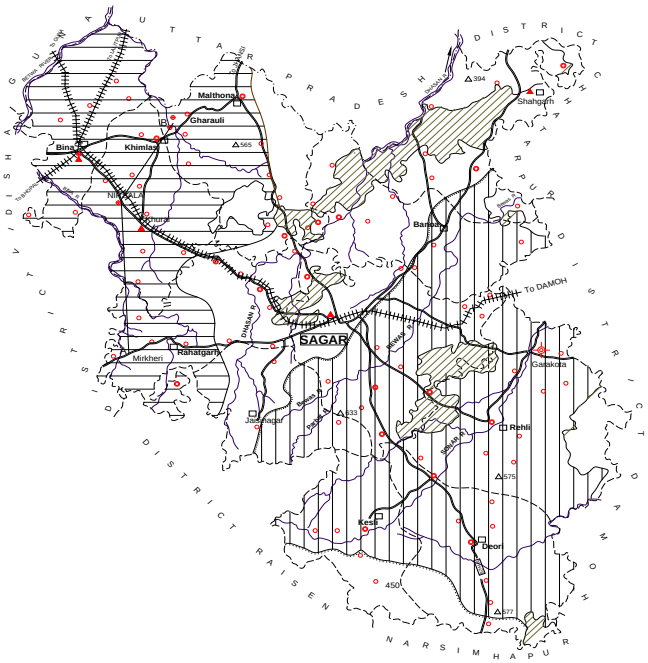
DISTRICT GROUND WATER INFORMATION BOOKLET

SAGAR DISTRICT

MADHYA PRADESH



Ministry of Water Resources
Central Ground Water Board
North Central Region
Government of India

BHOPAL
August' 2009

SAGAR DISTRICT AT A GLANCE

S.N.	ITEMS	STATISTIC	
1	**General Information : (As per 2001 census)**		
	(i) Geological Area	10,252 Sq. Kms.	
	(ii) Administrative Division : (As on 2006)	09	
	Number of Tehsils	11	
	Number of Blocks	760	
	Number of Panchayat	1868	
	Number of villages		
	(iii) Population	20,21,987 (2001)	
	(iv) Average Annual Rainfall (mm)	1234.8 mm	
2	**Geomorphology**		
	Major Physiographic Units : The District extends over two physiographic divisions. They are :	(i) Bundelkhand massif in the north. (ii) Malwa plateau in the south.	
	Major Drainages	Two drainage basin are there	
	(i) Ganga basin	986 Sq. Km.	
	a) Ken sub basin	4507 Sq. Km.	
	b) Betwa sub basin	5562 Sq. Km.	
	(iii)Narnada basin	342 Sq. Km.	
3	**Land Use**		
	(a) Forest Area	2978.02 Sq. Km.	
	(b) Net area sown	7106.90 Sq. Km.	
	(c) Cultivable area	88.14 Sq. Km.	
4	**Major Soil Types**		
		(a) Clay loam (b) Sandy clay loam (c) Sandy loam	
5	**Area Under Principal Crops (As on 20004-05)**		
	Wheat, Rice, Jowar, Maize & other	1829.44 hectare	
	Gram, Towar, Udad & others	3094.38 hectare	
	Sugar cane	7.20 Sq. Km	
6	**Irrigation by Different Sources**	**Nos.**	**Areas Sq km**
	Tube well/Bore wells	6558	398.52
	Dug wells	52910	1,169.59
	Canala	43	48.25
	Tanks/Ponds	34	25.64
	Other Sources	-	724.35
	Net Irrigated Area	-	2,366.35
7	**Number of Ground Water Monitoring Wells of CGWB. (As on 31.3.2007)**		
	No. of Dug Wells	19	
	No. of Piezometers	09	

8	**Predominant Geological Formations**	
	Alluvium, Laterite, Deccan traps, Lametas, Vindhyan, Bijawars, and Bundelkhand granite.	
9	**Hydrogeology**	
	Major Water Bearing Formation	Alluvium, Laterite, Intertreappean beds, Deccan traps, Vindhyans, Bijawars, Bundelkhand granites.
	Pre-Monsoon Depth to water level (2006)	3.16 – 14.33 mbgl
	Post-monsoon depth to water level (2006)	1.27 – 13.23 mbgl
10	**Ground Water Exploration by CGWB (As on 31.3.2007)**	
	No. of wells drilled EW	28
	Depth range (m)	85 – 200
	Discharge (lps)	Meager to 15.5
11	**Ground Water Quality**	
	Presence of chemical constituents more than permissible limit.	EC – 4120
12.	**Dynamic Ground Water Resources (2004)**	
	Annual Replenishable Ground Water Resources	1216.97 MCM
	Ne Annual Ground Water Draft	469.79 MCM
	Projected Demond for Domestic and Industrial uses upto 2025	41.37 MCM
	Stage of Ground Water Development	46.64%
	Semi – Critical Block	-
13	**Awareness and Training Activity**	
	Mass awareness programmes organized	1
	Date	23.01.08
	Place	Karrapur (Sagar)
	No. of Participants	325
14	**Efforts of Artificial Recharge & Rainwater Harvesting**	
	Project completed by CGWB	Nil
	Project under technical guidance of CGWB	Nil
15	**Ground Water Control and Regulation**	
	No. of Over Exploited Blocks	-
	No. of Critical Blocks	-
	No. of Blocks notified	-

16	**Major Ground Water Problems and Issues**	
	1) Water depleted areas	Eastern part of Sagar block, northern part of Rahli block and southern part of Banda block had deepest water level due to heavy pumping.
	2) Scope of Artificial Recharge	At present, the stage of ground water development in Sagar district is only 46.64% declining trend of water levels has been observed and there is need of artificial recharge to ground water system.

1.0 INTRODUCTION

Sagar district is located in the north central part of the state of Madhya Pradesh and occupies as area of 10252 sq km. The district extends between the latitude of $23^0$10' and 24^0 27' north, longitude of 78^0 04' and 79^0 21'east. The district is bound in the north by state of Uttar Pradesh, in the north east by Chhatarpur district in south and west by Raisen, in the south east by Narsimhapur district, in the northwest by Guna district and in the east by Damoh district. The National highway No. 26 passes through Sagar town. The district falls in survey of India toposheet No. 55M, 54L and 54P.

The district has seven Tehsil and eleven development blocks :

Table No. : 1 – Administrative Division District Dhar, M.P.

S. No.	Blocks	Area (Sq. Km)	No. of village	No. of Town
1	Sagar	874.64	152	1
2	Jaisinagar	731.96	145	1
3	Rahatgarh	816.12	198	1
4	Rahali	502.61	116	1
5	Garhakota	373.38	100	1
6	Devri	812.47	223	1
7	Kesli	696.39	164	1
8	Bina	687.17	156	1
9	Khurai	751.17	343	1
10	Malthone	680.79	173	1
11	Banda	807.22	164	1
12	Shahgarh	488.65	107	1

Soil

The major part of Sagar district is covered by black cotton soil . However, clay loam soils occurs in the northern parts of Banda blocks, north of Malthone, west of Sagar town, Kesli and Deori blocks. Sands clay loam covers the areas falling in the southern parts Deori and Kesli blocks, east of Rehli and northern parts of Shahgarh block. Rehli block is by and large, covered by sandy loam soils.

Drainage

The southern most tip of the district is drained by the Narmada river. However the major part of the area fall in the Ganga basin. The drainage of the district is towards north and north east. The five rivers, from west to east are the Bina, the Dhasan, the Bewas, the Sonar and the Bamner. The Bina takes its course upto several Kilometer to the south of the district and enters it near village Mahura. After flowing through Rahatgarh, the rivers takes a north easterly course and at places forms the boundary with Vidisha district.

The height of water fall at is about 15m and joins the Betwa at about 16 km west of Bina town.

The Dhasan emerges from just south of the district and flows initially in the south and then to the north. It also forms the boundary with Jhansi district of Uttar Pradesh. The Kopra and Bewas are tributaries of the Sonar. The Sonar joins Bamber and then both river joins Ken river. The Ken is a tributary of the Yamuna river.

The drainage pattern is of dendritic type. At a few place especially around Sagar town and near Khamlasa and Jaisinagar radial drainage pattern is also observed.

Irrigation

Irrigation in the district is mainly from dug wells (11.69 sq km.) tube wells (398.52 sq km). Canal (48.25 sq km). Ponds (25.64 sq km.) and from other source (724.35 sq. km). There are 52190 dug wells, 6558 tube wells, 34 tanks/ponds, 43 canal. So, net irrigated area is 2366.35 sq. km.

Cropping Pattern

The principal crop grown in the district is wheat sown in an area of 1637.78 sq km. the other major crop is Chana (Gram) sown in an area of 2015.87 sq km. The total production of various crops (2005-2006) in the district is (2004-2005) 543004 metre ton.

CGWB Activities

Detailed hydrogelogical studies :
CGWB (Indo-British) Betwa project – 1976-1981.
Normal exploratory drilling program – 1992-93.
Re-appraisal hydrogeological surveys – 1997-98.

2.0 RAINFALL & CLIMATE

There are six rain gange stations in Sagar district. A heavier amount of rainfall occurs along the south western boundary of the district and decreases towards the north and slightly towards the east. In the southwestern parts of the district, Rehli gets a marked amount of low rainfall mainly due to its location in the valley on the leeward side of the hill range.

The normal annual rainfall of the district is 1234.8 m.m. About 90% of the annual rainfall takes place during the southwest monsoon period i.e. June to September only 5.5% of annual rainfall takes place during water and about 4.5% of rainfall occurs during the summer months.

The month wise normals of rainfall at six stations show that the maximum rainfall occurs during the month of July followed by August.

The climate of Sagar district can be classified mainly into three season. Winter season starts from middle of November to end of February. March to May constitute summer season and the monsoon season starts from second week of June to end of September.

During winter season the January is the coldest months with the temperature falling as low as 11.6^0g C and max up to 24.5^0 C.

During the month of May, temperature goes up to 40.7^0 C (max.).

3.0 GEOMORPHOLOGY & SOIL TYPES

Sagar district lies at the north eastern edge of the Malwa plateau, which widens in the south and south west. It lies just north of the Narmada river and is separated from tis valley by a steep escarpment towards the south. The area is by and large cropped by the deccan trap lava flows whereas at places vindhayan sandstone also crops out. The average elevation of the district is about 452 to 533 mamsl with elevation as low as 353 mamsl in the Dhasan river bed in the north to as high as 683 mamsl at Naharmau peak in the southwest.

The physical divisions of the district are represented by the basins of several rivers. Cropping the district in an almost south-north direction. The area in the north west falling under Khurai tehsil is almost a level tract with an elevation of about 411 to 427 mamsl and is drained towards north-west by Thimpa, Parasasi and Bina rivers. These rivers are tributaries of the Betwa river. The Khurrai plan is separated from the rest of the district by a series of steeply rising hills. These hills attain an elevation of up to 533 mamsl and also act as a water divide.

To the east of and south-east of the above discussed hills are the five parallel valley of Dhasan, Bewas, Sonar, Kopra and Bamner rivers. These basins are separated by hills rising 91 to 153 meters above the general ground surface. The highest hill range of Tendu Dabar attains a height of 665 mamsl.

There is a very prominent lake in Sagar town around which the town has developed. As per Dr. W.D. west, the lake come into existence due to the erosion of the deccan traps and exposing the underlying Vindhyans.

In Sagar district land forms have been classified on the basis of genetic factor and the geomorphic processes involved. Further the geomorphic units have been classified on the basis of different erosion of rock material, process and relief amplitude. The classified system adopted is as per ITC scheme of classification of land forms.

Three groups of landforms have been identified in the area :

1. Denudational landforms
2. Depositional landforms
3. Structural landforms.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

Water Level

Ground water level form a very important parameter of the ground water system, as these are its physical reflection. The ground water balance express itself in the charge in water levels, hence a continuous record is important and useful, CGWB has 29 national hydrograph stations. Due to large scale ground water development the dug wells are drying up and the mater level record is becoming crratic.

Pre monsoon (May 2006)

During May 2006, pre monsoon the depth to water level (Plate – III) in Sagar district ranged between 3.16 mbgl at Banda, village of Banda block and 14.33 mbgl at Gourhamar village of Deori blocks water level in general falls between 7 to 11 mbgl.

Post-Monsoon (Nov-2006)

During post-monsoon period of the some year Nov.-2006. (Plate IV) the mater levels varied from 1.27 mbgl at Keshi village of Kesli blocks to 13.23 mbgl at Gonryhamer village of Deori blocks. The mater level in general falls between 4 to 9 mbgl.

Decadal Average Water Level (May 1995-2006).

The average of water levels for the last 10 years gives a more realistic picture as the water level of any particular year depends on rainfall and draft and may nany widely. The 10 years average water level for the pre monsoon period is between 4.10 mbgl to 14.39 mbgl. The 10 year water level for the post monsoon period is between 2.88 mbgl 12.42 mbgl.

Aquifer System and Aquifer Parameters :

4.1.1 Granites

The granites and granitic gneisses in the area are quite hard and generally devoid of any primary porosity. However, due to weathering of the top mantle, jointing and fracturing secondary porosity has developed at a few places. The thickness of the weathered mantle varies from negligible near the outcrops to as much as 15 meter in the valleys and topograhpics lows. The joints and fractures close down after 35 to 30 meter. Ground water in thus formation occurs under water table condition. Tube wells in the granites are and the ground water is withdrawn. Mostly through dug wells. The tube wells sustain a maximum discharge of about two litres per second (lps) for appreciable drawdowns. The yield of open wells ranges between 20 to 100 m^3/day.

4.1.2 Bijawar

The Bijawars are exposed in a tiny patch in the north eastern extremity of the district. These are composed of siliceous lime stones, breacia and shales. These formations have any significant ground water occurrence.

4.1.3 Vindhyans

In the vindhyan sandstones, primary porosity varies from negligible to as high as 30% depending on the degree of compaction. The storage and movement of ground water in these formation is controlled mainly by the secondary porosity and permeability created due to weathering jointing and fractured. Ground water occurrence is good along the liveaments and their in trisections and occurs under water table condition. The tube wells an these formation yield up to two lps and the dug wells have yields to 100 m^3/day.

4.1.4 Lametas

These are intertrappean formations comprising siliceous limestone and sandstone. The lametas are fairly thick at places and attain up to 45 meter thickness east of Sagar and near Deori. The limestones of the lametas are poor quality aquifer in the district. However, sandstones are semi consolidated and have primary porosity also. These formations support dug wells having moderate to good yield in the range of 50 to 200 m^3/day.

4.1.5 Deccan Traps

Deccan traps are the most important formations in the district due to their large aerial extent. The weathered jointed, fractured and vesicular units of basalts form moderately potential aquifers. The zeolitic basalt in weathered form also makes good aquifer. The red bole bed, which is predominantly clay, is non productive and acts as a confining layer also. A common weathering product of the trap is a friable light greenish or yellowish green mantenlin locally called as “Murram” however.

Murram does not occurs everywhere the trap zones bearing “Murram” forms potential aquifers. Basalt vindhyan contact is not a promising zone. However wherever thick vesicular and fractured/jointed zone is encountered in the basalts. It can sustain tube wells of moderate to good discharges. The discharge in the depth range of 38 to 40 and 47 m at Mirkheri was about 16 lps. The dug wells in these formations can sustain yield of up to 750 m^3/day.

4.1.6 Laterites

Laterite, a by product of weathering of basalt (at some places). In found only to the west of Sagar town. This formation has not attained significant thickness in the area.

4.1.7 Alluvium

The alluvial deposits are confined mostly to the area along the river courses and in the eastern parts of the district. It is composed of five to medium sand, silt, clay and kankar. The alluvium supports tube wells and dug wells wherever thick and can sustain tube wells with discharge up to 10 lps.

4.2 Aquifer Parameter

During exploratory drilling in vindhyan limestone (upper Bhander limestone) are also not promising as in village Gorhakota, a 58.3 meter thick zone of Bhander limestone was encountered in the depth range of 18.7 to 77.0 mbgl. This was underlain by 107.70 meter thick Ganurgarh shales followed by Rewa sandstone up to the drilled depth of 185 mbgl.

There were several shale bands in the depth range of 30 and 52 mbgl in the limestone. The limestone also contained solution cavities in the depth range of 18-22 mbgl. A well assembly tapping the zone between 53 and 69 mbgl was lowered in the bore hole. During PYT, the discharge obtained was only 0.7 lps for a draw down of 28.21 meters after 100 minutes.

Four exploratory bore holes in deccan trap country were drilled under the Betwa project. The bore hole at Mirkheri which was 171.33 m deep, encountered nine flows. The five zones in basalts were encountered in the depth range of 16-17 mbgl, 27.9-31.00 mbgl, 37.7-40.1 mbgl at 47 mbgl and between 58-59 mbgl.

All the zones were in jointed/amydaloidal basalt. The yield of the first and second zones tested together was only 3.2 lps. The tranmissivity was 36.3 m^2/day. The yield of the second and third zones tested together was 16.3 lps and the transmissivity was 43^2/day.

The borehole at Nirtala was drilled down to 88.68 mbgl and the vindhyan sandstone were struck at 52 mbgl. water was struck at two depths, between 42-42.5 mbgl in jointed basalt and at the basalt vindhyan contact at 52-52.5 mbgl. these zones tested together yielded 0.64 lps of water and the transmissivity value was only 0.3 m^2/day. Similarly at Sabda the depth drilled was 85-94 mbgl. the vindhyan basement was struk at 54.2 mbgl. the water bearing zones were at 48.0 -57.3 mbgl in jointed basalt and at 54.2-54.7 mbal at the basalt vindhyan contact.

This also yielded only 0.6 lps of water drilling at Garoli, the fourth site was done down to 122.49 mbgl, at this location, vindhyan sandstone was struck at 16.82 mbgl. no promising water bearing zones were encountered either in the basalts or in the vindhyans.

4.3 Ground Water Resources

The entire dirstrict non command area blocks are falling under safe category. There is no command area. The net annual ground water availability 115-61 mcm and draft from all uses 539.25 mcm. Net group water available for future irrigation use 604.38 mcm. The net annual ground water available in the Sagar district and draft from all uses for all eleven blocks is shown in Fig:5 and data in table No.2

4.4 Ground Water Quality

The electrical conductivity (EC) is a measure of total dissolved solids and hence of salinity. Ground water in a greater part of the area is fresh water in nature. However,

saline water formation is encountered near Khimlasa in Khurai block, Prahladpuar in Bonda block and Hirapur in Shahgarh block. These three areas having EC more than 3000 micro mhos/cm.

The ground water in the area is alkaline in nature in some parts and acidic is others. The PH valves are within normal acceptable limits.

Bicarbonate ions are commentagd found in ground water due to dissolution of carbon dioxide and carbonate minerals by naturally circulating waters. The predominance of bicarbonate ions in the water table aquifer of the district appears to indicate a continuous and rapid recharge of ground water as a result of precipitation and seepage.

The chloride concentration in the area is below 250mg/l. at all the locations, except at the three locations where the water is saline. The higher chloride valves in the area in general coincide with areas having high EC thus indicating that the salinity in ground water is mainly due to chloride.

Calcium is the predominant cations in the ground water of the area and except at Khimlasa in Khuerai block, it falls within permissible limits.

The magnesium concentration in Sagar district is within permissible limits.The concentration of sodium in the area ranges between 5 and 508 mg./l. The nitrate concentration in Sagar district ranges between NIL to 981 mg./l.

The fluoride concentration in the district ranges between 0.01 and 0.96 mg./l. There is no problem of excess fluoride in the shallow ground water of the district.

Hardness in Sagar district ranges between 80 and 985 mg./l. falling within permissible limits except at Khimlasa. In general, the ground water in Sagar in slightly hard since the total hardness in most of the samples in between 200 and 400 mg./l.

Thus on the whole ground water of Sagar is chemically fit for drinking purpose.

The SAR values of most of the ground water samples determines i.e. ground water is fit for irrigation use or not. The SAR values of almost 42% samples fall below 1.25, 17% samples between 1.25 and 2.5 (marginal), and 41% have SAR more than 2.5 (Not suitable for irrigation).

4.5 Status of Ground Water Development

Ground water is the main source of irrigation and drinking water in Sagar district. The net annual ground water availability in all the blocks of Sagar district is 115.61 MCM. Existing gross ground water draft for domestic and industrial water supply in the district is 288.47 MCM. Existing gross ground water draft for irrigation is 510.40 MCM.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1. Ground Water Development

Ground water is the main source for drinking and irrigation in the Sagar district. In general geology of the area along with climatological and pedalogical parameters provide the hydrological environment which governs the ground water development and management in the district. The total number of dug wells and tube wells in the district in the year 1997 was 37143 and 2452 respectively thus has been increased in the year 2005-2006 up to 52910 and 6558 respectively, shows rise in the development of ground water in the district. The stage of ground water development in the district is 46.64%

5.2 Water Conservation & Artificial Recharge

Artificial recharge studies by CGWB the Central Ground Water Board, under the Central Sector Scheme, has been extending technical and financial support to the state government for implementing practices in rural and urban areas of the district. At present no such project have been taken.

6.0 GROUND WATER RELATED PROBLEMS AND SPECIAL STUDIES

In Sagar district, there is no water logged area reported so for. There are no vulnerable area in the district. As per the available data ground water pollution has not been reported in the area. There are certain areas in the district that are depicting declining water level trends over the last decade.

7.0 AWARENESS AND TRAINING ACTIVITY

7.1 Mass Awareness Programme (MAP) - 01

7.2 Participation in Exhibition, Mela, faira etc. - NIL

7.3 Presentation & lecture delivered in Public forms/Radio/TV/Institution of reporte/Grass roots associations/NGO/Academic institution etc.

8.0 RECOMMENDATION

1. The present stage of ground water development in the district is 46.64%. Thus special care has to be taken while developing the resources.

2. The deccan trap are by and large not promising for being developed through tubewells. However, large diameter dug wells at suitable location would be more ideal to tap these formations.

3. Artificial Recharge practice in rural areas should be taken up earnestly to improve the ground water situation.

4. Change in cropping pattern is another measure which is to be taken care to save the ground water resources.

5. Roof top rainwater harvesting should be made mandatory considering the water scarcity in urban areas.

Table No.-2: GROUND WATER RESOURCES & STAGE OF DEVELOPMENT

Block	Command/Non Command Total	Not Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground Water Draft for Domestic & Industrial Water Supply	Existing Gross Ground Water Draft for All uses	Allocation for Domestic requirement supply up to next 25yr.	Net Ground Water Availability for Future Irrigation Development	Stage of Ground Water Development %
Sagar		**In MCM**						
Sagar	Command							
	Non-Command	151.81	91.68	3.53	95.21	4.98	55.16	62.71
	Block Total	**151.81**	**91.68**	**3.53**	**95.21**	**4.98**	**55.16**	**62.71**
Kesli	Command							
	Non-Command	88.23	28.67	2.28	30.95	3.42	56.13	35.08
	Block Total	**88.23**	**28.67**	**2.28**	**30.95**	**3.42**	**56.13**	**35.08**
Deori	Command	5.37	0.33	0.05	0.38	0.06	4.98	7.12
	Non-Command	127.02	15.37	2.31	17.68	2.61	109.03	13.92
	Block Total	**132.39**	**15.70**	**2.36**	**18.07**	**2.67**	**114.02**	**13.65**
Jaisinagar	Command							
	Non-Command	98.55	52.86	2.40	55.26	3.18	42.50	56.08
	Block Total	**98.55**	**52.86**	**2.40**	**55.26**	**3.18**	**42.50**	**56.08**
Rahatgarh	Command							
	Non-Command	110.61	49.12	2.98	52.11	4.34	47.13	47.11
	Block Total	**110.61**	**49.12**	**2.98**	**52.11**	**4.34**	**47.13**	**47.11**
Rehli	Command							
	Non-Command	117.04	68.90	3.36	72.26	4.87	43.27	61.74
	Block Total	**117.04**	**68.90**	**3.36**	**72.26**	**4.87**	**43.27**	**61.74**
Banda	Command							
	Non-Command	81.55	49.42	2.98	52.41	4.13	27.99	64.27
	Block Total	**81.55**	**49.42**	**2.98**	**52.41**	**4.13**	**27.99**	**64.27**
Shahgarh	Command	18.86	0.35	0.02	0.37	0.03	18.47	2.01
	Non-Command	46.39	18.09	1.88	19.98	2.82	25.47	43.07
	Block Total	**65.25**	**18.45**	**1.91**	**20.36**	**2.86**	**43.94**	**31.20**
Malthone	Command							
	Non-Command	88.46	32.23	2.56	34.76	3.99	52.23	39.34
	Block Total	**88.46**	**32.23**	**2.56**	**34.76**	**3.99**	**52.23**	**39.34**
Bina	Command							
	Non-Command	105.44	50.16	2.12	52.28	3.35	51.92	49.59
	Block Total	**105.44**	**50.16**	**2.12**	**52.28**	**3.35**	**51.92**	**49.59**
Khurai	Command							
	Non-Command	116.71	531.7	2.32	55.49	3.47	60.05	47.55
	Block Total	**116.71**	**531.7**	**2.32**	**55.49**	**3.47**	**60.05**	**47.55**
	District Total	***1156.12***	***510.40***	***28.84***	***539.25***	***41.35***	***604.38***	***46.64***