

# **HYDROLOGICAL CONDITIONS OF SEMI- ARID HARD ROCK REGIONS**

## **Writing Assignment**

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# Hydrological Conditions of Semi-arid Hard Rock Regions

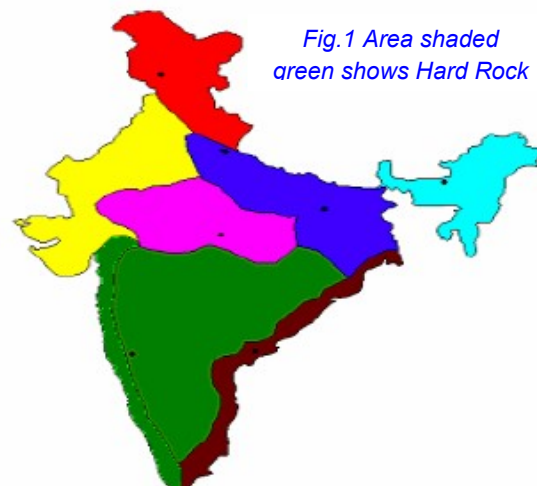
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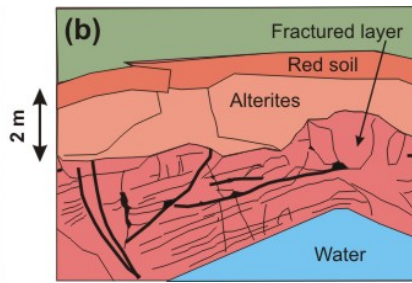
## *Synopsis*

*More than 60% of the geographical area of India comes under fractured hard rock terrain. The main hard rock terrain States are southern peninsular States and Central parts of India. The hydrologic processes there differ considerably from that of the alluvial plains due to the presence of dual porosities. Also, some of these falls under semi-arid category due to scanty rainfall distribution and face frequent drought conditions. The northern area of Karnataka, and typically the District of Belgaum, is under semi-arid hard rock region. Given in the write up is a brief description of the hydrological conditions and issues in this type of area is described the context of north Karnataka. Due to anthropogenic developments in the region, lowering of ground water levels is being noticed in the region. Besides, the region is being affected by issues of water quantity as well as quality. The main challenge in the semi-arid / arid regions of the hard rock region with regard to water resources management arises out of complexities in the fractured hydrogeology. In order to elaborate the nature of hydrological process in the region, the District of Belgaum, Karnataka is taken as a specimen. A few relevant hydrological/ hydro-meteorological information / data has been presented either in thematic form or tabular format.*

## **Introduction**

It is known that about 67% of the geographical area of India is covered by hard rock terrain. The southern peninsular States and Central parts of India (Telangana, AP, Maharashtra, MP, Odisha etc. ) falls under this category (**Fig.1**). In this region the hydrologic processes differ considerably from that of the alluvial plains due to the presence of primary as well as secondary porosities by virtue of weathered and fractured rocks (**Fig.2**) (Ref: *Week1 Module: Runoff Processes: International Edition*). Besides, much of this region (Deccan basaltic areas) can be classified under semi-arid category due to scanty rainfall distribution in space and time. There used to be frequent drought conditions in the semi-





*Fig.2 A typical well in Hard Rock Region*

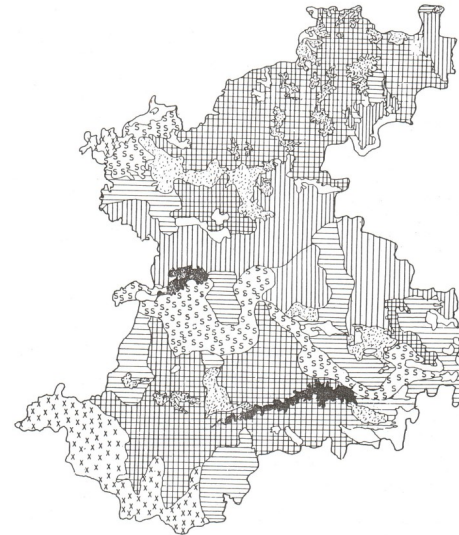
arid areas of the hard rock region. The northern areas of Karnataka including District Belgaum (my work place) can be classified under semi-arid hard rock region. The scanty nature of surface water availability necessitates conjunctive usage of surface and groundwater resources to meet water requirements of drinking, agriculture or industry. Further, ground water is considered to be the most dependable water resources in the region. A brief description of the hydrological conditions and issues in this type of area is described the context of north Karnataka.

### Hydrological Issues

In recent times, extraction of ground water has been increasing exponentially causing lowering of ground water levels in the north Karnataka region. Besides, increased agricultural and industrial activities in the region is triggering deterioration of water quality. Thus the regional is being affected by issues of water quantity as well as quality. One of the main challenges in the semi-arid / arid regions of the hard rock region is with regard to conservation, planning and management of the water resources as a consequence of complexities in the fractured hydrogeological formations (*Ref: Understanding the Hydrologic Cycle: International Edition*).

### Discussion of a Typical Study Hard Rock Region

In order elaborate the nature of hydrological process in the area some hydro meteorological information from the District of Belgaum, Karnataka is presented. The district lies in the northern part of Karnataka State between N latitudes 15° 22' and 16° 55' and E longitudes 74° 05' and 75° 55'. The topography is more or less undulating one. Climate in the district is semi-arid in most parts. In some parts it ranges from sub-humid to humid. Mean annual rainfall for the district is about 760 mms, 75 % of which is received during the SW monsoon. The district has two river systems, Ghataprabha and Malaprabha, which are major tributaries of River Krishna. There are two dams, one across Ghataprabha at Hidkal and the other across Malaprabha at Navilutheertha.



- AGRICULTURE (KHARIF)
- AGRICULTURE (RABI)
- DOUBLE CROP
- BARREN LAND
- SCRUBS
- FOREST

*Fig.3 Land use pattern of Belgaum Dist.*

The Geology varies through out the district and consists of basalt crystallines, meta sedimentaries, meta volcanic, pre-cambrian sedimentaries and basaltic terrains. The soils in the district also exhibit variation from northern to southern parts of the district, and constituted by shallow medium black soil, in Belgaum, Hukkeri, Chikkodi, and Raibag; red sandy loam soil, in Hukkeri, Gokak, and Ramdurg; deep black soil, in Hukkeri, Gokak, Ramdurg, Bailhongal and Soundatti and red fine loamy soil, in the hilly regions of Belgaum and Khanapur taluks.

Surface water availability of Belgaum district from Malaprabha basin is about 1100 MCM. Surface water availability of Belgaum district from Ghataprabha basin is about 2300 MCM. Groundwater potential of Belgaum district is estimated as 800 MCM (million cubic meter).

Land use pattern of Belgaum district, based on remote sensing images, is classified as: Agriculture Khariff- 12%, Agriculture Rabi- 31, Barren land- 8, Scrubs- 8, Forest land- 9 (**Fig.3**). Further, some of the hydrological information compiled are given in tabular format below for ready reference, viz, rainfall characteristics in different Taluks of Belgaum district (**Table-1**); Soil Properties and Infiltration values for Belgaum district (**Table-2**); Annual GW table fluctuation in Belgaum Dist. (**Table-3**) and Typical values of Average monthly water discharge ( $m^3/sec$ ) (**Table-4**).

**Table-1: Rainfall characteristics in different Taluks of Belgaum district**

Taluk	Mean Annual Rainfall mm	CV %	SD mm	Skewness	Mean Monsoon Rainfall mm	CV %	SD mm	Skewness
Athani	534.4	34.9	186.6	0.4	330.6	40.7	134.6	0.4
Bailahongal	674.4	26.5	178.6	0.6	430.1	36.1	155.1	2.8
Belgaum	1271.9	28.0	355.6	1.0	1018.0	23.5	239.7	1.4
Chikodi	605.8	26.2	157.3	0.4	390.6	37.4	145.9	0.4
Gokak	524.6	29.9	157.1	0.4	302.0	42.2	127.3	0.5
Hukkeri	715.1	24.3	173.7	3.3	437.3	32.8	143.6	5.2
Khanapur	1913.9	21.2	405.4	0.4	1659.7	23.0	382.5	0.2
Raibag	485.1	38.8	188.4	0.5	301.4	47.7	143.7	0.6
Ramdurg	507.6	28.9	146.5	0.4	309.8	39.5	122.3	0.4
Saundatti	517.5	34.1	176.5	0.5	295.6	39.4	116.5	0.9

**Table-4: Typical values of Average monthly water discharge ( $m^3/sec$ )**

Average monthly discharge at Gauge site Khanapur from Malaprabha												
Month	Jan.	Feb.	Mar	Apr	May	Jun.	Jul.	Aug.	Sep	Oct.	Nov	Dec
Q	1.3	0.5	-	-	-	799	3247	3536	870	396	96	10
Average monthly discharge at Gauge site Daddi from Ghataprabha												
Month	Jan.	Feb.	Mar	Apr	May	Jun.	Jul.	Aug.	Sep	Oct.	Nov	Dec
Q	1.9	0.3	-	-	0.9	2232	9384	9605	1910	616	155	39

**Table2: Soil Properties and Infiltration values for Belgaum district**

<b>Locations</b>	<b>Soil texture</b>	<b>Infiltration rate cm/hr</b>	<b>Runoff potential</b>
Athani	Heavy loam	1.6	High
Bailhongal	Heavy loam	1.2 - 6.6	Medium – High
Belgaum	Heavy –medium loam	1.8 - 4.8	Medium
Chikkodi	Light – Med loam	4.2 – 9.0	Low
Gokak	Medium loam	0.6 – 13.2	Low – High
Hukkeri	Light loam	2 - 4	Low –Med
Khanapur	Light Medium loam	1.8 – 20.4	Medium
Raibag	Light – Heavy loam	0.9 - 12.6	Low – High
Ramdurg	Med – Heavy laom	0.5-5.4	Low – Med
Saundatti	Light – Heavy loam	5.4 – 13.8	Med – High

**Table-3: Annual GW table fluctuation in Belgaum Dist.**

<b>Taluk</b>	<b>Min. fluctuation (m)</b>	<b>Max. fluctuation (m)</b>	<b>Average fluctuation (m)</b>
Athani	1.9	6.0	3.9
Bailhongal	1.3	6.3	3.3
Belgaum	3.3	6.7	5.4
Chikodi	2.1	10.2	4.2
Gokak	0.7	6.4	2.8
Hukkeri	0.5	6.1	3.8
Khanapur	3.8	10.2	6.0
Raibag	1.4	5.1	3.1
Ramdurg	1.1	5.3	2.3
Saundatti	0.9	4.2	2.2

## References

1. Understanding the Hydrologic Cycle: International Edition, 4th International Distance Learning Course: Basic Hydrological Sciences for Asian Region (WMO RA-II), 2017
2. Runoff Processes: International Edition, 4th International Distance Learning Course: Basic Hydrological Sciences for Asian Region (WMO RA-II), 2017

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