of pixels = number of rows * number of columns

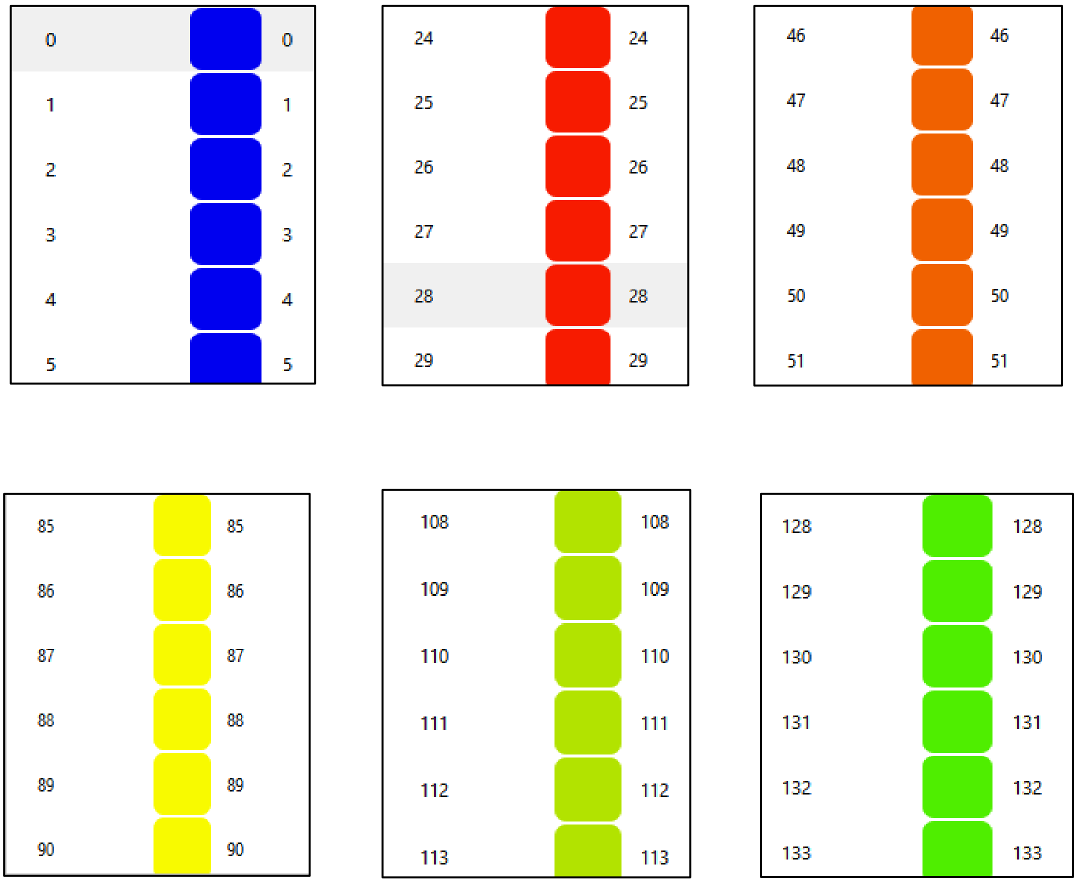
Colour BHUVAN Image :-

Steps:-

1. Open Qgis Software.
2. Layer -> Add Layer -> Add Raster Layer
3. Select Bhuvan Download data file .CSV
4. Select Layer -> Properties -> Symbology
5. Render :- Paletted/ Unique values
6. Colour Map -> Random colours (0 – 255)
7. Get Colour :- (0-8) :- (9- 27) :- (28- 46):- (47- 65) :-

   (66 -84) :- (85-103) :- (104-122):- (123-141):-

   (142-161):- (162-180):- (182-200):- (201-255):-
8. Apply



Get Latitude And Longitude On Map:-

Steps:-

1. Layer -> Add Layer -> Add Delimited Text Layer.
2. Select File -> (In the Station Name , Latitude, Longitude
3. File Format -> .CSV
4. Geometry Definition :- X Field :- latitude Y Field :- Longitude
5. Add.

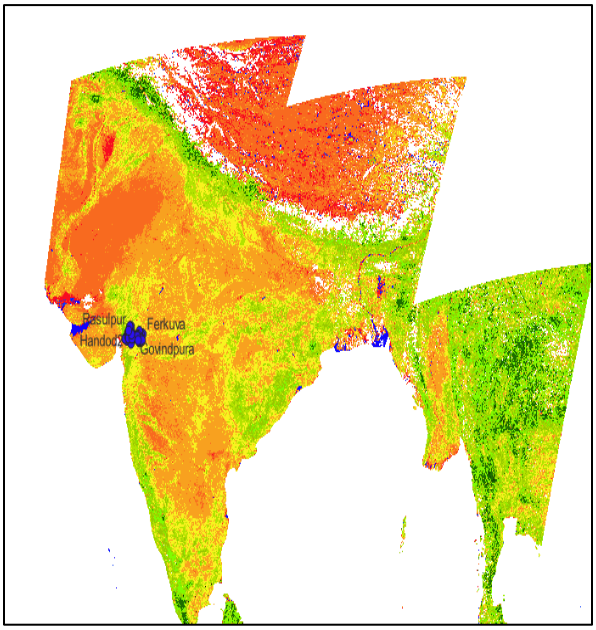
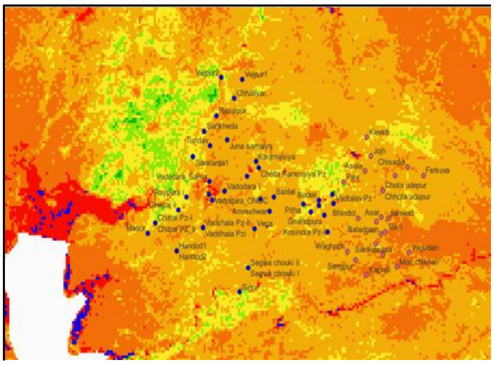
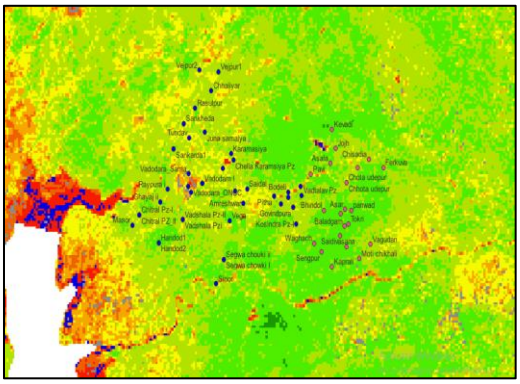


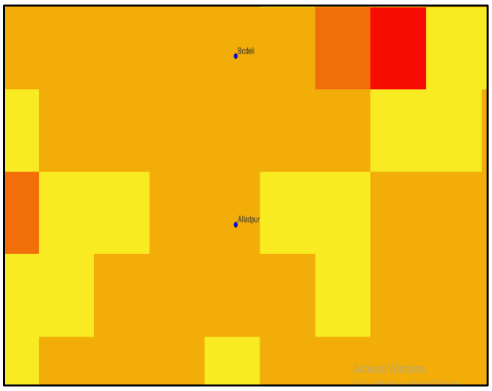
Fig1:- May 2013 (pre monsoon image)

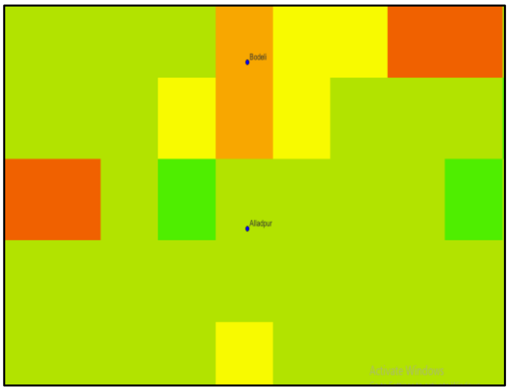
Fig1:- Oct 2013 (Post monsoon image)





- Image a is pre monsoon (feb-may) image of india.
- Image b is post monsoon(oct-jan) image of india.
- In both image we plot latitude and longitude of water station in Vadodara district
- After ploting we add there names.





We can see here the water station Alladpur pre-monsoon and post-monsoon images

And identify greenry in the image.

Satation	may 2011	post
Asala	64>84	85>105
Asar	84>105	106>126
Baladgam	64>84	106>126
Bhindol	64>84	106>126
Chavaria	64>84	106>126
Chhota udepur	64>84	85>105
Chisadia	64>84	85>105
Chota udepur	64>84	85>105
Devat (thadgam)	84>105	106>126
Ferkuva	64>84	85>105
Ghamodi	64<84	85>105
Jojh	64>84	106>126
Kaprali	64>84	106>126
Kevadi	64>84	106>126
Moti chikhali	64>84	85>105
panwad	64>84	106>126
Pavi	64>84	85>105
Saidivasana	64>84	106>126
Sengpur	85>105	106>126
Tokri	64>84	106>126
Vagudan	64>84	85>105
Waghach	64>84	85>105
Alladpur	85>105	128>147
Amreshwar	85>105	64>84
Bodeli	64>84	64>84
Chella Karamsiya Pz	43>63	85>105
Chhaliyar	43>63	43>63
Chitral PZ_II	85>105	85>105
Chitral Pz-I	85>105	85>105
Ghayaj ii	85>105	106>126
Govindpura	85>105	85>105
Handod1	127>147	85>105

Handod2	127>147	85>105
Juna samalya	85>115	43>63
Karamasiya	63>84	64>84
Kosindra Pz-I	64>84	85>105
Makni	85>105	85>105
Masor	106>126	85>105
Patiyapura	85>105	64>84
Pitha	85>105	85>105
Rasulpur	85>105	232>250
Raypura i	106>126	85>105
Saidal	85>105	85>105
Sankarda	106>126	43>63
Sankarda1	85>105	43>63
Sankheda	85>105	64>84
Segwa chouki ii	85>105	85>105
Segwa chowki I	85>105	85>105
Sinor	85>105	85>105
Suskal	106>126	85>105
Tundav	64>83	43>63
Vadodara I	85>105	106>126
Vadodara Ii	85>105	106>126
Vadodara_Kevada Bag	43>63	64>84
Vadodara_ONGC	64>84	85>105
Vadodara_Sama	43>63	43>63
Vadshala Pzi	85>105	85>105
Vadshala Pz-II	85<105	85>105
Vadtalav Pz	85>105	85>105
Vega	64>84	106>126
Vejpur1	85>105	232>250
Vejpur2	64>84	232>250
Waghodia Pz	85>105	64>84
Wankaner2	127>147	64>84

values1	values2
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5	6
4	6
4	6
4	6
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4	5
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4	5
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5	5
5	5
4	6
5	12
4	12
5	4
7	4

1	0>21
2	22>42
3	43>63
4	64>84
5	85>105
6	106>126
7	127>147
8	148>168
9	169>189
10	190>210
11	210>231
12	231>250

- **<u>All the data are merged together to do statistical operations:</u>**

water stations	latitude	longitude	year	PS	TS	QV2M	WS2M	pre	post	rainfall	water level
Alladpur	22.25	73.7167	2011	99.08	28.11	11.35	2.55	6	6	503.2	6.7
Amreshwar	22.2278	73.4833	2011	98.56	27.85	11.6	2.59	6	5	467.29	4.35
Asala	22.3833	73.9333	2011	99.08	28.11	11.35	2.55	5	6	558.1	11
Asar	22.2036	74.0106	2011	98.56	27.85	11.6	2.59	6	4	633.58	17.2
Baladgam	22.1375	74.0083	2011	98.56	27.85	11.6	2.59	5	7	633.58	13
Bhindol	22.2	73.9	2011	98.56	27.85	11.6	2.59	5	7	552.85	8.28
Bodeli	22.2708	73.7167	2011	99.08	28.11	11.35	2.55	4	5	496.83	1.98
Chavaria	22.1875	73.9875	2011	98.56	27.85	11.6	2.59	5	7	552.85	12.3
Chella Karamsiya Pz	22.3967	73.4322	2011	100.21	28.04	11.78	2.5	5	6	498.32	3.73
Chhaliyar	22.6667	73.3167	2011	100.21	28.04	11.78	2.5	5	4	545.46	20.75
Chhota udepur	22.3083	74.0167	2011	99.08	28.11	11.35	2.55	5	6	621.59	6.9
Chisadia	22.4	74.1333	2011	97.41	27.28	11.11	2.61	5	6	621.59	11.88
Chitral PZ_II	22.1819	72.9458	2011	100.31	28.32	12.15	2.62	7	7	468.72	26.4
Chitral Pz-I	22.1819	72.9458	2011	100.31	28.32	12.15	2.62	7	7	468.72	26.02
Chota udepur	22.3083	74.0167	2011	99.08	28.11	11.35	2.55	5	6	621.59	2.08
Devat (thadgam)	22.1	73.9833	2011	98.56	27.85	11.6	2.59	7	7	552.85	10.21
Ferkuva	22.3667	74.2083	2011	97.41	27.28	11.11	2.61	5	6	621.59	8.01
Ghamodi	22.3667	74.075	2011	97.41	27.28	11.11	2.61	5	6	621.59	8.96
Ghayaj ii	22.2333	73.0542	2011	100.31	28.32	12.15	2.62	8	7	442.04	29.5
Govindpura	22.2111	73.7414	2011	12.15	27.85	11.6	6.16	6	6	503.2	5.72
Handod1	22.0736	73.0458	2011	100.31	28.32	12.15	2.62	6	6	442.04	32.1
Handod2	22.0736	73.0458	2011	12.15	28.32	12.15	2.62	6	6	442.04	32
Jojh	22.4417	73.9625	2011	99.08	28.11	11.35	2.55	5	7	558.1	13.42
Juna samalya	22.5042	73.2833	2011	100.21	28.04	11.78	2.5	6	4	545.46	12.55
Kaprali	21.9792	73.9417	2011	98.56	27.85	11.6	2.59	5	7	544.95	7.5
Karamasiya	22.4208	73.4194	2011	100.21	28.04	11.78	2.5	5	5	498.32	11.25
Kevadi	22.5167	73.9417	2011	99.08	28.11	11.35	2.55	5	7	602.44	6.65
Kosindra Pz-I	22.1467	73.7556	2011	98.56	27.85	11.6	2.59	5	7	552.85	3.21
Makni	22.225	73.6792	2011	98.56	27.85	11.6	2.59	6	6	503.2	9.21
Masor	22.1417	72.9083	2011	100.31	28.32	12.15	2.62	6	6	468.72	13.04
Moti chikhali	22.0111	74.08333	2011	96.89	27.04	11.17	2.58	5	6	633.58	3.15
Panwad	22.2	74.0417	2011	98.56	27.85	11.6	2.59	5	7	633.58	14.7
Patiyapura	22.275	73.4417	2011	99.08	28.11	11.35	2.55	6	5	498.32	7.4
Pavi	22.3417	73.8333	2011	99.08	28.11	11.35	2.55	5	6	558.1	4.41
Pitha	22.2542	73.6417	2011	99.08	28.11	11.35	2.55	6	6	496.83	8.26
Rasulpur	22.6	73.2333	2011	100.21	28.04	11.78	2.5	6	12	544.58	5.4
Raypura i	22.2819	73.0903	2011	100.21	28.04	11.78	2.5	7	6	495.66	15.5
Saidal	22.2833	73.5028	2011	99.08	28.11	11.35	2.55	6	6	496.83	3.32
Saidivasana	22.0583	74.0167	2011	98.56	27.85	11.6	2.59	5	7	633.58	6.7
Sankarda	22.4389	73.1222	2011	100.21	28.04	11.78	2.5	7	4	495.66	29.35
Sankarda1	22.4389	73.1222	2011	100.21	28.04	11.78	2.5	7	4	495.66	29.4
Sankheda	22.5389	73.175	2011	100.21	28.04	11.78	2.5	8	5	544.58	33.2
Segwa chouki ii	22.0083	73.3833	2011	100.31	28.32	12.15	2.62	6	6	467.29	38.67
Segwa chowki I	22.0083	73.3833	2011	100.31	28.32	12.15	2.62	6	6	467.29	39.1
Sengpur	22.0375	73.8875	2011	98.56	27.85	11.6	2.59	6	7	552.85	9.7
Sinor	21.9125	73.3417	2011	100.31	28.32	12.15	2.62	6	6	476.71	23.2
Suskal	22.2917	73.7792	2011	99.08	28.11	11.35	2.55	7	6	558.1	3.79
Tokri	22.1472	74.0278	2011	98.56	27.85	11.6	2.59	5	7	633.58	18.57
Tundav	22.4833	73.2028	2011	100.21	28.04	11.78	2.5	5	4	495.66	16.35
Vadodara I	22.3047	73.2717	2011	100.21	28.04	11.78	2.5	6	7	498.32	22.3
Vadodara Ii	22.3047	73.2717	2011	100.21	28.04	11.78	2.5	6	7	498.32	8.18
Vadodara_Kevada Bag	22.2933	73.1983	2011	100.21	28.04	11.78	2.5	4	5	495.66	10.4
Vadodara_ONGC	22.2692	73.2128	2011	100.21	28.04	11.78	2.5	5	6	495.66	14.9
Vadodara_Sama	22.3425	73.2006	2011	100.21	28.04	11.78	2.5	4	4	495.66	3.9
Vadshala Pzi	22.1631	73.1694	2011	100.31	28.32	12.15	2.62	6	6	442.04	31.3
Vadshala Pz-II	22.1631	73.1694	2011	100.31	28.32	12.15	2.62	6	6	442.04	12.3
Vadtalav Pz	22.2586	73.7839	2011	99.08	28.11	11.35	2.55	6	6	558.1	11.61
Vagudan	22.0667	74.1417	2011	96.89	27.04	11.17	2.58	5	6	633.58	6.93
Vega	22.1594	73.4125	2011	100.31	28.32	12.15	2.62	5	8	467.29	5.88
Vejpur1	22.7417	73.3542	2011	100.21	28.04	11.78	2.5	6	12	545.46	1.9
Vejpur2	22.7472	73.2556	2011	100.21	27.23	11.78	2.5	5	12	545.46	2.53
Waghach	22.0708	73.85	2011	98.56	27.85	11.6	2.59	5	7	552.85	9.95
Waghodia Pz	22.3639	73.3769	2011	100.21	28.04	11.78	2.5	6	5	498.32	6.71
Wankaner2	22.5389	73.175	2011	100.21	28.04	11.78	2.5	8	5	544.58	40.2

This data is only of one year

- **Statistical operations on final data**

Cluster analysis:

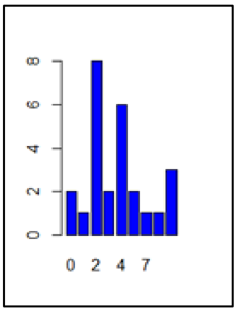
cluster analysis, in set of tools and algorithms that is used to classify different objects into groups in such a way that the similarity between two objects is maximal if they belong to the same group and minimal otherwise. In biology, cluster analysis is an essential tool for taxonomy (the classification of living and extinct organisms). In clinical medicine, it can be used to identify patients who have diseases with a common cause, patients who should receive the same treatment, or patients who should have the same level of response to treatment. In epidemiology, cluster analysis has many uses, such as finding meaningful conglomerates of regions, communities, or neighbourhoods with similar epidemiological profiles when many variables are involved and natural groupings do not exist. In general, whenever one needs to classify large amounts of information into a small number of meaningful categories, cluster analysis may be useful.

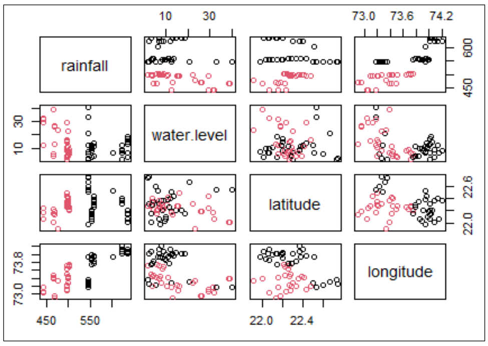
Researchers are often confronted with the task of sorting observed data into meaningful structures. Cluster analysis is an inductive exploratory technique in the sense that it uncovers structures without explaining the reasons for their existence. It is a hypothesis-generating, rather than a hypothesis-testing, technique. Unlike discriminant analysis, where objects are assigned to pre existing groups on the basis of statistical rules of allocation, cluster analysis generates the groups or discovers a hidden structure of groups within the data.

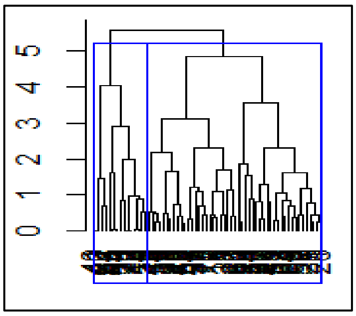
The choice of a distance type is crucial for all hierarchical clustering algorithms and depends on the nature of the variables and the expected form of the clusters. For example, the Euclidean distance tends to yield spherical clusters. Other commonly used distances include the Manhattan distance, the Chebyshev distance, the power distance, and the percent disagreement. The Manhattan distance is defined as the average distance across variables. In most cases, it yields results similar to the simple Euclidean distance. However, the effect of single large differences (outliers) is dampened (since they are not squared). The Chebyshev distance may be appropriate when objects that differ in just one variable should be considered different. The power distance is used when it is important to increase or decrease the progressive weight that is assigned to variables on which the respective objects are very different. The power distance is controlled by two user-defined parameters, *r* and *p*. Parameter *p* controls the progressive weight that is placed on differences on individual variables, while parameter *r* controls the progressive weight that is placed on larger differences between objects. If *r* and *p* are equal to 2, then that distance is equal to the Euclidean distance. The percent disagreement may be used when the data consist of categorical variables.

- Below are the graph of clustering which is done on the water level, rainfall, latitude, longitude of water stations from 2011 to 2012
- Fig1: figure one is are barplot which shows according to majority rule best number of clusters.
- Fig2: figure two is a scatter plot matrix of rainfall, water level ,latitude, longitude .
- Fig3: figure three is a dendrogram which shows which element is goes in which cluster according to euclidean distance.

2011







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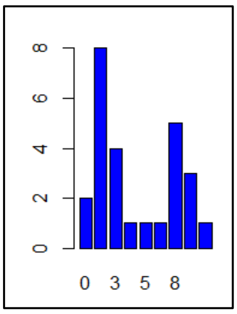
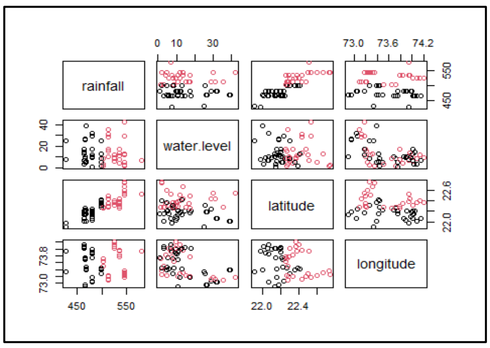
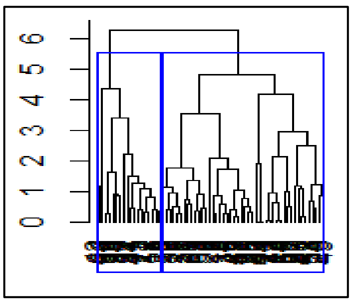
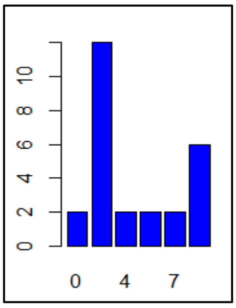
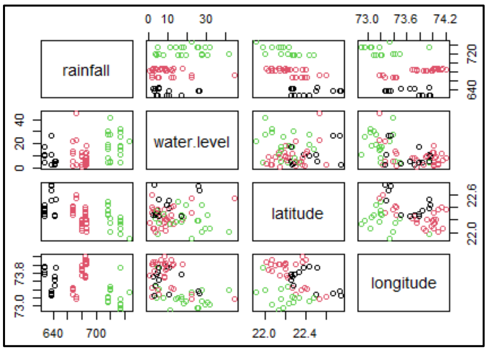


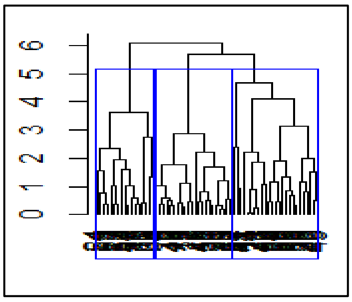




2013







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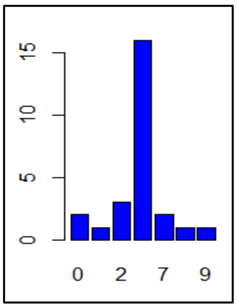

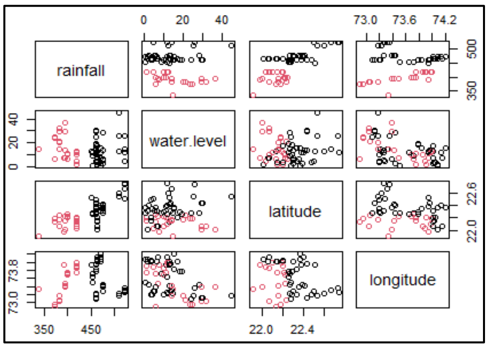

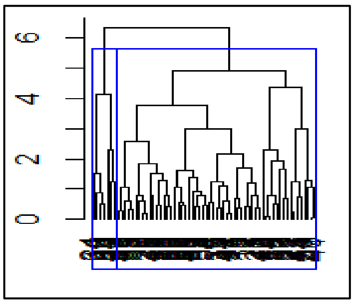

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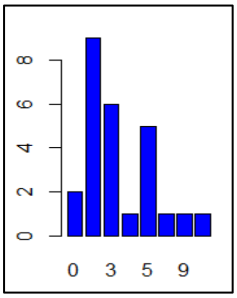

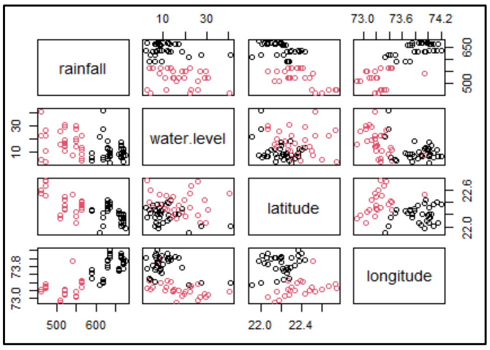

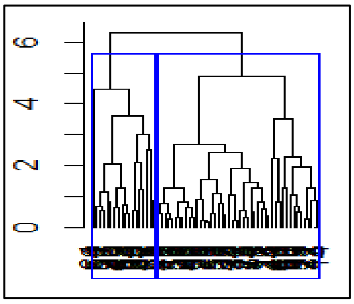

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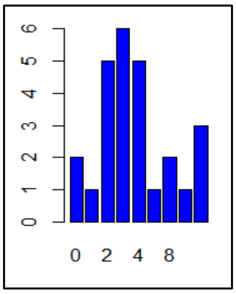

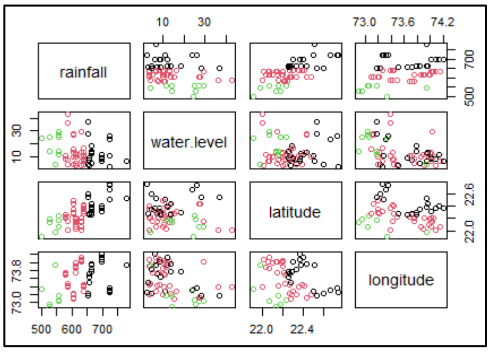

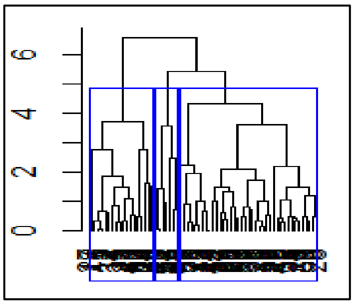

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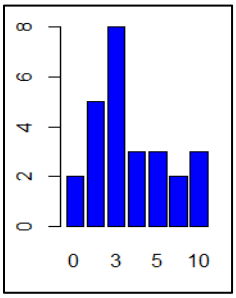

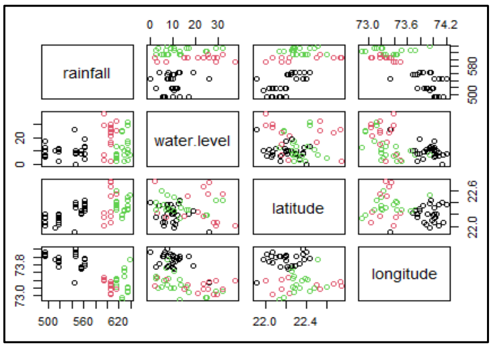

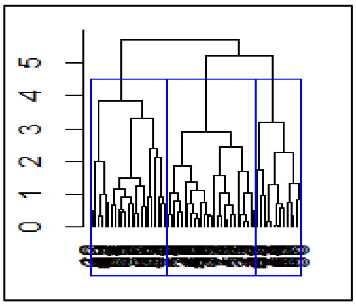

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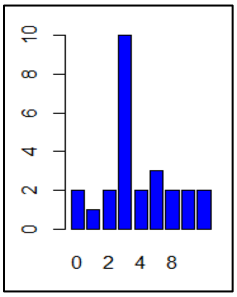

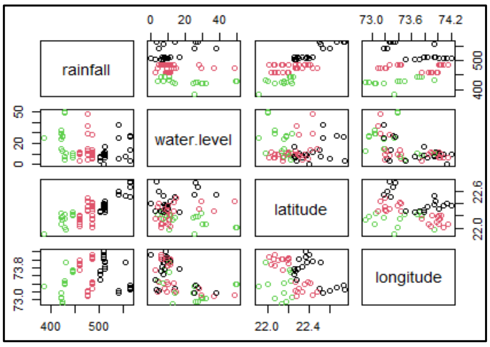

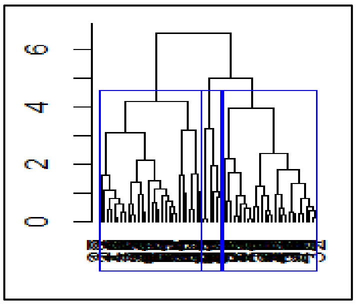

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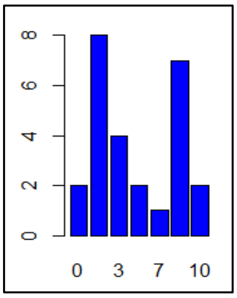

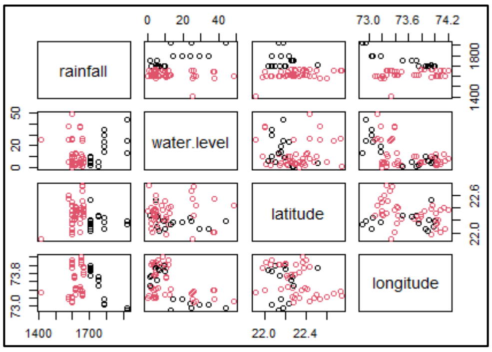

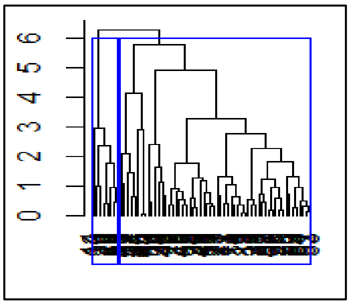

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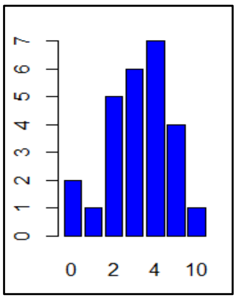
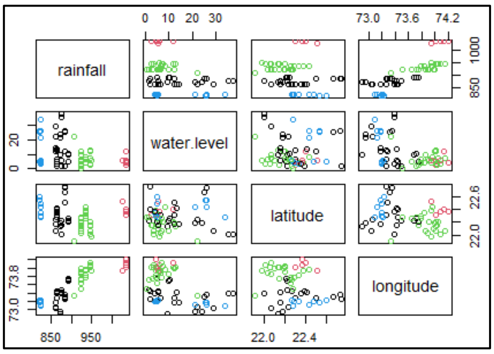
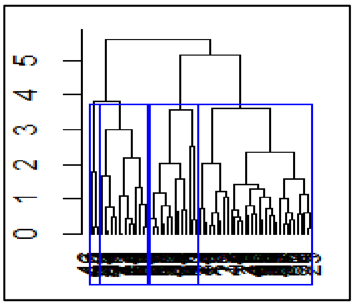






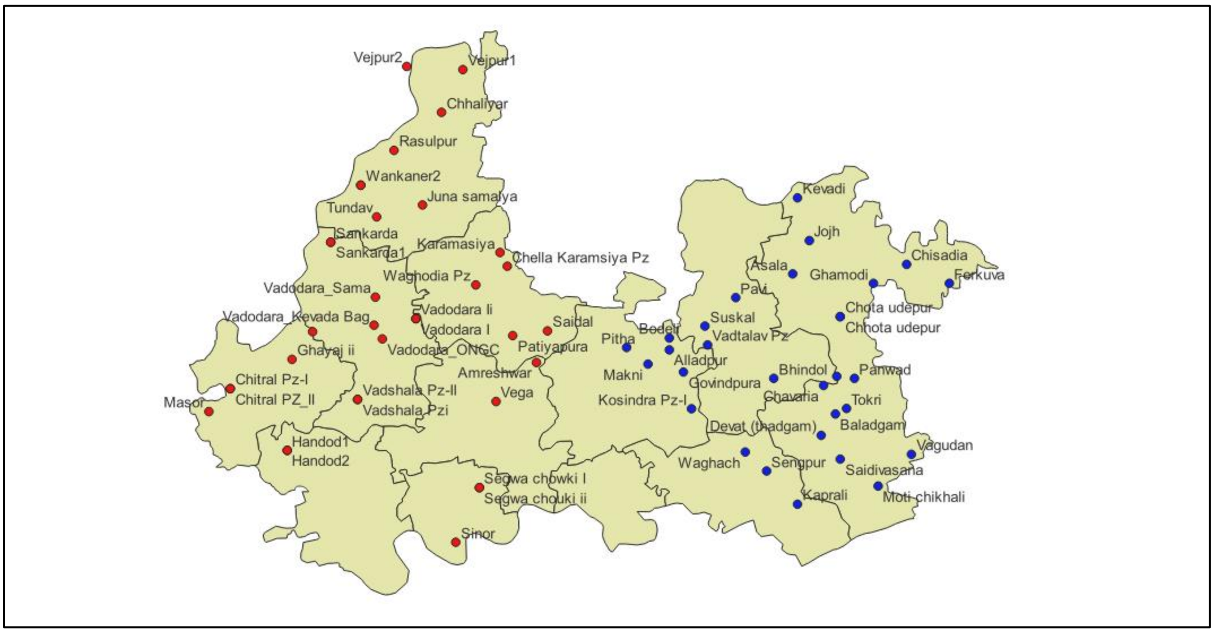
Cluster vector :

station	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alladpur	1	1	3	2	1	3	1	3	1	2
Amreshwar	2	1	3	2	1	3	3	3	1	3
Asala	1	2	2	2	1	3	1	3	1	3
Asar	1	1	3	2	1	3	1	3	1	3
Baladgam	1	1	3	2	1	3	1	3	1	3
Bhindol	1	1	3	2	1	3	1	3	1	3
Bodeli	1	2	2	2	1	3	3	3	1	3
Chavaria	1	1	3	2	1	3	1	3	1	3
Chella Karamsiya Pz	2	2	2	2	2	3	3	3	1	2
Chhaliyar	2	2	2	1	2	2	2	2	2	4
Chhota udepur	1	2	3	2	1	3	1	3	1	1
Chisadia	1	2	3	2	1	3	1	3	1	1
Chitral PZ_II	2	1	1	1	2	1	2	1	2	4
Chitral Pz-I	2	1	1	1	2	1	2	1	2	4
Chota udepur	1	2	3	2	1	3	1	3	1	1
Devat (thadgam)	1	1	3	2	1	3	1	3	1	3
Ferkuva	1	2	3	2	1	3	1	3	1	1
Ghamodi	1	2	3	2	1	3	1	3	1	1
Ghayaj ii	2	1	1	1	2	1	2	1	2	4
Govindpura	1	1	3	2	1	3	1	3	1	3
Handod1	2	1	1	1	2	1	2	1	2	4
Handod2	2	1	1	1	2	1	2	2	2	4
Jojh	1	2	2	2	1	3	1	3	1	3
Juna samalya	2	2	2	1	2	2	3	2	1	2
Kaprali	1	1	3	2	1	3	1	3	1	3
Karamasiya	2	2	2	2	2	3	3	3	1	2
Kevadi	1	2	2	2	2	2	3	2	1	1
Kosindra Pz-I	1	1	3	2	1	3	1	3	1	3
Makni	1	1	3	2	1	3	1	3	1	3
Masor	2	1	1	1	2	1	2	1	2	2
Moti chikhali	1	1	3	2	1	3	1	3	1	3
Panwad	1	1	3	2	1	3	1	3	1	3

Patiyapura	2	2	3	1	2	3	3	3	1	2
Pavi	1	2	2	2	1	3	1	3	1	3
Pitha	1	2	2	2	1	3	3	3	1	3
Rasulpur	2	2	2	1	2	2	3	2	2	2
Raypura i	2	2	1	1	2	3	3	1	2	4
Saidal	2	2	2	2	1	3	3	3	1	3
Saidivasana	1	1	3	2	1	3	1	3	1	3
Sankarda	2	2	1	1	2	1	2	1	2	4
Sankarda1	2	2	1	1	2	1	2	1	2	4
Sankheda	2	2	2	1	2	2	2	2	2	4
Segwa chouki ii	2	1	1	1	2	1	2	1	2	4
Segwa chowki I	2	1	1	1	2	1	2	1	2	4
Sengpur	1	1	3	2	1	3	1	3	1	3
Sinor	2	1	1	1	2	1	2	1	2	4
Suskal	1	2	2	2	1	3	1	3	1	3
Tokri	1	1	3	2	1	3	1	3	1	3
Tundav	2	2	1	2	2	3	3	3	1	2
Vadodara I	2	2	2	2	2	3	3	1	1	2
Vadodara Ii	2	2	2	2	2	3	3	3	1	2
Vadodara_Kevada Bag	2	2	1	2	2	3	3	3	1	2
Vadodara_ONGC	2	2	1	2	2	3	3	3	1	2
Vadodara_Sama	2	2	1	2	2	3	3	3	1	2
Vadshala Pzi	2	1	1	1	2	1	2	1	2	2
Vadshala Pz-II	2	1	1	1	2	1	3	1	2	2
Vadtalav Pz	1	2	2	2	1	3	1	3	1	3
Vagudan	1	1	3	2	1	3	1	3	1	3
Vega	2	1	3	2	1	3	3	3	1	2
Vejpur1	2	2	2	1	2	2	2	2	2	4
Vejpur2	2	2	2	1	2	2	3	2	2	4
Waghach	1	1	3	2	1	3	1	3	1	3
Waghodia Pz	2	2	2	2	2	3	3	3	1	2
Wankaner2	2	2	1	1	2	2	2	2	2	4

Cluster1: **Cluster2:** **Cluster3:** **Cluster4:**

2011 :-



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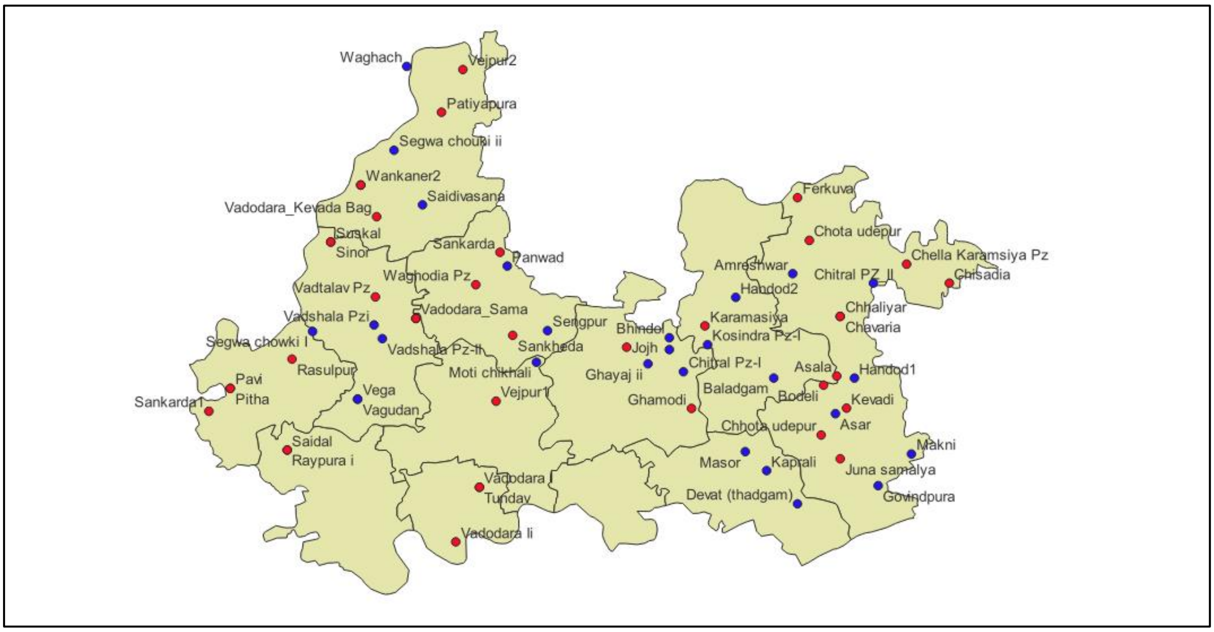
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Wankaner2
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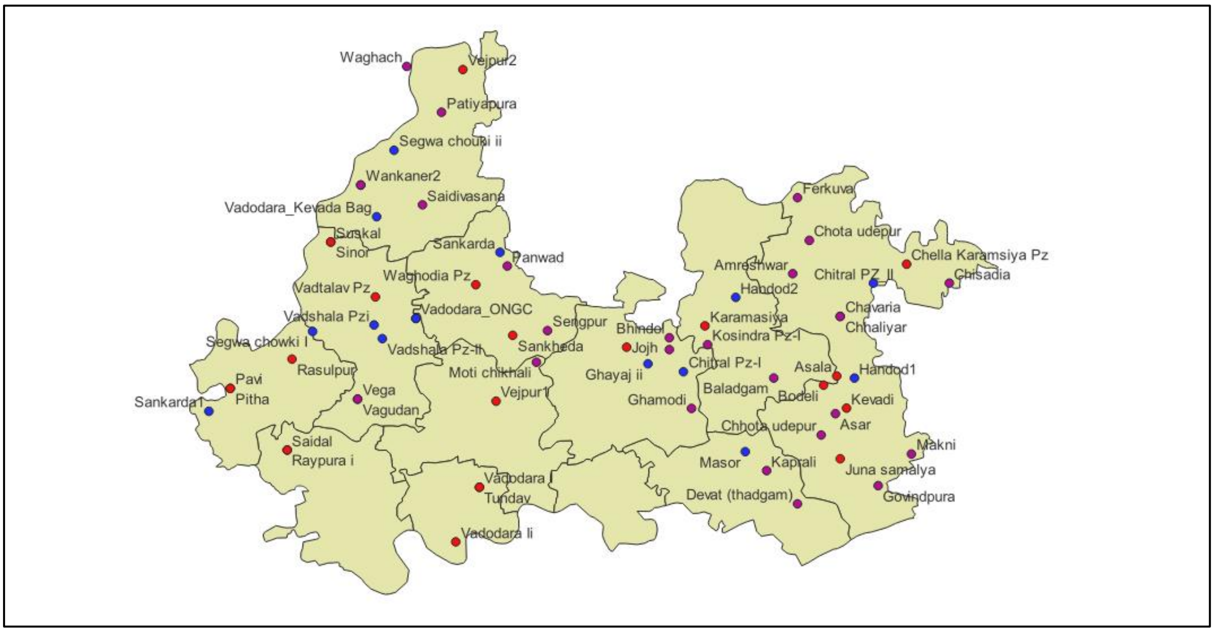
Sankarda
Panwad
Waghodia Pz
Vadtalav Pz
Vadodara_Sama
Vadshala Pzi
Vadshala Pz-II
Segwa chowki I
Sengpur
Sankheda
Rasulpur
Moti chikhali
Pavi
Pitha
Sankarda1
Vega
Vagudan
Vejpur1
Saidal
Raypura i
Vadodara I
Tunday
Vadodara Ii
Ferkuva
Chota udepur
Chella Karamsiya Pz
Chisadia
Amreshwar
Chitral PZ_II
Handod2
Chhaliyar
Chavaria
Karamasiya
Kosindra Pz-I
Bhindol
Jojh
Ghayaj ii
Chitral Pz-I
Asala
Handod1
Baladgam
Bodeli
Ghamodi
Kevadi
Chhota udepur
Asar
Makni
Masor
Kaprali
Juna samalya
Devat (thadgam)
Govindpura

2013 :-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Panwad
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Vadtalav Pz
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Sengpur
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Rasulpur
Moti chikhali
Pavi
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Vejpur1
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Kosindra Pz-I
Bhindol
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Ghayaj ii
Chitral Pz-I
Asala
Handod1
Baladgam
Bodeli
Ghamodi
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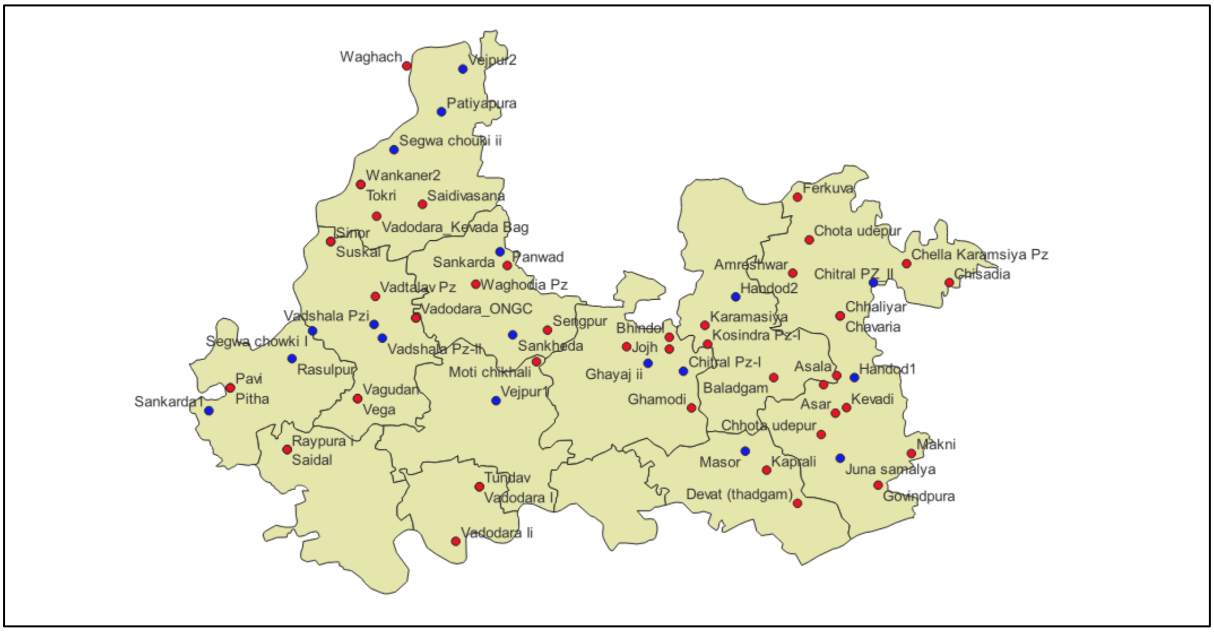
Makni
Masor
Kaprali
Juna samalya
Devat (thadgam)
Govindpura

2014 :-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Panwad
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Waghodia Pz
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Ghayaj ii
Pavi
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Kosindra Pz-I
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Masor
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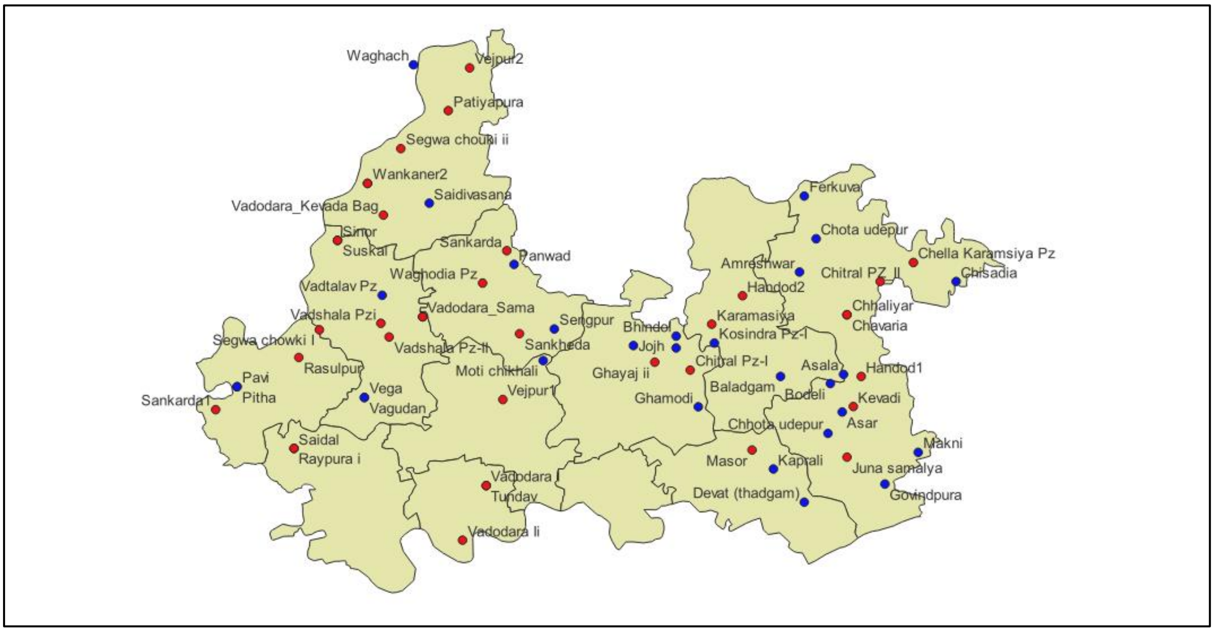
Devat (thadgam)
Govindpura

2015 :-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Ghayaj ii
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Kosindra Pz-I
Chitral Pz-I
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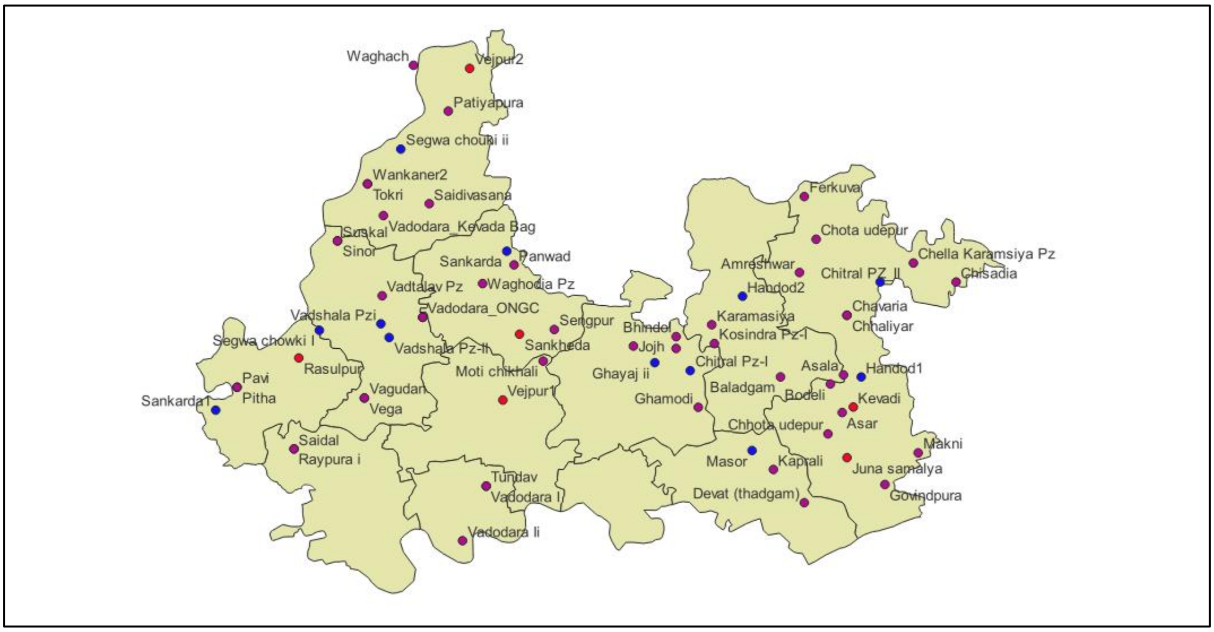
Devat (thadgam)
Govindpura

2016 :-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Waghodia Pz
Vadshala Pzi
Vadodara_ONGC
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Rasulpur
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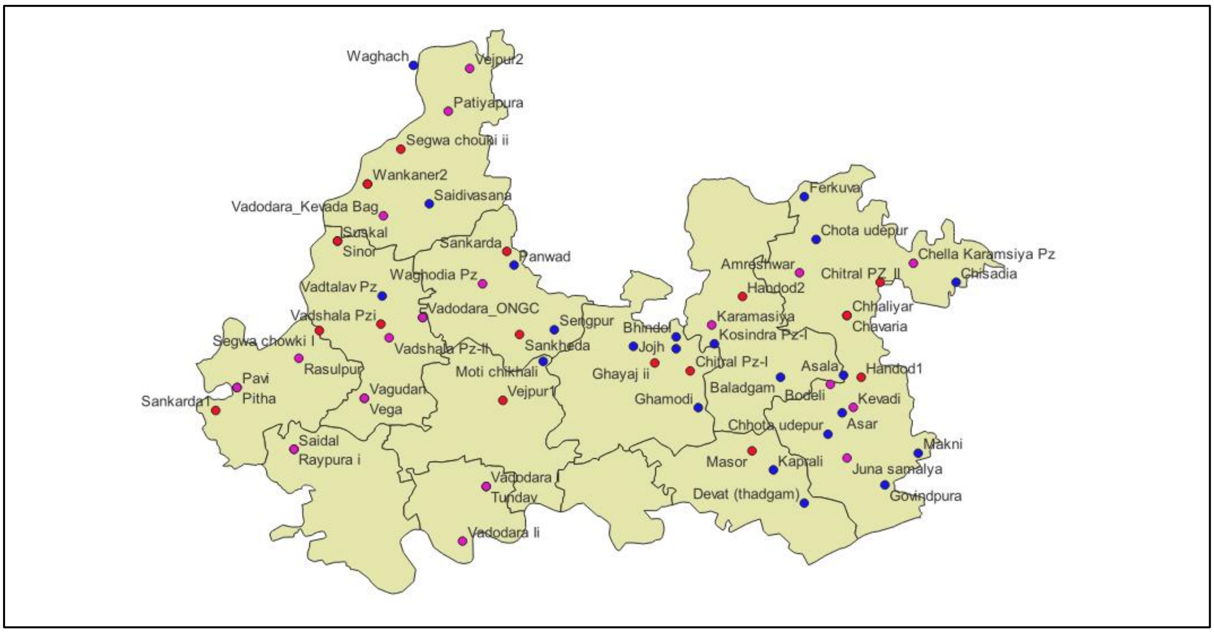
Devat (thadgam)
Govindpura

2017 :-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Waghodia Pz
Vadtalav Pz
Vadshala Pzi
Vadodara_ONGC
Segwa chowki I
Vadshala Pz-II
Sengpur
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Rasulpur
Moti chikhali
Pavi
Pitha
Vagudan
Vega
Vejpur1
Sankarda1
Saidal
Raypura i
Vadodara I
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Vadodara Ii
Bhindol
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Ferkuva
Chota udepur
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Amreshwar
Chitral PZ_II
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Chhaliyar
Chavaria
Karamasiya
Kosindra Pz-I
Chitral Pz-I
Asala
Handod1
Baladgam
Bodeli
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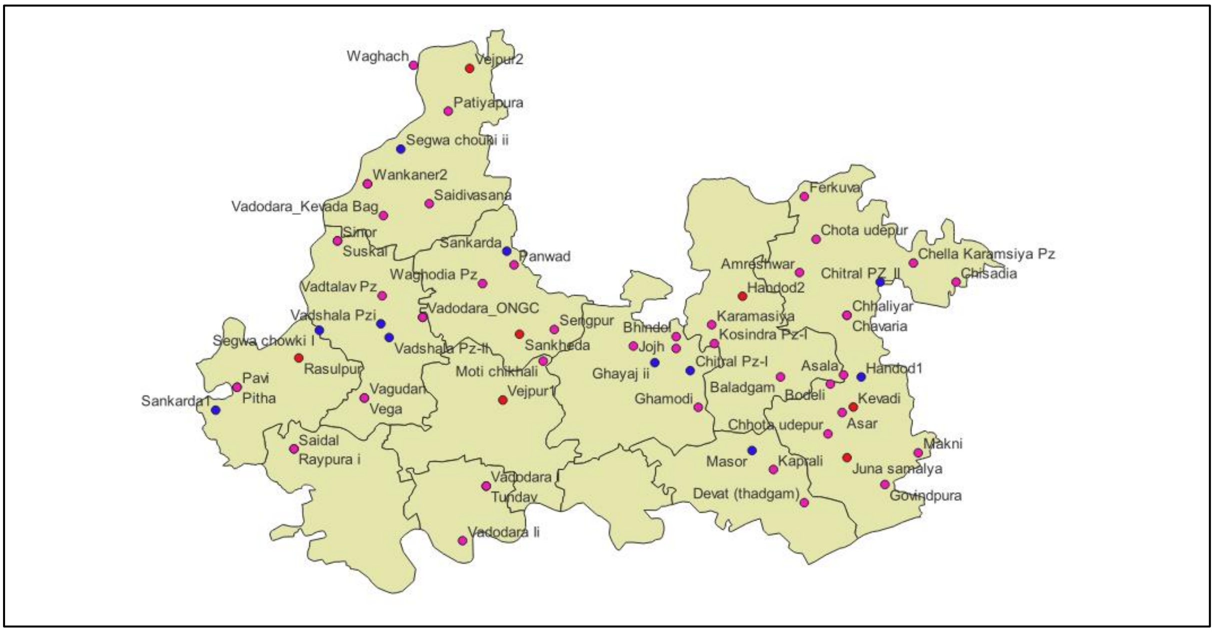
Masor
Kaprali
Makni
Juna samalya
Devat (thadgam)
Govindpura

2018 :-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Panwad
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Vadshala Pzi
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Vadodara Ii
Ferkuva
Chota udepur
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Baladgam
Bodeli
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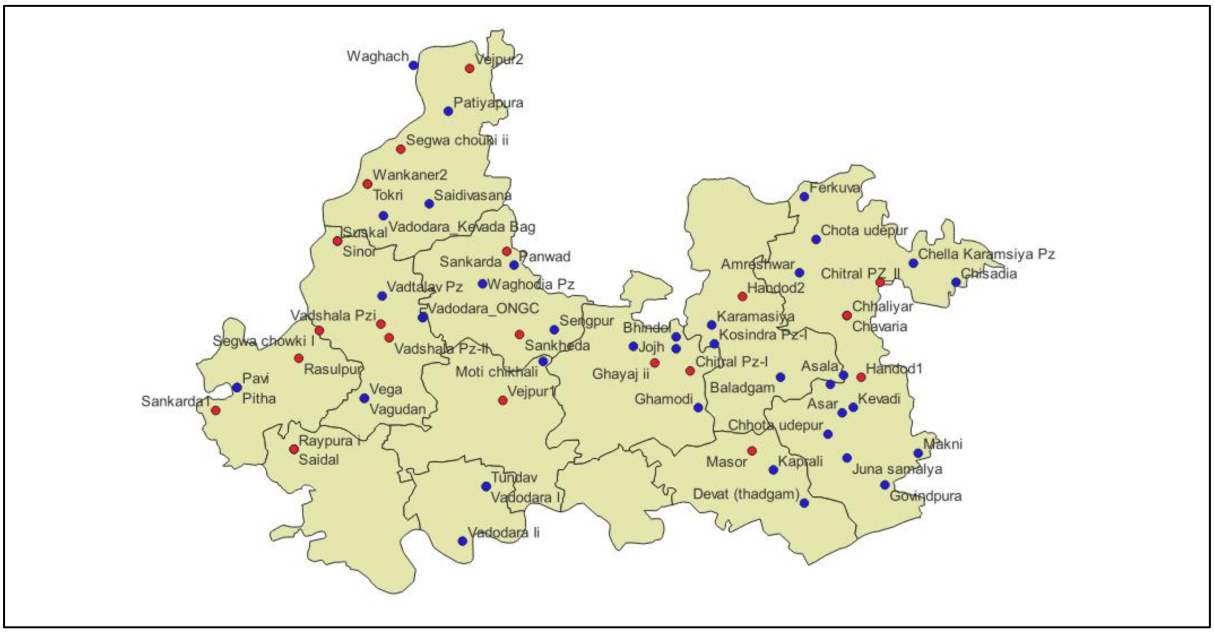
Kaprali
Juna samalya
Devat (thadgam)
Govindpura

2019 :-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Sinor
Sankarda
Panwad
Vadtalav Pz
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Vadshala Pzi
Vadodara_ONGC
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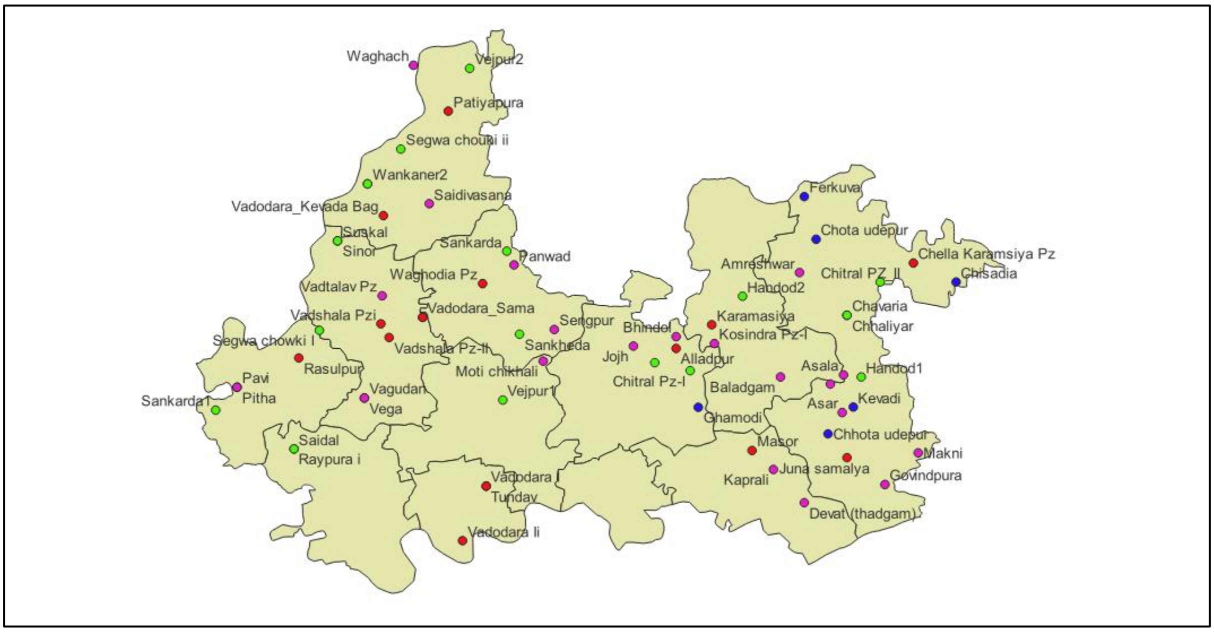
Devat (thadgam)
Govindpura

2020 :-



- **<u>cluster analysis code:</u>**

```
########### library ###############
library(factoextra)
library(NbClust)
library(ggplot2)
library(clv)
library(dplyr)
library(foreign)
########## file #########
df<-read.csv(file.choose(),header = TRUE)
df<-as_tibble(df)
########## 2011 ##########
head(df)
dim(df)
names(df)
d<-df%>%filter(year==2011)
```

```
d
d1<-subset(d,select = -c(water.stations,year,PS,TS,QV2M,WS2M,pre,post))
d1
str(d1)
########### Standardization ##############
mean.vect<-apply(d1,2,mean)
sd.vect<-apply(d1,2,sd)
z<-scale(d1,mean.vect,sd.vect)
hist(z)
########## cluster ########
df1<-NbClust(d1,min.nc = 2,max.nc =10,method="kmeans")
######### barplot for optimal number of cluster ###############
barplot(table(df1$Best.nc[1,]),col="blue")
############ distance ###########
d2<-dist(z)
d2
############ k mean clustering ##############
data_clustered<-kmeans(d2,2)
data_clustered
data_clustered<-data_clustered$cluster
data_clustered
setk<-kmeans(d1,2)
setk$cluster
plot(d1,col=setk$cluster)
########### dendogram ############
h.fit<-hclust(d2)
h.fit
########### in one line  dendogram ############
plot(h.fit,hang = -1)
rect.hclust(h.fit,k=2,border = "blue")
rect.hclust
```

(similarly we do cluster analysis for remaining years)

- **Applying econometric operation on the data :**

Durbin–Watson:-

The Durbin–Watson (DW) test for lag 1 autocorrelation has been generalized (DWG) to test for autocorrelations at higher lags. This includes the Wallis test for lag 4 autocorrelation. These tests are also applicable to test for the important hypothesis of randomness. It is found that for small sample sizes a normal distribution or a scaled beta distribution by matching the first two moments approximates well the null distribution of the DW and DWG statistics. The approximations seem to be adequate even when the samples are from nonnormal distributions. These approximations require the first two moments of these statistics. The expressions of these moments are derived.

What Is Multicollinearity?

Multicollinearity is the occurrence of high intercorrelations among two or more independent variables in a multiple regression model. Multicollinearity can lead to skewed or misleading results when a researcher or analyst attempts to determine how well each independent variable can be used most effectively to predict or understand the dependent variable in a statistical model.

In general, multicollinearity can lead to wider confidence intervals that produce less reliable probabilities in terms of the effect of independent variables in a model.

Statistical analysts use multiple regression models to predict the value of a specified dependent variable based on the values of two or more independent variables. The dependent variable is sometimes referred to as the outcome, target, or criterion variable.

Variance inflation factor (VIF):-

Variance inflation factor (VIF) is a measure of the amount of multicollinearity in a set of multiple regression variables. Mathematically, the VIF for a regression model variable is equal to the ratio of the overall model variance to the variance of a model that includes only that single independent variable. This ratio is calculated for each independent variable. A high VIF indicates that the associated independent variable is highly collinear with the other variables in the model.

A variance inflation factor is a tool to help identify the degree of multicollinearity. A multiple regression is used when a person wants to test the effect of multiple variables on a particular outcome. The dependent variable is the outcome that is being acted upon by the independent variables—the inputs into the model. Multicollinearity exists when there is a linear relationship, or correlation, between one or more of the independent variables or inputs.

Multicollinearity creates a problem in the multiple regression because the inputs are all influencing each other. Therefore, they are not actually independent, and it is difficult to test how much the combination of the independent variables affects the dependent variable, or outcome, within the regression model.

In statistical terms, a multiple regression model where there is high multicollinearity will make it more difficult to estimate the relationship between each of the independent variables and the dependent variable. Small changes in the data used or in the structure of the model equation can produce large and erratic changes in the estimated coefficients on the independent variables.

Heteroscedasticity :-

In statistics, heteroscedasticity happens when the standard deviations of a predicted variable, monitored over different values of an independent variable or as related to prior time periods, are non-constant.

White Test :-

the White test is a statistical test that establishes whether the variance of the errors in a regression model is constant: that is for homoskedasticity.

This test, and an estimator for heteroscedasticity-consistent standard errors, were proposed by Halbert White in 1980.[1] These methods have become extremely widely used, making this paper one of the most cited articles in economics.[2]

In cases where the White test statistic is statistically significant, heteroskedasticity may not necessarily be the cause; instead the problem could be a specification error. In other words, the White test can be a test of heteroskedasticity or specification error or both. If no cross product terms are introduced in the White test procedure, then this is a test of pure heteroskedasticity. If cross products are introduced in the model, then it is a test of both heteroskedasticity and specification bias.

ADF (Test) :-

Augmented Dickey Fuller test (ADF Test) is a common statistical test used to test whether a given Time series is stationary or not. It is one of the most commonly used statistical test when it comes to analyzing the stationary of a series.

In ARIMA time series forecasting, the first step is to determine the number of differencing required to make the series stationary.

Steps:

- first extract water level, rainfall, surface temperature, surface pressure data from various sides.
- Then we fit linear model on the data and then we check autocorrelation (durbin Watson) , heteroscedasticity(white test) and multicollinearity and collect all the p values in table format .
- Fit ADF test on all the variable (64 ADF test on every water stations).and we collect all the data in table format and it look like below.

<u>Rcode :</u>

```
######## libraray ##########

library(dplyr)

library(car)

library(lmtest)

library(faraway)

library("tseries")

library(xts)

##########data import ##############
```

```
df<-read.csv(file.choose(),header = T)

str(df)

########## operations on data #############

df$water.stations<-factor(df$water.stations)

df1<-df[,-2]

year<-c(2011:2020)

month<-rep(1,times=10)

day<-rep(1, 10)

df<-cbind.data.frame(year,month,day, df1)

ss<-paste0(year,"-", month, "-", day)

ss

class(ss)

ss1<-as.Date(ss, "%Y-%m-%d")

ss2<-function(x){

  return(xts(x, ss1))

}

levels(df1$water.stations)

colnames(df1)

########### alladpur ############

ws1<-df1%>%filter(water.stations == "Alladpur")%>%select(-water.stations)

ws1

########### autocorl ##########

fit1<-lm(water.level ~ ., data = ws1)

durbinWatsonTest(fit1)

summary(fit1)

############ heteroscedasticity ################
```

```
############# white test ###############

fit2<-lm(water.level ~. , data = ws1)

fit2

summary(fit2)

bptest(fit2)

bptest(fit2, ~ fitted(fit2) + I(fitted(fit2)^2))

########## multicolinearity ############

round(cor(ws1),2)

fit3<-lm(water.level ~. ,  ws1)

fit3

summary(fit3)

vif(fit3)

########## ADF test ##############

attach(ws1)

adf.test(PS)

adf.test(TS)

adf.test(QV2M)

adf.test(WS2M)

adf.test(pre)

adf.test(post)

adf.test(rainfall)

adf.test(water.level)
```

after performing all econometric operation on the data we put all the values in excel and form a table as below :

Measure	Alladpur	Amreshwar	Asala	Asar	Baladgam	Bhindol	Bodeli	Chavaria	Chella Karamsiya Pz	Chhaliyar	Chhota udepur	Chisadia	Chitral PZ_II	Chitral Pz-I	Chota udepur	Devat (thadgam)	Ferkuva	Ghamodi	Ghayaj ii	Govindpura
PS	3.05E+01	-8.07E+00	-4.67E-01	1.52E+01	-8.47447	-3.54E+01	3.83E+01	-8.07E+00	-4.65E+00	-9.42E+00	1.49E+00	1.28E+01	-7.02E+00	-2.78E+01	5.19E+01	2.63E+01	-28.13213	2.06E+01	-8.79E+01	-1.27E+01
TS	-7.31E+00	1.49E+00	1.28E+01	-5.55E-01	1.63744	-9.73E-01	-3.06E+00	1.69E+00	2.35E-01	-2.13E+00	2.10E+00	-5.32E-01	1.25E+00	6.97E+00	-3.03E+01	-2.03E-01	12.91967	-1.08E+01	1.04E+01	3.27E+00
QV2M	-7.72E+00	8.94E-01	-0.186941	5.37E+00	0.917314	-2.09E+00	-7.27E+00	2.39E+00	-2.14E+00	-4.52E+00	-4.67E-01	5.94E+00	-1.26E+00	1.27E+00	-3.91E+01	7.13E-02	10.21087	-1.26E+01	3.19E+00	1.44E+01
WS2M	-2.57E+01	7.84E+00	8.991715	2.03E+01	4.20189	9.46E+00	-2.50E+01	2.12E+00	-9.46E+00	-3.31E+01	1.76E+00	2.94E+01	1.32E+01	2.32E+01	-1.14E+02	8.21E+00	42.45591	-3.12E+01	1.20E+01	7.10E+00
pre	3.03E+00	-1.93E-01	1.125623	3.58E-01	1.077437	-8.01E-01	1.89E+00	1.28E+00	-1.14E+00	7.06E-01	-1.29E+00	4.38E+00	8.81E-01	6.46E-01	7.45E+00	1.55E+00	-1.04657	3.78E+00	-3.27E-01	-1.46E-01
post	5.93E-02	1.60E-02	0.240208	-9.03E-01	1.331321	1.72E+00	-4.15E-01	9.24E-01	-1.08E+00	1.98E-01	-4.52E-01	-3.20E+00	1.49E+00	1.82E+00	-2.10E+00	1.67E+00	2.53809	-2.58E+00	-1.98E+00	1.67E+00
rainfall	5.33E-03	-3.74E-03	-0.006729	-1.18E-02	0.001651	1.86E-03	4.45E-04	-3.41E-03	2.90E-03	7.55E-03	-1.68E-03	-4.70E-03	7.71E-04	1.54E-02	2.21E-02	-6.12E-03	-0.0057	2.75E-03	5.58E-03	-3.37E-03
R^2	0.7339	0.6489	0.6646	0.9984	0.9457	0.5698	0.8928	0.8037	0.9831	0.4241	0.9539	0.9998	0.9124	0.9945	0.973	0.8899	0.7369	0.5807	0.8887	0.8871
Adj R^2	-0.1974	0.21	0.2453	0.9927	0.7557	-0.9359	0.5177	0.1167	0.9239	-1.591	0.7927	0.9993	0.6058	0.9753	0.8785	0.5046	-0.1842	-0.8869	0.4992	0.4918
P-val	0.6614	0.3631	0.338	0.005644	0.1774	0.8603	0.3275	0.5346	0.05792	0.9503	0.1522	0.0005325	0.2745	0.01906	0.09132	0.3352	0.6566	0.8508	0.3383	0.3426
DW	2.183617	2.386626	1.87453	3.504729	2.490057	3.200165	2.574578	2.381076	2.351091	3.376292	1.891044	2.310784	2.943944	2.050357	2.782446	2.67605	2.332646	2.798807	3.085882	1.963386
DW(p-val)	0.004	0.704	0.452	0.108	0.026	0.556	0.214	0.44	0.168	0.138	0.148	0.056	0.188	0.722	0.842	0.396	0.94	0.964	0.836	0.304
Autocorretion	-0.194608	-0.2348462	-0.0343158	-0.7561501	-0.43057	-0.6306012	-0.4021984	-0.2166004	-0.3060284	-0.7039119	0.001565105	-0.1851829	-0.5847226	-0.05814891	-0.4386211	-0.4395735	-0.2916524	-0.438832	-0.5841441	-0.1012151
p-value BP	0.4158	0.8386	0.2486	0.2269	0.4565	0.2324	0.2332	0.2132	0.6042	0.2787	0.2031	0.204	0.2258	0.2459	0.1903	0.5207	0.2045	0.2109	0.4631	0.2968
p-value WT	0.3396	0.6174	0.3517	0.6325	0.08476	0.1009	0.3458	0.5965	0.6763	0.3111	0.07268	0.02232	0.5621	0.1885	0.1266	0.8814	0.05363	0.8026	0.6082	0.3994
VIF(PS)	5.570439	2.72E-11	-5.49E-11	3.211535	3.827998	8.093081	2.245462	28.645143	3.436824	11.725615	4.119271	2.742976	7.214474	7.214474	4.119271	5.64475	3.883806	5.986857	30.025705	98.174517
VIF(TS)	27.885853	2.97E-11	-1.75E-10	10.489373	14.35021	17.174569	14.794867	154.935514	17.402493	34.703836	70.640137	9.488349	23.931746	23.931746	70.640137	24.858089	14.547975	32.435003	29.571157	2.944759
VIF(QV2M)	38.562779	1.07E+00	6.24E+00	13.365084	19.80217	23.877408	40.616992	170.472195	28.744978	49.001126	162.482528	10.549913	27.591621	27.591621	162.482528	38.307147	15.141338	29.36669	25.167884	103.901086
VIF(WS2M)	5.676929	2.82E-02	2.84E-02	7.371258	4.473985	8.758216	11.975908	31.949569	4.4928	3.119104	36.836857	2.411077	5.382364	5.382364	36.836857	7.602021	3.475698	5.467153	3.366043	1.740984
VIF(pre)	3.20452	1.36E-05	3.46E-06	2.528711	2.886305	3.948933	3.614528	2.963921	2.234663	1.329672	17.44928	1.424524	3.539692	3.539692	17.44928	3.890417	1.169557	3.59579	7.407103	1.347389
VIF(post)	3.471042	3.84E+00	5.66E+00	1.457934	4.362506	10.993797	3.819895	23.16216	3.424646	5.735436	1.883256	1.614573	6.291672	6.291672	1.883256	3.867158	3.292805	4.669285	9.107861	1.163713
VIF(rainfall)	4.496939	2.00E+07	3.17E+07	2.418696	10.97464	2.544254	6.123464	3.033942	7.372379	6.514351	19.162322	2.065558	3.525208	3.525208	19.162322	3.261151	2.433627	2.126848	2.62608	2.62787
ADF(PS)	0.3497	0.4295	0.3497	0.4295	0.4295	0.4295	0.3497	0.4295	0.3288	0.3288	0.3497	0.3528	0.3908	0.3908	0.3497	0.4295	0.3528	0.3528	0.3908	0.9372
ADF(TS)	0.9782	0.983	0.9782	0.9501	0.983	0.983	0.9782	0.983	0.9857	0.9857	0.9782	0.9886	0.9841	0.9841	0.9782	0.983	0.9886	0.9886	0.9841	0.983
ADF(QV2M)	0.9485	0.9091	0.9485	0.9091	0.9091	0.9091	0.9485	0.9091	0.9675	0.9675	0.9485	0.93	0.9372	0.9372	0.9485	0.9091	0.93	0.93	0.9372	0.9091
ADF(WS2M)	0.7981	0.8385	0.7981	0.8385	0.8385	0.8385	0.7981	0.8385	0.3083	0.3083	0.7981	0.6571	0.7171	0.7171	0.7981	0.8385	0.6571	0.6571	0.7171	0.8852
ADF(pre)	0.4459	0.383	0.6195	0.9114	0.2234	0.4118	0.8052	0.6195	0.99	0.7583	0.01	0.8007	0.8536	0.8536	0.01	0.1042	0.4118	0.01	0.99	0.892
ADF(post)	0.08751	0.9537	0.816	0.7503	0.9709	0.982	0.7794	0.99	0.4387	0.9586	0.8577	0.9687	0.01	0.01	0.8577	0.3155	0.31	0.924	0.01	0.982
ADF(rainfall)	0.8763	0.9727	0.9569	0.2038	0.2038	0.66	0.99	0.66	0.99	0.99	0.9525	0.9525	0.99	0.99	0.9525	0.66	0.9525	0.9525	0.99	0.8763
ADF(water level)	0.01	0.01	0.7006	0.9696	0.3129	0.3806	0.9789	0.09538	0.976	0.7017	0.9536	0.6195	0.9523	0.99	0.01	0.99	0.01	0.7505	0.9236	0.6094

Handod1	Handod2	Jojh	Juna samalya	Kaprali	Karamasiya	Kevadi	Kosindra Pz-I	Makni	Masor	Moti chikhali	Panwad	Patiyapura	Pavi	Pitha	Rasulpur	Raypura i	Saidal	Saidivasana	Sankarda	Sankarda1	Sankheda	Segwa chouki ii	Segwa chowki I
-4.73E+01	-1.597705	2.09E+01	-2.89E+02	-4.44E+01	8.13E+00	-4.19E+03	2.85E+01	1.52E+01	-2.90E+01	2.49E+01	80.910459	9.70E+01	1.25E+02	47.57354	1.27E+02	3.23E+02	-6.62E+01	-2.37E+01	1.86E+02	7.35E+01	-1.18E+02	5.71E+01	9.22E+01
5.96E+00	-1.940015	8.83E-01	4.74E+01	1.50E+01	-1.17E+00	8.56E+02	-5.30E+00	-2.50E+00	5.20E+00	-7.74E+00	-14.42942	8.99E+00	-1.06E+01	-3.311944	-6.66E+00	-6.64E+01	-1.39E+00	9.38E+00	-2.66E+01	-7.65E+00	1.96E+01	-1.30E+01	-1.64E+01
4.88E+00	-5.82E-01	-4.52E+00	4.85E+01	9.84E+00	-5.82E-01	1.07E+03	-7.99E+00	-2.33E+00	2.51E+00	-5.41E+00	-23.630086	1.13E+01	-8.16E+00	-6.129367	-5.31E+00	-6.29E+01	-1.78E+00	6.21E+00	-3.76E+01	-1.00E+01	1.04E+01	-2.45E+01	-1.54E+01
1.37E+01	4.889217	-1.54E+01	3.92E+01	2.41E+01	4.44E+00	4.85E+03	-4.08E+01	-3.81E+00	2.23E+01	-5.00E+00	-85.83399	-1.51E+02	-5.33E+01	-59.507894	-4.85E+01	4.91E+00	-1.24E+01	2.06E+01	-1.63E+01	-7.58E+00	1.94E+01	-5.69E+01	5.79E+00
4.34E-01	-2.167467	1.89E-01	-1.47E+01	-6.39E+00	3.49E-01	-1.54E+02	-7.20E-01	6.57E-03	6.61E-01	-6.62E-01	-10.336595	-2.23E+01	-9.99E-01	-3.826014	-9.64E+00	1.38E+01	-2.74E+00	8.24E-01	-6.23E+00	-6.68E-01	-6.88E+00	6.76E-01	1.24E+01
1.39E+00	-2.55979	-4.41E-01	5.02E+00	1.46E+00	3.38E-01	2.60E+02	-1.65E+00	-1.52E+00	6.78E-01	-2.07E+00	-2.502431	8.59E+00	-4.48E+00	-0.849524	1.68E+00	-1.96E+01	6.99E+00	2.21E+00	-1.12E+01	-2.13E+00	-5.61E+00	-6.81E+00	-4.23E+00
-7.15E-04	0.00361	2.36E-03	-2.76E-02	6.72E-03	-1.28E-03	-1.13E+00	6.02E-03	3.82E-04	3.51E-04	-2.05E-03	0.030483	-2.83E-02	-3.93E-04	0.008503	8.59E-03	3.12E-02	-8.66E-04	-5.92E-03	4.13E-02	7.21E-03	8.35E-03	1.29E-02	-3.12E-03
0.9532	0.6716	0.8883	0.9796	0.999	0.9968	0.9505	0.9949	0.8931	0.2536	0.5128	0.9994	0.6897	0.5606	0.9999	0.7177	0.9211	0.9855	0.954	0.935	0.963	0.9974	0.9386	0.7926
0.7893	0.01478	-0.005264	0.8163	0.9912	0.9709	0.5543	0.954	0.03772	-5.717	-3.385	0.9944	-1.793	-2.955	0.9992	-1.541	0.2901	0.8691	0.5862	0.4149	0.6671	0.9769	0.7238	0.06686
0.1545	0.5369	0.6548	0.3062	0.06825	0.1241	0.4634	0.1555	0.6436	0.9987	0.9752	0.05462	0.9056	0.9633	0.02019	0.886	0.5681	0.26	0.4481	0.5229	0.4055	0.1105	0.1989	0.5566
3.158706	2.609025	2.750263	2.749238	3.063166	2.840674	2.17897	3.500649	2.440349	2.881886	3.478218	2.849314	2.999285	1.78712	3.266681	3.297295	3.016974	2.652487	2.221486	2.591657	2.591657	3.269144	2.667437	2.582296
0.552	0.95	0.814	0.104	0.872	0.2	0.318	0.73	0.632	0.64	0.574	0.172	0.13	0.71	0.1	0.486	0.784	0.258	0.048	0.406	0.408	0.01	0.788	0.728
-0.6259919	-0.3226272	-0.3764393	-0.3789156	-0.5475134	-0.4207908	-0.1551363	-0.7592821	-0.2474259	-0.4612221	-0.7558546	-0.4663705	-0.5235143	0.09274937	-0.6614058	-0.6681323	-0.5779425	-0.3340919	-0.1390133	-0.3261892	-0.3261892	-0.6838487	-0.426356	-0.4096682
0.3498	0.5093	0.3016	0.2653	0.2655	0.2712	0.8411	0.3346	0.2849	0.4857	0.2781	0.5011	0.2697	0.281	0.31	0.3939	0.3575	0.2693	0.3119	0.5428	0.5428	0.3878	0.61	0.6051
0.424	0.4032	0.05956	0.02742	0.2311	0.5108	0.5481	0.0677	0.1998	0.5275	0.07314	0.272	0.009591	0.02868	0.01914	0.8546	0.4416	0.303	0.2219	0.2877	0.8189	0.08875	0.3736	0.49
22.795917	7.20E+00	1.90E+01	3.80E-02	7.26E-03	1.75E-01	6.83E+04	4.01E-03	7.06E+04	4.68E+00	2.07E-01	6.29E-03	4.00E-01	9.80E+00	6.24E-02	3.04E-03	4.58E-01	5.18E+00	1.21E-01	2.04E-03	2.91E-01	2.05E+00	2.11E+01	21.084935
51.53243	3.42E+00	5.59E+05	7.21E-05	3.33E+02	3.76E+01	6.59E+03	5.76E+02	1.62E+01	9.84E+00	4.19E-05	5.60E+02	3.52E+01	1.39E+00	5.31E-05	2.02E+03	9.35E+01	3.88E+00	6.06E-05	2.45E+03	3.62E+01	5.47E+00	4.72E+01	47.219632
53.672114	7.56E+01	5.97E+00	3.00E+00	4.22E+01	1.40E+03	2.92E+04	3.46E+01	6.06E+02	2.04E+00	4.20E-01	2.98E+01	2.24E+03	5.46E-01	2.26E+00	3.44E+01	5.66E+02	7.52E+01	1.90E+00	5.42E+01	3.47E+02	3.44E+00	4.10E+01	40.952765
5.380889	4.90E-02	3.13E-06	2.23E+02	1.11E+00	4.11E-01	1.01E-02	1.43E+00	4.11E-02	4.09E-07	3.25E+01	1.21E+00	1.14E+00	7.84E-07	4.04E+01	6.04E-01	1.39E-01	1.13E-06	6.57E+01	9.70E-01	7.07E-02	7.59E-07	2.85E+00	2.8506
2.789168	1.61E+00	1.68E+00	3.20E+02	6.10E+02	2.62E+00	1.81E+03	5.27E+02	2.64E+00	5.91E-01	6.26E+01	5.65E+02	2.52E+01	9.76E-01	9.50E+01	1.54E+02	4.39E+00	1.84E+00	2.73E+02	1.65E+02	1.84E+00	2.94E+00	2.35E+00	2.351071
12.176346	7.68E-06	2.49E+03	1.27E+03	1.02E+01	1.66E-04	1.00E+07	5.24E+00	3.83E-05	1.15E+04	4.21E+01	4.18E+00	1.22E-04	3.43E+03	7.24E+01	8.72E+01	1.10E-04	5.12E+03	1.03E+02	6.58E+00	7.07E-05	1.35E+03	5.84E+00	5.842965
2.482377	3.09E+06	2.15E+07	8.36E+07	1.02E+06	4.65E+05	1.04E+11	1.84E+06	1.64E+05	5.73E+07	7.31E+07	8.29E+05	1.13E+06	1.73E+07	1.18E+09	2.62E+05	9.29E+04	6.27E+06	5.07E+08	9.24E+05	9.10E+04	1.28E+07	3.50E+00	3.502949
0.3908	0.9372	0.3497	0.3288	0.4295	0.3288	0.3497	0.4295	0.4295	0.3908	0.5037	0.4295	0.3497	0.3497	0.3497	0.3288	0.3288	0.3497	0.4295	0.3288	0.3288	0.3288	0.3908	0.3908
0.9841	0.9841	0.9782	0.9857	0.983	0.9857	0.9782	0.983	0.983	0.9841	0.9861	0.983	0.9782	0.9782	0.9782	0.9857	0.9857	0.9782	0.983	0.9857	0.9857	0.9857	0.9841	0.9841
0.9372	0.9372	0.9485	0.9675	0.9091	0.9675	0.9485	0.9091	0.9091	0.9372	0.9006	0.9091	0.9485	0.9485	0.9485	0.9675	0.9675	0.9485	0.9091	0.9675	0.9675	0.9675	0.9372	0.9372
0.7171	0.7171	0.7981	0.3083	0.8385	0.3083	0.7981	0.8385	0.8385	0.7171	0.6587	0.8385	0.7981	0.7981	0.7981	0.3083	0.3083	0.7981	0.8385	0.3083	0.3083	0.3083	0.7171	0.7171
0.5068	0.5068	0.06887	0.2877	0.1414	0.9624	0.01	0.99	0.8071	0.1414	0.8698	0.8592	0.4262	0.6513	0.9262	0.7492	0.6219	0.6021	0.6853	0.4782	0.4782	0.3574	0.4782	0.4782
0.9286	0.9286	0.99	0.9755	0.01	0.8185	0.4979	0.982	0.8337	0.9788	0.01751	0.99	0.8559	0.685	0.9886	0.8074	0.9537	0.7274	0.03866	0.6274	0.6274	0.9371	0.9799	0.9799
0.99	0.99	0.9569	0.99	0.7773	0.99	0.99	0.66	0.8763	0.99	0.2038	0.2038	0.99	0.9569	0.99	0.99	0.99	0.99	0.2038	0.99	0.99	0.99	0.9727	0.9727
0.9101	0.01	0.9585	0.04546	0.7136	0.01	0.557	0.8725	0.807	0.9669	0.4718	0.01	0.01	0.99	0.01	0.977	0.899	0.9574	0.99	0.99	0.6274	0.9702	0.9604	0.9741

Handod1	Handod2	Jojh	Juna samalya	Kaprali	Karamasiya	Kevadi	Kosindra Pz-I	Makni	Masor	Moti chikhali	Panwad	Patiyapura	Pavi	Pitha	Rasulpur	Raypurai	Saidal	Saidivasana	Sankarda	Sankarda1	Sankheda	Segwa chouki ii	Segwa chowki I
-4.73E+01	-1.597705	2.09E+01	-2.89E+02	-4.44E+01	8.13E+00	-4.19E+03	2.85E+01	1.52E+01	-2.90E+01	2.49E+01	80.910459	9.70E+01	1.25E+02	47.57354	1.27E+02	3.23E+02	-6.62E+01	-2.37E+01	1.86E+02	7.35E+01	-1.18E+02	5.71E+01	9.22E+01
5.96E+00	-1.940015	8.83E-01	4.74E+01	1.50E+01	-1.17E+00	8.56E+02	-5.30E+00	-2.50E+00	5.20E+00	-7.74E+00	-14.42942	8.99E+00	-1.06E+01	-3.311944	-6.66E+00	-6.64E+01	-1.39E+00	9.38E+00	-2.66E+01	-7.65E+00	1.96E+01	-1.30E+01	-1.64E+01
4.88E+00	-5.82E-01	-4.52E+00	4.85E+01	9.84E+00	-5.82E-01	1.07E+03	-7.99E+00	-2.33E+00	2.51E+00	-5.41E+00	-23.630086	1.13E+01	-8.16E+00	-6.129367	-5.31E+00	-6.29E+01	-1.78E+00	6.21E+00	-3.76E+01	-1.00E+01	1.04E+01	-2.45E+01	-1.54E+01
1.37E+01	4.889217	-1.54E+01	3.92E+01	2.41E+01	4.44E+00	4.85E+03	-4.08E+01	-3.81E+00	2.23E+01	-5.00E+00	-85.83399	-1.51E+02	-5.33E+01	-59.507894	-4.85E+01	4.91E+00	-1.24E+01	2.06E+01	-1.63E+01	-7.58E+00	1.94E+01	-5.69E+01	5.79E+00
4.34E-01	-2.167467	1.89E-01	-1.47E+01	-6.39E+00	3.49E-01	-1.54E+02	-7.20E-01	6.57E-03	6.61E-01	-6.62E-01	-10.336595	-2.23E+01	-9.99E-01	-3.826014	-9.64E+00	1.38E+01	-2.74E+00	8.24E-01	-6.23E+00	-6.68E-01	-6.88E+00	6.76E-01	1.24E+01
1.39E+00	-2.55979	-4.41E-01	5.02E+00	1.46E+00	3.38E-01	2.60E+02	-1.65E+00	-1.52E+00	6.78E-01	-2.07E+00	-2.502431	8.59E+00	-4.48E+00	-0.849524	1.68E+00	-1.96E+01	6.99E+00	2.21E+00	-1.12E+01	-2.13E+00	-5.61E+00	-6.81E+00	-4.23E+00
-7.15E-04	0.00361	2.36E-03	-2.76E-02	6.72E-03	-1.28E-03	-1.13E+00	6.02E-03	3.82E-04	3.51E-04	-2.05E-03	0.030483	-2.83E-02	-3.93E-04	0.008503	8.59E-03	3.12E-02	-8.66E-04	-5.92E-03	4.13E-02	7.21E-03	8.35E-03	1.29E-02	-3.12E-03
0.9532	0.6716	0.8883	0.9796	0.999	0.9968	0.9505	0.9949	0.8931	0.2536	0.5128	0.9994	0.6897	0.5606	0.9999	0.7177	0.9211	0.9855	0.954	0.935	0.963	0.9974	0.9386	0.7926
0.7893	0.01478	-0.005264	0.8163	0.9912	0.9709	0.5543	0.954	0.03772	-5.717	-3.385	0.9944	-1.793	-2.955	0.9992	-1.541	0.2901	0.8691	0.5862	0.4149	0.6671	0.9769	0.7238	0.06686
0.1545	0.5369	0.6548	0.3062	0.06825	0.1241	0.4634	0.1555	0.6436	0.9987	0.9752	0.05462	0.9056	0.9633	0.02019	0.886	0.5681	0.26	0.4481	0.5229	0.4055	0.1105	0.1989	0.5566
3.158706	2.609025	2.750263	2.749238	3.063166	2.840674	2.17897	3.500649	2.440349	2.881886	3.478218	2.849314	2.999285	1.78712	3.266681	3.297295	3.016974	2.652487	2.221486	2.591657	2.591657	3.269144	2.667437	2.582296
0.552	0.95	0.814	0.104	0.872	0.2	0.318	0.73	0.632	0.64	0.574	0.172	0.13	0.71	0.1	0.486	0.784	0.258	0.048	0.406	0.408	0.01	0.788	0.728
-0.6259919	-0.3226272	-0.3764393	-0.3789156	-0.5475134	-0.4207908	-0.1551363	-0.7592821	-0.2474259	-0.4612221	-0.7558546	-0.4663705	-0.5235143	0.09274937	-0.6614058	-0.6681323	-0.5779425	-0.3340919	-0.1390133	-0.3261892	-0.3261892	-0.6838487	-0.426356	-0.4096682
0.3498	0.5093	0.3016	0.2653	0.2655	0.2712	0.8411	0.3346	0.2849	0.4857	0.2781	0.5011	0.2697	0.281	0.31	0.3939	0.3575	0.2693	0.3119	0.5428	0.5428	0.3878	0.61	0.6051
0.424	0.4032	0.05956	0.02742	0.2311	0.5108	0.5481	0.0677	0.1998	0.5275	0.07314	0.272	0.009591	0.02868	0.01914	0.8546	0.4416	0.303	0.2219	0.2877	0.8189	0.08875	0.3736	0.49
22.795917	7.20E+00	1.90E+01	3.80E-02	7.26E-03	1.75E-01	6.83E+04	4.01E-03	7.06E+04	4.68E+00	2.07E-01	6.29E-03	4.00E-01	9.80E+00	6.24E-02	3.04E-03	4.58E-01	5.18E+00	1.21E-01	2.04E-03	2.91E-01	2.05E+00	2.11E+01	21.084935
51.53243	3.42E+00	5.59E+05	7.21E-05	3.33E+02	3.76E+01	6.59E+03	5.76E+02	1.62E+01	9.84E+00	4.19E-05	5.60E+02	3.52E+01	1.39E+00	5.31E-05	2.02E+03	9.35E+01	3.88E+00	6.06E-05	2.45E+03	3.62E+01	5.47E+00	4.72E+01	47.219632
53.672114	7.56E+01	5.97E+00	3.00E+00	4.22E+01	1.40E+03	2.92E+04	3.46E+01	6.06E+02	2.04E+00	4.20E-01	2.98E+01	2.24E+03	5.46E-01	2.26E+00	3.44E+01	5.66E+02	7.52E+01	1.90E+00	5.42E+01	3.47E+02	3.44E+00	4.10E+01	40.952765
5.380889	4.90E-02	3.13E-06	2.23E+02	1.11E+00	4.11E-01	1.01E-02	1.43E+00	4.11E-02	4.09E-07	3.25E+01	1.21E+00	1.14E+00	7.84E-07	4.04E+01	6.04E-01	1.39E-01	1.13E-06	6.57E+01	9.70E-01	7.07E-02	7.59E-07	2.85E+00	2.8506
2.789168	1.61E+00	1.68E+00	3.20E+02	6.10E+02	2.62E+00	1.81E+03	5.27E+02	2.64E+00	5.91E-01	6.26E+01	5.65E+02	2.52E+01	9.76E-01	9.50E+01	1.54E+02	4.39E+00	1.84E+00	2.73E+02	1.65E+02	1.84E+00	2.94E+00	2.35E+00	2.351071
12.176346	7.68E-06	2.49E+03	1.27E+03	1.02E+01	1.66E-04	1.00E+07	5.24E+00	3.83E-05	1.15E+04	4.21E+01	4.18E+00	1.22E-04	3.43E+03	7.24E+01	8.72E+01	1.10E-04	5.12E+03	1.03E+02	6.58E+00	7.07E-05	1.35E+03	5.84E+00	5.842965
2.482377	3.09E+06	2.15E+07	8.36E+07	1.02E+06	4.65E+05	1.04E+11	1.84E+06	1.64E+05	5.73E+07	7.31E+07	8.29E+05	1.13E+06	1.73E+07	1.18E+09	2.62E+05	9.29E+04	6.27E+06	5.07E+08	9.24E+05	9.10E+04	1.28E+07	3.50E+00	3.502949
0.3908	0.9372	0.3497	0.3288	0.4295	0.3288	0.3497	0.4295	0.4295	0.3908	0.5037	0.4295	0.3497	0.3497	0.3497	0.3288	0.3288	0.3497	0.4295	0.3288	0.3288	0.3288	0.3908	0.3908
0.9841	0.9841	0.9782	0.9857	0.983	0.9857	0.9782	0.983	0.983	0.9841	0.9861	0.983	0.9782	0.9782	0.9782	0.9857	0.9857	0.9782	0.983	0.9857	0.9857	0.9857	0.9841	0.9841
0.9372	0.9372	0.9485	0.9675	0.9091	0.9675	0.9485	0.9091	0.9091	0.9372	0.9006	0.9091	0.9485	0.9485	0.9485	0.9675	0.9675	0.9485	0.9091	0.9675	0.9675	0.9675	0.9372	0.9372
0.7171	0.7171	0.7981	0.3083	0.8385	0.3083	0.7981	0.8385	0.8385	0.7171	0.6587	0.8385	0.7981	0.7981	0.7981	0.3083	0.3083	0.7981	0.8385	0.3083	0.3083	0.3083	0.7171	0.7171
0.5068	0.5068	0.06887	0.2877	0.1414	0.9624	0.01	0.99	0.8071	0.1414	0.8698	0.8592	0.4262	0.6513	0.9262	0.7492	0.6219	0.6021	0.6853	0.4782	0.4782	0.3574	0.4782	0.4782
0.9286	0.9286	0.99	0.9755	0.01	0.8185	0.4979	0.982	0.8337	0.9788	0.01751	0.99	0.8559	0.685	0.9886	0.8074	0.9537	0.7274	0.03866	0.6274	0.6274	0.9371	0.9799	0.9799
0.99	0.99	0.9569	0.99	0.7773	0.99	0.99	0.66	0.8763	0.99	0.2038	0.2038	0.99	0.9569	0.99	0.99	0.99	0.99	0.2038	0.99	0.99	0.99	0.9727	0.9727
0.9101	0.01	0.9585	0.04546	0.7136	0.01	0.557	0.8725	0.807	0.9669	0.4718	0.01	0.01	0.99	0.01	0.977	0.899	0.9574	0.99	0.99	0.6274	0.9702	0.9604	0.9741

The ADF value less than 0.05 then we cannot perform ARIMA on the value so we remove this values from the table and fit ARIMA model on remaining values and form a table in excel as below.

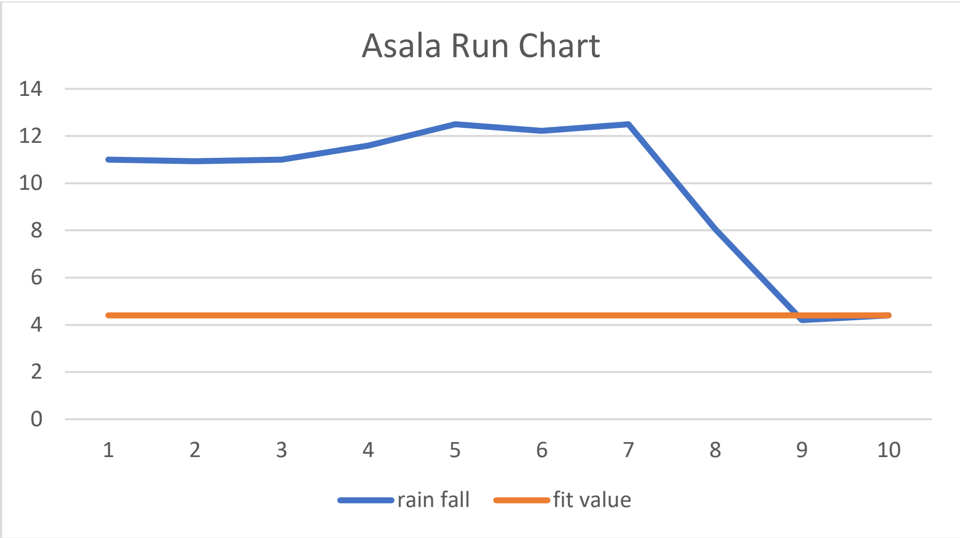
ARIMA MODEL:-

Using ARIMA model, you can forecast a time series using the series past values. In this post, we build an optimal ARIMA model from scratch and extend it to Seasonal ARIMA (SARIMA) and SARIMAX models.

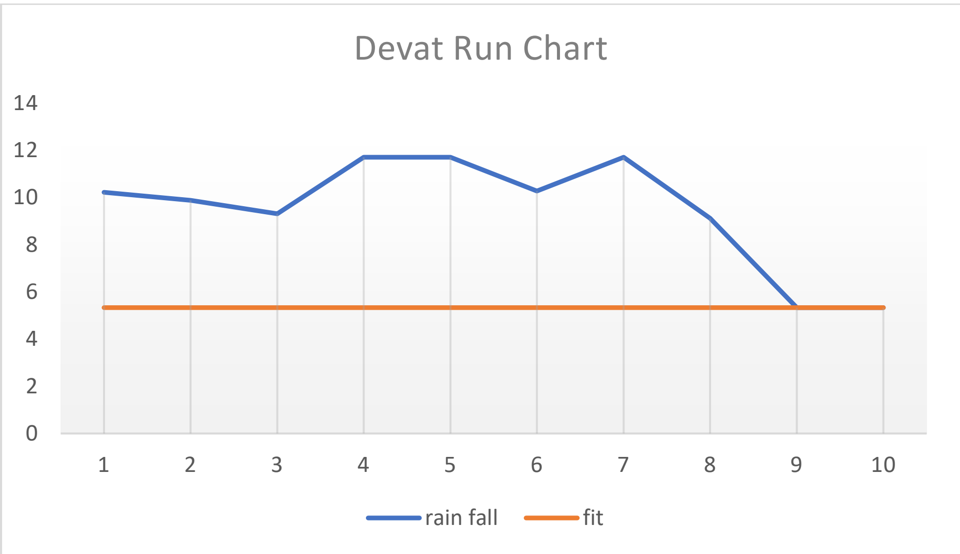
water stations	(p,d,q)	AIC	forcast 3 yr(2021,2022,2023)
Asala	(0,1,0)	40.01	(4.4 ,4.4 ,4.4)
Asar	(0,1,0)	46.69	(11.9 ,11.9 ,11.9)
Baladgam	(0,0,0)	24.67	(12.693 ,12.693 ,12.693)
Bhindol	(0,0,0)	54.08	(7.24 ,7.24 ,7.24)
Bodeli	(0,0,0)	52.76	(4.473 ,4.473 ,4.473)
Chavaria	(0,0,0)	36.62	(11.682 ,11.682 ,11.682)
Chella Karamsiya Pz	(0,0,0)	33.43	(2.839 ,2.839 ,2.839)
Chhaliyar	(0,0,0)	62.97	(22.274 ,22.274 ,22.274)
Chhota udepur	(0,0,0)	46.95	(7.112 ,7.112 ,7.112)
Chisadia	(0,0,0)	63.04	(9.564 ,9.564 ,9.564)
Chitral PZ_II	(0,0,0)	39.91	(25.198 ,25.198 ,25.198)
Chitral Pz-I	(0,0,0)	67.35	(27.366 ,27.366 ,27.366)
Devat (thadgam)	(0,1,0)	38.75	(5.33 ,5.33 ,5.33)
Ghamodi	(0,0,0)	53.64	(6.657 ,6.657 ,6.657)
Ghayaj ii	(0,0,0)	60.34	(23.956 ,23.956 ,23.956)
Govindpura	(0,0,0)	46.96	(6.917 ,6.917 ,6.917)
Handod1	(0,1,0)	26.74	(29.05 ,29.05 ,29.05)
Jojh	(0,0,0)	48.15	(11.804,11.804,11.804)
Juna samalya	(0,0,0)	53.66	(11.564,11.564,11.564)
Kaprali	(0,0,0)	48.59	(7.598, 7.598, 7.598)
Kevadi	(0,0,0)	31.39	(30.583,30.583,30.583)
Kosindra Pz-I	(0,0,0)	34.92	(2.408, 2.408, 2.408)
Makni	(0,0,0)	31.57	(9.938, 9.938, 9.938)
Masor	(0,0,0)	52.15	(11.921,11.921,11.921)
Moti chikhali	(0,0,0)	41.52	(4.087, 4.087, 4.087)
Pavi	(0,0,0)	56.4	(5.949, 5.949, 5.949)
Rasulpur	(0,0,0)	51.43	(5.373, 5.373, 5.373)
Raypura i	(0,0,0)	66.93	(26.607, 26.607, 26.607)
Saidal	(0,0,0)	34.51	(2.445, 2.445, 2.445)
Saidivasana	(0,0,0)	43.18	(5.426,5.426,5.426)
Sankarda	(0,0,0)	77.83	(31.192, 31.192, 31.192)
Sankarda1	(0,0,0)	48.96	(27.903 ,27.903 ,27.903)
Sankheda	(0,0,0)	66.16	(29.552,29.552,29.552)
Segwa chouki ii	(0,0,0)	69.13	(37.558 ,37.558 ,37.558)
Segwa chowki I	(0,0,0)	66.68	(37.718,37.718,37.718)
Sengpur	(0,0,0)	48.95	(8.745 8.745, 8.745)
Sinor	(0,0,0)	55.21	(23.002,23.002,23.002)
Suskal	(0,0,0)	68.49	(9.632,9.632,9.632)
Tokri	(0,0,0)	74.46	(8.811 , 8.811 , 8.811)
Tundav	(0,0,0)	64.39	(11.207,11.207,11.207)
Vadodara I	(0,0,0)	69.72	(18.276, 18.276, 18.276)
Vadodara Ii	(0,0,0)	48.56	(7.15 , 7.15 7.15)
Vadodara_Kevada Bag	(0,1,0)	42.74	(4.1 , 4.1 , 4.1)
Vadodara_ONGC	(0,1,0)	50.08	(5.4 , 5.4, 5.4)
Vadodara_Sama	(0,0,0)	66.64	(6.171,6.171,6.171)
Vadshala Pzi	(0,0,0)	66.67	(19.89 ,19.89 ,19.89)
Vadtalav Pz	(0,0,0)	65.51	(13.383, 13.383, 13.383)
Waghach	(0,0,0)	47.16	(9.252,9.252,9.252)
Waghodia Pz	(0,0,0)	49.5	(6.484, 6.484 6.484)

After fitting ARIMA on remaining data we fit RUN chart on actual water level and fitted water level on 5 water stations which is taken randomly .

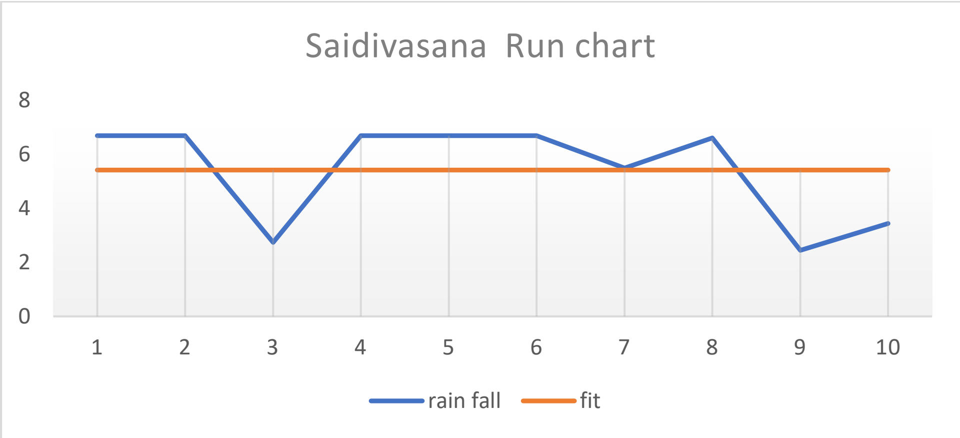
Asala :


Asala Run Chart
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
rain fall
fit value

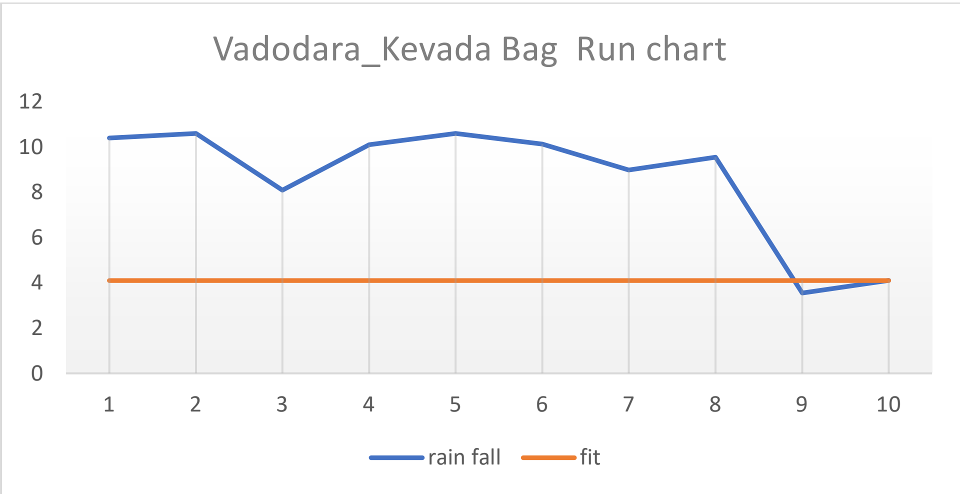
Devat:


Devat Run Chart
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
rain fall
fit

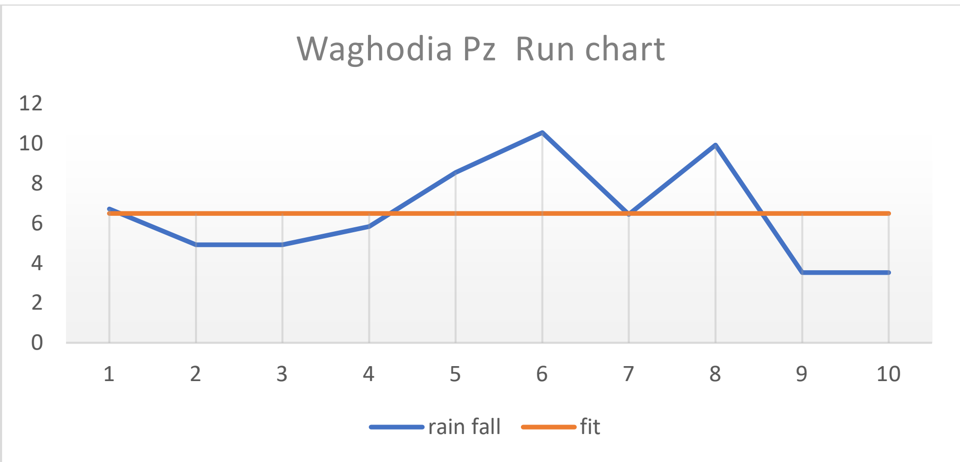
Saidivasana:



Vadodara kevada bag:

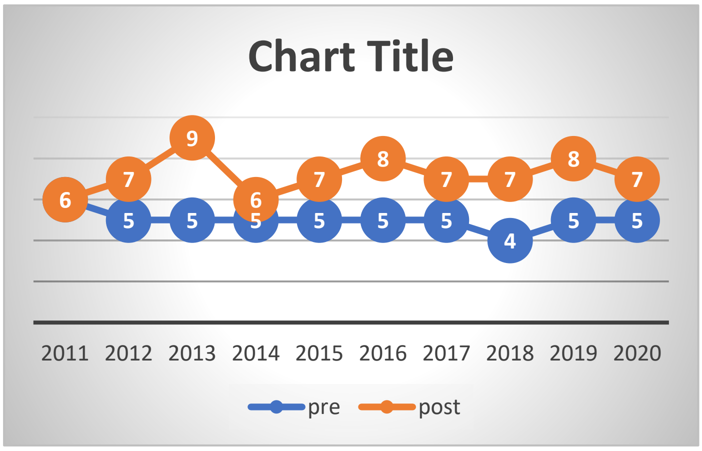


Waghodia PZ :



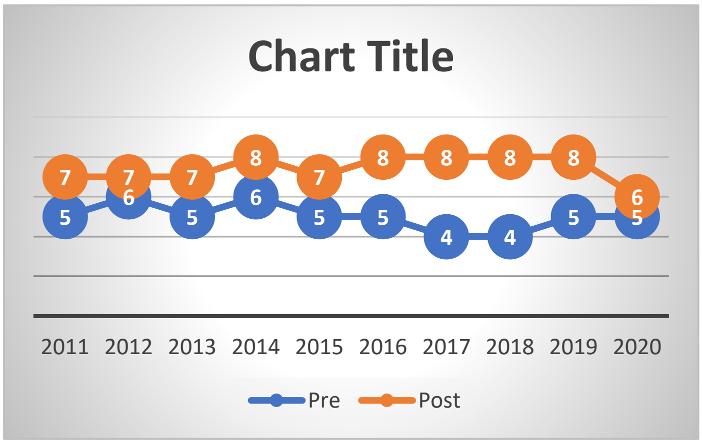
Graphical representation :

Alladpur



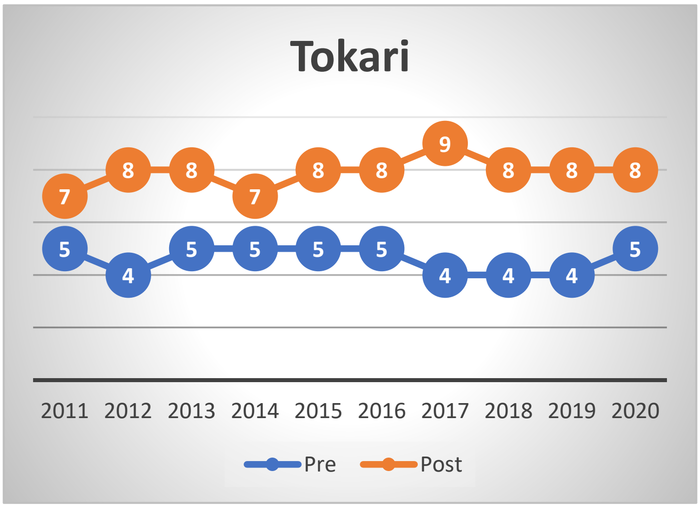
It is graph of pre and post monsoon data of Alladpur

Jojh :



It is graph of pre and post monsoon data of Jojh

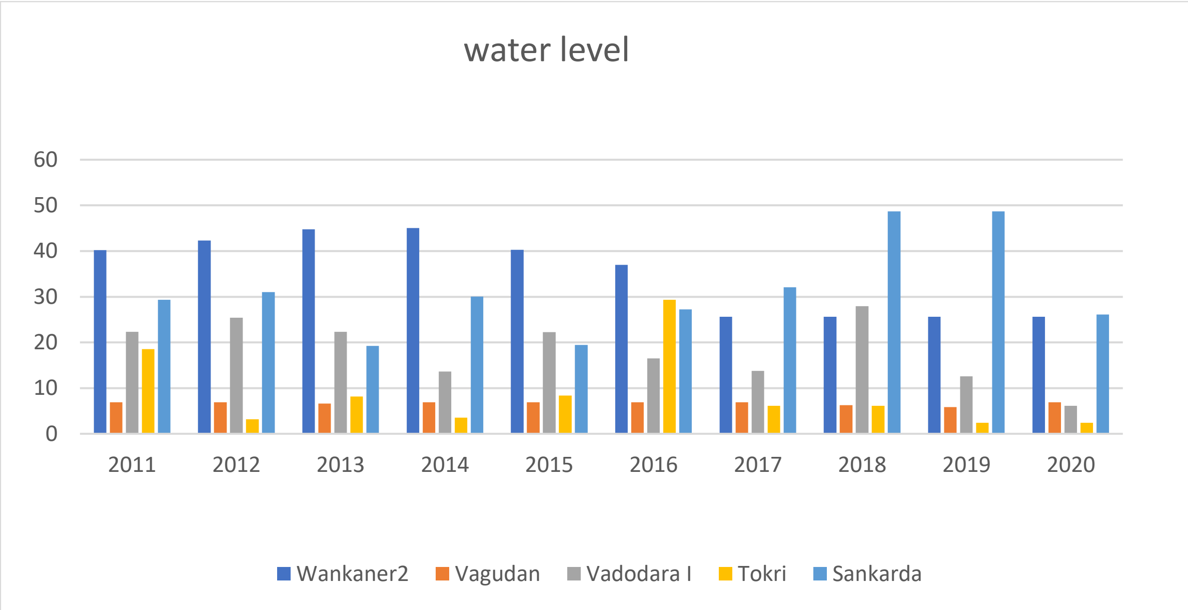
Tokari:



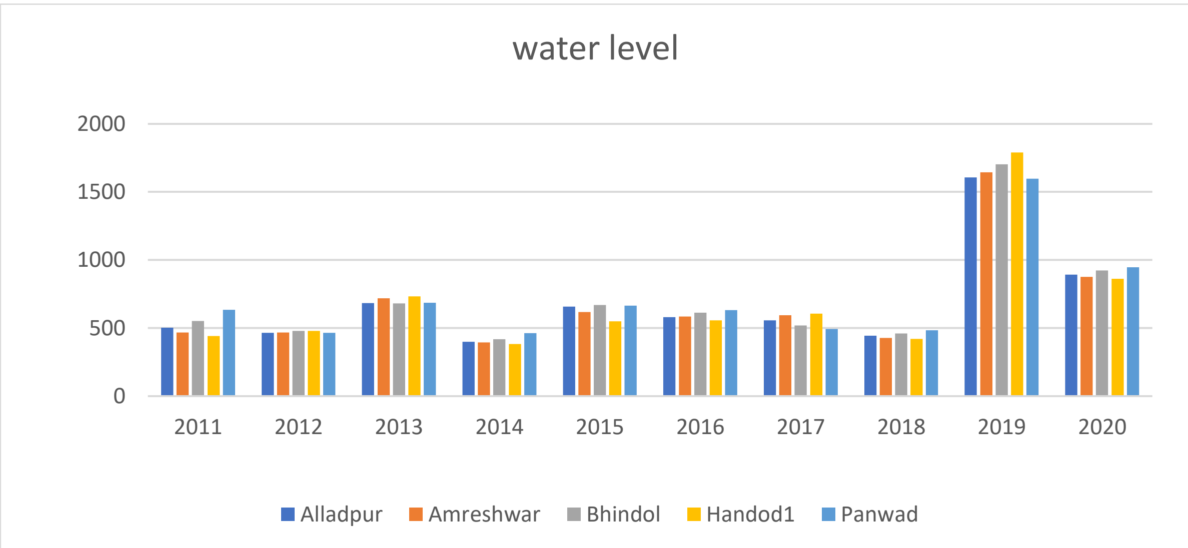
It is graph of pre and post monsoon data of Tokari.

WATER LEVEL :-

It is graph of water level of wankaner2, vegudan, vadodara1, tokri, sankarda which we can see handod1 has high water level in all other respective water stations

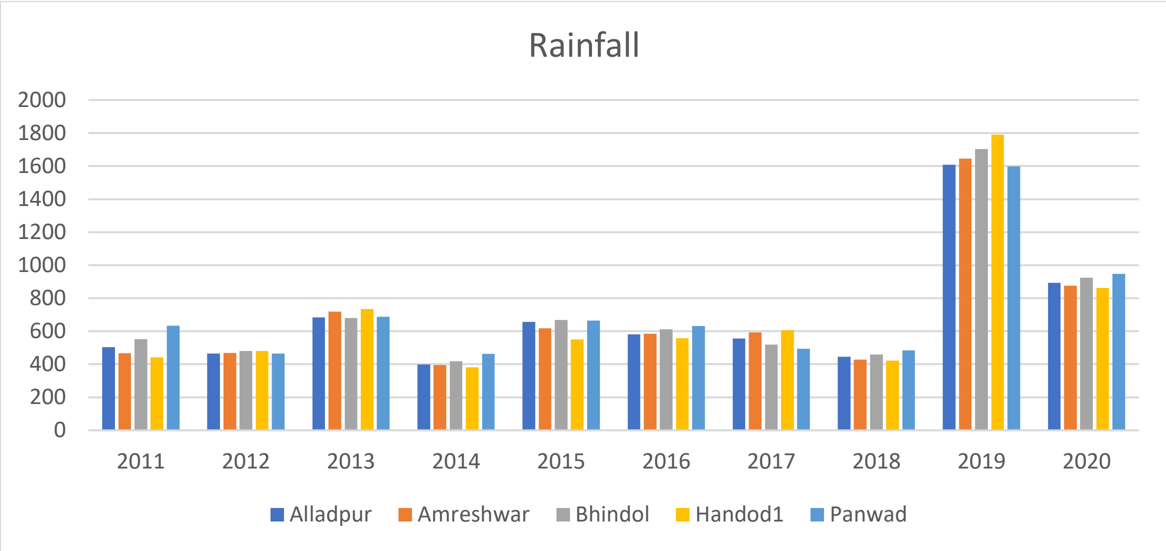


It is graph of water level of Alladpur, Amreshwar, Bhindol, Handod1, Panwad in which we can see handod1 has high water level in all other respective water stations

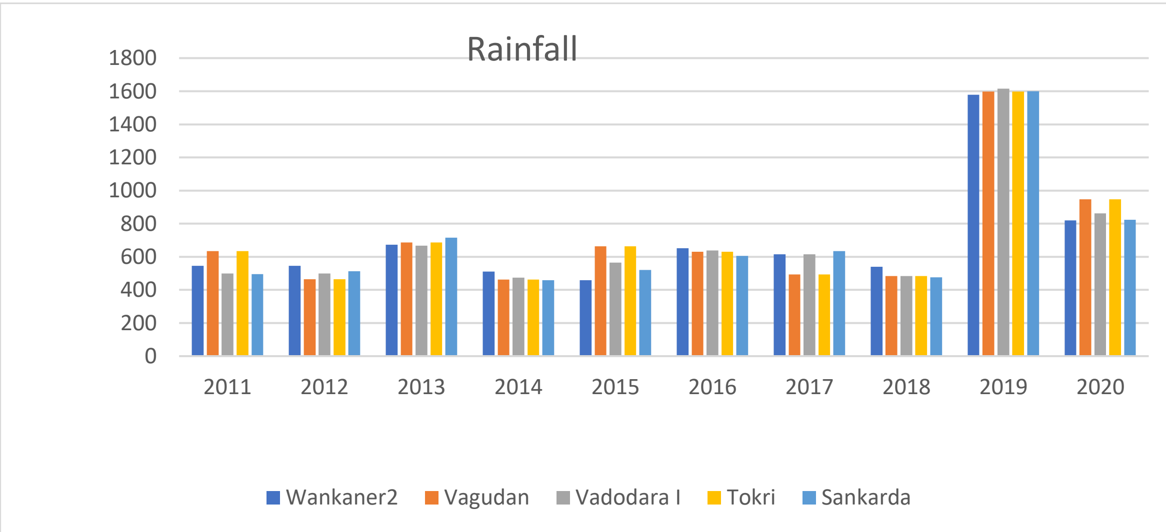


Rainfall:

It is graph of rainfall of Alladpur, Amreshwar, Bhindol, Handod1, Panwad



It is graph of rainfall of wankaner2, vegudan, vadodara1, tokri, sankarda



Conclusion:

CLUSTER ANALYSIS:

- As time goes on increasing no. of cluster goes on increasing
- Karamasiya ,karamsiya pzi and waghodia pzi lies in the same cluster over the all years
- Chitral pz,chitral pzi lies in same cluster over the all years
- Kaprali &moti chikhali is lies in same cluster over the years
- Segwa chowki I ,segwa chouki ii and sinor lies in same cluster over the years

ARIMA :

p is the number of autoregressive terms,

d is the number of nonseasonal differences needed for stationarity, and

q is the number of lagged forecast errors in the prediction equation.

Firstly we perform ADF test on water level on every water stations and the p value of ADF test is if less than 0.05 the we cannot perform ARIMA model on that station.
After that we do ARIMA on remaining and gives interpretation of 5 random stations as below

1)asala, devat, Vadodara kevada bag has ARIMA(0,1,0) model the series Y is not stationary, the simplest possible model for it is a random walk model, which can be considered as a limiting case of an AR(1) model in which the autoregressive coefficient is equal to 1.

$\hat{Y}_t = \mu + Y_{t-1}$

...where the constant term is the average period-to-period change (i.e. the long-term drift) in Y. This model could be fitted as a *no-intercept regression model* in which the first difference of Y is the dependent variable. Since it includes (only) a nonseasonal difference and a constant term, it is classified as an "ARIMA(0,1,0) model with constant."

2)saidivasana, waghodia pz has ARIMA(0,0,0) and has white noise so it means that

the errors are uncorrelated across time. This doesn't imply anything about the size of the errors, so no in general it is not an indication of good or bad fit.

<u>Forcast:</u> according to ARIMA the water level will remain constant over the year .

References:-

1:ARCGIS:

https://www.youtube.com/watch?v=XgA61zKJuMY

2:QGIS:

https://www.youtube.com/watch?v=5glQGfNFWWg

3.HOW TO CREATE LOCATION MAP OF STUDY AREA IN QGIS

https://www.youtube.com/watch?v=sGMTJeE1C-Y

4.BHUVAN NRCS

https://bhuvan.nrsc.gov.in/

5.India-WRIS

https://indiawris.gov.in/wris

6.CHRS Data Portal

https://chrsdata.eng.uci.edu/

7.POWER Data Access Viewer

https://power.larc.nasa.gov/data-access-viewer/

8.USGS Earth Explorer

https://earthexplorer.usgs.gov/