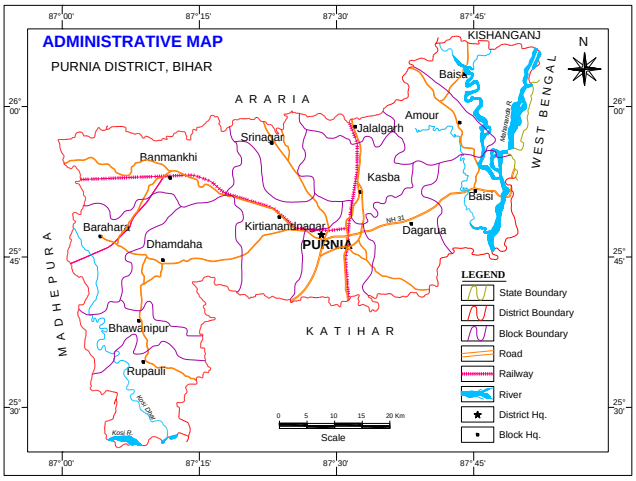
# भूजल सूचना पुस्तिव

# पुर्णियां जिला, बिहार

## Ground Water Information Booklet

## Purnia District, Bihar State




केन्द्रीय भूमिजल बोर्ड

जल संसाधन मंत्रालय

**(भारत सरकार)**

**मध्य-पूर्वी क्षेत्र**

**पटना**

Central Ground Water Board

Ministry of Water Resources

(Govt. of India)

**Mid-Eastern Region**

**Patna**

# सितंबर 2013

September 2013

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**Ground Water Information Booklet**
# Purnia District, Bihar State

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# PURNIA DISTRICT AT A GLANCE

| Sl. No. | Items | Statistics |
|---|---|---|
| 1. | **GENERAL INFORMATION** | |
| | **I Geographical Area (Sq. Km.)** | 3229 |
| | **II Administrative Divisions**<br>**No. of Panchayats/Villages**<br>**Number of Tehsil/Block** | 4<br>246/1296<br>14 |
| | **III Population (As per 2011 Census)** | Rural: 2921614<br>Urban: 343005 |
| | **IV Average Annual Rainfall (mm)** | 1411.5 |
| 2 | **GEOMORPHOLOGY** | |
| | **Major Physiographic Units** | Gangetic Alluvium |
| | **Major Drainages** | Ganga, Kosi, Panar, Mahananda, Kaska |
| 3 | **LAND USE** | |
| | **a) Forest Area** | 113 ha |
| | **b) Net Area Sown** | 208302 ha |
| | **c) Total cropped Area** | 260377 ha |
| 4 | **MAJOR SOIL TYPES** | Alluvial soil (fine loamy, sandy to coarse loamy soil) |
| 5 | **PRINCIPAL CROPS** | Paddy,Jute ,Wheat, Maize,Millet etc. |
| 6 | **IRRIGATION BY DIFFERENT SOURCES (Area in hectares)** | |
| | **Dugwells** | - |
| | **Tubewells/Borewells (STW)** | 151,000ha |
| | **Tanks/ponds** | - |
| | **Canals** | - |
| | **Other Sources** | - |
| | **Net Irrigated Area** | 109,000 ha |
| | **Gross Irrigated Area** | 151,000 ha |
| 7 | **NUMBER OF GROUND WATER MONITERING WELLS OF CGWB (2011)** | |
| | **No. of Dugwells** | 07 |
| | **No. of Piezometers** | Nil |
| 8 | **PREDOMINANT GEOLOGICAL FORMATIONS** | Quaternary alluvium |
| 9 | **HYDROGEOLOGY** | |
| | **Major water bearing formations** | Alluvium |
| | **Pre-monsoon Depth to water level during 2011** | 3.7-5.4 m bgl |

| | | |
|---|---|---|
| | **Post-monsoon Depth to water level during 2011** | 1.74 – 3.42m bgl |
| | **Long term water level trend in last 10 yrs(2002 – 2011) in m/yr** | No significant decline |
| **10** | **GROUND WATER EXPLORATION BY CGWB (As on 31-03-2013)** | |
| | **No. of well drilled (EW,OW, PZ, SH, Total)** | Nil |
| | **Depth Range (m)** | - |
| | **Discharge ($m^3$/hr)** | - |
| | **Storativity (s)** | - |
| | **Transmissitivity ($m^2$/day)** | - |
| **11** | **GROUND WATER QUALITY** | Good for drinking and irrigation |
| | **Presence of Chemical constituents more than the permissible limit (e.g.EC, F, As, F)** | Arsenic, and Iron |
| | **Type of Water** | Potable |
| **12** | **DYNAMIC GROUND WATER RESOURCES (as on 31st March 2009) In mcm** | |
| | **Annual Replenishible Ground Water Resources** | 900.66 |
| | **Net Annual Ground Water Draft** | 392.07 |
| | **Projected Demand for Domestic and Industrial Uses up to 2025** | 85.28 |
| | **Stage of Ground Water Development** | 43.5% |
| **13** | **AWARENESS AND TRAINING ACTIVITY** | |
| | **One day Training Programme Organized** | Nil |
| | **Date** | |
| | **Place** | |
| | **No. of Participants** | |
| | | |
| | | |
| | | |
| **14** | **GROUND WATER CONTROL AND REGULATION** | |
| | **No. of OE Blocks** | Nil |
| | **No. of Critical Blocks** | Nil |
| | **No. of Blocks Notified** | Nil |
| **15** | **MAJOR GROUND WATER PROBLEMS AND ISSUES** | Presence of Arsenic (As) in Purnia east and kasba, Iron (Fe) at few places |
| | **Note: Latest available data may be incorporated** | |

# GROUND WATER INFORMATION BOOKLET
# PURNIA DISTRICT, BIHAR STATE

## 1.0 Introduction

The district Purnia, as it existed in 1951 with an area of 12,784.64sq.k.m.is agricultural district. After separating the Katihar district, the area of Purnia district was7943 sq.k.m. In the year 1990, Araria and Kishanganj was separated from Purnia district.

Purnia district is located between $25^0$ 21'00'' and $26^0$ 05'26'' north latitudes, and $86^0$ 59'30'' and $87^0$ 51'18'' east longitudes and fall under part of Survey of India Toposheat no. 72O and 72 N. Purnia district occupies an area of 3229 sq. km. District is surrounded by Madhepura district in the west, Kishanganj in the east, Araria in the north and Katihar in south.

Agriculture is the main source of sustenance for majority of population in the district. The district is rich in ground water resource, which can be developed for irrigation purpose.

The ground water information booklet of the district contains information, in brief, pertaining to administrative set-up, climate, irrigation practises, geomorphology, soils, hydrogeology and ground water potential.

## 1.1 Administration

Purnia district having 3229 sq. km. has four subdivision namely Purnia, Baisi, Dhadaha and Banmankhi and fouteen blocks covering 1280 revenue villages with district head quarter at Purnia . The district head quarter of Purnia district is well connected from state capital Patna by road( NH-31).Katihar is nearest railway station of NFR for Purnia.The District town Purnia is connected by metergauge railway line with Katihar.Block headquaters of the district is connected with district headquarter by weather metal road. The district boundaries, administrative divisions, major roads, rivers are presented in Fig 1.

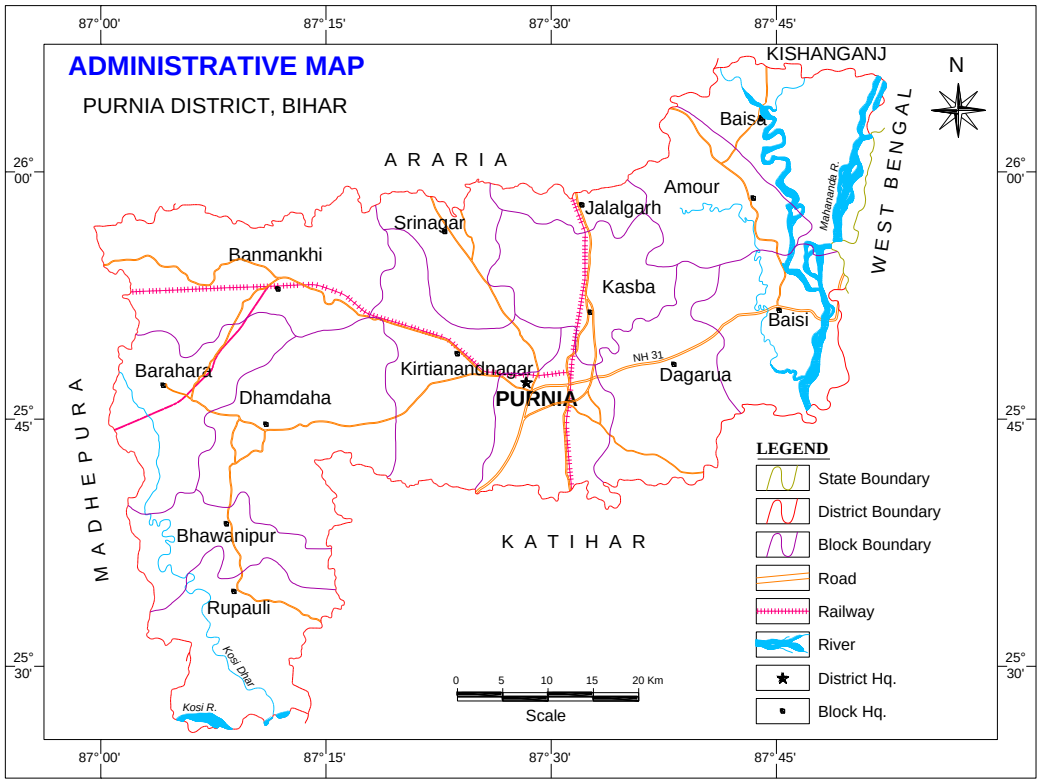


**Fig. 1** Administrative map of Purnia district

### 1.2 Basin/sub-basin, Drainage

There are two sub basins namely Kosi river basin and Mahananda river basin in the district. Drainage in parts of Kosi basin is marked by presence of dhars, which are abandoned channels of river Kosi. Some of the dhars are locally known as Katua dhar, Saura nala, Kankai nala ,Riga nadi. Suara is principle tributtory of river Kosi flows to eastern side of Purnia district. The rivers are effluent in nature. River Mahananda flows in the eastern part of the district.

### 1.3 Irrigation practices

There are Four cropping season in practice in the district.They are Bhadai, Aghani, Rabbi and Garma. Generally Bhadai and Aghani form Khariff season followed by Rabbi and Garma. Rice and wheat are stapple food of the district. Cash crop grown in the area are Jute ,Sugar cane anmd fruits.The total cropped area of district is 260377 hectrare and net sown area is 208302 hectare. The irrigation in the district is provided both by surface as well as ground water. Surface water irrigation is mainly through net work of Eastern Kosi main canal. Irrigation Ground water is easily exploitable with the help of Bamboo boring and shallow tube

wells fitted mostly with diesel pumps. Shallow tube wells are restricted to a depth of 30- 40m. These wells are mostly privately owned.

**1.4 Studies/Activities of CGWB**

Central Ground Water Board has covered the district under systematic hydrogeological survey and a major part the district has been covered under ground water management study. District hydrogeological report and ground water management study report has been issued.

There are seven Hydrograph Network Stations in the district, which monitored 4 times in a year to measure the water level of the phreatic aquifer.

**2.0 Climate and Rainfall**

The district is characterized by moist humid climate. The winter season commences in November and lasts till Februry.January is the coldest month with mean daily temperature in the range of 5-10$^{o}$c and mean daily maximum temperature in the range of 20-25$^{o}$c. Summer season starts from march and lasts up to june. It is followed by the monsoon season and lasts till September. October is transitional period. About 80% of the total annual rainfall is received during the monsoon months of june to September. The average erainfall of Purnia district is 1411.5mm.

**3.0 Geomorphology and Soil types**

The district forms a part of kosi mega fan. Physiographically, it represents gently sloping flat monotonous land with regional slope varying from 0.2 m/km to as low as 0.08 m/km. The regional slope is towards south- east direction. The relief of land form varies from 35m amsl in south to 43.2 m amsl in north. There are series of undulations formed due to shifting of Kosi. However, on regional scale, district is flat topography. GSI has mapped three types of land forms existing in the area- (a) Elevated land form called Purnia terraces (b) Kosi plain , and (c) present day active flood plains called Diara Plain.

**Soil**

The soils of the district area can be grouped under soil of active alluvial plain, recent alluvial plain and alluvial cone of river Kosi. The soil of active alluvial plain group are sandy to coarse loamy in nature. Soils of recent alluvial plain are fine loamy, sandy to coarse loamy soil.

## 4.0 Ground Water Scenario

### 4.1 Hydrogeology

Purnia district lies in the Gangatic alluvial plain. The older alluvium is found in the north of Purnia consisting of coarse gravel and surface kankar and the newer alluvium composed of silts, clays occurring south of Purnia. The entire district is occupied by thick quaternary alluvial deposits. These alluvial deposits are carried by the river system originating from the Himalayas. The alluvial deposit ranges from clay, silt to sand of various sizes, gravel pebble and boulders. These alluvial deposits contain one of the most prolific aquifer systems in the Gangatic alluvium of North Bihar plain.

#### 4.1.1 Mode of Occurrence of Ground Water

The district contains of one of the most excellent aquifer system in the Gangatic alluvium of North Bihar plain. Quaternary sediments in the area comprise sand, gravel and pebble constitute the potential aquifer. The frequent lateral facies change in the area is common phenomenon. So the nature of the granular material may change within short distance. However due to dominance of granular material over fine clastics in alluvial sediments,the aquifer are continuous and regionally extensive . It is found to occur continuously down to the depth of exploration of 80- 90 meter, at places capped by thin clay capping.

The ground water occurs under water table condition in the district. The hydrogeological map of the district in Fig. 2 and the hydrogeological cross section of the district is shown in Fig. 3.

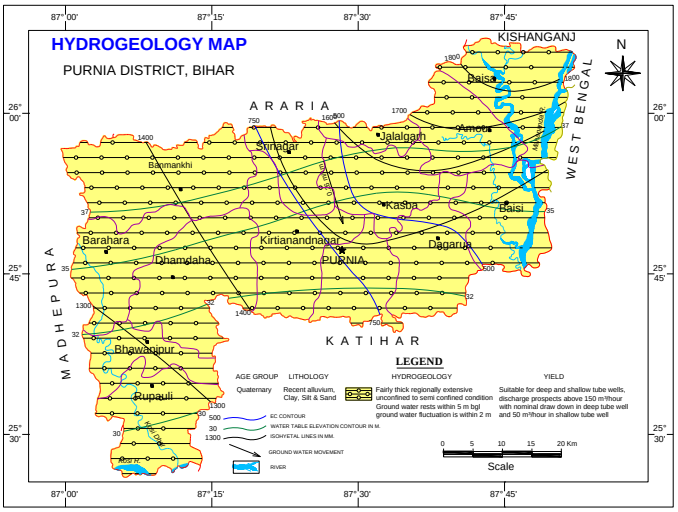


**Fig 2**. Hydrogeological map of Purnia district

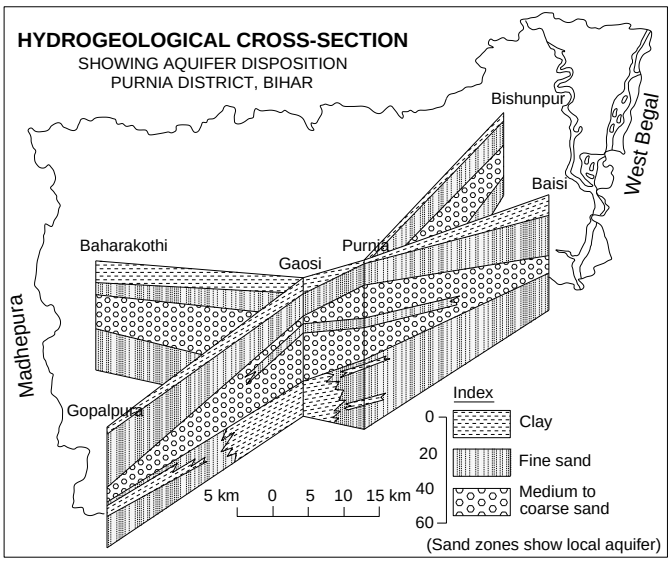


**Fig 3.** Hydrogeological cross section in parts of Purnia district

### 4.1.2 Water Level Fluctuation

The water level is measured at 7 HNS stations in the district and it has been found that that the pre-monsoon (May 2011) depth to water level generally varies from 3.7 to 11.10 mbgl. It remains within 5m (except in the southern part) in major part of the district, (Fig. 4). The post-monsoon water level generally varies from 1.7 to 3.42 m bgl .However, it remain within 4 m in major part of the district (Fig. 5). The seasonal water level fluctuation from pre to post monsoon show rise of 0.97 to 2.51m.

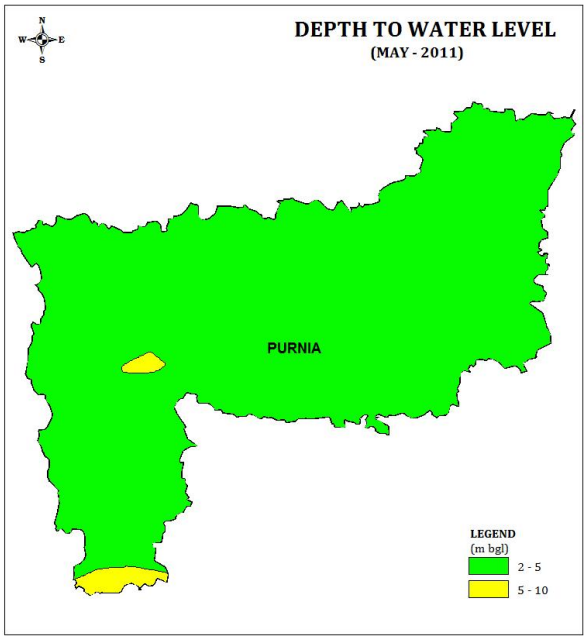


**Fig 4.** Pre-monsoon (May 2011) water level map of Purnia district

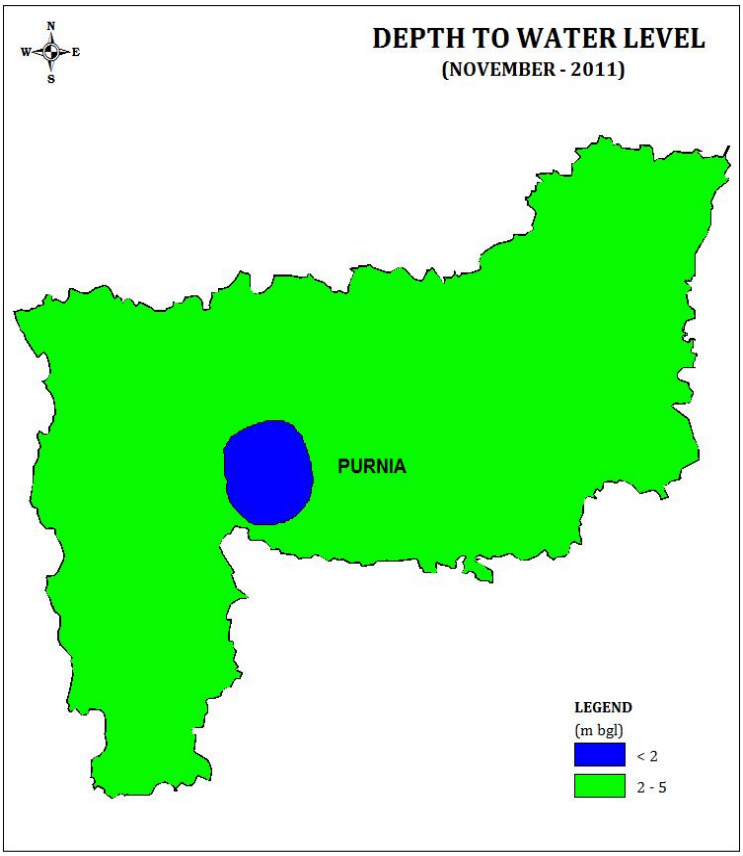


**Fig 5**. Post-monsoon (November 2011) water level map of Purnia district

### 4.1.3 Ground Water Hydraulics

The entire district is underlain by Quaternary unconsolidated sediments of sands, gravel, pebbles constituting prolific and regionally extensive aquifers of huge thickness. It is found to occur continuously down to the depth of exploration of 80- 90 meter, at places capped by thin clay capping. Though the aquifer system in the district are excellent no basic data is available on the aquifer parameter as no exploratory drilling is carried out by CGWB in the district and thus long duration pumping test are not available. However, The yield of heavy duty tube wells constructed by State government ranges from 150- 210 $m^3$/hr for a drawdown less than 2.5 m and yield of shallow tube wells ranges from 50- 70 $m^3$/hr for a drawdown of about 2m.

## 4.2 Ground Water Resources

The net annual replenish able ground water resource as on 31st March 2009 is 90066 ha.m. The gross annual draft for all uses is estimated as 39207 ha.m. Allocation of ground

water for domestic and industrial use for 25 years is estimated as 8528 ha.m. The block wise resource is given in Table 1. The stage of ground water development is 43.5%.

**Table 1:** Block-wise dynamic ground water resource of Purnia district (As on 31st March 2009, in ha m)

| Sl. No | Assessment Unit/District | Net Annual Ground water Availability | Existing Gross Ground Water Draft for Irrigation | Existing Gross Ground water Draft for Domestic and Industrial Water Supply | Existing Gross Ground Water Draft For all Uses | Allocation for Domestic and Industrial Requirement supply upto year 2025 | Net Ground Water Availability for future irrigation development | Stage of Ground Water Development (%) |
|---|---|---|---|---|---|---|---|---|
| 1 | Amaur | 7307 | 2525 | 411 | 2935 | 733 | 4049 | 40.2 |
| 2 | Baisa | 5989 | 1838 | 277 | 2115 | 494 | 3657 | 35.3 |
| 3 | Baisi | 6384 | 2652 | 314 | 2966 | 560 | 3171 | 46.5 |
| 4 | Banmankhi | 9928 | 3070 | 634 | 3704 | 937 | 5922 | 37.3 |
| 5 | Baraharakothi | 6324 | 2366 | 310 | 2676 | 554 | 3404 | 42.3 |
| 6 | Bhawanipur | 4493 | 1885 | 235 | 2120 | 420 | 2189 | 47.2 |
| 7 | Dagarua | 6205 | 3537 | 319 | 3856 | 570 | 2098 | 62.1 |
| 8 | Dhamdaha | 9877 | 3401 | 432 | 3833 | 772 | 5704 | 38.8 |
| 9 | Jalalgarh | 3134 | 1224 | 160 | 1384 | 286 | 1625 | 44.1 |
| 10 | K. Nagar | 7804 | 2825 | 325 | 3150 | 580 | 4399 | 40.4 |
| 11 | Kasba | 4646 | 1792 | 385 | 2177 | 489 | 2365 | 46.9 |
| 12 | Purnia(E) | 7124 | 2785 | 665 | 3450 | 1241 | 3098 | 48.4 |
| 13 | Rupauli | 6908 | 2788 | 349 | 3137 | 623 | 3497 | 45.4 |
| 14 | Srinagar | 3942 | 1552 | 151 | 1703 | 269 | 2121 | 43.2 |
| | **Total** | **90066** | **34240** | **4966** | **39207** | **8528** | **47298** | 43.5 |

## 4.3 Chemical Quality of Ground Water

Ground water samples collected from HNS stations were collected and analyzed and it indicate that in general, ground water of pheratic aquifer is suitable for drinking and irrigation purposes. The ground water is mildly alkaline in nature with maximum value of 8.14. Electrical conductivity (Ec) ranges from 62 micro seimens/cm at Potiah to 1319 micro seimens/cm at Banmankhi. Chloride ranges from 4 mg/l to 185 mg/ l with average value of 65 mg/ l. All major parameters are within the permissible limit. Arsenic concentration above permissible limit of 50 ppb has been found at few places in Kasba and Purnia east blocks. The arsenic contaminated water above regulatory limit of 50 ppb is hazardous for human health. Iron above permissible limit is also reported from few places in the district. The minimum, maximum and average value of parameter analysed are given in table 2.

**Table 2:** Minimum, maximum and average value of chemical parameter of ground water pheratic aquifer in Purnia district.

| Parameter | Minimum | Maximum | Average |
|---|---|---|---|
| EC (µs at 25°c) | 62 | 1319 | 533 |
| pH | 6.79 | 8.14 | 7.25 |
| $HCO_3^-$ (mg/lit) | 43 | 488 | 174 |
| $Cl^-$ (mg/lit) | 4 | 185 | 65 |
| $Ca^{+2}$ (mg/lit) | 8 | 62 | 29 |
| $Mg^{+2}$ (mg/lit) | 1 | 44 | 18 |
| TH (mg/lit) | 25 | 275 | 145 |
| $Na^+$ (mg/lit) | 8 | 115 | 40 |
| $K^+$ (mg/lit) | 1 | 109 | 17 |

**4.4 Status of Ground Water Development** (Blockwise)

The stage of ground water development is 43.5%. The stage of ground water development is highest in Dagarua (62.1%) and lowest in Baisa (35.3%). As stages of ground water development in all the blocks are less than 70%, and there is no long-term decline in water levels.In most of the blocks of the district, the stage of ground water development is below 50% indicating ample scope of ground water development in future. All the blocks are under safe category. Blockwise Stage of Ground Water of Purnia district is depicted in Fig.6.

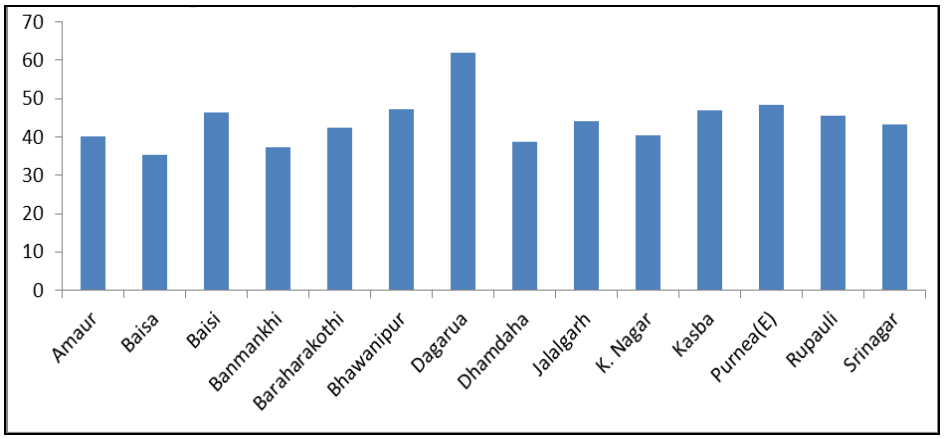


**Fig 6.** Block wise Stage of Ground Water Development of Purnia district

## 5.0 Ground Water Management Strategy

### 5.1 Ground Water Development

In an agrarian district like Purnia, with the majority of Population directly or indirectly depend upon agriculture, the development of ground water for irrigation would help in enhancing the the agriculture productivity. As the district is underlain by potential aquifers and the stage of ground water development is low (43.5%), there is an ample scope of ground water development. In the district ground water is developed by dugwells, filter point wells for domestic purposes and by shallow tubewells, bamboo boring as well as by deep tube wells for irrigation purposes. Presently, ground water for irrigation purpose is developed by 266659 shallow tube wells. Adequate power supply for energisation of pump sets will be a key factor for ground water development. In the arsenic affected area, it is advisable to tap the deeper aquifer for drinking water supply.

Bamboo borings are generally 15-20 m deep and give reasonable discharge. Shallow tubewells of 100mm dia. and having a depth of 30-40m, tapping 10m thickness of granular zones can yield as high as 50 m3/hr .The aquifer system in the district is favourable for installation of deep tube wells of 250mm dia., lowered to a depth of 80-100m and tapping 20-30 m of granular zone.

### 5.2 Water conservation and Artificial Recharge

All the blocks of the district fall under the safe category. The ground water level is shallow. Hydrogeological condition of the district indicates no such activity is required at present.

## 6.0 Ground Water Related Issues and Problems

The Arsenic contamination of ground water is found at few places in the district Iron above permissible limit is also found at few places in the district. Adequate measures should be taken for supply of arsenic and iron free water to people for drinking. The stage of ground water development in most of the blocks of district is low and it can be increased to enhance the irrigation intensity.

## 7.0 Mass Awareness and Training Activity

Mass Awareness Programme (MAP) and Water Management Training Program (WMTP) yet to be organized in this district.

## 8.0 Area notified by CGWA / SGWA

All the blocks falls under safe category and none of the block of the district has been notified under CGWA / SGWA.

## 9.0 Recommendation

1. The stage of ground water development in the district is low (43%.) and it is below 50% in most of the blocks. Ground water development may be increased to enhance the irrigation intensity. The ground water can be developed by constructing shallow tubewells of 100mm dia. and having a depth of 30-40m, tapping 10m thickness of granular zones to get yield as high as 50 m3/hr .The aquifer system in the district is favourable for installation of deep tube wells of 250mm dia., lowered to a depth of 80-100m and tapping 20-30 m of granular zone.
2. The drinking water supply to the villagers of the arsenic affected area should be from the deep tube wells.
3. Construction of Tube wells tapping shallow aquifers for drinking purpose should be avoided in arsenic affected areas. The arsenic concentration of ground water of tube wells tapping shallow aquifer in the area should be analyzed .
4. The energisation of pumps would help in ground water development. Non-conventional energy resource can be used for the energisation of pump sets, where it seems feasible.