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Water resource development plan for Dindori : A tribal district

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■ **ABSTRACT :** Dindori is a trible district of Madhya Pradesh situated in Upper Narmada Basin. The district is far away from agricultural development. Only traditional farming with limited irrigated area (1.2%) is being practiced. In order to improve this situation a detailed water resource plan is prepared as water is the key resource. First net availability of ground water is estimated and possible numbers of ground water structures are worked out and resulting increase in irrigated area is also determined. Similarly the surface water resources are also taken in account. Looking to all this suitable changed cropping pattern for the district is also suggested. In order to recharge ground water possible location for recharge structures are found out for each block of the district as per CGWB guide lines.

■ **KEY WORDS :** Water resource, River basin, Ground water, Surface water, Ground water potential, Irrigation intensity, Ground water recharge, Ground water structure, Ground water development, Water resource planning

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Water is a precious natural vital resource, for sustaining all life on the earth. It is in a continuous circulatory movement called hydrologic cycle. It is not uniformly distributed in time and space. Due to its multiple benefits and the problems created by its excesses, shortages and quality deterioration, water as a resource requires special attention through proper planning and management.

Water is in scarcecity due to increase in water requirements for more crops due to increase in population, industrial development and human needs and desire for higher standards of living.

On the other side the 1640 million population of India in 2050, half of them urban and half of them rural, would need 9 M.ha.m. of water to meet their domestic needs based on conservative estimates of 200 litre per capita per day (lpcd) for urban areas and 100 lpcd for rural areas. The latter includes demands of live stock. The country has to increase the area under irrigation from present 28 per cent to roughly about 40 per cent by the year 2050. The possible options available to meet the future irrigation and food needs may, therefore, include effective management, change of cropping pattern, evaporation control and reduction of conveyance losses. Problems of salinity, alkalinity, water logging etc. reduce the productivity. Thus, the above challenges are intimately related to strategies for the management of water.

Now, the optimum and sustainable water utilization is the endeavour of the all above to fulfill the multiple increasing demands of water. In recent times, the Integrated Planning and Management of total water resource of an area has been considered as a strategy to achieve the objective of optimum and sustainable utilization with emphasis on the inter-actions and inter-

dependencies between objectives, goals and the criterion to evaluate the alternative plans.

Madhya Pradesh, the "Hridaya Pradesh" of India is blessed with natural resources with a geographical area of 3,08,000 sq km covered in six major river basins with various sub-basins for each tributary. The Narmada basin is a major river having basin area of 86256 sq km. The basin lies in the Central and Western parts of the state in the form of a lenticular river valley stretching in east-west direction in the districts of Shahdol, Dindori, Mandla, Jabalpur, Narsinghpur, Hoshangabad, Seoni, Chhindwara, Betul, Raisen, Sehore, Dewas, Khandwa, Khargone, Dhar and Jhabhua.The Narmada basin is divided into three sub basins namely Narmada Upper sub basin, Narmada Middle and Narmada Lower. Dindori is an important tribal district of M.P. The average ground water development and percentage of irrigated area in Dindori district is in single digit figure. It shows that there is a great need of increasing irrigation intensity in this trible district by increasing irrigated area through integrated planning of water use. This is possible through a realistic assessment of status and planning a strategy of utilizing water resources. Present study has been undertaken to fulfill above needs.

METHODOLOGY

Study area :

The district is a tribal dominate district, out of the total population 95 per cent lives in rural area and 65.33 per cent population is tribal *i.e.* Baiga, Koal, Pardhan, Dhula, Bhoomia and Agaria tribes. The economy of the district depends on forest produce and agriculture. The 37.32 per cent area of the district is covered by Sal forest. Irrigation facilities are not adequate. Only 1569 hectare land is under irrigation. Dhan, Makka, Kodo, Kutki and oil seed Ramtilla (Jagni) are main crops. Modern techniques of agriculture are almost not in practice. Therefore, production rate is very low. Overall, the economy of the district is very poor and per capita income is very low.

The district is located at eastern part of Madhya Pradesh at 80.35^0 to 81.58^0 longitudes and 22.17^0 to 23.22^0 latitude. The geographical area of the district is 6128 sq.km with the height of 1100m above sea level. The population density of the district is 95 per sq km, which is very low in comparison to the state and national average. According to 2001 census conducted by Government of India out of total population of the district about 95.37 per cent (Anonymous, 2002 a and b) live in rural and 4.63 per cent live in urban areas, obviously depicting that Dindori district has rural category population in an almost over-whelming majority far in excess to the state and national population (73.5% and 72.2%, respectively). Annual population growth for the district is 1.35 per cent per annum, which is less than the average growth rate 2.43 per annum in Madhya Pradesh and 2.14 per cent in India.

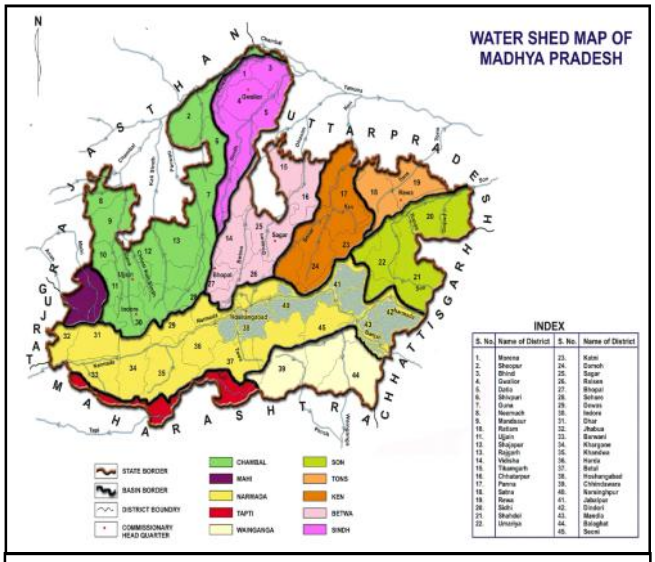

Fig. A : Location of Dindori district, in Upper Narmada Basin and Madhya Pradesh

In order to know the status of water resources, both the surface water and ground water were taken in account. Dindori district have very little irrigated area that too, through minor irrigation tanks and open wells only. Looking to these facts, it was necessary to analyze both the sources separately.

Ground water estimation :

As per the recommendations of GEC (1997, 1984 and 2009) revenue block was taken as unit area for estimation of ground water recharge. First of all, the rechargeable area is delineated from each block, as per the standard procedure. Further the blocks are divided into Command Area and Non-command Area. Ground-water recharge in the district under study has been estimated using water level fluctuation method (GEC, 1997). Water level observations for all the blocks were collected from the year 2002 to the year 2008 and anlysed

for fluctuation (pre-monsoon to post-monsoon). Geology of all the block of the area is considered. The specific yield value was taken considered as 2 per cent as recommended by GEC (1997) as the entire district is having hard formation. Using this information the recharge for each block of the study area is calculated for each year from 2002 to 2008 as Rc = W.L.F. x Sy x A.

Assessment of ground water potential :

For this purpose annual ground water recharge, existing ground water draft and future domestic needs of each block is considered. The rainfall recharge was normalized and used for assessing net availability, as per the norms given by GEC, under section 5.6. Non-monsoon recharge and contribution of reservoirs and irrigation structures was considered as per the norms. Then existing ground water draft, future reserve for domestic use are deducted and finally net ground water availability is found out.

Surface water resources in the districts was considered and assessed on the basis of the information from Narmada Valley Development Authority and Water Resources Department, Govt. of M.P. (Anonymous, 1987, 1990 and 1994).

RESULTS AND DISCUSSION

In order to know the temporal variation of recharge during this period, years wise recharge values are compared and presented from Fig. 1 to 6. Recharge so obtained, was normalized as per the standard procedure. This normalized recharge is then compared with the

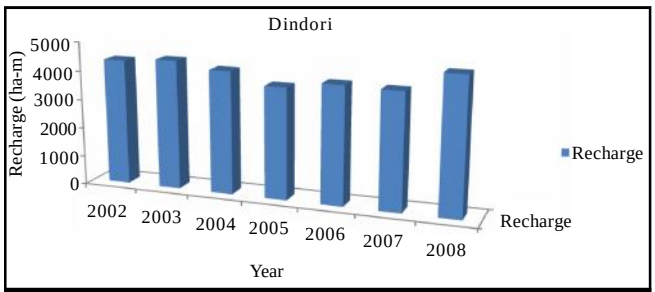

Fig. 1 : Temporal variatin of recharge in Dindori block

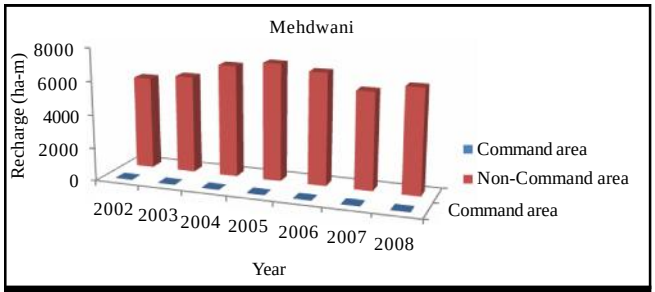

Fig. 2 : Temporal variatin of recharge in Mehdwani block

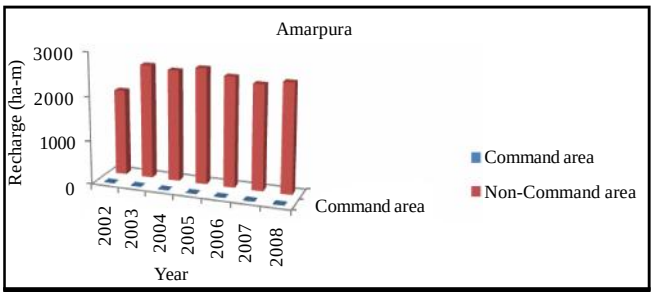

Fig. 3 : Temporal variatin of recharge in Amarpura block

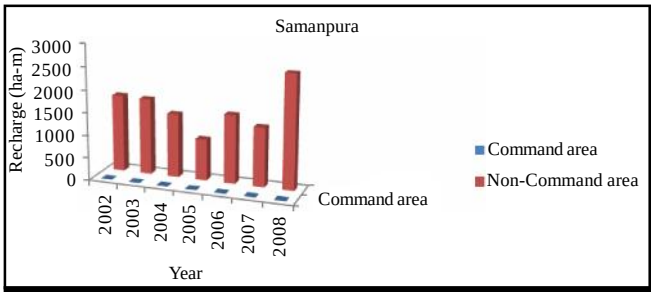

Fig. 4 : Temporal variatin of recharge in Samanpura block

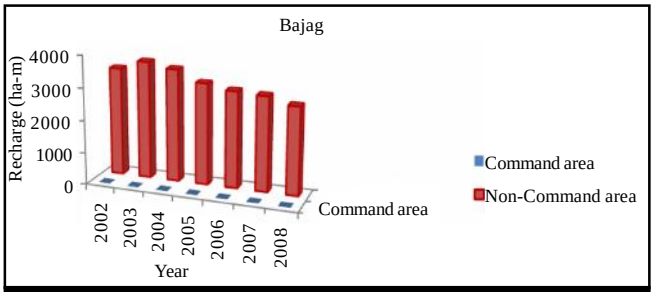

Fig. 5 : Temporal variatin of recharge in Bajag block

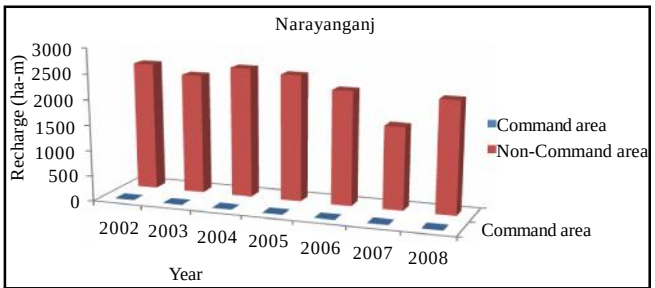

Fig. 6 : Temporal variatin of recharge in Narayanganj block

recharge obtained through rainfall - infiltration method using standard norms given by GEC (1997) under the section 5.6.

Surface water resource estimation :

In Dindori district there is no major and medium irrigation project but a large number of minor irrigation projects exist. The total design capacity of these minor structures is 8862 hectares, but the irrigation is only in 2553 hectares, which is 28.80 per cent of the design capacity. This means the minor irrigation projects are very poorly managed and maintained. Following may be the possible causes responsible for this situation.

Lack of water courses, undulating topography, insufficient collection of water in the reservoirs constructed, incomplete engineering works at the Dam, lack of public interest towards irrigated agriculture and improper cropping pattern/system.

Strategy for water resources utilization :

In order to improve water resource utilization a strategy is prepared for the district. The strategy is prepared in two parts separately as, demand side strategy and supply side strategy.

Demand side strategy :

The demand side strategy of this district is to increase the demand means to bring more area under irrigation and to have high remunerative crops. In order to achieve this, a detailed planning is prepared for the

Table 1 : Assessment of net availability of ground water in Dindori district

District/ Blocks	Block	Recharge from rainfall during monsoon season (ha-m)	Recharge from other sources during monsoon season (ha-m)	Recharge from other sources during non-monsoon season (ha-m)	Total annual ground water recharge (ha-m)	Natural discharge during non-monsoon season (ha-m)	Net annual ground water availability	Existing gross ground water draft for irrigation (ha-m)	Existing gross ground water draft for domestic and industrial water (ha-m)	Existing gross ground water draft for all uses (ha-m)	Allocation for domestic and industrial requirement supply upto next 25 years (ha-m)	Net ground water availability for future irrigation development (ha-m)	Stage of ground water development (%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Amarpur	3743	7	13	3763	204	3559	160	169	329	507	2892	9
2	Bajag	3116	3	8	3127	227	2900	189	237	426	585	2126	15
3	Dindori	5361	13	17	5391	448	4943	312	225	537	419	4212	11
4	Karanjia	4900	0	1	4901	349	4552	297	193	490	465	3790	11
5	Mehadwani	3743	5	8	3756	253	3503	1609	187	180	535	1359	5
6	Shahpura	3496	20	36	3552	424	3128	190	268	458	455	2483	15
7	Samnapur	2700	2	9	2711	263	2448	216	176	392	433	1799	16
District total		27059	50	92	27201	2168	25033	2973	1455	2812	3399	18661	11

Table 2 : Number of additional ground water structures to be made in Dindori district (Anonymous, 2008 and 2009)

Name of block	Net sown area (ha)	Surface water res. (ha-m) minor-irrigation	%	Existing G.W.	Utilizable G.W. (ha-m)	Feasible no. of G.W. structures		Additional area can be brought under irrigation	
						Open Well	T.W.	Area (ha)	Percentage to NSA
Dindori	58108	303	7	312	3461	2308	Nil	4615	8
Amanpur	27780	136	8	160	2474	1649	Nil	3299	12
Samnapur	30223	360	8	216	1682	1121	Nil	2243	7
Bajag	32337	366	10	189	2000	1333	Nil	2666	8
Karanjia	39047	601	7	297	3134	2089	Nil	4179	11
Shahpura	53883	510	7	190	2296	1531	Nil	3062	6
Mehandwani	30430	38	8	1609	1020	680	Nil	1360	4
Total						10711		21424	

Table 3 : Location of percolation tanks in Dindori district

Sr. No.	Block/Mandal	Village	Latitude	Longitude	Number	Storage capacity (Mcm)
1.	Amarpur	Bhanpur	$22^0$36'30"	$80^0$54'30"	02	0.4
2.		Amarpur	$22^0$46'30"	$80^0$57'30"	02	0.4
3.	Samnapur	Padariya	$22^0$50'50"	$81^0$00'30"	02	0.4
4.		Samnapur	$22^0$47'00"	$80^0$24'00"	02	0.4
5.	Karanjia	Bondar	$22^0$42'00"	$81^0$40'00"	02	0.4
6.	Dindori	Shahpur	$23^0$02'00"	$81^0$01'00"	02	0.4
7.		Dindori	$22^0$56'40"	$81^0$05'00"	02	0.4

districts. For this number of feasible ground water structures has been worked out. With these ground water structures additional area which may be brought under irrigation has been estimated and suitable crops foe this area are also included in this plan. It is presented through Table 1 and 2. Modified cropping pattern in this district is as follows:

– Mustard area should be increased in the entire districts.

– The bunded fields of paddy should be increased from 10000 ha to 20000 ha.

– Early maturing hybrids of paddy should be introduced and there is potential of bringing about 15000 ha area of paddy under hybrids.

– Kodo-kutki area should be reduced by 8000 ha by maize (from 43000 ha).

– Kodo-kutki + Arhar intercropping should be introduced.

– Intercropping of Gram + Mustard should be introduced.

Assessment of net availability :

Strategy for supply side :

In orders to improve water use efficiency in this district following strategy is suggested for the supply side of water resources.

– Making water users association (WUA) effective and active.

– Construction and maintenance of water courses through WUA

– Creating /Bringing public awareness in public regarding proper water use/ irrigation and its advantages and *vice-versa*.

– Use efficient irrigation methods.

Besides this, for charging ground water, artificial recharge plan is prepared for this district. Though, ground water recharge possibilities are limited in hard rocks, however, feasible artificial recharge pockets are found out and number of recharge structures and their capacity is presented in the following Table 3. Similar work related to the present investigation was also carried out by Jat *et al*. (2009); Jain and Sinha (2010); Khepar and Chaturvedi (1982) and Seth (1991).

Conclusion:

Following conclusions can be drawn from this study

– Ground water availability in various blocks of Dindori district varies from 1359 ha-m to 4212 ha-m.

– Ground water development in all the blocks is very poor (5-16%). This shows under utilization of ground water resource in the district.

– Thus, 10711 open wells can be installed in the district and 21424 ha area can be brought under irrigation.

– There is no major and medium irrigation project operating in the district. Though, there is number of minor irrigation projects.

– These minor irrigation projects are poorly managed and achieving 28 per cent irrigation of the designed potential. Peoples awaking about water resource utilization, proper crop plan and making Water Users Associations functional may increase the irrigated area by 8 per cent.

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