TELANGANA STATE

Ground Water Level Analysis

Jan 2021 - Feb 2022

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INTRODUCTION:

Telangana State is the 29th State (Act, 2014) formed in India covering geographical area of 1,12,077 Km2 (after transferring 107 villages from Khammam district to residual Andhra Pradesh). It lies between NL 15° 48' and 19° 54'and EL 77° 12' and 81° 50'. The state is bordered by the states of Maharashtra, Chattisgarh in the north, Karnataka in the west and Andhra Pradesh in the south, east and north-east. Administratively, the State comprises 33 districts covering an area of 1,12,077 sq. km (44,273 sq. mi). The largest district is Bhadradri Kothagudem whereas Hyderabad is the smallest 2 and governed by 585 revenue mandals (blocks/tahsils) with 10,434 revenue villages. Total population of the state is ~3.5 Crores (2011 census), of which 61 % lives in rural area and 39% in urban area. The density of population is 312 per Sq. Km.

Ground water level monitoring is a scientific surveillance system to establish the periodic and long-term changes in ground water regime. The water level data over a period of time provides information on changes in ground water levels with progressive ground water development. Monitoring of a network of ground water monitoring wells provides periodical information on ground water regime scenario in different hydrogeological environments in the area.

Ground water regime is monitored through a network of dug wells and piezometers known as Ground Water Monitoring Stations (GWMS). The dug wells, which are owned by government and non-government agencies and individual users, tap shallow aquifers. Piezometers (basically bore wells/tube wells) constructed exclusively for ground water regime monitoring under Hydrology Project tap both shallow and deeper aquifers. Some of the exploratory wells/ observatory wells drilled under exploratory drilling programme of CGWB tapping deeper aquifers are converted to piezometers for regular monitoring. The network of observation wells are monitored 4 times a year by the officials of Central Ground Water Board during the following periods.

Period	Date
January	1 st to 10th of the month
May (Pre-monsoon)	21st to 30th of the month
August (Mid-monsoon)	21st to 30th of the month
November (Post-monsoon)	1 st to 10th of the month

The chemical quality of ground water is monitored (dug wells/Piezometers) once in the month of May (pre-monsoon season) of every year to observe the effect of geogenic, anthropogenic contamination on ground water in different hydrogeological environments over a period of time. The database on water levels and chemical quality is entered over a period of time since 1969. The database is maintained in Oracle database using GEMS (Ground water Estimation and Management System) software, which is adopted by all ground water agencies in the country.

CODE:

Telangana Ground Water Level Analysis Jan 2021 - Feb 2022

Data Extraction

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
%matplotlib inline
```

```
d=pd.read_csv('ground_water_level_2021_January- 2022 February.csv')
df=d.copy()
```

```
print(d)
       district       mandal       village        lat       long        date
\
0       ADILABAD      Adilabad       Adilabad  19.668299  78.524700  01-01-2021
1       ADILABAD   Bazarhatnur    Bazarhatnur  19.458888  78.350833  01-01-2021
2       ADILABAD          Bela     Chandpally  19.684431  78.848456  01-01-2021
3       ADILABAD      Bheempur           Arli  19.831960  78.379310  01-01-2021
4       ADILABAD      Bheempur       Bheempur  19.772188  78.417841  01-01-2021
...          ...           ...            ...        ...        ...         ...
16851    YADADRI     Valigonda     T. somaram  17.399953  78.952290  01-02-2022
16852    YADADRI     Valigonda    Varkatpally  17.338506  78.932216  01-02-2022
16853    YADADRI     Valigonda    Vemulakonda  17.347782  79.143433  01-02-2022
16854    YADADRI       Y.Gutta     Mallapuram  17.633555  78.911638  01-02-2022
16855    YADADRI       Y.Gutta     Motakondur        NaN        NaN  01-02-2022

       value
0       8.90
1       6.01
2       8.10
3       8.05
4       6.91
...      ...
16851   5.15
16852   5.08
16853   3.08
16854   6.20
16855  10.74
```

```
[16856 rows x 7 columns]
```

```
#Shape of the Dataset
d.shape
```

```
(16856, 7)
```

```
#Information of the Dataset
d.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 16856 entries, 0 to 16855
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   district  16856 non-null  object
 1   mandal    16856 non-null  object
 2   village   16856 non-null  object
 3   lat       13846 non-null  float64
 4   long      13426 non-null  float64
 5   date      16856 non-null  object
 6   value     14857 non-null  float64
dtypes: float64(3), object(4)
memory usage: 921.9+ KB
```

```
#Displays the first five records
d.head()
```

	district	mandal	village	lat	long	date	value
0	ADILABAD	Adilabad	Adilabad	19.668299	78.524700	01-01-2021	8.90
1	ADILABAD	Bazarhatnur	Bazarhatnur	19.458888	78.350833	01-01-2021	6.01
2	ADILABAD	Bela	Chandpally	19.684431	78.848456	01-01-2021	8.10
3	ADILABAD	Bheempur	Arli	19.831960	78.379310	01-01-2021	8.05
4	ADILABAD	Bheempur	Bheempur	19.772188	78.417841	01-01-2021	6.91

```
#Displays the last 5 records
d.tail()
```

	district	mandal	village	lat	long	date	value
16851	YADADRI	Valigonda	T. somaram	17.399953	78.952290	01-02-2022	5.15
16852	YADADRI	Valigonda	Varkatpally	17.338506	78.932216	01-02-2022	5.08
16853	YADADRI	Valigonda	Vemulakonda	17.347782	79.143433	01-02-2022	3.08
16854	YADADRI	Y.Gutta	Mallapuram	17.633555	78.911638	01-02-2022	6.20
16855	YADADRI	Y.Gutta	Motakondur	NaN	NaN	01-02-2022	10.74

```
d.columns
```

```
Index(['district', 'mandal', 'village', 'lat', 'long', 'date', 'value'],
dtype='object')
```

```
d.sample(5)
```

	district	mandal	village	lat	long	date	value
15894	KAMAREDDY	BICHKUNDA	DOULTHAPUR	NaN	NaN	01-02-2022	4.76
15080	NALGONDA	Gundlapally	Vavikole	16.669333	78.751417	01-01-2022	1.92
14668	KAMAREDDY	Lingampet	Khannapur	18.190000	78.159999	01-01-2022	14.33
5310	MEDCHAL	Balanagar	Balanagar 1	17.466000	78.448000	01-05-2021	6.12
246	KAMAREDDY	DOMAKONDA	ANCHANOOR	NaN	NaN	01-01-2021	NaN

Data Cleansing

```
#Check null values
d.isnull().sum()
```

```
district        0
mandal          0
village         0
lat          3010
long         3430
date            0
value        1999
dtype: int64
```

```
#Fill null values with 0
d.fillna('0',axis=1,inplace=True)
```

```
#Check null values
d.isnull().sum()
```

```
district     0
mandal       0
village      0
lat          0
long         0
date         0
value        0
dtype: int64
```

```
#Check duplicated values
d.duplicated().sum()
```

```
0
```

```
In [14]: #Convert to upper case
d['district'].str.upper()
```

```
Out[14]:
0          ADILABAD
1          ADILABAD
2          ADILABAD
3          ADILABAD
4          ADILABAD
             ...
16851      YADADRI
16852      YADADRI
16853      YADADRI
16854      YADADRI
16855      YADADRI
Name: district, Length: 16856, dtype: object
```

```
#Convert to lower case
d['mandal'].str.lower()
```

```
0          adilabad
1          bazarhatnur
2               bela
3           bheempur
4           bheempur
             ...
16851      valigonda
16852      valigonda
16853      valigonda
16854        y.gutta
16855        y.gutta
Name: mandal, Length: 16856, dtype: object
```

```
d
```

	district	mandal	village	lat	long	date	value
0	ADILABAD	Adilabad	Adilabad	19.668299	78.5247	01-01-2021	8.9
1	ADILABAD	Bazarhatnur	Bazarhatnur	19.458888	78.350833	01-01-2021	6.01
2	ADILABAD	Bela	Chandpally	19.684431	78.848456	01-01-2021	8.1
3	ADILABAD	Bheempur	Arli	19.83196	78.37931	01-01-2021	8.05
4	ADILABAD	Bheempur	Bheempur	19.772188	78.417841	01-01-2021	6.91
...	...	...	...	...	...	...	...
16851	YADADRI	Valigonda	T. somaram	17.399953	78.95229	01-02-2022	5.15
16852	YADADRI	Valigonda	Varkatpally	17.338506	78.932216	01-02-2022	5.08
16853	YADADRI	Valigonda	Vemulakonda	17.347782	79.143433	01-02-2022	3.08
16854	YADADRI	Y.Gutta	Mallapuram	17.633555	78.911638	01-02-2022	6.2
16855	YADADRI	Y.Gutta	Motakondur	0	0	01-02-2022	10.74

16856 rows × 7 columns

Data Transformation

```
#drop the columns
d.drop(['lat','long'],axis=1,inplace=True)
```

```
d
```

	district	mandal	village	date	value
0	ADILABAD	Adilabad	Adilabad	01-01-2021	8.9
1	ADILABAD	Bazarhatnur	Bazarhatnur	01-01-2021	6.01
2	ADILABAD	Bela	Chandpally	01-01-2021	8.1
3	ADILABAD	Bheempur	Arli	01-01-2021	8.05
4	ADILABAD	Bheempur	Bheempur	01-01-2021	6.91
...	...	...	...	...	...
16851	YADADRI	Valigonda	T. somaram	01-02-2022	5.15
16852	YADADRI	Valigonda	Varkatpally	01-02-2022	5.08
16853	YADADRI	Valigonda	Vemulakonda	01-02-2022	3.08
16854	YADADRI	Y.Gutta	Mallapuram	01-02-2022	6.2
16855	YADADRI	Y.Gutta	Motakondur	01-02-2022	10.74

16856 rows × 5 columns

```
#Rename the column
d.rename(columns={'district':'District'},inplace=True)
```

```
d
```

	District	mandal	village	date	value
0	ADILABAD	Adilabad	Adilabad	01-01-2021	8.9
1	ADILABAD	Bazarhatnur	Bazarhatnur	01-01-2021	6.01
2	ADILABAD	Bela	Chandpally	01-01-2021	8.1
3	ADILABAD	Bheempur	Arli	01-01-2021	8.05
4	ADILABAD	Bheempur	Bheempur	01-01-2021	6.91
...	...	...	...	...	...
16851	YADADRI	Valigonda	T. somaram	01-02-2022	5.15
16852	YADADRI	Valigonda	Varkatpally	01-02-2022	5.08
16853	YADADRI	Valigonda	Vemulakonda	01-02-2022	3.08
16854	YADADRI	Y.Gutta	Mallapuram	01-02-2022	6.2
16855	YADADRI	Y.Gutta	Motakondur	01-02-2022	10.74

16856 rows × 5 columns

```
d.dtypes
```

```
District    object
mandal      object
village     object
date        object
value       object
dtype: object
```

```
#Change the data types
d["date"] = pd.to_datetime(d["date"],format="%d-%m-%Y")
d['District']=d['District'].astype('string')
d['value']=d['value'].astype('float')
#d= d.convert_dtypes() automatic conversion
```

```
d.dtypes
```

```
District           string
mandal             object
village            object
date        datetime64[ns]
value             float64
dtype: object
```

```
#Sort the data by District
d.sort_values(by='District',ascending=True)
```

	District	mandal	village	date	value
0	ADILABAD	Adilabad	Adilabad	2021-01-01	8.90
12044	ADILABAD	Bheempur	Bheempur	2021-11-01	4.75
12043	ADILABAD	Bheempur	Arli	2021-11-01	7.10
12042	ADILABAD	Bela	Chandpally	2021-11-01	7.50
12041	ADILABAD	Bazarhatnur	Bazarhatnur	2021-11-01	2.82
...	...	...	...	...	...
10828	YADADRI	S.Narayanpur	S.Narayanpur	2021-09-01	9.83
10829	YADADRI	Thurkapally	Gandamalla	2021-09-01	5.00
10830	YADADRI	Valigonda	Arror	2021-09-01	0.98
10832	YADADRI	Valigonda	Varkatpally	2021-09-01	2.07
16855	YADADRI	Y.Gutta	Motakondur	2022-02-01	10.74

16856 rows × 5 columns

```
d['month']=d['date'].dt.month
d['year']=d['date'].dt.year
```

Data Wrangling

Districts with ground water level less than 2 mbgl

```
District1=d[d['value']<2]
List1=pd.DataFrame(District1.groupby('District') ['village'].count())
print("Total number of Districts: ",District1['District'].nunique())
List1.sort_values('village',ascending=False)
Total number of Districts:  33
```

District	village
KAMAREDDY	398
SURYAPET	395
RANGAREDDY	333
MEDCHAL	291
NALGONDA	284
NIZAMABAD	248
KHAMMAM	216
NIRMAL	183
MEDAK	144
SIDDIPET	131
BHADRADRI	113
MAHABUBABAD	110
NAGARKURNOOL	108
JAGITYAL	101
HYDERABAD	93
HANUMAKONDA	91
JOGULAMBA(GADWAL)	85
YADADRI	78
MANCHERIAL	75
KUMURAM BHEEM	75
VIKARABAD	56
SIRCILLA	51
WARANGAL	50
KARIMNAGAR	46
WANAPARTHY	39
MAHABUBNAGAR	36
JANGAON	34
BHUPALPALLY	32
PEDDAPALLY	26

	village
District	
MULUGU	25
SANGAREDDY	25
ADILABAD	25
NARAYANPET	11

Districts with ground water level in the range of 2-10 mbgl

In [27]:

```
District2=d[(d['value']>2) & ((d['value']<10))]
List2=pd.DataFrame(District2.groupby('District') ['village'].count())
print("Total number of Districts: ",District2['District'].nunique())
List2.sort_values('village',ascending=False)
Total number of Districts:  33
```

Out[27]:

	village
District	
NALGONDA	799
BHADRADRI	622
NIZAMABAD	555
RANGAREDDY	475
SIDDIPET	398
MAHABUBABAD	363
YADADRI	341
KAMAREDDY	335
KHAMMAM	331
JAGITYAL	328
NIRMAL	303
MEDAK	297
SURYAPET	295
NAGARKURNOOL	282
MEDCHAL	272
JANGAON	266
MULUGU	257
SIRCILLA	256
VIKARABAD	241
MAHABUBNAGAR	234
SANGAREDDY	213
BHUPALPALLY	212
NARAYANPET	211
HYDERABAD	193
WARANGAL	191

	village
District	
KARIMNAGAR	190
HANUMAKONDA	167
ADILABAD	164
PEDDAPALLY	164
KUMURAM BHEEM	147
WANAPARTHY	137
MANCHERIAL	113
JOGULAMBA(GADWAL)	104

Districts with ground water level in the range of 10-20 mbgl

```
District3=d[(d['value']>10) & ((d['value']<20))]
List3=pd.DataFrame(District3.groupby('District') ['village'].count())
print("Total number of Districts: ",District3['District'].nunique())
List3.sort_values('village',ascending=False)
Total number of Districts:  33
```

	village
District	
NIZAMABAD	293
MEDAK	267
KAMAREDDY	217
SANGAREDDY	204
SIDDIPET	187
NALGONDA	140
VIKARABAD	138
BHUPALPALLY	133
RANGAREDDY	128
NAGARKURNOOL	100
MEDCHAL	95
MAHABUBNAGAR	94
NIRMAL	88
MULUGU	80
BHADRADRI	71
YADADRI	71
SIRCILLA	69
MANCHERIAL	61
KUMURAM BHEEM	55
SURYAPET	51
HYDERABAD	49

	village
District	
JOGULAMBA(GADWAL)	42
PEDDAPALLY	38
JANGAON	36
KHAMMAM	25
KARIMNAGAR	24
ADILABAD	18
MAHABUBABAD	16
NARAYANPET	16
WARANGAL	8
HANUMAKONDA	7
JAGITYAL	3
WANAPARTHY	3

Districts with ground water level in the range of 20-40 mbgl

```
District4=d[(d['value']>20) & ((d['value']<40))]
List4=pd.DataFrame(District4.groupby('District') ['village'].count())
print("Total number of Districts: ",District4['District'].nunique())
List4.sort_values('village',ascending=False)
Total number of Districts:  22
```

	village
District	
MEDAK	104
NIZAMABAD	79
BHADRADRI	52
SANGAREDDY	48
BHUPALPALLY	43
KAMAREDDY	28
MEDCHAL	26
SIDDIPET	26
VIKARABAD	25
NALGONDA	22
NIRMAL	13
PEDDAPALLY	10
KHAMMAM	9
KARIMNAGAR	6
JOGULAMBA(GADWAL)	6
KUMURAM BHEEM	3
ADILABAD	3

	village
District	
MULUGU	2
RANGAREDDY	2
SIRCILLA	2
MAHABUBABAD	1
HYDERABAD	1

Districts with ground water level above 40 mbgl

```
District5=d[d['value']>40]
List5=pd.DataFrame(District5.groupby('District') ['village'].count())
print("Total number of Districts: ",District5['District'].nunique())
List5.sort_values('village',ascending=False)
Total number of Districts:  4
```

	village
District	
BHADRADRI	10
KHAMMAM	5
MEDCHAL	1
VIKARABAD	1

District with maximum ground water level

```
Max_groundwater=d[d['value']==d['value'].max()]
Max_groundwater
```

	District	mandal	village	date	value	month	year
3522	VIKARABAD	Vikarabad	Maildevarpally	2021-03-01	48.39	3	2021

District with minimum ground water level except 0

```
d1=d.copy()
d1['month']=d1['month'].astype('Int64')
d1['year']=d1['year'].astype('Int64')
d1[d1['value']==0]=np.nan


Min_groundwater=d1[d1['value']==d1['value'].min()]
Min_groundwater
```

	District	mandal	village	date	value	month	year
8844	MANCHERIAL	Bhimini	Rampur	2021-08-01	0.03	8	2021
11887	SURYAPET	Mothey	Urlaguda	2021-10-01	0.03	10	2021

Districts with ground water level 0

```
data1=df.copy()
Districts=data1[data1['value']==0]
Lists=pd.DataFrame(Districts.groupby('district') ['village'].count())
print("Total number of Districts: ",Districts['district'].nunique())
Lists.sort_values('village',ascending=False)
Total number of Districts:  3
```

	village
district	
MANCHERIAL	7
BHADRADRI	3
KUMURAM BHEEM	3

Average Water levels in Each District

```
Average_waterlevel=pd.DataFrame(d.groupby('District') ['value'].mean())
Average_waterlevel
```

	value
District	
ADILABAD	6.043571
BHADRADRI	7.213986
BHUPALPALLY	10.107262
HANUMAKONDA	3.575338
HYDERABAD	4.964702
JAGITYAL	3.798341
JANGAON	5.718571
JOGULAMBA(GADWAL)	5.604328
KAMAREDDY	5.873561
KARIMNAGAR	5.079925
KHAMMAM	4.162262
KUMURAM BHEEM	6.097786
MAHABUBABAD	4.003878

	value
District	
MAHABUBNAGAR	7.331016
MANCHERIAL	5.552302
MEDAK	10.064746
MEDCHAL	5.348149
MULUGU	6.885577
NAGARKURNOOL	5.573143
NALGONDA	5.337657
NARAYANPET	5.414244
NIRMAL	5.457925
NIZAMABAD	7.821293
PEDDAPALLY	6.638193
RANGAREDDY	4.811055
SANGAREDDY	11.090061
SIDDIPET	7.887278
SIRCILLA	6.164101
SURYAPET	2.995148
VIKARABAD	9.109156
WANAPARTHY	3.292967
WARANGAL	4.205198
YADADRI	5.708367

Descriptive Statistics

```
d['value'].describe()
```

```
count    16856.000000
mean         6.214560
std          5.862603
min          0.000000
25%          2.140000
50%          4.700000
75%          8.750000
max         48.390000
Name: value, dtype: float64
```

```
d.describe().transpose()
```

	count	mean	std	min	25%	50%	75%	max
value	16856.0	6.214560	5.862603	0.0	2.14	4.7	8.75	48.39
month	16856.0	5.785714	3.648563	1.0	2.00	5.5	9.00	12.00
year	16856.0	2021.142857	0.349937	2021.0	2021.00	2021.0	2021.00	2022.00

In [37]:

```
# Average Groundwater level in mbgl
d['value'].mean()
```

Out[37]:

```
6.214560393925013
```

In [38]:

```
# Median
d['value'].median()
```

Out[38]:

```
4.7
```

In [39]:

```
#Standard Deviation
d['value'].std()
```

Out[39]:

```
5.862602891502532
```

In [40]:

```
# Variance
d['value'].var()
```

Out[40]:

```
34.370112663453845
```

In [41]:

```
# Mode
d1=d.copy()
d1[d1['value']==0]=np.nan
d1['value'].mode()
```

Out[41]:

```
0    4.1
dtype: float64
```

Data Visualization

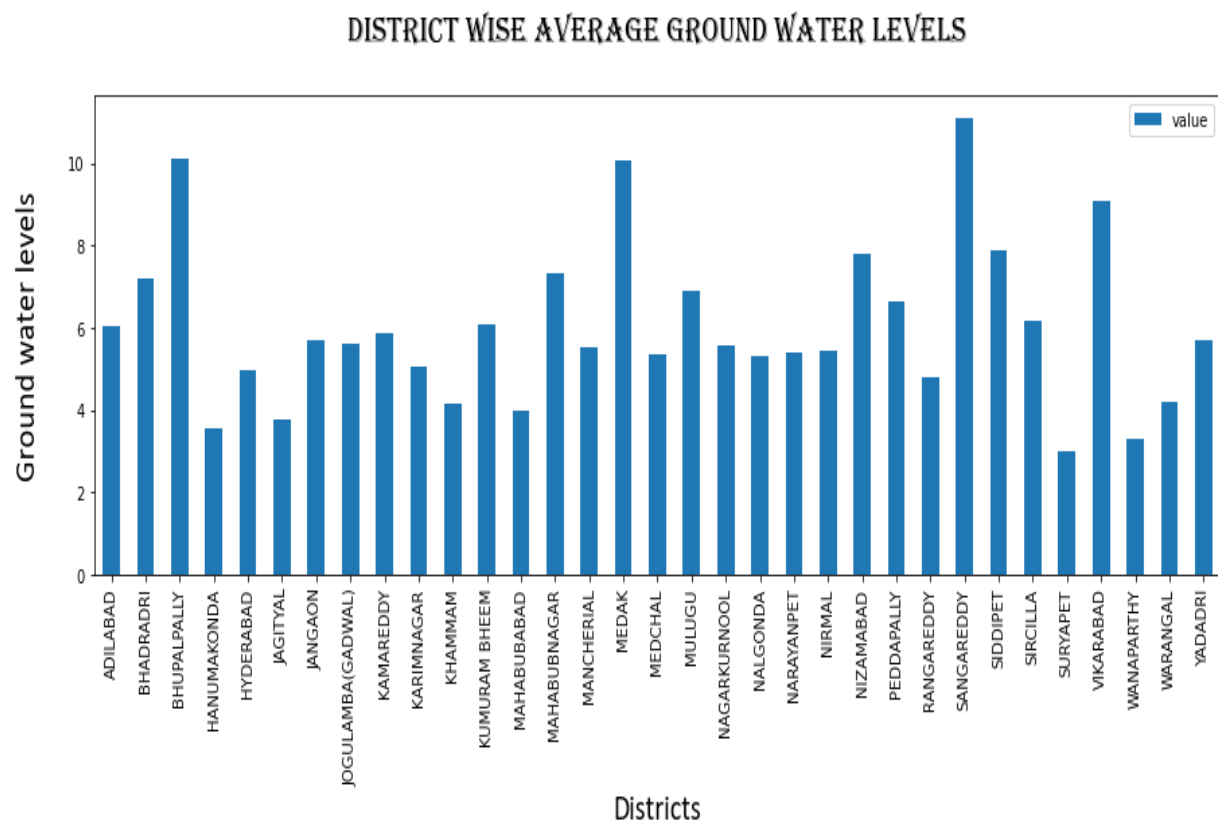**District wise Maximum Ground water levels**

```
font1={'family':'Algerian','color':'black','size':20,'fontweight':'bold'}
font2={'family':'Calibri','color':'black','size':20}

pd.DataFrame(d.groupby('District')
['value'].max()).plot.bar(figsize=(15,5))
plt.title("District wise Max Ground water levels",fontdict=font1,pad=30)
plt.xlabel("Districts",fontdict=font2,labelpad=5)
plt.ylabel("Ground water levels",fontdict=font2,labelpad=20)
plt.xticks(color='black', rotation=90)
plt.yticks(color='black')
plt.show()
```
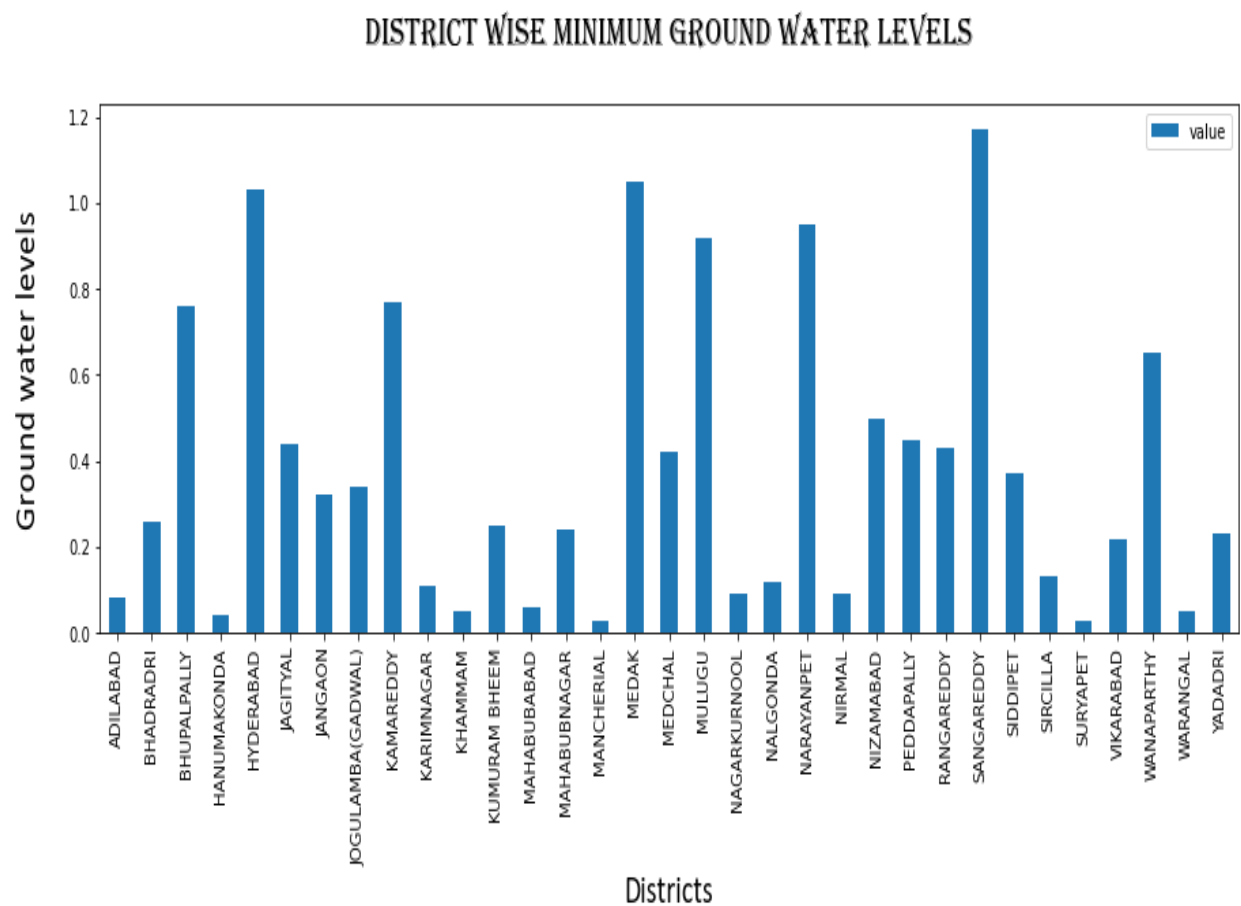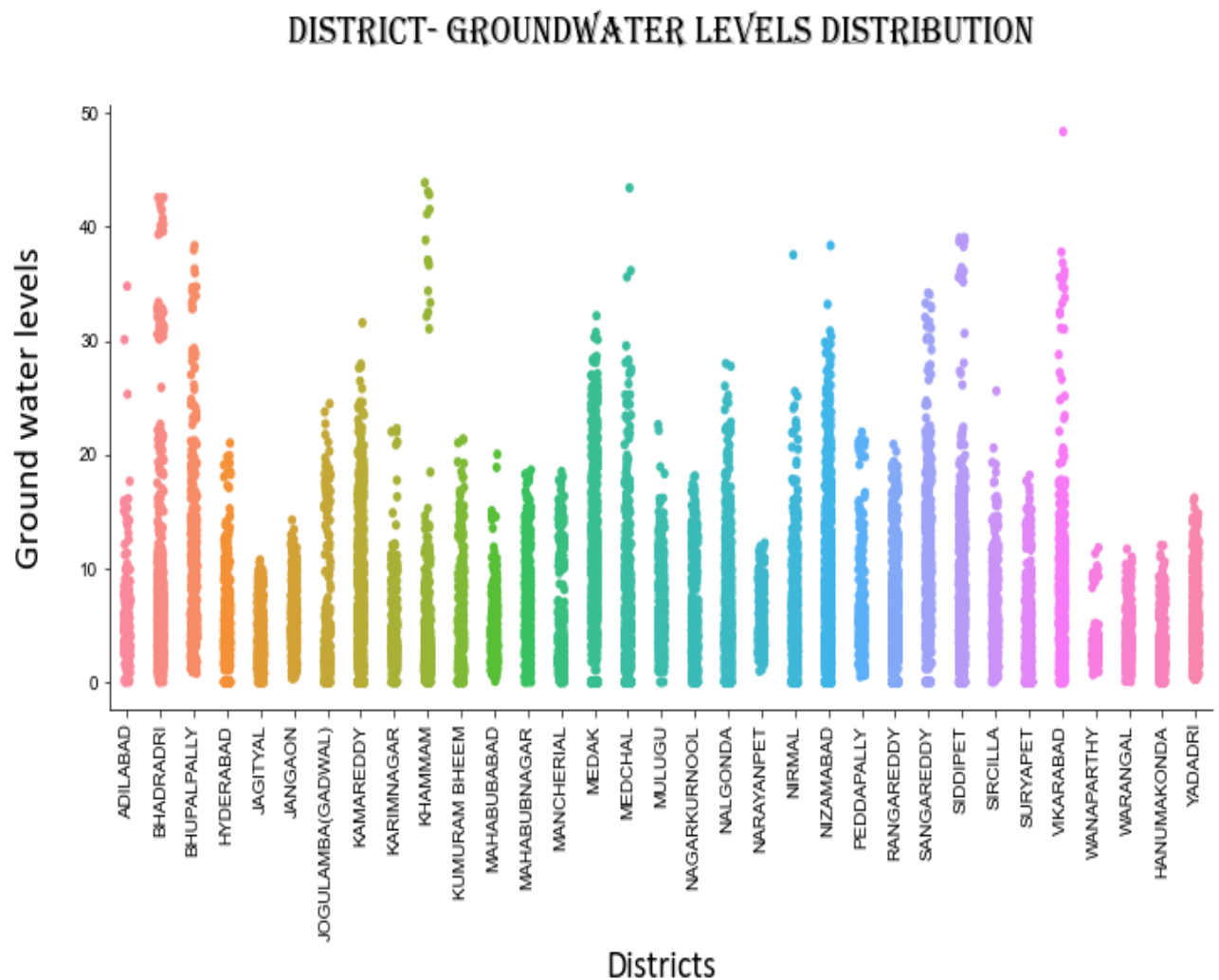

DISTRICT WISE MAX GROUND WATER LEVELS
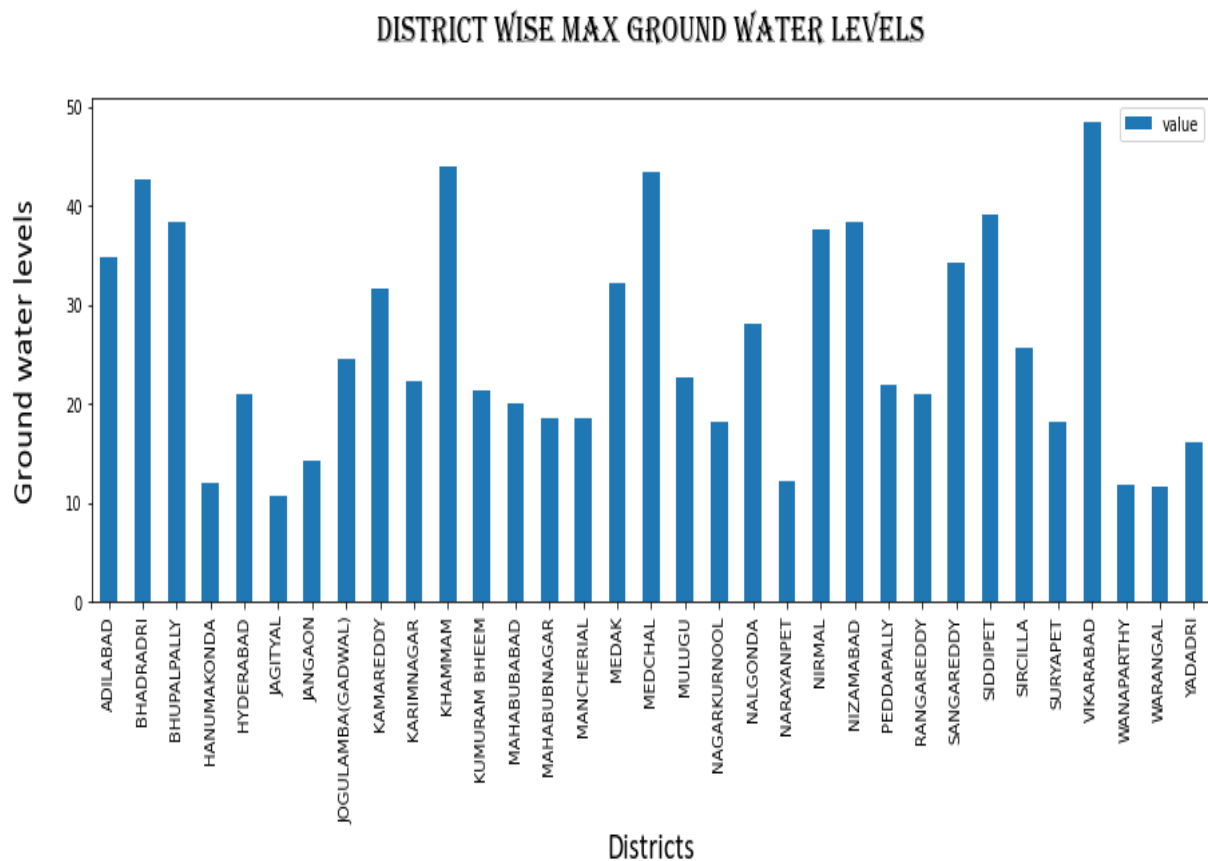
District wise Average Ground water levels

```
font1={'family':'Algerian','color':'black','size':20,'fontweight':'bold'}
font2={'family':'Calibri','color':'black','size':20}

pd.DataFrame(d.groupby('District')
['value'].mean()).plot.bar(figsize=(15,5))
plt.title("District wise Average Ground water
levels",fontdict=font1,pad=30)
plt.xlabel("Districts",fontdict=font2,labelpad=5)
plt.ylabel("Ground water levels",fontdict=font2,labelpad=20)
plt.xticks(color='black', rotation=90)
plt.yticks(color='black')
plt.show()
```

District wise Minimum Ground water levels

```
font1={'family':'Algerian','color':'black','size':20,'fontweight':'bold'}
font2={'family':'Calibri','color':'black','size':20}

pd.DataFrame(d1.groupby('District')
['value'].min()).plot.bar(figsize=(15,5))
plt.title("District wise Minimum Ground water
levels",fontdict=font1,pad=30)
plt.xlabel("Districts",fontdict=font2,labelpad=5)
plt.ylabel("Ground water levels",fontdict=font2,labelpad=20)
plt.xticks(color='black', rotation=90)
plt.yticks(color='black')
plt.show()
```

```
# District- Groundwater levels Distribution
import seaborn as sns
plt.style.use('seaborn-bright')
sns.set_style("ticks")
plt.style.use('seaborn-bright')
sns.catplot(y="value",x='District',hue='District',data=d,height=5,aspect=2)
plt.title("District- Groundwater levels
Distribution",fontdict=font1,pad=30)
plt.xlabel("Districts",fontdict=font2,labelpad=5)
plt.ylabel("Ground water levels",fontdict=font2,labelpad=20)
plt.xticks(color='black', rotation=90)
plt.yticks(color='black')
plt.show()
```

DISTRICT- GROUNDWATER LEVELS DISTRIBUTION

```
from pandas_profiling import ProfileReport
k=ProfileReport(d)
k.to_file('Report.html')
```

```
k
```

Report generated with pandas-profiling.

SUMMARY:

Districts and number of Villages with Groundwater levels

Groundwater levels less than 2 mbgl	Groundwater levels >2-<10 mbgl
TOTAL- 33 Districts, 4008 Villages ['ADILABAD', 25 Villages], ['BHADRADRI', 113], ['BHUPALPALLY', 32], ['HANUMAKONDA', 91], ['HYDERABAD', 93], ['JAGITYAL', 101], ['JANGAON', 34], ['JOGULAMBA(GADWAL)', 85], ['KAMAREDDY', 398], ['KARIMNAGAR', 46], ['KHAMMAM', 216], ['KUMURAM BHEEM', 75], ['MAHABUBABAD', 110], ['MAHABUBNAGAR', 36], ['MANCHERIAL', 75], ['MEDAK', 144], ['MEDCHAL', 291], ['MULUGU', 25], ['NAGARKURNOOL', 108], ['NALGONDA', 284], ['NARAYANPET', 11], ['NIRMAL', 183], ['NIZAMABAD', 248], ['PEDDAPALLY', 26], ['RANGAREDDY', 333], ['SANGAREDDY', 25], ['SIDDIPET', 131], ['SIRCILLA', 51], ['SURYAPET', 395], ['VIKARABAD', 56], ['WANAPARTHY', 39], ['WARANGAL', 50], ['YADADRI', 78]	TOTAL- 33 Districts, 9456 Villages ['ADILABAD', 164 Villages], ['BHADRADRI', 622], ['BHUPALPALLY', 212], ['HANUMAKONDA', 167], ['HYDERABAD', 193], ['JAGITYAL', 328], ['JANGAON', 266], ['JOGULAMBA(GADWAL)', 104], ['KAMAREDDY', 335], ['KARIMNAGAR', 190], ['KHAMMAM', 331], ['KUMURAM BHEEM', 147], ['MAHABUBABAD', 363], ['MAHABUBNAGAR', 234], ['MANCHERIAL', 113], ['MEDAK', 297], ['MEDCHAL', 272], ['MULUGU', 257], ['NAGARKURNOOL', 282], ['NALGONDA', 799], ['NARAYANPET', 211], ['NIRMAL', 303], ['NIZAMABAD', 555], ['PEDDAPALLY', 164], ['RANGAREDDY', 475], ['SANGAREDDY', 213], ['SIDDIPET', 398], ['SIRCILLA', 256], ['SURYAPET', 295], ['VIKARABAD', 241], ['WANAPARTHY', 137], ['WARANGAL', 191], ['YADADRI', 341]

Groundwater levels >10-<20 mbgl	Groundwater levels >20-<40 mbgl
TOTAL- 33 Districts, 2827 Villages	TOTAL- 22 Districts, 511 Villages
['ADILABAD', 18 Villages],	['ADILABAD', 3 Villages],
['BHADRADRI', 71],	['BHADRADRI', 52],
['BHUPALPALLY', 133],	['BHUPALPALLY', 43],
['HANUMAKONDA', 7],	['HYDERABAD', 1],
['HYDERABAD', 49],	['JOGULAMBA(GADWAL)', 6],
['JAGITYAL', 3],	['KAMAREDDY', 28],
['JANGAON', 36],	['KARIMNAGAR', 6],
['JOGULAMBA(GADWAL)', 42],	['KHAMMAM', 9],
['KAMAREDDY', 217],	['KUMURAM BHEEM', 3],
['KARIMNAGAR', 24],	['MAHABUBABAD', 1],
['KHAMMAM', 25],	['MEDAK', 104],
['KUMURAM BHEEM', 55],	['MEDCHAL', 26],
['MAHABUBABAD', 16],	['MULUGU', 2],
['MAHABUBNAGAR', 94],	['NALGONDA', 22],
['MANCHERIAL', 61],	['NIRMAL', 13],
['MEDAK', 267],	['NIZAMABAD', 79],
['MEDCHAL', 95],	['PEDDAPALLY', 10],
['MULUGU', 80],	['RANGAREDDY', 2],
['NAGARKURNOOL', 100],	['SANGAREDDY', 48],
['NALGONDA', 140],	['SIDDIPET', 26],
['NARAYANPET', 16],	['SIRCILLA', 2],
['NIRMAL', 88],	['VIKARABAD', 25]
['NIZAMABAD', 293],	
['PEDDAPALLY', 38],	
['RANGAREDDY', 128],	
['SANGAREDDY', 204],	
['SIDDIPET', 187],	
['SIRCILLA', 69],	
['SURYAPET', 51],	
['VIKARABAD', 138],	
['WANAPARTHY', 3],	
['WARANGAL', 8],	
['YADADRI', 71]	

Districts with ground water level above 40 mbgl

Total: 4 Districts, 17 Villages

['BHADRADRI', 10 Villages], ['KHAMMAM', 5], ['MEDCHAL', 1], ['VIKARABAD', 1]

From the above tables, it's clear that we have 33 Districts and 4008 Villages with groundwater level less than 2mbgl and only 4 Districts with ground water level above 40 mbgl.

India is the largest user of groundwater in the world. It uses an estimated 230 cubic kilometers of groundwater per year - over a quarter of the global total. More than 60% of irrigated agriculture and 85% of drinking water supplies are dependent on groundwater.

One of the most effective ways to address the issue of groundwater depletion is to find alternative sources of water. Alternative water sources can be used to help replenish aquifers. Deriving water from other sources would also give aquifers time to refill instead of pumping too much water from them at once.

WAYS TO PROTECT AND CONSERVE GROUNDWATER

- Plant more trees
- Rainwater harvesting and recycled wastewater also allow to reduce scarcity and ease pressures on groundwater and other natural water bodies
- Use native plants in your landscape. They look great, and don't need much water or fertilizer. Also choose grass varieties for your lawn that are adapted for your region's climate, reducing the need for extensive watering or chemical applications.
- Use fewer chemicals around your home and yard, and make sure to dispose of them properly - don't dump them on the ground!
- Properly dispose of potentially toxic substances like unused chemicals, pharmaceuticals, paint, motor oil, and other substances. Many communities hold household hazardous waste collections or sites - contact your local health department to find one near you.
- Shut off the water when you brush your teeth or shaving, and don't let it run while waiting for it to get cold. Keep a pitcher of cold water in the fridge instead.
- Check all the faucets, fixtures, toilets, and taps in your home for leaks and fix them right away, or install water conserving models.
- Limit yourself to just a five minute shower, and challenge your family members to do the same! Also, make sure to only run full loads in the dish and clothes washer.
- Water the lawn and plants during the coolest parts of the day and only when they truly need it. Make sure you, your family, and your neighbors obey any watering restrictions during dry periods.
- Reduce the amount of "stuff" you use and reuse what you can. Recycle paper, plastic, cardboard, glass, aluminum and other materials.
- Use all natural/nontoxic household cleaners whenever possible. Materials such as lemon juice, baking soda, and vinegar make great cleaning products, are inexpensive, and environmentally-friendly.
- Get involved in water education! Learn more about groundwater and share your knowledge with others.

REFERENCES:

https://data.telangana.gov.in/dataset/telangana-ground-water-department-water-level-data

https://matplotlib.org/

https://seaborn.pydata.org/